Background: Up to 8% of women in their reproductive years are affected by Premenstrual Dysphoric Disorder (PMDD). Sleep disturbances such as insomnia or hypersomnia are one of the DSM-IV-TR’s defining criteria for the diagnosis of PMDD and are found in about 70% of women with the disorder. However, studies are lacking that specifically address the effects of PMDD on quality of sleep.

Aim: This study was designed to evaluate the prevalence of Premenstrual Dysphoric Disorder (PMDD) and its impact on sleep quality in female university students.

Methods: We developed an 18-item PMDD scale based on The Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV-TR) to diagnose PMDD in female university students who ranged in age from 18 to 30 years and had regular menstrual cycles. Participants were categorized into a PMDD group or a No/PMDD group and sleep quality was compared between the two groups. The evaluation tool used to measure sleep quality was the Pittsburgh Sleep Quality Index (PSQI).

Results: The prevalence of PMDD in female university students was 25.5%. Analysis of the PSQI demonstrated that 80.5% of those in PMDD group had a PSQI that scored >5; however, only 56.4% in the No/PMDD group had a PSQI that scored >5 ($\chi^2=12.459, p<0.001$). The mean PSQI score was 8.2 (3.4) in the PMDD group and was 6.5 (3.1) in the No/PMDD group ($t=3.648, p<0.001$).

Conclusions: Female university students who experience PMDD are deeply affected by sleep problems. Lower sleep quality, daytime dysfunction, and sleep disturbance are common sleep problems among female university students with PMDD.

Keywords: Premenstrual Dysphoric Disorder; Sleep quality; Pittsburgh Sleep Quality Index; female university students

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1. Introduction:
About 50-80% of women during their reproductive years experience premenstrual symptoms that vary from mild to severe.[1] Premenstrual Syndrome (PMS) affects 20–40% of women, and its more severe form, Premenstrual Dysphoric Disorder (PMDD), affects 3-8% of women.[3,4] PMDD is classified under “depressive disorder not otherwise specified” in the The Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV-TR).[4] PMDD symptoms such as depressed mood, anxiety, irritability, fatigue, and sleep disruption occur exclusively during the luteal phase of the menstrual cycle, remit after the onset of menses, and disappear throughout the follicular phase.[5] PMDD is associated with significant functional impairment and impact on quality of life, but the etiologies remain poorly understood.[6] Studies indicate that women with PMS or PMDD report sleep-related
complaints such as difficulty sleeping, fatigue, and poor concentration."^[8] Furthermore, sleep disturbances such as insomnia or hypersomnia are one of the DSM-IV-TR's defining criteria for the diagnosis of PMDD,^[4, 6] and they are present in about 70% of women with PMDD.^[9]

A study by Parry and colleagues did not show any difference regarding sleep EEG variables between controls and patients with PMDD,^[10] but other studies showed significantly increased rapid eye movement (REM) sleep onset latency,^[6] significantly increased stage-two sleep, or significantly reduced REM sleep^[11] in women with PMDD when compared to healthy controls, regardless of the menstrual phase.

Some studies have shown that work-related stress may increase PMS or PMDD.^[12, 13] Work pressure, low autonomy at work, and little variety in work conditions have been shown to be significantly higher among women with PMS when compared to those without the symptoms.^[14, 15] PMDD symptoms can also interfere with school and home life. Stress due to long hours of study and work-related pressure may affect the prevalence rate of PMDD as well as sleep disturbance in adolescent girls. However there is a lack of studies on the assessment of PMDD and its impact on sleep quality among female university students, so this study was designed to evaluate the prevalence of PMDD as well as statements regarding sleep quality within this cohort.

2. Material and methods

2.1 Participants

As shown in Figure 1, this cross-sectional study was conducted from May 2013 to August 2014 at the Kermanshah Azad University, Kermanshah, Iran. Of the 2409 students at Kermanshah Azad University, 1486 were female.

Approximately 20% of the female students were recruited by random sampling. Inclusion criteria was as follows: (a) age range of 18-30 years; (b) regular menstrual cycles (3-7 days of menstruation between intervals of 21-35 days); (c) no use of medication such as hormonal contraceptives or antipsychotics; (d) no major medical problems; (e) no recent experience of catastrophe before or during the study. Subjects who had a psychiatric illness or any other underlying disease (e.g. diabetes, cardiovascular) were excluded from the study. All participants provided written informed consent and completed a questionnaire.

