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Relationship between Premenstrual Syndrome and Premenstrual Dysphoric Disorder and Eating Disorders

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ABSTRACT

Background: Premenstrual syndrome (PMS) is a periodic disorder of the menstrual cycle, and its most severe form is premenstrual dysphoric disorder (PMDD), which occurs as a complex disorder. Eating disorder is also a type of eating behavior disorder with complications. Considering the high prevalence of PMS, and consequently, PMDD in society and the negative impact that inappropriate eating behaviors and eating disorders have on individuals' quality of life, the aim of this study was to investigate the relationship between moderate to severe PMS and PMDD and eating behaviors and eating disorders. **Methods:** This descriptive-analytical study was conducted on 290 female students of Babol University of Medical Sciences in 2022. Eligible individuals completed demographic questioners, premenstrual symptoms screening tool (PSST), three-factor eating questionnaire reduced 18 (TFEQ-R18), and 26-item eating attitudes test (EAT-26). The data were analyzed using SPSS at significance level of 0.05. **Results:** Totally, 162 participants (55.86%) had moderate to severe PMS symptoms, of whom 47 (16.21% of all girls and 29.01% of PMS girls) also reported dysmenorrhea. Mean scores for eating disorders (Mild PMS: 6.18±5.29, moderate or severe PMS: 8.49±7.75, PMDD: 9.66±7.89), emotional eating (no or mild PMS: 6.05±2.50, moderate or severe PMS: 6.70±2.90, PMDD: 7.17±3.14) and uncontrolled eating (Mild PMS: 19.30±5.26, moderate or severe PMS: 20.73±5.22, PMDD: 22.15±6.40) increased with increasing PMS severity. After controlling for other predictors, participants with an overweight and those in the PMDD group exhibited significantly higher mean emotional eating scores compared to the non-PMS group. **Conclusion:** The present study showed that emotional eating was significantly associated with PMDD symptoms in overweight individuals.

Introduction

Menstruation is considered a natural phenomenon of reproductive age associated with various disorders that can have a side effect on the life quality of women in reproductive age (Mitsuhashi *et al.*, 2022). The symptoms of this disorder may also vary among different people depending on age, duration, quantity and quality of bleeding, leading to a different prevalence in

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different societies (Taheri *et al.*, 2020). For example, the prevalence of premenstrual syndrome (PMS) has been found to be 47.8% worldwide, of which about 20% suffer from relatively severe symptoms that lead to interruption of their activities. In addition, at least 3 to 8% are susceptible to premenstrual dysphoric disorder (PMDD) (Gudipally and Sharma, 2022). In Iran, the prevalence of PMS is high and has been reported to be 54.9% (Ranjbaran *et al.*, 2017).

PMS is one of these common disorders that many women experience periodically (at regular intervals) at the end of the luteal phase of the menstrual cycle (7 to 14 days before menstrual bleeding) with a range of physical, psychological and emotional experiences (Ghasemipour *et al.*, 2019, Hantsoo *et al.*, 2022). However, in some cases, PMS symptoms are more severe and interfere with normal daily activities, work, school performance or interpersonal relationships, preventing a person from daily life and severely affecting their quality of life (Quaglia *et al.*, 2023). PMDD, the most severe form of premenstrual syndrome, on the other hand, is a complex and debilitating condition resulting from unstable estrogen and progesterone levels, causing debilitating emotional symptoms and behaviors such as depression and severe anxiety and even psychosis (Ferna´ndez *et al.*, 2019, Osborn *et al.*, 2020).

In general, the symptoms associated with this condition, which can have side effects on people's quality of life, are divided into three categories: physical, behavioral and emotional symptoms (Abu Alwafa *et al.*, 2021). Hence, the common behavioral and emotional symptoms include weakness and fatigue, quick temper, mood swings, depression, irritability and short temper (Najafi Sharjabad *et al.*, 2017). Common physical symptoms also include abdominal muscle cramps, headache, back pain, bloating, changes in appetite, breast swelling and sensitivity (Abu Alwafa *et al.*, 2021). Also, eating disorder is one of the most important physical symptoms that occur during this period (Dahlgren and Qvigstad, 2018, Hardin *et al.*, 2020).

Eating behavior is one of the most important aspects shaped by environmental, physiological, and psychological factors. It is considered a part of nutrition psychology, encompassing variables related to diet and normative eating habits (Assadi Tehran *et al.*, 2019). In fact, eating behavior can be considered an influential factor on food intake and consequently for individual health (Tahvildary *et al.*, 2017). In general, eating behavior can be divided into three categories: 1) restrictive eating behavior (conscious restriction in order to control or lose weight), 2) uncontrolled eating (the tendency to eat more than usual due to loss of control, accompanied by a mental feeling of hunger) and 3) emotional eating (due to the inability to resist emotional triggers) (Banna *et al.*, 2018).

