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The Prevalence of Premenstrual Dysphoric Disorder and Its Modulation by Lifestyle and Psychological Factors in High School Students

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The purposes of this study were to investigate the prevalence of PMDD in Japanese adolescent girls and identify PMDD modulation by lifestyle and psychological factors and compared the result with those in PMS. Self-reported questionnaires were delivered to 675 high school students in Kobe City from June to July 2004. Items of questionnaires have included student's background, menstruation, lifestyle factors and health difficulties. Diagnosis criteria of PMS from Mortola et al. and diagnosis of PMDD based on DSM-IV criteria were used in this study. It was found that the prevalence of PMDD was 8.4% and PMS was 18.5%. There was a significantly differences in the rate of PMDD among each grade (first grade 5.4%, second grade 7.4% and third grade 12.6%, respectively). This study supports the possibility of the influence of stay awake late at night, exercise, stress experience, eating pattern, complication of headache and migraine to the morbidity of PMDD and the strong relationship between stress and PMDD. This study suggested the necessity of giving a proper information and appropriate health guidance to decrease premenstrual symptoms.

Key words

Premenstrual dysphoric disorder (PMDD), Premenstrual syndrome (PMS), High school students, Quality of life (QOL)

Background

Menstruation is defined as a cyclic bleeding from endometrium that naturally stop within a confined days, usually within interval of approximately one month[1]. In some women, premenstrual symptoms interfere with their daily functioning. The morbidity of premenstrual symptoms was divided into Premenstrual syndrome (PMS) and Premenstrual dysphoric disorder (PMDD). PMS is characterized by the presence of at least one of physical (e.g., breast tenderness, headache, change in appetite, dizziness, lethargy) or physiological symptoms (e.g., irritability, unstable emotion, depression, anxiety) during the 5 days before menstruation and relief of symptoms in the onset of menstruation. These symptoms are severe enough to impair social or economic performance[2-3]. PMDD is considered a more severe form of PMS[4]. PMDD is distinguished from PMS by the severity of symptoms, predominance of mood symptoms, and role dysfunction, particularly in personal relationships and marital/family domains[5].

Although the pathological condition of PMDD was not clear, recently, there is ample evidence suggesting that serotonergic functioning in central nervous system is altered during the luteal phase in women with PMS and PMDD[6]. To treat them, pharmacological and

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psychological treatment was suggested[6-8].

Since there was no diagnostic criteria of PMDD in Japan, the diagnostic criteria of PMDD based on DSM-IV criteria as proposed by American Psychiatric Association[4] was employed. It is estimated that although 2% - 9% of women of reproductive age experience symptoms that may meet the criteria of PMDD, there are only a small number of women who seek for treatment[8-10]. Especially in adolescent, many students may be suffered from PMDD. Little is known, however, regarding the incidence of PMDD in high school students and its modulation by characteristic and psychological factors. Thus, we investigated the prevalence of PMDD based on DSM-IV criteria of PMDD and the effect of lifestyle and psychological factors on PMDD in high school students at Kobe City, and compared the result with those in PMS.

Subjects and Methods

1. Subjects

For this study purpose, 675 students from S female high school at Kobe City, Hyogo Prefecture were recruited (first grade students 242, second grade students 202 and third grade students 231, respectively). Permission to conduct the study was granted by the institu-

Table 1 Diagnosis Criteria of PMDD

A. In most menstrual cycles during the past, five (or more) of the following symptoms were present for most of the time during the last week of the luteal phase, began to remit within a few days after the onset of the follicular phase, and were absent in the week post-menses, with at least one of the symptoms being either (1), (2), (3) or (4):
   (1) Markedly depressed mood, feelings of hopelessness or self-deprecating thoughts
   (2) Marked anxiety, tension, feelings of being "keyed up" or "on edge"
   (3) Marked affective lability (e.g., feeling suddenly sad or tearful or increased sensitivity to rejection)
   (4) Persistent and marked anger or irritability or increased interpersonal conflicts
   (5) Decreased interest in usual activities (e.g., work, school, friends, hobbies)
   (6) Subjective sense of difficulty in concentrating
   (7) Lethargy, easy fatigability or marked lack of energy
   (8) Marked change in appetite, overeating or specific food cravings
   (9) Hypersomnia or insomnia
   (10) A subjective sense of being overwhelmed or out of control
   (11) Other physical symptoms, such as breast tenderness or swelling, headaches, joint or muscle pain, a sensation of "bloating", weight gain