2.2 Procedure

2.2.1 Demographics

Demographic information such as age, marital status and history of disease was obtained. We also asked information about the respondents’ menstruation

| Characteristic | with PMDD (n=67) | without PMDD (n=197) | p-value |
|---------------|-----------------|----------------------|---------|
| Age (years)   | 23.4 (4.1)      | 23.7 (4.7)           | 0.654   |
| BMI (kg/m²)   | 20.8 (2.3)      | 21.3 (3.9)           | 0.213   |
| Menstrual cycle (days) | 6.0 (1.6) | 6.0 (1.5)           | 0.956   |
| Age at menarche (years) | 13.4 (1.1) | 13.7 (1.2)         | 0.167   |
| Had given birth to children | 3 (4.4%)  | 22 (11.2%)        | 0.102   |

Table 1. Comparison of demographic variables between two groups of female university students with and without Premenstral Dysphoric Disorder

PMDD, Premenstrual Dysphoric Disorder

Figure 1. Flowchart of the study

2409 students enrolled at the Kermanshah Azad University, Kermanshah, Iran from May 2013 to August 2014

1486 students were female

298 randomly selected female students (20% of total) from 18 to 30 years old with regular menstrual cycles were administered the Premenstrual Symptoms Screening Tool (PSST) and the Pittsburgh Sleep Quality Index (PSQI)

36 excluded due to incomplete data

262 female university students completed the questionnaires

67 female university students with PMDD included in the study analysis

PMDD, Premenstrual Dysphoric Disorder

195 female university students without PMDD included in the study analysis
regarding the regularity of menstrual cycles, physical symptoms during menstruation, knowledge of PMS, and actions taken to attenuate its symptoms.

2.2.2 PMDD scale
In order to confirm the diagnosis of PMDD, we used the Premenstrual Symptoms Screening Tool (PSST). This scale is a standard form and includes 19 items that describe both physical and emotional symptoms. Each item is rated on a scale of 0 “not at all” to 3 “extreme”. These items represent the PMS and PMDD criteria as described in the DSM-IV-TR. Participants were first asked whether or not they had any symptoms listed in the questionnaire that began to appear one or two weeks prior to the start of menstruation and disappeared 3-4 days after menstruation in most menstrual cycles during the past year.

A participant was given the diagnosis of PMDD if she answered “severe” for at least one of the following items in the core symptoms: depressed mood, moodiness, anxiety and edginess, and anger or irritability; answered “moderate” or “severe” for at least four items in other symptoms: fatigue, insomnia/hypersomnia, difficulty concentrating, appetite change/cravings, decreased interest in usual activities, feeling overwhelmed/out of control, physical symptoms (headache, breast tenderness and/or swelling, bloating and joint/muscle pain, etc.); and also answered “severe” for at least one of the items regarding interference with work, school, usual activities and relationships. The Iranian version of the PSST was validated with Cronbach’s alpha coefficient, 0.93.

2.2.3 Sleep assessment
The evaluation tool used to assess sleep quality was the Pittsburgh Sleep Quality Index (PSQI). The tool measures subjective sleep quality in the preceding one-month period and is comprised of 19 self-rated questions. The items are grouped into seven component scores: sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. The PSQI score (range, 0-21) is calculated by summing the component scores, whereby a higher score indicates a worse sleep condition. A global PSQI score of five has been suggested to distinguish poor quality of sleep (PSQI>5) from good quality of sleep (PSQI< 5). The Iranian version of PSQI has diagnostic sensitivity of 100% and specificity of 93%. Overall the Cronbach’s alpha coefficient was 0.89.

2.2.4 Statistical analysis
Statistical analysis was conducted using SPSS version 19.0 with a significance threshold of p< 0.05. The Student t-test or Mann-Whitney U test, and χ² test were used to compare the variables between the groups.