Since inappropriate behaviors can become disorders if not properly addressed and treated, eating disorders symptoms are diagnosed by abnormal eating behaviors that occur after serious eating behavior problems (Radfar *et al.*, 2018). In fact, eating disorder is a type of problem characterized by eating behaviors that manifest in the symptoms of bulimia nervosa (where an individual consumes a large amount of food and then vomits), anorexia nervosa (where an individual avoids eating food even when hungry), and disordered eating behaviors (Radfar *et al.*, 2018, xxxxCenter). Therefore, based on some studies conducted, there are potential grounds for the existence of a relationship between menstruation and its symptoms and eating-related behaviors and disorders (Çoban *et al.*, 2021, Hashim *et al.*, 2019, Kwon *et al.*, 2022, Quaglia *et al.*, 2023, Taheri *et al.*, 2020, Yen *et al.*, 2020). In one study, PMS was suggested as an indicator of ovarian hormonal sensitivity in women at risk of eating disorders (Hardin *et al.*, 2020). In addition, some studies have shown that as PMS symptoms increase in severity, disordered eating behaviors also increase, such that emotional eating and uncontrolled eating behaviors have been frequently reported in women or adolescents with PMDD (Çoban *et al.*, 2021, Yen *et al.*, 2020).

Considering the relatively high prevalence of PMS and consequently PMDD in society and the

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negative impact that inappropriate eating behaviors and eating disorders can have on the life quality of individuals, the aim of this study was to examine the relationship between moderate to severe PMS and PMDD and eating behaviors and nutritional disorders as well as the demographic characteristics and health behaviors of female students of Babol University of Medical Sciences.

Methods and Materials

Study design and participants

The present research was a descriptive-analytical study conducted cross-sectionally on female students of Babol University of Medical Sciences in the year 2022. In this study, the sample size was determined based on the article by Nobels *et al.* and calculated using the following formula. In the aforementioned relationship, type I error rate was set at 0.05, the power was set at 80%, and a correlation coefficient of 0.25 (r) was used, estimating a minimum sample size of 124 (Nobles *et al.*, 2016). As this study was an analytical study, the same number was set for the control group (individuals without PMS). Therefore, considering a drop-out rate of 10% due to incomplete questionnaires, a total of 290 individuals were selected using the random sampling method and included in the study after informed consent was obtained.

$$n \geq \left(\frac{Z_{1-\beta} + Z_{1-\frac{\alpha}{2}}}{\frac{1}{2}\log_e \frac{1+r}{1-r}} \right)^2 + 3$$

The inclusion criteria for this study included being a female student and willingness to participate in the study. The exclusion criteria consisted of diseases such as polycystic ovary syndrome, thyroid disorders, the use of psychiatric medications, hormone therapy, the use of contraceptives, irregular menstruation and pregnancy. In light of the COVID-19 pandemic, the data were collected using the instruments described below, in both written and virtual form.

Ethical considerations

This study was approved by the Ethics Committee of Babol University of Medical Sciences under the code IR.MUBABOL.HRI.REC.1401.046.

Data Collection Tools

Initial Information: Initially, the questionnaires were distributed to the students who met the entry criteria and did not meet the exit criteria. They filled out the questionnaires with informed consent while being informed about the research objectives and the implementation method. Additionally, the students could receive an interpretation and the results of the questionnaires if they provided their email at the end. Using a checklist designed by the researchers of this study, demographic information was examined, including individual characteristics related to age, marital status, body mass index (BMI), physical activity, smoking and alcohol consumption, and average daily tea and coffee consumption in cups.

Assessment of PMS and PMDD: The Premenstrual Symptoms Screening Tool (PSST 24) was used to assess PMS and PMDD. In this study, the Persian standard version of this questionnaire was used, which has been validated by relevant specialists and has an acceptable reliability with a Cronbach's alpha coefficient above 0.7 (Ahmadi *et al.*, 2015). This questionnaire consists of 19 items and two sections. The first section contains 14 questions about mood, physical and behavioral symptoms, while the second section contains questions to assess the impact of symptoms on the person's life. To diagnose moderate or severe PMS, the following three conditions must coexist: 1) there must be at least one moderate or severe case in items 1 to 4, 2) in addition to the previous condition, there must be at least 4 moderate or severe cases in items 1 to 14, and 3) there must be at least one moderate or severe case in the section assessing the impact of symptoms on life (the last 5 items). For a diagnosis of PMDD, three conditions must also be present simultaneously: 1) there must be at least one severe case in items 1 to 4, 2) there must also be at least 4 moderate or severe cases in questions 1 to 14, and 3) there must be at least one severe case in the section that assesses the impact of symptoms on life (the last 5 questions).

Eating behavior assessment: The Three Factor

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Eating Questionnaire (TFEQ-R18) consists of 18 items divided into three components: restrained eating, uncontrolled eating, and emotional eating. Items 1 to 17 are rated on a four-point Likert scale ranging from completely true to completely false, while one item is rated on an eight-point Likert scale. For the evaluation, items 1 to 13 are rated with 4, 3, 2 and 1 points if the answers are completely correct, mostly correct, mostly incorrect, and completely incorrect, respectively. Reverse scoring is used for items 14 to 17. Higher scores in each domain indicate a higher level of restrained eating, uncontrolled eating, and emotional eating. The reliability and validity of this questionnaire was reviewed by Mostafavi *et al*. and found to be acceptable (Mostafavi *et al.*, 2017).

Evaluation of attitudes toward nutrition: The Eating Attitudes Test (EAT-26) questionnaire is used as a screening tool for self-assessment of eating habits and symptoms of eating disorders. It contains 26 questions related to attitudes, habits and eating disorders (symptoms of anorexia nervosa and bulimia nervosa), which are measured on a Likert scale. Accordingly, for questions 1 to 25, the options "always", "almost always" and "often" are rated as 3, 2 and 1 respectively, while the remaining options are rated as zero points. For question 26, the options "sometimes", "rarely" and "never" are scored as 1, 2 and 3 respectively, while the remaining options are also scored as zero. Respondents who answered "always" or "almost always" to question 9 (I vomit after eating) are considered to have bulimia nervosa, and those who answered "always" or "almost always" to question 2 (I avoid eating even when I am hungry) are considered to have anorexia nervosa. The score range varies from zero to 78, with a score of twenty or more, indicating the potential presence of an eating disorder. The validity of the Persian version is considered satisfactory, and the reliability according to the test-retest method was given as 0.91 (Assadi Tehran *et al.*, 2019).

