# Investigating influencing factors on premenstrual syndrome (PMS) among female college students

Su Jeong Yi[1], Miok Kim[1*] and Ina Park[2]

## Abstract

**Background** Premenstrual syndrome (PMS) affects women's physical and mental health. Depression, stress, sleep disturbance, and eating attitude problems have been known to influence PMS. Furthermore, restrictions of daily life due to the COVID-19 pandemic have led to changes in sleep patterns and eating attitudes. Thus, it is necessary to closely examine how these factors affect PMS. This study aimed to examine the levels of PMS, stress, depression, sleep disturbance, and eating attitude problems among female college students who experience dysmenorrhea and determine the factors associated with PMS.

**Methods** A cross-sectional online survey design was conducted using a convenience sample of 143 female college students in C City, South Korea. Data were collected from September 1 to 19, 2021 in South Korea using an online self-administered survey. Differences in participants' level of PMS according to physical health variables (e.g., smoking, water intake, menstrual pain intensity) and psychological issues (i.e., stress, depression, sleep disturbances, and eating attitude problems) were assessed with independent sample t-tests and one-way ANOVAs. Correlational analyses between these variables were also conducted. Additionally, multiple regression was performed to identify the factors influencing PMS.

**Results** PMS severity was between normal (27.3%) and premenstrual dysphoric disorder (PMDD) (72.7%). PMS was associated positively with depression ($r = .284$, $p = 001$), stress ($r = .274$, $p = .001$), sleep disturbance ($r = .440$, $p < .001$), and eating attitude problems ($r = .266$, $p = .001$). Additionally, menstrual pain intensity ($\beta = 0.204$), sleep disturbances ($\beta = 0.375$), and eating attitude problems ($\beta = 0.202$) were found to influence PMS. The regression model was significant ($F = 16.553$, $p < .001$) with an explanatory power of 24.7%.

**Conclusions** Considering the influencing factors of PMS identified in this study, interventions for participants experiencing PMS should be made. We propose that further study should be conducted to examine whether the severity of PMS changes according to menstrual pain, the pattern and degree of its change, and the paths through which sleep quality and eating attitude problems affect PMS.

**Keywords** Premenstrual syndrome, Dysmenorrhea, Psychological stress, Depression, Sleep, Eating disorder

*Correspondence:
Miok Kim
aprilsea@dankook.ac.kr
[1]Department of Nursing, Dankook University, 119, Dandae-ro, Dongnam-gu, Cheonan-si, Chungcheongnam-do, Korea
[2]Center for Sport Science in Chungnam, 370-24, Nambu-ro, Asan-si, Chungcheongnam-do, Republic of Korea

## Introduction

Premenstrual syndrome (PMS) is a combination of more than 200 complex symptoms including physical symptoms, behavioral symptoms, and emotional symptoms [1], which develop approximately 2–10 days before the period and disappear just before or shortly after menstruation begins [2]. Even though the etiology of PMS is unclear, a wide variety of factors seem to come into play, including interactions between biological factors (e.g., hormonal imbalance and neurotransmitter changes) [3] and psychosocial factors (e.g., attitude toward menstruation and stress) [4] as well as routine health behaviors (e.g., exercise, smoking, drinking, sleep duration, diet, and nutrient intake) [1]. PMS is experienced by 99% of Korean women of reproductive age (15 to 49 years), and 13.6 to18.6% of them are diagnosed with premenstrual dysphoric disorder (PMDD) [5], which is included in the depressive disorders chapter of the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) [6]. Specifically, women 21–25 years old (college students) have a higher incidence of PMS than high school students and middle-aged women [7]. Although 28.0% of female college students experience severe PMS-induced stress [8] and disturbances in everyday life, they rarely receive professional care [9].

The COVID-19 pandemic has had a major impact on reproductive health, with previous studies indicating changes in menstrual cycles, including regularity, frequency, duration, and PMS symptoms, due to COVID-19-related stress [2, 10]. Stress from COVID-19 can disrupt glucocorticoid hormone levels and affect menstrual cycle regularity [11]. Among such negative emotions, stress can further exacerbate emotional and psychological symptoms associated with PMS. And depression is known to have the highest influence on PMS [4]. Because women at risk of depression tend to have a high likelihood of PMS, it is necessary to assess the risk of depression in women with PMS [12]. PMS should be considered together with psychological and emotional problems experienced by women.

The COVID-19 lockdown has also influenced lifestyle habits, leading to changes in dietary habits, physical activity, sleep patterns, and psychological well-being [13]. Women experiencing PMS are particularly susceptible to sleep disturbances due to hormonal changes associated with the menstrual cycle [14]. They may face difficulties in various aspects of sleep, such as duration, quality, latency, maintenance, and wake-up time, compared to women unaffected by PMS [14]. Additionally, a higher proportion of women with PMS suffer from poor sleep quality compared to those without PMS (75.6% vs. 58.8%) [15], and women with sleep disorders have a 1.7-fold risk of experiencing PMS compared to women without sleep

disorders [16], highlighting the close association between PMS and sleep quality.

Eating attitude problems have been linked to PMS [17], and differences in appetite and eating habits are observed between healthy women and those with PMS [18]. Particularly, female college students with PMS are significantly associated with eating attitude problems and depression [19]. Moreover, hospitalizations for eating behavior-related problems, such as anorexia nervosa and other eating disorders, have increased during the COVID-19 pandemic [20, 21]. Thus, understanding the relationship between eating habits and PMS in female college students is crucial.