B. The disturbance markedly interferes with work or school of with usual social activities and relationships with others (e.g., avoidance of social activities, decreased productivity and efficiency at work or school)

C. The disturbance is not merely an exacerbation of the symptoms of another disorder, such as Major Depressive Disorder, Panic Disorder, Dysthymic Disorder, or a Personality Disorder (although it may be superimposed on any of these disorders)

D. Criteria A, B, and C must be confirmed by prospective daily ratings during at least two consecutive symptomatic cycles. (The diagnosis may be made provisionally prior to this confirmation)

tional review board at Kobe University School of Medicine and the principal of participating school before this study was performed.

2. Questionnaires

From June to July in 2004 the self-reported questionnaires were delivered to the students who attend the class on the day it was delivered. Items of questionnaires have included student's background (grade, height, and weight), menstruation cycle (age of menarche, regularity of menstruation), lifestyle factors (stay awake late at night, regular exercise, breakfast consumption, diet experience, stress experience) and health difficulties (dizziness, stiff shoulder, chilliness, headache and migraine). Regular menstruation was defined as a menstruation cycle in every 25 - 38 days and the duration of flow was 3 - 7 days. Migraine was defined as follows: (1) headache lasting 4 to 72 hours, (2) headache has at least 2 of the following characteristics: unilateral location, pulsating quality, severe intensity (inhibits or prohibits daily activities), aggravation by walking stairs or similar routine physical activities and (3) during headache at least 1 of the following: nausea, vomiting or both, or photophobia and phenophobia.

3. Diagnosis of PMS and PMDD

Diagnosis criteria of PMS from Mortola et al[2] and diagnosis of PMDD based on DSM-IV criteria (Table 1)[10] were used. Those who met the criteria of PMS were excluded from PMDD criteria. For this study, we divided students into three groups: 'non-PMS/PMDD', 'PMS' and 'PMDD'. The student's background, menstruation cycle, lifestyle factors and health difficulties were compared among three groups.

4. Japanese Version of STAI (State-trait Anxiety Inventory)

In order to measure the anxiety level among the students, Japanese version of STAI was used. STAI is a well-known 40-item instrument that assesses both anxiety as an emotional state and individual differences in anxiety as a personality trait.

Statistical Analysis

Microsoft Excel and Statcel were used in the process of analyses. The result displayed as frequencies, percentages, mean and standard deviation (SD). Student t-test, χ^2 tests, Mann-Whittney test and one way ANOVA were used for comparison between groups. A p value of less than 0.05 was considered to be statistically significant.

Table 2. Characteristics of the Students in Each Grade

	First grade (N=242)	Second grade (N=202)	Third grade (N=231)	P value
Height (cm)	157.7±5.2 (145-173)	157.9±4.7 (142-171)	158.3±5.5 (142-174)	N.S
Weight (kg)	49.0±5.7 (33-66.6)	49.5±6.1 (37-78)	51.1±6.7 (37-78)	p<0.01
BMI (kg/m2)	19.7±2.0 (14.7-29.2)	19.8±2.1 (15.6-30.1)	20.3±2.5 (15.0-31.3)	p<0.01
Age of menarche (years)	12.1±1.1 (9-15)	12.2±1.1 (9-15)	12.0±1.1 (9-16)	N.S
Regularity of menstruation				
a. Regular	114/233 (48.9%)	106/194 (54.6%)	127/224 (56.7%)	
b. Irregular	61/233 (26.2%)	62/194 (32.0%)	71/224 (31.7%)	p<0.01
c. Did not known	58/233 (24.9%)	26/194 (13.4%)	26/224 (11.6%)	

Results

1. Student's Background

The characteristics of the students in each grade are presented in Table 2. There were no significant differences in percentages of the first grade, second grade and third grade students, respectively, in height and age of menarche. In contrary, weight, BMI and regularity of menstruation significantly differ ($p<0.01$).