Assessment of depression, anxiety, and stress: The DASS-21 (Depression-Anxiety-Stress Scale) questionnaire was used to assess depression, anxiety and stress. This scale consists of 21 items that assess each of the psychological constructs of depression, anxiety and stress using 7 different statements. Questions 3, 5, 10, 13, 16, 17 and 21 refer to the depression subscale, while questions 2, 4, 7, 9, 15, 19 and 20 refer to the anxiety subscale. Questions 1, 6, 8, 11, 12, 14 and 18 correspond to the stress subscale. The score for each construct is the sum of the scores for the corresponding questions. Moreover, each question is rated on a four-point Likert scale, ranging from "does not apply to me at all" (zero value) to "applies very much to me" (maximum value). The score for each subscale therefore ranges from a minimum of zero to a maximum of 21. As the DASS-21 is the shortened version of the main scale (which contains 42 questions), the final score for each of these subscales must be doubled. In the study by Tayebi et al., the reliability of the questionnaire was determined using Cronbach's alpha which was 0.79, 0.72 and 0.80 for depression, anxiety and stress, respectively (Tayebi *et al.*, 2015).

Data analysis

Mean, standard deviation (SD), number and percentage were used to describe the basic differences between the PMS categories. The Kolmogorov-Smirnov test was used to assess the normality of the data. One-way ANOVA followed by Tukey test, one-way Welch's ANOVA followed by a Games-Howell test, chi-square test and Monte Carlo chi-square test were used. Univariate linear regression was employed to determine the relationship between PMS and eating disorders, emotional eating, uncontrolled eating and cognitive restraint. Multiple linear regression was used to adjust for potential confounders. Finally, all analyses were performed using SPSS version 26 software (IBM Corp.). The significance level of the tests was reported as less than 0.05.

Results

The baseline characteristics of the study participants based on the PMS categories are reported in **Table 1**. The mean age of the

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participants was 22.88±3.22 years. In the current study, the number of participants in No/Mild PMS, Mod/Sev PMS, and PMDD group were 128 (44.1%), 115(39.7%), and 47(16.2%), respectively. The mean values of depression (*P*<0.001), stress (*P*<0.001), anxiety (*P*<0.001), eating disorders (*P*=0.003), emotional eating (*P*=0.042) and uncontrolled eating (*P*<0.012) differed significantly between the PMS categories.

Table 1. The baseline features of study participants based on PMS.

Variables	No or Mild PMS (n=128)	Moderate or severe PMS (n=115)	PMDD (n=47)	Total	*P*-value
Age (y)	22.86^{a}±3.64*	22.90^{a}±2.75	22.89^{a}±3.16	22.88±3.22	0.995‡
Depression score	10.09^{a}±8.76	15.39^{b}±9.97	19.53^{b}±11.82	13.72±10.37	<0.001‡
Stress score	14.59^{a}±8.88	20.64^{b}±8.74	25.57^{c}±9.57	18.77±9.80	<0.001†
Anxiety score	7.41^{a}±6.90	12.58^{b}±8.19	18.00^{c}±10.60	11.18±8.94	<0.001‡
Eating disorders score	6.18^{a}±5.29	8.49^{b}±7.75	9.66^{b}±7.89	7.66±6.91	0.003‡
Emotional eating score	6.05^{a}±2.50	6.70^{a}±2.90	7.17^{a}±3.14	6.49±2.80	0.042‡
Uncontrolled eating score	19.30^{a}±5.26	20.73^{ab}±5.22	22.15^{b}±6.40	20.33±5.52	0.012‡
Cognitive restraint score	16.10^{a}±4.07	15.33^{a}±3.97	15.21^{a}±4.85	15.65±4.17	0.261†
Physical activity					
Irregular	82(64.1)**	75(65.2)	28(59.6)	185(63.8)	0.904§
2 days in week	30(23.4)	27(23.5)	11(23.4)	68(23.4)	
≥3 days in week	16(12.5)	13(11.3)	8(17.0)	37(12.8)	
Coffee or tea (daily)					
0-1	52(40.6)	51(44.3)	24(51.1)	127(43.8)	0.763§
2-3	59(46.1)	51(44.3)	17(36.2)	127(43.8)	
More than 3	17(13.3)	13(11.3)	6(12.8)	36(12.4)	
Anorexia nervosa					
No	128(100.0)	111(96.5)	46(97.9)	285(98.3)	0.093$^{¥}$
Yes	0(0.0)	4(3.5)	1(2.1)	5(1.7)	
Bulimia nervosa					
No	128(100.0)	115(100.0)	47(100.0)	290(100.0)	-
Yes	0(0.0)	0(0.0)	0(0.0)	0(0.0)	

***PMS**: Premenstrual syndrome; **PMDD:** Premenstrual dysphoric disorder**; *:** Mean±SD**; **:** n (%); †: One-way ANOVA test followed by Tukey's test**;** $^{‡:}$ Welch One-way ANOVA test followed by Games-Howell's test; $^{§:}$ Chi-Square test; $^{¥}$: Monte Carlo Chi-Square test; Means with same superscript letters are not significantly different (P>0.05).*