3. Results
From a total of 298 female student participants, 262 completed the questionnaires. Thirty-six were dropped from the analysis because of incomplete data. After the assessment of the questionnaire by psychiatrists who were blinded from the study, 67 students were diagnosed with PMDD and 195 were recognized as healthy controls, as shown in Figure 1. So, we analyzed the data according to the presence or absence of PMDD symptoms. Demographic characteristics are shown in Table 1.

More students with PMDD reported ‘anxiety or tension’ (79.1%), ‘anger or irritability’ (74.6%), ‘decreased interest in usual activity’ (80.5%), and ‘fatigue or lack of energy’ (92.5%). Premenstrual symptoms impaired ‘work or school or social life activities’ (92.5%). The rates of prevalence of each premenstrual symptom are shown in Figure 2.

| Table 1. Comparison of demographic variables between two groups of female university students with and without Premenstral Dysphoric Disorder |
|-------------------------------------------------|-----------------|-----------------|-----------------|-----------------|
| characteristic | with PMDD (n=67) | without PMDD (n=197) | statistical value | p-value |
|-----------------|-----------------|-----------------|-----------------|-----------------|
| age (years)     | 23.4 (4.1)      | 23.7 (4.7)      | t=0.449         | 0.654           |
| BMI (kg/m²)     | 20.8 (2.3)      | 21.3 (3.9)      | t=1.072         | 0.213           |
| menstrual cycle (days) | 6.0 (1.6)   | 6.0 (1.5)       | t=0.287         | 0.956           |
| age at menarche (years) | 13.4 (1.1) | 13.7 (1.2)      | t=1.386         | 0.167           |
| had given birth to children | 3 (4.4%)    | 22 (11.2%)      | χ²=2.675        | 0.102           |

data presented as mean (SD) or number (%)
Table 2 shows the sleep quality parameters. Analysis of the PSQI demonstrated that 80.5% in the PMDD group had a PSQI score >5, which indicates poor sleep quality. However, 56.4% in the No/PMDD group had a PSQI score >5 (p<0.0001). The mean PSQI score was 8.2(3.4) (range= 2-17) in the PMDD group and was 6.5 (3.1) (range= 2-19) in the No/PMDD group (p<0.0001). Analysis of PSQI components showed that the mean duration of sleep per night was reported to be 6.8 (1.6) hours in the PMDD group and was 6.9 (1.6) hours in the NO/PMDD group (p=0.771). The mean duration of sleep latency was 39 (15) and 33 (25) min for the PMDD group and the No/PMDD group, respectively (p=0.216).

Habitual sleep efficacy of both groups did not differ significantly. Nonetheless, taking sleep medications was more frequent in the PMDD group when compared to the No/PMDD group (16.4% vs. 7.6%, [p=0.039]).

Sleep disturbance was present in 25.3% of the students in the PMDD group but only in 10.2% of the students in the No/PMDD group (p<0.001). Furthermore, 16.4% of those in the PMDD group reported that their sleep quality was “fairly bad or bad”, while only 7.1% of those in No/PMDD group rated their sleep quality as “fairly bad or bad” (p=0.026).

Self-reports of daytime dysfunction was less frequent in students in the No/PMDD group with 34.3%, whereas 56.7% of students in the PMDD reported daytime dysfunction (p=0.006).