Previous research [22, 23] various related factors have been investigated focusing on the incidence and severity of PMS. In this study, we examine the levels of PMS, stress, depression, sleep disturbances, and eating attitude problems in female college students who experience dysmenorrhea and determine influencing factors associated with PMS. The findings will contribute to developing efficient nursing intervention programs for preventing and managing PMS.

## Methods

### Study design

This study is a cross-sectional survey research aimed at exploring factors related to PMS among female college students.

### Participants

The inclusion criteria for the study participants are unmarried female college students in their 20s who have experienced menstrual pain, understand the purpose of the research, and can respond to the survey. The exclusion criteria for the study participants are those who have not experienced menstrual pain, have a history of childbirth, or are currently undergoing treatment for mental health issues. They were recruited based on the research findings that the more severe the dysmenorrhea, the more severe the PMS symptoms [24] and that 90.2% of female college students experience weak to strong dysmenorrhea [25]. The minimum sample size of this study estimated using the G*Power 3.1 program was 153 participants for power 0.80, effect size 0.15, and significance level 0.05 with 19 predictors. Considering a dropout rate of 10%, the online questionnaire survey remained open until the number of respondents reached 170, and after removing the respondents who gave uniform answers to all items, data from 143 respondents were finally used for analysis in this study.

### Data collection

At the time of data collection for this research, all university classes had transitioned to online format due to

the COVID-19 pandemic, and it was a period of active communication through the university's self-moderated discussion boards. To collect data for this study, we employed a self-selection approach where individuals who met specific criteria voluntarily participated. We encouraged all members of the university community, including students and faculty, to post promotional messages on the university's self-moderated discussion boards.

The promotional messages were directly authored by the researchers and included information about the research's purpose and significance, participation methods, criteria for selecting and excluding research participants, and a link to the survey (using Google Forms). Participants who believed they met the research criteria, such as being female university students in their 20s or having experienced menstrual cramps, were directed to the survey link and asked to confirm their eligibility. Those who met the selection criteria were provided with an 'Informed Participant Information Sheet' detailing the research's purpose and participation procedures, and they were given the opportunity to provide their online consent. The survey commenced after this entire process was completed.

This self-selection approach was chosen due to the online nature of our study and the unique circumstances of the COVID-19 pandemic, which made traditional sampling methods less feasible. It has been demonstrated as an effective method for recruiting research participants in this context.

The promotional messages remained posted until all necessary participants for the research were recruited. Following the recruitment of all required participants, a message was posted expressing gratitude for research participation and announcing the conclusion of data collection. The data collection period for this study occurred from September 1st to September 19th, 2021.

## Research tools
### PMS
The level of PMS was measured using the Shortened Premenstrual Assessment Form (SPAF) developed by Allen et al. [26] and translated by Lee et al. [27]. The SPAF consists of 10 items eliciting information on the level of each of the PMS symptoms that develop during the premenstrual week. Each item is rated on a 6-point Likert scale (1=strongly disagree, 6=strongly agree), with the total score ranging from 10 to 60 points, where a higher score indicates more severe PMS symptoms. The cut-off of 27 points was used to distinguish between PMDD and non-PMDD cases. The Cronbach's α value was 0.91 in the study of Lee et al. [27] and 0.87 in this study.

### Stress
The level of stress was measured using the Korean version of the Perceived Stress Scale (PSS) developed by Cohen et al. [28] and translated by Lee et al. [29]. This scale consists of 10 items, and each item is rated on a 4-point Likert scale (0=almost never, 1=sometimes, 2=fairly often, 3=very often). A higher total score indicates a higher level of perceived stress. Cronbach's α reliability coefficient was 0.82 in the study of Lee et al. [29] and 0.79 in this study, indicating good internal consistency of the scale.

### Depression
Depression was measured using the Korean version of the Center for Epidemiologic Studies Depression Scale-Revised (K-CESD-R) originally conceived by Eaton et al. [30] and translated into Korean and validity- and reliability-tested by Lee et al. [31]. This tool consists of 20 items eliciting information on participants' weekly frequency of depression symptoms. Each item is rated on a 4-point Likert scale (0=not at all or less than one day, 1=1–2 days, 2=3–4 days, 3=5–7 days or nearly every day for 2 weeks). The higher the total score, the higher the level of depression, with 0–20 points defined as normal, 21–40 points as risk, and 41–60 points as high-risk groups. Cronbach's α reliability coefficient was 0.98 in the study of Lee et al. [31] and 0.91 in this study.

### Sleep disturbances
Sleep disturbances were measured using the General Sleep Disturbance Scale (GSDS) developed by Lee [32] and translated by Choi et al. [33]. This tool consists of 21 items asking for the frequency of sleep problems in the past week grouped into six factors: sleep onset, maintenance of sleep, quality of sleep, quantity of sleep, fatigue and alertness at work, and use of substances to help induce sleep. The total score ranges between 0 and 147 points, where higher scores indicate greater likelihood of sleep problems. The lowest Cronbach's α reliability coefficient was 0.75 in the GSDS developed by Lee [32] and 0.81 in this study.

### Eating attitude problems
Eating attitude problems were measured using the Eating Attitudes Test-26 (EAT-26) developed by Garner et al. [34], with its Korean version standardized by Rhee et al. [35]. This tool comprises 26 items measuring diet-related problems clustered in four factors: self-control of eating and bulimic symptoms, preoccupation with being thinner, food preoccupation, and dieting. Each item is rated on a 4-point Likert scale (0=never, 3=always), with a higher score indicating higher likelihood of eating attitude problems. Based on a previous study [36], the total score range of 0–21 points is assessed as normal, 22–26

points as a possible eating disorder, and 27–78 as a severe disorder. Cronbach's α reliability coefficient of the Korean version standardization study with women was 0.81; that of this study was 0.83.