The univariate linear regression analysis to evaluate association between baseline characteristics of participants and eating disorders, emotional eating, uncontrolled eating and cognitive restraint is illustrated in **Table 2**. In the unhealthy overweight group compared to the normal or underweight group, higher mean of emotional eating (β=1.144, *P*=0.002, confidence interval (CI)95%: 0.410, 1.878) and uncontrolled eating were observed (β=1.498, *P*=0.045, 95%CI: 0.035, 2.961). A higher mean of eating disorders (β=4.108, *P*=0.001, 95%CI :1.698, 6.518) and cognitive restraint (β=1.892, *P*=0.012, 95%CI: 0.426, 3.358) was observed in the group with physical activity 2 days a week compared to the irregular group. Also, a higher mean score for emotional eating was observed in the 2-3 times daily coffee or tea group compared to the 0-1 times daily coffee or tea group (β=1.071, *P*=0.002, 95%CI: 0.389, 1.753). Depression was associated with emotional eating (β=0.045, *P*=0.005, 95%CI: 0.014, 0.076), uncontrolled eating (β=0.109, *P*<0.001, 95%CI: 0.049, 0.170) and cognitive restraint (β=-0.079, *P*=0.001, 95%CI: -0.124, -0.033). Moreover, stress was associated with eating disorders (β=0.095, *P*=0.021, 95%CI: 0.014, 0.176), emotional eating (β=0.040, *P*=0.016, 95%CI: 0.008, 0.073), uncontrolled eating (β=0.101, *P*=0.002, 95%CI: 0.037, 0.165) and cognitive restraint (β=-0.080, *P*=0.001, 95%CI: -

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0.128, -0.031). Anxiety was also associated with eating disorders (β=0.200, *P*<0.001, 95%CI: 0.113, 0.286), emotional eating (β=0.043, *P*=0.019, 95%CI: 0.007, 0.079), and uncontrolled eating (β=0.139, *P*<0.001, 95%CI: 0.070, 0.209).

Table 2. Univariate linear regression analysis to evaluate association between baseline participant features and eating disorders, emotional eating, uncontrolled eating and cognitive restraint.

Variables	Eating disorders	Emotional eating	Uncontrolled eating	Cognitive restraint
Age				
β	-0.179	0.033	-0.005	-0.061
95% Confidence interval	-0.444, 0.087	-0.073, 0.140	-0.216, 0.206	-0.217, 0.095
P-value	0.186	0.536	0.961	0.443
Weight statous (Ref: Normal or Under Weight)				
Unhealthy overweight				
β	0.346	1.144	1.498	0.484
95% Confidence interval	-1.497, 2.190	0.410, 1.878	0.035, 2.961	-0.628, 1.595
P-value	0.712	0.002	0.045	.392
Marital status (ref: single)				
Married				
β	1.769	-0.185	-0.501	-0.073
95% Confidence interval	-0.208, 3.746	-0.989, 0.619	-2.088, 1.087	-1.273, 1.127
P-value	0.079	0.651	0.535	.904
Physical activity (ref: irregular)				
2 days in week				
β	1.265	-0.118	0.877	0.828
95% Confidence interval	-0.633, 3.163	-0.901, 0.665	-0.666, 2.419	-0.326, 1.982
P-value	0.191	0.767	0.264	0.159
≥3 days in week				
β	4.108	-0.124	-0.330	1.892
95% Confidence interval	1.698, 6.518	-1.119 ,0.870	-2.289, 1.629	0.426, 3.358
P-value	0.001	0.806	0.741	0.012
Coffee or tea (0-1 daily)				
2-3 times daily				
β	-1.252	1.071	0.512	0.606
95% Confidence interval	-2.958, 0.454	0.389, 1.753	-0.856, 1.879	-0.425, 1.638
P-value	0.150	0.002	0.462	0.248
More than 3 times daily				
β	-1.315	0.773	-0.027	0.447
95% Confidence interval	-3.882, 1.252	-0.252, 1.799	-2.084, 2.030	-1.105, 1.999
P-value	0.314	0.139	0.979	.571
Depression				
β	0.045	0.045	0.109	-0.079
95% Confidence interval	-0.032, 0.122	0.014, 0.076	0.049, 0.170	-0.124, -0.033
P-value	0.253	0.005	<0.001	0.001
Stress				
β	0.095	0.040	0.101	-0.080
95% Confidence interval	0.014, 0.176	0.008, 0.073	0.037, 0.165	-0.128, -0.031
P-value	0.021	0.016	0.002	0.001
Anxiety				
β	0.200	0.043	0.139	-0.020
95% Confidence interval	0.113, 0.286	0.007, 0.079	0.070, 0.209	-0.074, 0.034
P-value	<0.001	0.019	<0.001	0.467

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Linear regression model with subgroup analysis based on BMI and marital status category to evaluate the association between PMS and eating disorders is represented in **Table 3**. In total population, the PMS group (β=2.307, *P*=0.009, 95%CI: 0.588, 4.026) and the PMDD group (β=3.480, *P*=0.003, 95%CI: 1.198, 5.762) compared to the non-PMS group, had a higher mean score of eating disorder. Also, in normal or under weight BMI class, the PMS group (β=2.076, *P*=0.037, 95%CI: 0.128, 4.024) and the PMDD group (β=2.739, *P*=0.041, 95%CI: 0.118, 5.360) compared to the non-PMS group, showed higher mean of eating disorder. In the PMDD group compared to the Non-PMS group, mean of eating disorder was expected to increase by 5.489 points (β=5.489, *P*=0.025, 95%CI: 0.711, 10.267), in unhealthy overweight BMI class. A higher mean of eating disorder score was observed in the single group, the PMS group (β=2.139, *P*=0.024, 95%CI: 0.279, 3.999) and the PMDD group (β=3.760, *P*=0.004, 95%CI: 1.204, 6.316) compared to the non-PMS group.