4. Discussion
4.1 Main Finding

4.1.1 Prevalence of PMDD

In this questionnaire-based, case–control study we evaluated the sleep quality in PMDD female university students and in controls. To our knowledge this is the first large sample study that assesses the relationship between PMDD and sleep quality. Our findings showed that the prevalence rate of PMDD among Iranian female university students was 25.5%. This prevalence rate was higher than those reported of women in other epidemiological studies which reported that 3-8% of women are affected by PMDD.\[2,3\] But our findings are similar to other studies reported specifically among students. The prevalence rate of 36.1% of PMDD was reported by Issa and colleagues in a study among medical students.\[15\] Niser and colleagues reported a PMDD prevalence rate of 5.8% among unmarried
female medical students in Pakistan.\[20\] Also, prevalence rates of 6.1%, 17.2%, and 18.2% were reported among university students in Nigeria, Croatia and Pakistan, respectively.\[21-23\] The underlying causes of this high incidence of PMDD in these students are unknown, but we can suggest several possible mechanisms. The prevalence of PMDD in Iranian females is high, and other Iranian studies report a range of PMDD prevalence rates from 13%-59%.\[17, 24\] It is a fact that this prevalence rate is affected by cultural influences.\[25\] Life style is a main factor influencing PMDD in the Iranian population.\[26\] The diagnosis of PMDD by the DSM-IV-TR criteria includes at least five mood symptoms that must present during repeated menstrual cycles. In a retrospective design of PMDD assessment which is based on memory, the description of the women’s mood symptoms are subjective and the recall of symptoms’ severity and frequency may be amplified among these women.\[27-29\] Moreover, the responses may be associated with personality characteristics. Bailey and colleagues found that 40% of women diagnosed with PMS or PMDD also had comorbid affective or anxiety disorders.\[29\] Contrary to the study by Cohen and colleagues that found an association of PMDD and lower education,\[30\] other studies have found PMS/PMDD had higher prevalence rates among students,\[15, 29\] which is also supported by the findings of Takeda and colleagues that showed that one half of female students experienced both irritability and depression.\[31\] Limited information about the cause and treatment of PMDD may also contribute to the high prevalence rate of PMDD in adolescent girls. Furthermore, students are under much stress due to the long hours of study, employment pressure, and the costs of university tuition. In addition, because many female students experience much stress in daily life and have little information about reproductive health, they may feel much stress about menstruation.

### 4.1.2 PMDD and sleep quality

In this study, we found that female university students with PMDD are deeply affected by sleep problems. Lower sleep quality and daytime dysfunction are common sleep problems among students with PMDD. These findings are important, given that sleep disturbance is highly prevalent in adolescence and university students.

As suggested by previous studies, several factors may contribute to an increased rate of sleep problems in the female study participants with premenstrual symptoms. Baker and colleagues\[6\] conducted a sleep EEG analysis, including a subjective sleep quality measure and an objective polysomnography, of nine women with PMS or PMDD and twelve asymptomatic control subjects at the luteal phase (LP) and at the follicular phase (FP) of the menstrual cycle. The women with severe PMS had significantly higher depression scores and poorer subjective sleep quality when symptomatic during the LP, but based on the polysomnogram, there were no specific alterations in the sleep architecture associated with the premenstrual symptoms.

| Table 2. Comparison of sleep quality parameters between two groups of female university students with and without Premenstrual Dysphoric Disorder |
|---------------------------------|----------------|-----------------|------------------|----------------|----------------|
| sleep abnormalities             | with PMDD     | without PMDD    | statistical value | p-value      |
|                                 | (n=67)        | (n=195)         |                   |              |
| PSQI score                      | 8.2 (3.4)     | 6.5 (3.1)       | 3.648             | <0.0001      |
| PSQI ≥ 5                        | 54 (80.5%)    | 110 (56.4%)     | 12.459            | <0.0001      |
| subjective sleep quality (fairly/very bad) | 11 (16.4%) | 14 (7.1%)       | 4.931             | 0.026        |
| sleep latency (minutes)         | 39 (15)       | 33 (25)         | 1.049             | 0.216        |
| sleep duration (hours)          | 6.8 (1.6)     | 6.9 (1.6)       | 0.387             | 0.771        |
| habitual sleep efficiency (<85%)| 24 (35.8%)    | 61 (31.2%)      | 0.469             | 0.494        |
| sleep disturbance               | 17 (25.3%)    | 20 (10.2%)      | 9.396             | 0.002        |
| use of sleep medication (>once a week) | 11 (16.4%) | 15 (7.6%)       | 4.247             | 0.039        |
| daytime dysfunction             | 38 (56.7%)    | 67 (34.3%)      | 10.379            | 0.001        |