### Data analysis
The data collected were analyzed using the SPSS version 26.0 program. The participants' characteristics were analyzed and presented in terms of mean, standard deviation, frequency, and percentage. Differences between variables were tested using an independent t-test and one-way ANOVA, Scheffe's test was performed as post-hoc testing, Pearson's correlation coefficient was used to calculate the correlations between variables, and multiple regression analysis was performed to identify the factors influencing PMS.

### Ethical considerations
This study obtained approval from the Institutional Review Board (IRB No. 2021-07-053) of the data collection institution, ensuring that participants could voluntarily participate and provide informed consent. To prevent any incidental harm to the participants, collected data were encrypted and stored with restricted data access to prevent unauthorized access. It was clarified that the data would not be used for purposes other than the research.

Participants were informed in advance that they had the right to discontinue their participation or withhold information at any time if they wished. It was also explained that participants could access counseling services within the university if needed due to emotional experiences during their participation. The research results were described to be used as foundational data for the development of interventions to assist individuals experiencing PMS.

In appreciation of their participation, a token of gratitude was provided for the time spent by the participants.

## Results
### Differences in the level of PMS according to the general and menstruation-related characteristics
The participants' mean age was 22.56 years. Most had a normal BMI (66.4%), followed by underweight (16.8%), overweight (9.1%), and obese (7.7%). The majority of participants did not engage in regular exercise (60.8%), did not smoke (93.7%), and consumed alcohol (55.2%). A high proportion skipped breakfast (78.3%) and were not on a weight loss diet (76.2%). The majority drank 1–2 cups of coffee per day (91.6%) and 3–4 glasses of water per day (35.0%). Menstrual characteristics were also recorded, with most having menarche at age 12–13 (40.6%), regular menstrual cycles (65.0%), and 5–6 days of menstruation flow (59.4%). The level of dysmenorrhea

was assessed using the Numeric Rating Scale, resulting in a mean pain level of 6.73±2.16. Severe pain was reported by 66.4%, moderate pain by 23.8%, and mild pain by 9.8%. Painkillers were the most commonly used strategy for pain relief (72.7%). Significant differences in PMS were observed in BMI, amount of menstruation flow, and menstrual pain intensity. Post-hoc testing showed that PMS was significantly higher for those with severe pain intensity (7–10 points) compared to mild pain intensity (1–3 points) (Table 1).

The measurement and analysis of the variables for the participants' characteristics resulted in the following findings: Significant differences in PMS were observed in BMI (F=3.535, $p$=.017), amount of menstruation flow (F=4.241, $p$=.016), and menstrual pain intensity (F=4.228, $p$=.016). In the post-hoc testing, however, only the menstrual pain intensity of 7–10 points (severe) was found to have a significantly higher PMS level than 1–3 points (mild) (Table 1).

### Level of PMS, depression, stress, sleep disturbances, and eating attitude problems
The severity of PMS, measured on a scale of 10 to 60, had a mean score of 34.25(11.03). According to the scoring criteria of the PMS severity measurement tool, 104 participants (72.7%) scored 27 or higher, indicating a level comparable to PMDD. The stress level, measured on a scale of 0 to 40, had a mean score of 17.48(5.22). The depression level, measured on a scale of 0 to 60, had a mean score of 15.55(11.87), with 72.7% of the participants within the normal range. The average score for sleep disturbance was 54.94(13.80), and 91.6% of the participants showed normal eating attitude (Table 2).

### Correlation between PMS, stress, depression, sleep disturbance, and eating attitude problems
PMS was positively correlated with depression (r=.284, $p$=.001), stress (r=.274, $p$=.001), sleep disturbances (r=.440, $p$<.001), and eating attitude problems (r=.266, $p$=.001) (Table 3).

### Influencing factors on PMS
Multiple regression analysis was performed by inputting the menstrual pain intensity, which showed post-hoc differences among the participants' general characteristics and major variables (depression, stress, sleep disturbances, and eating attitude problems). In the analysis of multicollinearity between independent variables, the tolerance limit was greater than 0.1 (0.933–0.975) and the VIF was less than 10 (1.026–1.072), demonstrating that there was no problem of multicollinearity. As a results of multiple regression analysis, menstrual pain intensity ($\beta$=0.204), sleep disturbances ($\beta$=0.375), and eating attitude problems ($\beta$=0.202) were found to have an effect on