Table 3. Linear regression model with subgroup analysis based on weight status and marital status category to evaluate association between PMS and eating disorders.

Variables	Crude model			Adjusted model		
	β	95% Confidence interval	*P*-value	β	95% Confidence interval	*P*-value
Total population[a]						
No or Mild PMS (ref)	0	-	-	0	-	-
Moderate or sevre PMS	2.307	0.588, 4.026	0.009	1.699	-.219, 3.616	.082
PMDD	3.480	1.198, 5.762	0.003	1.467	-1.128, 4.063	.266
Normal or under weight[b]						
No or Mild PMS (ref)	0	-	-	0	-	-
Moderate or sevre PMS	2.076	0.128, 4.024	0.037	1.436	-.783, 3.655	.203
PMDD	2.739	0.118, 5.360	0.041	.942	-2.095, 3.979	.541
Unhealthy overweight[c]						
No or Mild PMS (ref)	0	-	-	0	-	-
Moderate or sevre PMS	3.017	-0.719, 6.752	0.112	2.342	-1.927, 6.612	.276
PMDD	5.489	0.711, 10.267	0.025	2.248	-3.343, 7.839	.423
Marital Status: Single[d]						
No or Mild PMS (ref)	0	-	-	0	-	-
Moderate or sevre PMS	2.139	0.279, 3.999	0.024	1.673	-.403, 3.749	.114
PMDD	3.760	1.204, 6.316	0.004	1.669	-1.272, 4.611	.264
Marital Status: Married[d]						
No or Mild PMS (ref)	0	-	-	0	-	-
Moderate or sevre PMS	3.660	-0.776, 8.095	0.104	3.436	-1.855, 8.727	.197
PMDD	2.440	-2.708, 7.589	0.346	.439	-5.778, 6.656	.887

***PMS**: Premenstrual syndrome; **PMDD**: Premenstrual dysphoric disorder; [a]: Adjusted for age (year), marital status (single/married), physical activity (irregular/ 2 days in week/ ≥3 days in week), tea or coffee (0-1 daily/2-3 daily/ more than 3 daily), depression, stress, and anxiety; [b]: Adjusted for age (year), marital status (single/married), physical activity (irregular/ 2 days in week/ ≥3 days in week), Tee or coffee (0-1 daily/2-3 daily/ more than 3 daily), depression, stress, and anxiety; [c]: Adjusted for age (year), physical activity (Irregular/ 2 days in week/ ≥3 days in week), Tea or coffee (0-1 daily/2-3 daily/ more than 3 daily), depression, stress, and anxiety; [d]: Adjusted for age (year), physical activity (Irregular/ 2 days in week/ ≥3 days in week), Tea or coffee (0-1 daily/2-3 daily/ more than 3 daily), depression, stress, and anxiety.*

Linear regression model assessing the relationship between PMS and emotional eating, uncontrolled eating and cognitive restraint is shown in **Table 4**. In PMDD group compared to the non-PMS group, higher mean of emotional eating was observed (β=1.123, *P*=0.018, 95%CI: 0.192, 2.055). In addition, a higher mean value of uncontrolled eating was observed in the PMS group (β=1.426, *P*=0.042, 95%CI: 0.049, 2.802) and the PMDD group (β=2.844, *P*=0.002, 95%CI:

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1.017, 4.672) compared to the non-PMS group.

The linear regression model with subgroup analysis based on weight statous category to assess the association between PMS and emotional eating, uncontrolled eating and cognitive restraint is shown in **Table 5**. In normal or underweight class, and PMDD group compared to the non-PMS group, a higher mean of uncontrolled eating was observed (β=2.422, *P*=0.022, 95%CI: 0.350, 4.494). In addition, in the unhealthy overweight class, and in PMDD group compared to the non-PMS group, a higher mean of emotional eating was observed (β=2.831, *P*=0.002, 95%CI: 1.040, 4.623). In the unhealthy overweight class, when controlling for the other predictors in the model, and comparing PMDD group to the non-PMS group, a higher mean of emotional eating was observed (β=2.004, *P*=0.048, 95%CI: 0.018, 3.991).

Table 4. Linear regression model to evaluate association between PMS and emotional eating, uncontrolled eating and cognitive restraint.