Data presented as mean (SD) or number (%).
showed no intergroup differences; however, there were significant menstrual phase effects on sleep EEG measures. In both groups, REM sleep was decreased and REM latencies were increased in the LP compared to the FP.[10] Lee and colleagues showed that compared to controls, women who experienced negative mood symptoms during the LP had slow-wave sleep (SWS) patterns that were decreased at both menstrual phases.[34] Another study by Parry and colleagues revealed that women with PMS had more stage 2 sleep and less REM sleep, compared to controls.[11] Similar results were shown in a study by Lamarche and colleagues who found decreased SWS and REM sleep and increased stage 2 sleep during the LP in both healthy and women with PMS.[35] A reduction in REM sleep during LP compared to FP has also been reported by Shechter and colleagues who observed this variation in healthy women and patients with PMDD.[36] Similarly, in their sleep EEG study Parry and colleagues examined eight women with moderate to severe premenstrual depression and eight controls, two nights per week over the course of one menstrual cycle and found that depressed women had more stage 2 sleep and less REM sleep than controls.[11] In contrast, a small polysomnographic study by Chuong and colleagues demonstrated no significant change in nine sleep parameters associated with the menstrual cycle or differences between three patients with PMS and six control subjects who were studied for two consecutive nights during each of three different menstrual phases.[37]

In conclusion, we have shown that university students with PMDD perceive their sleep quality to be poor. Studying as well as daily life stress may produce or exacerbate PMDD. Self-awareness and psychological and psychiatric interventions may help students with PMDD to increase their productivity and quality of life. Further studies need to address the associations between sleep problems and long term outcomes in students with PMDD, such as their psychological development.

4.2 Limitation
This study had some methodological limitations. First, it was a questionnaire based study and we did not use reliable objective measures such as actigraphy, which is a reliable tool for confirming a diagnosis and evaluating sleep problems.[40,41] Second, the DSM-IV-TR suggests that PMDD should be diagnosed prospectively, which was not done in the present study.

4.3 Importance
With a prevalence rate of 25%, this study identifies PMDD as an important issue in female students’ reproductive health. Another important implication of this study is the importance of evaluating the sleep quality of female students. The data suggest that low sleep quality strongly relates to PMDD symptoms. By screening students’ sleep, it may be possible to intervene early and even prevent PMDD through counseling or psycho-education about sleep behaviors and their effects on PMDD symptoms.

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Conflict of interest statement
The authors declare no conflict of interest.

Informed consent
Written consent and/or assent were obtained from all study participants.

Ethical review
All procedures were approved by the Institutional Ethics Committee of Kermanshah University of Medical Sciences (KUMS).

Contribution:
HK and AC designed the study; HK, AC, BK, and MN performed the assessments; MRG analyzed the data;
HK, MRG, AC, BK, and MN evaluated the questionnaires; and HK and MRG wrote the paper.
大学生睡眠质量与经前期烦躁障碍

Habibolah KHAZAIE, Mohammad Rasoul GHADAMI, Behnam KHALEDI-PAVEH, Azita CHEHRI, Marzieh NASOURI

背景：高达 8% 的育龄妇女受经前期烦躁障碍（PMDD）所困。DSM-IV-TR 把失眠或嗜睡等睡眠紊乱作为 PMDD 的诊断标准之一。大约 70% 的 PMDD 患者存在睡眠紊乱。然而，专注解决 PMDD 对睡眠质量影响的有关研究却非常缺乏。

目的：本研究旨在评估女大学生中 PMDD 的患病率及其对睡眠质量的影响。

方法：我们根据精神障碍诊断与统计手册第四版修订版 (DSM-IV-TR) 开发了 PMDD 量表 (18 项)。对月经周期规律、年龄在 18~30 岁的女大学生，用上述量表诊断 PMDD。把研究对象分为 PMDD 组或非 PMDD 组，比较两组的睡眠质量。用匹兹堡睡眠质量指数 (PSQI) 评估睡眠质量。

结果：女大学生 PMDD 的患病率为 25.5%。PSQI 分析表明 PMDD 组中 80.5% 的女大学生 PSQI 得分 > 5, 而非 PMDD 组中相应的比例只有 56.4% (χ²=12.459, p<0.001)。PMDD 组 PSQI 平均分 (标准差) 为 8.2 (3.4) 而非 PMDD 组为 6.5 (3.1) (t=3.648, p<0.001)。

结论：患有 PMDD 的女大学生睡眠问题严重。睡眠质量差、日间功能障碍以及睡眠紊乱是患 PMDD 的女大学生中常见的睡眠问题。

关键词：经前期烦躁障碍；睡眠质量；匹兹堡睡眠质量指数；女大学生

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