Yi *et al. BMC Women's Health*        (2023) 23:592

Page 5 of 9

**Table 1** PMS according to general and menstruation-related characteristics (N = 143)

| Variables | Categories | Mean ± SD | n (%) | PMS | |
|---|---|---|---|---|---|
| | | | | Mean ± SD | t/F (p) |
| Age (years) | | 22.56 ± 1.91 | | | |
| BMI | Underweight[a] | | 24 (16.8%) | 30.54 ± 8.61 | 3.530 (0.017) |
| | Normal | | 95 (66.4%) | 36.32 ± 10.94 | |
| | Overweight[b] | | 13 (9.1%) | 29.54 ± 8.65 | |
| | Obese[c] | | 11 (7.7%) | 30.00 ± 14.85 | |
| Regular exercise | Yes | | 56 (39.2%) | 36.39 ± 11.35 | 1.886 (0.061) |
| | No | | 87 (60.8%) | 32.86 ± 10.66 | |
| Smoking | Yes | | 9 (6.3%) | 36.44 ± 12.49 | 0.617(0.538) |
| | No | | 134 (93.7%) | 34.10 ± 10.96 | |
| Drinking | Yes | | 79 (55.2%) | 34.16 ± 10.11 | − 0.094 (0.925) |
| | No | | 64 (44.8%) | 34.34 ± 12.15 | |
| Breakfast | Yes | | 31 (21.7%) | 36.35 ± 13.12 | 1.056 (0.297) |
| | No | | 112 (78.3%) | 33.66 ± 10.37 | |
| Weight loss diet | Yes | | 34 (23.8%) | 35.71 ± 12.83 | 0.884(0.378) |
| | No | | 109 (76.2%) | 33.79 ± 10.43 | |
| Daily caffeine intake | 1–2 cups | | 131 (91.6%) | 34.19 ± 10.73 | 0.022 (0.978) |
| (200 ml per cup) | 3–4 cups | | 9 (6.3%) | 34.67 ± 13.05 | |
| | ≥ 5 cups | | 3 (2.1%) | 35.33 ± 21.73 | |
| Daily water intake | 1–2 glasses | | 31 (21.7%) | 34.55 ± 11.06 | 1.013 (0.389) |
| (200 ml per glass) | 3–4 glasses | | 50 (35.0%) | 32.34 ± 10.53 | |
| | 5–6 glasses | | 36 (25.2%) | 34.75 ± 10.95 | |
| | 7–8 glasses | | 28(18.2%) | 36.85 ± 12.01 | |
| Age at menarche | < 12 years | | 9 (6.3%) | 33.67 ± 12.69 | 0.583 (0.627) |
| | 12–13 years | | 58 (40.6%) | 33.98 ± 11.48 | |
| | 13–14 years | | 31 (21.7%) | 32.55 ± 10.96 | |
| | > 14 years | | 45 (31.5%) | 35.97 ± 10.29 | |
| Regularity of menstrual cycle | Regular | | 93 (65.0%) | 34.29 ± 11.46 | 0.387 (0.680) |
| | Irregular | | 46 (32.2%) | 34.57 ± 10.11 | |
| | Other | | 4 (2.8%) | 29.50 ± 13.03 | |
| Average menstrual cycle | ≤ 25 days | | 11 (7.7%) | 32.46 ± 9.56 | 0.408 (0.748) |
| | 26–29 days | | 59 (41.3%) | 33.37 ± 11.94 | |
| | 30–33 days | | 43 (30.1%) | 35.33 ± 10.53 | |
| | ≥ 34 days | | 30 (21.0%) | 35.07 ± 10.64 | |
| Average menstrual period | < 3 days | | 4 (2.8%) | 29.75 ± 6.08 | 0.630 (0.597) |
| | 3–4 days | | 34 (23.8%) | 33.62 ± 9.50 | |
| | 5–6 days | | 85 (59.4%) | 34.09 ± 12.27 | |
| | ≥ 7 days | | 20 (14.0%) | 36.75 ± 8.29 | |
| Amount of Menstruation | Low[a] | | 10 (7.0%) | 40.30 ± 12.96 | 4.241 (0.016) |
| | Normal | | 103 (72.0%) | 32.65 ± 10.92 | |
| | High[b] | | 30 (21.0%) | 37.70 ± 9.48 | |
| Menstrual pain intensity (NRS) | 1-3[a] | 6.73 ± 2.16 | 14 (9.8%) | 28.00 ± 11.40 | 4.228 (0.016) |
| | 4–6 | | 34 (23.8%) | 32.06 ± 9.54 | (a < b) |
| | 7-10[b] | | 95 (66.4%) | 35.95 ± 11.11 | |
| Main strategy to deal with menstrual pain | Enduring or resting | | 26 (18.2%) | 32.46 ± 13.17 | 0.576 (0.632) |
| | Warm pack | | 9 (6.3%) | 37.00 ± 10.20 | |
| | Painkiller | | 104 (72.7%) | 34.59 ± 10.38 | |
| | Other | | 4 (2.8%) | 30.75 ± 16.38 | |

PMS. The regression model was significant (F = 16.553, $p < .001$) with an explanatory power of 24.7% (Table 4).

## Discussion

In this study, we examined the levels of PMS, stress, depression, sleep disturbances, and eating attitude problems among female college students who experience

Yi *et al. BMC Women's Health*          (2023) 23:592

Page 6 of 9

**Table 2** Level of PMS, stress, depression, sleep disturbance, and eating attitude (N = 143)

| Variables | | n(%) | Range of Score | Mean ± SD |
|---|---|---|---|---|
| PMS | 10 ~ 26 (non-PMDD) | 39(27.3%) | 10–60 | 34.25 ± 11.03 |
| | 27 ~ 60 (PMDD) | 104(72.7%) | | |
| Stress | | | 0–40 | 17.48 ± 5.22 |
| Depression | Normal (1–20) | 104(72.7%) | 0–60 | 15.55 ± 11.87 |
| | Probable depression (21–40) | 34(23.8%) | | |
| | Definite depression (41–60) | 5(3.5%) | | |
| Sleep disturbances | | | 0-147 | 54.94 ± 13.80 |
| Eating attitude problem | Normal (0–21) | 131(91.6%) | 0–78 | 8.80 ± 8.36 |
| | Possible eating disorder (22–26) | 6(4.2%) | | |
| | Severe eating disorder (27–78) | 6(4.2%) | | |

**Table 3** Correlations between PMS, stress, depression, sleep disturbances, and eating attitude problems(N = 143)

| | PMS | Stress | Depression | Sleep disturbances | Eating attitude problems |
|---|---|---|---|---|---|
| PMS | 1 | | | | |
| Stress | 0.274 (0.001) | 1 | | | |
| Depression | 0.284 (0.001) | 0.548 (< 0.001) | 1 | | |
| Sleep disturbances | 0.440 (< 0.001) | 0.411 (< 0.001) | 0.594 (< 0.001) | 1 | |
| Eating attitude problems | 0.266 (0.001) | 0.259 (0.002) | 0.254 (0.002) | 0.227 (0.006) | 1 |