Variables	Crude model			Adjusted model		
	β	95% Confidence interval	*P*-value	β	95% Confidence interval	*P*-value
Emotional eating[a]						
No or Mild PMS (ref)	0	-	-	0	-	-
Moderate or sevre PMS	0.649	-0.053, 1.350	0.070	0.483	-0.235, 1.200	0.187
PMDD	1.123	0.192, 2.055	0.018	0.858	-0.149, 1.865	0.095
Uncontrolled eating[b]						
No or Mild PMS (ref)	0	-	-	0	-	-
Moderate or sevre PMS	1.426	0.049, 2.802	0.042	0.657	-0.756, 2.070	0.361
PMDD	2.844	1.017, 4.672	0.002	1.400	-0.584, 3.383	0.166
Cognitive restraint[c]						
No or Mild PMS (ref)	0	-	-	0	-	-
Moderate or sevre PMS	-0.771	-1.825, 0.283	0.151	-0.265	-1.351, 0.820	0.631
PMDD	-0.889	-2.288, 0.510	0.212	-0.069	-1.572, 1.434	0.928

***PMS**: Premenstrual syndrome; **PMDD**: Premenstrual dysphoric disorder; [a]: Adjusted for normal or under weight/unhealthy overweight, tea or coffee (0-1 daily/2-3 daily/ more than 3 daily), depression, stress, and anxiety; [b]: Adjusted for normal or under weight/unhealthy overweight, physical activity (irregular/ 2 days in week/ ≥3 days in week), depression, stress, and anxiety; [c]: Adjusted for physical activity (irregular/ 2 days in week/ ≥3 days in week), tea or coffee (0-1 daily/2-3 daily/ more than 3 daily), depression, and stress.*

In **Table 6,** linear regression model with subgroup analysis was shown based on marital status to evaluate association between PMS and emotional eating, uncontrolled eating and cognitive restraint . In the single group, by comparing PMDD group to the non-PMS group, a higher mean of emotional eating was observed (β=1.160, *P*=0.036, 95%CI: 0.079, 2.241). After PMDD group was compared to the non-PMS group, a higher mean of uncontrolled eating was observed (β=3.316, *P*=0.002, 95%CI: 1.217, 5.414) in the single group

Discussion

The aim of this study was to evaluate the relationship between PMS and premenstrual PMDD and eating behaviors and eating disorders in female students of Babol University of Medical Sciences. Of the 290 female students studied, 39.6% had moderate to severe PMS and 16.2% suffered from PMDD.

A 2013 study by Matsumoto *et al*. found that about 90% of women of reproductive age were affected by PMS and PMDD, with about 20 to 40% suffering from PMS and 2 to 8% suffering from PMDD (Matsumoto *et al.*, 2013). Gao *et al*. in 2022 used various studies in a systematic review and meta-analysis to investigate the prevalence and global and regional burden of PMS and PMDD (Gao *et al.*, 2022). They reported the prevalence of PMDD in Korean women, a Bulgarian population, university female students in Jordan and young

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adult women in southern Brazil as 2.4, 3.3, 7.7 and 17.6%, respectively. It has been noted that the prevalence of PMDD may vary by culture and ethnic group (Chumpalova *et al.*, 2020). Dutta and Sharma, in their 2021 meta-analysis conducted in India determined the prevalence of PMS and PMDD, and reported a combined prevalence of PMS and PMDD of 43 and 8%, respectively, after analyzing the results of 25 studies that examined PMS and PMDD (Dutta and Sharma, 2021). Additionally, in a cross-sectional study conducted by Acikgoz *et al.* on 618 first-year university students in Turkey in 2017, the prevalence of PMS was reported to be 58.1% (Acikgoz *et al.*, 2017). Furthermore, in a study by Çoban *et al*. in 2021, in which 504 nursing students took part, the prevalence of PMDD was put at 15.9% (Çoban *et al.*, 2021).

Table 5. Linear regression model with subgroup analysis based on weight statous category to evaluate association between PMS and emotional eating, uncontrolled eating and cognitive restraint.

Variables	Crude Model			Adjusted Model		
	β	**95% Confidence interval**	***P*-value**	**β**	**95% Confidence interval**	***P*-value**
Normal or Underweight						
Emotional eating[a]						
No or Mild PMS (ref)	0	-	-	0	-	-
Moderate or sevre PMS	0.425	-0.369, 1.219	0.293	0.304	-0.519, 1.127	0.467
PMDD	0.453	-0.616, 1.522	0.404	0.319	-0.854, 1.492	0.592
Uncontrolled eating[b]						
No or Mild PMS (ref)	0	-	-	0	-	-
Moderate or sevre PMS	1.475	-0.065, 3.015	0.060	0.914	-0.721, 2.550	0.272
PMDD	2.422	0.350, 4.494	**0.022**	1.562	-0.776, 3.901	0.189
Cognitive restraint[c]						
No or Mild PMS (ref)	0	-	-	0	-	-
Moderate or sevre PMS	-1.090	-2.357, 0.177	0.091	-0.567	-1.905, 0.770	0.404
PMDD	-0.966	-2.672, 0.739	0.265	-0.118	-1.992, 1.755	0.901
Unhealthy Overweight						
Emotional eating[a]						
No or Mild PMS (ref)	0	-	-	0	-	-
Moderate or sevre PMS	1.298	-0.103, 2.699	0.069	1.065	-0.388, 2.518	0.148
PMDD	2.831	1.040, 4.623	0.002	2.004	**0.018, 3.991**	**0.048**
Uncontrolled eating[b]						
No or Mild PMS (ref)	0	-	-	0	-	-
Moderate or sevre PMS	1.227	-1.803, 4.257	0.422	1.037	-1.987, 4.061	0.496
PMDD	3.787	-0.089, 7.662	0.055	2.257	-1.870, 6.384	0.279
Cognitive restraint[c]						
No or Mild PMS (ref)	0	-	-	0	-	-
Moderate or sevre PMS	0.177	-1.691, 2.045	0.851	0.553	-1.239, 2.345	0.540
PMDD	-0.680	-3.069, 1.710	0.572	0.438	-2.001, 2.877	0.721