**Table 4** Influencing factors on PMS(N = 143)

| Dependent variable | Independent variable | B | S.E. | β | t (p) |
|---|---|---|---|---|---|
| PMS | Constant | 12.279 | 3.406 | | 3.605 (< 0.001) |
| | Pain | 4.747 | 1.716 | 0.204 | 2.766 (0.006) |
| | Sleep disturbances | 0.300 | 0.060 | 0.375 | 4.979 (< 0.001) |
| | Eating attitude problems | 0.267 | 0.099 | 0.202 | 2.685 (0.008) |

$F(p) = 16.553(< 0.001)$, $R = .513$, $R^2 = 0.263$, $Adj.R^2 = 0.247$, D-W = 1.987

NRS ≤ 7 (Severe) → 1

dysmenorrhea and determined factors associated with PMS.

The mean pain intensity of dysmenorrhea experienced by the participants of this study was 6.73/10, and the majority (66.4%) of participants experienced severe pain of seven points or higher. In this study, menstrual pain intensity was identified as the primary factor affecting the level of PMS, which is consistent with findings of previous research [37] and aligns with the finding that menstrual pain is a significant pathway to PMS [38]. The PMS measurement tool includes two items expressing pain, which can explain the high correlation between the level of PMS and the menstrual pain intensity. Moreover, the fact that menstrual pain intensity was identified as the first determinant of the level of PMS—a complex syndrome combining physical, behavioral, and emotional symptoms—can be interpreted as meaning that various symptoms of PMS are closely related to pain. According to a previous study [39], Korean female college students perceive menstruation as a factor that weakens their physical and psychological health more markedly than their U.S. counterparts, which is the reason behind their more intense pain reports. Therefore, it is necessary to understand dysmenorrhea as more than a mere physical symptom (i.e., dysmenorrhea is psychological as well as physical), reconsider menstruators' perceptions of menstruation, and seek out diverse factors related to PMS. Moreover, it is necessary to establish appropriate coping strategies for each of those factors, going beyond medication or palliative treatment.

All participants in this study experienced dysmenorrhea. Among the participants, 72.7% were found to have scores on the PMS severity measurement equivalent to PMDD, indicating more severe symptoms compared to the typical PMS. This finding is in contrast to previous research [40] where 85% of adolescents experience premenstrual syndrome, of which only 38% are classified as PMDD. An accurate clinical diagnosis of PMDD requires daily prospective symptom assessment [27]. Due to the substantial potential prevalence of PMDD among female college students experiencing dysmenorrhea, a more proactive interest in this issue is necessary. Healthcare providers should guide the subjects to observe unpleasant premenstrual symptoms daily during their menstrual period in order to understand the degree of changes in symptoms. They should also educate them about the importance of proactive management and the methods to do so, based on the severity of the symptoms.

In this study, stress and PMS levels were positively correlated, which is consistent with previous research [41]. However, stress was not confirmed as a determinant of PMS, unlike a previous study that identified stress as a determinant of PMS [42]. Changes in hormonal levels throughout the menstrual cycle may affect sensitivity to stress, intensifying PMS symptoms by responding more intensely to stressors, particularly in the premenstrual or luteal phase [43]. Moreover, because stress acts as a significant factor for irregular menstrual cycles, thereby affecting changes in menstrual function [44], it is important to include stress as a variable for PMS intervention. Intervention strategies are required to strengthen individuals' coping ability and protective factors against stress through an in-depth understanding of premenstrual emotional characteristics and negative emotion control strategies by college students themselves.

Whereas depression was positively correlated with the level of PMS, it was not confirmed as a determinant of PMS, which is partially consistent with the findings of previous research [4]. Given that the level of PMS is a significant risk factor for depression [19] and that college students who experience PMS are more likely to experience depression compared to those who do not [19], it is necessary to assess the risk of depression [11]. PMS induces negative emotions due to hormonal changes and lasts for a short time, disappearing with the onset of menstruation. However, because symptoms appear repeatedly over a long time and are not uniform but accompanied by a wide variety of physical, emotional, and behavioral symptoms, healthcare professionals need to understand the correlation between college students' PMS experiences and emotional problems such as depression. They should prepare multifaceted interventional strategies capable of countering emotional problems more efficiently through preliminary assessments of depression severity and positive communication among family members.

However, sleep disturbance showed a positive correlation with PMS and was identified as the second determinant of PMS. This finding is similar to those of previous studies [45, 46] that revealed correlations between PMS, sleep duration, and sleep quality [45, 46] and identified unsatisfactory sleep quality as a determinant of PMS in female college students [47]. Our results also support the findings in a previous study that women with PMS had a shorter sleep duration, needed a longer time to fall asleep, and had lower quality of sleep compared with women without PMS [48]. Sleep, a basic human need, is an essential factor for individuals to maintain good health and satisfaction, including physical, mental, social, and spiritual functions and overall quality of life [49]. Since the outbreak of COVID-19, infection control policies, such as online education and social distancing, have changed various aspects of psychological health (e.g., stress and depression) [50] as well as lifestyle (e.g., sleep problems) [51]. Changed lifestyle patterns, in particular, lowered sleep quality due to the use of digital media before bedtime [52]. Sleep will have to be considered an important variable in PMS intervention, and a quality sleep management strategy should focus more on sleep quality than on sleep duration.