***PMS**: Premenstrual syndrome; **PMDD**: Premenstrual dysphoric disorder; [a]: Adjusted for tea or coffee (0-1 daily/2-3 daily/ more than 3 daily), depression, stress, and anxiety; [b]: Adjusted for physical activity (irregular/ 2 days in week/ ≥3 days in week), depression, stress, and anxiety; [c]: Adjusted for physical activity (irregular/ 2 days in week/ ≥3 days in week), tea or coffee (0-1 daily/2-3 daily/ more than 3 daily), depression, and stress.*

Based on the above studies, the prevalence of PMS and PMDD was found to be generally below or close to 50%, which is the estimated prevalence in the current study. However, this prevalence of PMS, despite above 50%, was relatively low compared to the results of some studies conducted in Iran. For example, the study by Ranjbaran *et al.* in 2017 reported an overall prevalence of PMS of 70.8%, with a subgroup analysis showing prevalence rates of 80.4% in school students >12 years old, 68.9% in university students and 54.9% in the general population (Ranjbaran *et al.*, 2017).

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Moreover, the study by Najafi Sharjabad *et al*., which included a sample of 408 students from Bushehr University of Medical Sciences, found a high prevalence of PMS of 83% (Najafi Sharjabad *et al*., 2017). Furthermore, Azarnive studied on 240 female students from Zabol University and found a high prevalence of this syndrome of 75.8% (Azarnive and Tavakoli Khoramizi, 2016).

Table 6. Linear regression model with subgroup analysis based on marital status to evaluate association between PMS and emotional eating, uncontrolled eating and cognitive restraint.

Variables	Crude Model			Adjusted Model		
	β	95% Confidence interval	*P*-value	β	95% Confidence interval	*P*-value
Marital status: Single						
Emotional eating[a]						
No or Mild PMS (ref)	0	-	-	0	-	-
Moderate or sevre PMS	0.741	-0.045, 1.527	0.064	0.618	-0.187, 1.423	0.132
PMDD	1.160	0.079, 2.241	0.036	1.075	-0.097, 2.247	0.072
Uncontrolled eating[b]						
No or Mild PMS (ref)	0	-	-	0	-	-
Moderate or sevre PMS	1.349	-0.178, 2.875	0.083	0.491	-1.070, 2.052	0.536
PMDD	3.316	1.217, 5.414	0.002	2.263	-0.011, 4.538	0.051
Cognitive restraint[c]						
No or Mild PMS (ref)	0	-	-	0	-	-
Moderate or sevre PMS	-0.828	-1.986, 0.331	0.161	-0.259	-1.454, 0.936	0.670
PMDD	-0.854	-2.446, 0.738	0.291	-0.070	-1.779, 1.639	0.936
Marital Status: Married						
Emotional eating[a]						
No or Mild PMS (ref)	0	-	-	0	-	-
Moderate or sevre PMS	0.192	-1.451, 1.835	0.816	-0.149	-1.892, 1.593	0.864
PMDD	1.012	-0.895, 2.919	0.292	0.110	-2.031, 2.250	0.918
Uncontrolled eating[b]						
No or Mild PMS (ref)	0	-	-	0	-	-
Moderate or sevre PMS	1.718	-1.620, 5.056	0.307	1.106	-2.364, 4.576	0.525
PMDD	1.512	-2.363, 5.387	0.438	0.389	-3.958, 4.737	0.858
Cognitive restraint[c]						
No or Mild PMS (ref)	0	-	-	0	-	-
Moderate or sevre PMS	-0.543	-3.213, 2.126	0.685	-0.310	-3.239, 2.619	0.832
PMDD	-0.964	-4.063, 2.134	0.536	-0.814	-4.486, 2.858	0.658

***PMS**: Premenstrual syndrome; **PMDD**: Premenstrual dysphoric disorder; [a]: Adjusted for BMI (normal or under weight/unhealthy overweight), Tea or coffee (0-1 daily/2-3 daily/ more than 3 daily), depression, stress, and anxiety; [b]: Adjusted for BMI (normal or under weight/unhealthy overweight), physical activity (Irregular/ 2 days in week/ ≥3 days in week), depression, stress, and anxiety; [c]: Adjusted for physical activity (Irregular/ 2 days in week/ ≥3 days in week), TeA or coffee (0-1 daily/2-3 daily/ more than 3 daily), depression, and stress.*

Different and sometimes contradictory prevalence rates for PMS and PMDD have been reported in various studies conducted both domestically and internationally. This is likely due to differences in measurement instruments, demographic characteristics of the populations studied, cultural and social aspects, physical activities, and attitudes and behaviors related to diet, which are thought to be major factors in this inconsistency. An important point is that PMS and PMDD become common mental disorders in women and significantly affect their daily functioning. Therefore, epidemiologic studies on PMS and PMDD and their associated factors can serve as a scientific basis for the prevention and treatment of premenstrual disorders (Gao *et al*., 2022).