Finally, more serious eating attitude problems were found to be associated with higher levels of PMS, and eating attitude problems were thus identified as the third determinant of PMS level. This finding is in line with that of a previous study in which eating attitude problems—measured with EAT-26, the same tool used in this study—were observed more frequently in adolescents with PMS than in those without it [53]. Specifically, adolescents with PMS scored higher in emotional and uncontrolled eating behaviors. Moreover, a higher level of neurotic bulimia is more closely associated with moderate-to-severe PMS than no or mild PMS, with the highest level manifesting in cases diagnosed with PMDD, suggesting that the extent of eating attitude problems may differ depending on the premenstrual emotional state [54]. Given that PMDD is defined as a more serious form of PMS, eating attitude problems may increase as PMS severity increases. Therefore, it is essential to meticulously examine the severity of PMS symptoms experienced by the participants and plan customized interventional strategies accordingly.

PMS and dysmenorrhea are important health issues that women experience, and it is very meaningful to approach and solve them from various angles. The findings from this research are expected to greatly aid in supporting women experiencing PMS. The results of this study can help women improve their understanding of their dysmenorrhea and PMS symptoms and improve their ability to manage emotional difficulties and stress. Since intervention strategies should be customized for each individual, various approaches and methods should be used to manage stress, relieve depression, improve sleep quality, and solve dietary problems that suit the various situations and needs of women. Healthcare professionals, schools, universities, and other institutions should actively utilize these research findings to support women experiencing PMS.

As limitations of this study, it may be noted that because the study analyzed data obtained through a cross-sectional survey conducted at one university, it cannot be extended to discussing the causal relationships between PMS and individual variables such as stress, depression, sleep disturbances, and eating attitude problems. Additionally, its results cannot be directly generalized to all female college students. Despite this limitation, this study is significant because it has successfully

Yi *et al. BMC Women's Health*        (2023) 23:592

Page 8 of 9

measured the level of PMS experienced by female college students who have dysmenorrhea and identified three determinants of PMS, including emotional factors (i.e., depression and stress) and lifestyle factors (i.e., sleep, diet, and exercise).

## Conclusions

In this study, we examined the levels of PMS, stress, depression, sleep disturbances, and eating attitude problems among female college students who experience dysmenorrhea and determined factors associated with PMS. Menstrual pain intensity, sleep disturbances, and eating attitude problems were found to have an effect on PMS. Because PMS exacerbates in the late luteal phase of the menstrual cycle and is accompanied by predictable and periodic psychological and physical symptoms that are resolved with the onset of menstruation. Therefore, individuals should have a good understanding of their own menstrual pain patterns and be able to set up suitable coping strategies, such as exercise, alternative therapy, and painkiller medication. Furthermore, to minimize the experience of PMS symptoms and negative effects, individual coping strategies for emotional well-being should be sought, and effective interventions applied to help correct problems accompanying sleep and eating attitudes. We propose that further study should be conducted to examine whether the severity of PMDD changes according to menstrual pain, the pattern and degree of its change, and the paths through which sleep quality and eating attitude problems affect PMS.

### List of abbreviations
BMI            Body mass index
COVID-19       Novel coronavirus disease 2019
DSM-5          Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition
EAT-26         Eating Attitudes Test-26
GSDS           General Sleep Disturbance Scale
K-CESD-R       Center for Epidemiologic Studies Depression Scale-Revised
NRS            Numeric Rating Scale
PMDD           Premenstrual dysphoric disorder
PMS            Premenstrual syndrome
PSS            Perceived Stress Scale
SPAF           Shortened Premenstrual Assessment Form

## References
1.  Kim HY, Kim SN. Effects of life style and life stress on premenstrual syndrome among female university students. Asia-pacific J Multimedia Serv Convergent Art Humanit Sociol. 2018;8(3):791–802. https://doi.org/10.21742/AJMAHS.2018.03.85
2.  Kim MO. A study on the premenstrual syndrome and health promoting behavior in female college students. J Korean Data Anal Soc. 2018;20:3:1565–77. https://doi.org/10.37727/jkdas.2018.20.3.1565
3.  Rapkin AJ, Akopians AL. Pathophysiology of premenstrual syndrome and premenstrual dysphoric disorder. Menopause Int. 2012;18(2):52–9. https://doi.org/10.1258/mi.2012.012014
4.  Lee EJ, Yang SK. Do depression, fatigue, and body esteem influence premenstrual symptoms in nursing students? Korean J Women Health Nurs. 2020;26:3:231–9. https://doi.org/10.4069/kjwhn.2020.09.10
5.  Halbreich U, Borenstein J, Pearlstein T, Kahn LS. The prevalence, impairment, impact, and burden of premenstrual dysphoric disorder (PMS/PMDD). Psychoneuroendocrinology. 2003;28:3:1–23. https://doi.org/10.1016/S0306-4530(03)00098-2
6.  American Psychiatric Association. Diagnostic and statistical manual of mental disorders: DSM-5. 5th ed. Washington, DC: American psychiatric association; 2013.
7.  Kim MJ, Nam YS, Oh KS, Lee CM. Some important factors associated with premenstrual syndrome: influence of exercise, menarche, and age on PMS. Korean J Growth Dev. 2003;11:2.
8.  Jung GS, Hyun MO, Choi IR. The influential factors on premenstrual syndrome college female students. J Korea Academia-Industrial Cooperation Soc. 2014;15:5:3025–36. https://doi.org/10.5762/KAIS.2014.15.5.3025
9.  Menstrual pain? Premenstrual syndrome is a treatable disease! Busan: Mediup, Jung EH. 2015. http://www.mediup.co.kr/board/index.html?id=market&no=13152. Accessed 25 May 2015.
10. Sharp GC, Fraser A, Sawyer G, Kountourides G, Easey KE, Ford G, et al. The COVID-19 pandemic and the menstrual cycle: research gaps and opportunities. Int J Epidemiol. 2022;51(3):691–700. https://doi.org/10.1093/ije/dyab239
11. Phelan N, Behan LA, Owens L. The impact of the COVID-19 pandemic on women's reproductive health. Front Endocrinol. 2021;191. https://doi.org/10.3389/fendo.2021.642755
12. Acikgoz A, Dayi A, Binbay T. Prevalence of premenstrual syndrome and its relationship to depressive symptoms in first-year university students. Saudi Med J. 2017;38:11:1125–31. https://doi.org/10.15537/smj.2017.11.2052
13. Di Renzo L, Gualtieri P, Pivari F, Soldati L, Attinà A, Cinelli G. Eating habits and lifestyle changes during COVID-19 lockdown: an Italian survey. J Transl Med. 2020;18:1–15. https://doi.org/10.1186/s12967-020-02399-5
14. Jehan S, Auguste E, Hussain M, Pandi-Perumal SR, Brzezinski A, Gupta R, et al. Sleep and premenstrual syndrome. J Sleep Med Disord. 2016;3:5.
15. Ozisik KHI, Tanriverdi G, Degirmenci Y. Subjective sleep quality in premenstrual syndrome. Gynecol Endocrinol. 2012;28:8:661–4. https://doi.org/10.3109/09513590.2011.650769
16. Xing X, Xue P, Li SX, Zhou J, Tang X. Sleep disturbance is associated with an increased risk of menstrual problems in female Chinese university

students. Sleep Breath. 2020;24:4:1719–27. https://doi.org/10.1007/s11325-020-02105-1

17. Yoshimi K, Shiina M, Takeda T. Lifestyle factors associated with premenstrual syndrome: a cross-sectional study of Japanese high school students. J Pediatr Adolesc Gynecol. 2019;32:6:590–5. https://doi.org/10.1016/j.jpag.2019.09.001

18. Yen JY, Liu TL, Chen IJ, Chen SY, Ko CH. Premenstrual appetite and emotional responses to foods among women with premenstrual dysphoric disorder. Appetite. 2018;125:18–23. https://doi.org/10.1016/j.appet.2018.01.029

19. Na H, Jung YE, Kwon H, Hong H, Park MY. Association among premenstrual syndrome, eating habits, and depression in female college students. Mood and Emotion. 2018;16:44–9. https://doi.org/10.0000/me.2018.16.1.44

20. Haripersad YV, Kannegiesser-Bailey M, Morton K, Skeldon S, Shipton N, Edwards K, Martin AC. Outbreak of Anorexia Nervosa admissions during the COVID-19 pandemic. Arch Dis Child. 2021;1063:e15–5. https://doi.org/10.1136/archdischild-2020-319868

21. Lin JA, Hartman-Munick SM, Kells MR, Milliren CE, Slater WA, Woods ER, et al. The impact of the COVID-19 pandemic on the number of adolescents/young adults seeking eating disorder-related care. J Adolesc Health. 2021;69:4:660–3. https://doi.org/10.1016/j.jadohealth.2021.05.019

22. Bilir E, Yıldız Ş, Yakın K, Ata B. The impact of dysmenorrhea and premenstrual syndrome on academic performance of college students, and their willingness to seek help. Turk J Obstet Gynecol. 2020;173:196–201. https://doi.org/10.4274/tjod.galenos.2020.97266

23. Shi Y, Shi M, Liu C, Sui L, Zhao Y, Fan X. Associations with physical activity, sedentary behavior, and premenstrual syndrome among Chinese female college students. BMC Womens Health. 2023;23:173. https://doi.org/10.1186/s12905-023-02262-x

24. Baek SS, Song MS, Jo JY. Influence of health promotion behaviors and job stress on premenstrual syndrome in female undergraduate students. Korean Soc Wellness. 2018;13:3:411–22. https://doi.org/10.21097/ksw.2018.08.13.3.411

25. Song HS, Lim SH. Effects of PMS coping mechanisms and food cravings on PMS symptoms in female college students in a region. J Korean Soc Sch Health. 2020;33:2:106–14. https://doi.org/10.15434/kssh.2020.33.2.106

26. Allen SS, McBride CM, Pirie PL. The shortened premenstrual assessment form. J Reprod Med. 1991;36:11.

27. Lee MH, Kim JW, LEE JH, Kim DM. The standardization of the shortened premenstrual assessment form and applicability on the internet. J Korean Neuropsychiatr Assoc. 2002;40:1.

28. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. J Health Soc Behav. 1983;24:4:385–96. https://doi.org/10.2307/2136404

29. Lee J, Shin C, Ko YH, Lim J, Joe SH, Kim S, Jung IK, Han C. The reliability and validity studies of the Korean version of the perceived stress scale. Korean J Psychosom Med. 2012;20(2):127–34.

30. Eaton WW, Smith C, Ybarra M, Muntaner C, Tien A. Center for epidemiologic studies Depression Scale: review and revision. CESD and CESD-R); 2004. pp. 363–77.

31. Lee S, Oh ST, Ryu SY, Jun JY, Lee K, Lee E, et al. Validation of the Korean version of Center for epidemiologic studies depression scale-revised (K-CESD-R). Korean J Psychosom Med. 2016;24:1.