The results of the present study showed that in girls with moderate to severe PMS and in girls with PMDD, the scores for uncontrolled eating

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behaviors and emotional eating were more prevalent compared to girls without these disorders, while restrictive eating behaviors were observed less frequently. In line with this finding, the study by Çoban et al. indicated that PMDD is defined as a more severe form of PMS with more stringent criteria, and it was found that the prevalence of emotional and uncontrolled eating behaviors was significantly higher in the PMDD group (Çoban *et al.*, 2021). A study conducted by Yen *et al*. in 2020 showed that women with PMDD symptoms reported uncontrolled eating behavior as the most important feature of their eating behavior (Yen *et al.*, 2020). Um *et al.* also found in a 2021 study that the emotional eating score was higher in the group with PMDD symptoms than in those without these symptoms (Um and Lee, 2022). In agreement with the results of the current study and the proposed studies, it can be claimed that moderate to severe PMS symptoms and consequently depressive disorders are significantly related to uncontrolled and emotional eating behavior, because in agreement with the research of Quaglia *et al.* in 2023, individuals with these symptoms consume more calories in the premenstrual phase and have a greater tendency to eat (Quaglia *et al.*, 2023).

In the present study, girls with moderate to severe PMS as well as those with depressive disorders reported more symptoms and signs of eating disorders, including binge eating disorder and anorexia nervosa. Similarly, in the study by Çoban et al., it was observed that as the severity of premenstrual symptoms increased, a person's diet became more susceptible to disordered eating (Çoban *et al.*, 2021). Moreover, in the study by Badrasawi *et al*., the total score of eating disorder symptoms was significantly higher in girls with PMS and PMDD (Badrasawi *et al.*, 2021). In the current study, the relative frequency of eating disorders was higher in people with PMS than in the group with more severe depressive disorders. This is in contrast to the study by Çoban, which found that the prevalence of eating disorders was significantly higher in PMDD (Çoban *et al.*, 2021). It should be noted that not all individuals with PMDD have moderate to severe PMS. Therefore, comparing the prevalence of eating disorders between individuals with premenstrual syndrome and those with PMDD may not be very meaningful. In the study by Badrasawi, severe psychological and physical symptoms were significantly more common in women with eating disorders characterized by binge eating (Badrasawi *et al.*, 2021). Nobles *et al*. found in their study of a national epidemiologic sample in the United States that women with PMS and PMDD were more likely to develop eating disorders associated with binge-eating symptoms and considered PMDD and PMS to be some of the most significant comorbid conditions with binge-eating disorder (Nobles *et al.*, 2016). In contrast, no binge eating symptoms were observed at all in the present study. Eating disorders were found in 19 individuals and anorexia nervosa symptoms in only 5 individuals in the current study. Despite the small numbers, both showed significant associations. Given this fact, it is important to examine this relationship in the context of associated mental disorders.

In the ongoing study, the incidence of moderate to severe PMS and depressive disorder in the participating girls showed no significant correlation with their demographic characteristics, physical activity, tobacco use, or consumption of tea and coffee. Consistent with this finding, various studies have observed a lack of significant relationships, including the study by Quaglia *et al.*, which found no significant difference in body mass index between girls with and without PMS (Quaglia *et al.*, 2023). In the study by Purdue-Smithe *et al*. in 2016, the occurrence of PMS was not significantly related to caffeine and coffee consumption (Purdue-Smithe *et al.*, 2016). Additionally, Hashim *et al*. in 2019 observed no significant relationship between regular or irregular physical activity and the presence or absence of premenstrual syndrome (Hashim *et al.*, 2019). Conversely, Teixeira *et al*. reported in 2013 that there was a significant inverse relationship between the level of physical activity and the prevalence of PMS (Teixeira *et al.*, 2013).

This study had its strengths and weaknesses.

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One of the strengths of the present study was that, to the authors' knowledge, it was the first study conducted on Iranian students to examine the relationship between PMS and PMDD and eating disorders and eating behaviors. One weakness of this study was that it was limited to Babol University of Medical Sciences, which represents a small sample of Iranian female students. Due to the cross-sectional nature of this study, causal relationships also could not be established. Therefore, while a significant association was found between PMS and disordered eating behaviors, the direction of this relationship remains unclear. In addition, based on the available information, the role of some intervening variables in the study was controlled for; however, there are still confounding factors that could influence the results and need to be controlled for in future studies. It was also not determined whether the study participants took supplements such as minerals, vitamins and herbal medicines to relieve premenstrual symptoms. In addition, the survey was only conducted once among the participants, whereas repeated responses to the questionnaire at different stages of the menstrual cycle and over different months would have provided more reliable and clearer information. Moreover, the daily energy intake of the study participants was not investigated, which could be another weakness of this study. This study had also limitations related to the use of self-reported instruments, including the PSST and TFEQ-R18, which may have introduced response bias. Therefore, it is suggested that future studies include a larger sample size and include different groups of women from the community. Considering the extensive effects of possible related factors, the prevalence of PMS and PMDD can be estimated more accurately. Given the high prevalence of PMS and PMDD in this study and considering the negative impact of PMS and PMDD on daily functioning and quality of life, it is recommended to focus on the detection of eating behavior disorders in individuals with PMS and PMDD symptoms among young women, especially university students.

Conclusion

The present study showed that irregular eating behavior (emotional eating) was significantly associated with PMDD symptoms. Additionally, girls with moderate to severe PMS or PMDD had significantly higher scores for total eating disorder symptoms, emotional eating, and uncontrolled eating compared to those without these conditions.

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Authors' contributions

Hamidia A, Faramarzi M, and Shirafkan H designed research; Faramarzi M and Hoseini N conducted research; Amiri SM analyzed data; and Hamidia A, Faramarzi M, Hoseini N and Amiri SM wrote the paper. Hamidia A had primary responsibility for final content. All authors read and approved the final manuscript.

Conflict of interests

The authors declared no conflict of interest.

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