32. Lee KA. Self-reported sleep disturbances in employed women. Sleep. 1992;15:6:493–8. https://doi.org/10.1093/sleep/15.6.493

33. Choi HJ, Kim SJ, Kim BJ, Kim IJ. Korean versions of self-reported sleep questionnaires for research and practice on sleep disturbance. Korean J Rehabil Nurs. 2012;15:1:1–10. https://doi.org/10.7587/kjrehn.2012.1

34. Garner DM, Olmsted MP, Bohr Y, Garfinkel PE. The eating attitudes test: psychometric features and clinical correlates. Psychol Med. 1982;12:4:871–8. https://doi.org/10.1017/S0033291700049163

35. Rhee MK, Lee YH, Park SH, Sohn CH, Chung YC, Hong SK, et al. A standardization study of the Korean version of eating attitudes test-26 I: reliability and factor analysis. Korean J Psychosom Med. 1998;6:2.

36. Cho GS, Kim KS, Ryu SY. The prevalence of disordered eating attitude and its associated factors among high school girls. J Korean Soc Matern Child Health. 2004;8:2.

37. Kang DHS. Influencing factors in premenstrual syndrome (PMS) among nursing students. J Digit Converg. 2017;15:3:277–86. https://doi.org/10.14400/JDC.2017.15.3.277

38. Chae MO, Jeon HO, Kim A. A structural model for premenstrual coping in university students: based on biopsychosocial model. J Korean Acad Nurs. 2017;47:2:257–66. https://doi.org/10.4040/jkan.2017.47.2.257

39. Hong KJ, Park YS, Kim JE, Kim HW. Transcultural differences on perimenstrual discomforts, menstrual attitudes and sex role acceptance between Korean and American college students. J Korean Acad Nurs. 1998;28:2:233–43. https://doi.org/10.4040/jkan.1998.28.2.233

40. Lee JY, Kim SM, Kang SH, Chung HG, Choi JH, So HS, et al. Association of premenstrual syndrome and premenstrual dysphoric disorder with depression, sleep quality and sleep pattern in Korean female high-school students. Anxiety and Mood. 2016;12:2.

41. Kim HS. Factors affecting perceived stress, depression and sleep disturbance on the dysmenorrhea among female university students. J Korean Appl Sci Technol. 2021;38:2:399–410. https://doi.org/10.12925/jkocs.2021.38.2.399

42. Andani RW. Relationship between degree of stress and physical activity of female students with premenstrual syndrome. Jurnal Berkala Epidemiologi. 2020;8:2:125–33. https://doi.org/10.20473/jbe.V8I22020.125-133

43. Liu Q, Wang Y, Van HCH, Qiao W. Stress reactivity and emotion in premenstrual syndrome. Neuropsychiatr Dis Treat. 2017;13:1597–602. https://doi.org/10.2147/ndt.s132001

44. Dhawan A, Hernole J. Effect of perceived pandemic stress and sleep variation on menstrual cycle occurrence, its severity and premenstrual syndrome: a cross sectional study. J Women's Health Dev. 2020;3:4:437–45. https://doi.org/10.26502/fjwhd.2644-28840052

45. Baek JH, Choi-Kwon SM. Secondary data analysis on the factors influencing premenstrual symptoms of shift work nurses: focused on the sleep and occupational stress. J Korean Acad Nurs. 2020;50:4:631–40. https://doi.org/10.4040/jkan.19230

46. Erbil N, Yücesoy H. Relationship between premenstrual syndrome and sleep quality among nursing and medical students. Perspect Psychiatr Care. 2022;58:2:448–55. https://doi.org/10.1111/ppc.12628

47. Lee SH, Kim YJ, Jeong JY, Yeom JY, Kim BR, Cho EJ. The relationship between menstrual characteristics, academic stress, and endocrine disruptor exposure behavior to premenstrual syndrome in female college students. Asia-Pacific J Multimedia Serv Convergent Art Humanit Sociol. 2018;8:7.

48. Önay Ö, Aydın C. Premenstrual syndrome as a sleep disturbing factor: a cross-sectional study. Acta Med. 2021;52:2:145–51. https://doi.org/10.32552/2021.ActaMedica.561

49. Garbarino S, Lanteri P, Durando P, Magnavita N, Sannita WG. Co-morbidity, mortality, quality of life and the healthcare/welfare/social costs of disordered sleep: a rapid review. Int J Environ Res Public Health. 2016;13:8831. https://doi.org/10.3390/ijerph13080831

50. Ahorsu DK, Lin CY, Imani V, Saffari M, Griffiths MD, Pakpour AH. The fear of COVID-19 scale: development and initial validation. Int J Ment Health Addict. 2022;20:3:1537–45. https://doi.org/10.1007/s11469-020-00270-8

51. Chen CY, Chen IH, O'Brien KS, Latner JD, Lin CY. Psychological distress and internet-related behaviors between schoolchildren with and without overweight during the COVID-19 outbreak. Int J Obes (Lond). 2021;45:677–86. https://doi.org/10.1038/s41366-021-00741-5

52. Park HE, Jung NH, Jo H. A survey of Korean college students' anxiety and depression in COVID-19. J Res Methodol. 2021;6:3:255–78. https://doi.org/10.21487/jrm.2021.11.6.3.255

53. Isgin-Atici K, Buyuktuncer Z, Akgül S, Kanbur N. Adolescents with premenstrual syndrome: not only what you eat but also how you eat matters! J Pediatr Endocrinol Metab. 2018;31:11:1231–9. https://doi.org/10.1515/jpem-2018-0125

54. Çoban ÖG, Karakaya D, Önder A, İşleyen Z, Adanır AS. Association of premenstrual dysphoric disorder and eating behaviors among nursing students: a cross-sectional study. J Pediatr Adolesc Gynecol. 2021;34:2:203–8. https://doi.org/10.1016/j.jpag.2020.11.019

## Publisher's Note