2. The Prevalence of PMDD and PMS

Out of 675 students included in this study, 57 students (8.4%) met the criteria of PMDD and 125 students (18.5%) met the criteria of PMS (Table 3). There was a significantly differences in the rate of PMDD among each grade (first grade 5.4%, second grade 7.4%, third grade 12.6%, respectively). The rate of prevalence of each premenstrual symptom is shown in Table 4. As can be seen, the most common symptom was irritability (32.1%), abdominal bloating (19.1%) and depression

Table 3. The Prevalence of PMS and PMDD in Each Grade

	First grade (N=242)	Second grade (N=202)	Third grade (N=231)	Total (N=675)
Non PMS/PMDD	184/242 (76.0%)	132/202 (65.3%)	156/231 (67.5%)	472/675 (69.9%)
PMS	36/242 (14.9%)	50/202 (24.8%)	39/231 (16.9%)	125/675 (18.5%)
PMDD	13/242 (5.4%)	15/202 (7.4%)	29/231 (12.6%)*	57/675 (8.4%)
No Answer	9/242 (3.7%)	5/202 (2.5%)	7/231 (3.0%)	21/675 (3.1%)

* $p < 0.05$ vs. first grade and vs. the second grade

Table 4. Prevalence Rates of Premenstrual Symptoms

	Symptom positive	370/675 (54.8%)
Premenstrual Symptoms	Symptom negative	289/675 (42.8%)
Breast tenderness		99/675 (14.7%)
Abdominal bloating		129/675 (19.1%)
Headache		66/675 (9.8%)
Swollen extremities		44/675 (6.5%)
Depression		105/675 (15.6%)
Angry outburst		57/675 (8.4%)
Irritability		217/675 (32.1%)
Anxiety		35/675 (5.2%)
Confusion		18/675 (2.7%)
Social withdrawal		28/675 (4.1%)
Affective lability		71/675 (10.5%)
Decreased interest in usual activities		57/675 (8.4%)
Difficulty in concentrating		89/675 (13.2%)
Lethargy		38/675 (5.6%)
Marked change in appetite		103/675 (15.3%)
Hypersomnia or insomnia		77/675 (11.4%)

(15.6%). The average number of symptoms experience by students is shown in Table 5. The third grade students significantly complained of more symptoms as compared to other groups.

3. Lifestyle Factors

Lifestyle factors in the three groups (non-PMS/PMDD, PMS, and PMDD) are summarized in Table 6. PMDD group has a significantly higher percentage of stay awake late at

Table 5. Number of Symptoms Before Menstruation in Each Grade

Grade	Number of symptoms	P Value
First grade	1.2±2.0	
Second grade	1.9±2.3	
Third grade	2.4±3.0	p<0.001
Total participant	1.8±2.5	

Table 6. Lifestyle Factors in The Three Groups (Non-PMS/PMDD, PMS, and PMDD)

	Non-PMS/PMDD (N=472)	PMS (N=125)	PMDD (N=57)
Height	157.9±5.2 (142-174)	158.5±5.1 (148-173)	157.9±5.1 (146-166.5)
Weight	49.8±6.2 (33-78)*	49.4±5.7 (38-70)*	51.9±7.3 (40-78)
BMI	20.0±2.2 (14.7-31.1)*	19.6±2.2 (15.6-31.3)**	20.7±2.5 (16.2-29.4)
Stay awake late (at night)			
Yes	334/471 (70.9%)**	89/123 (72.4%)**	51/57 (89.5%)
No	137/471 (29.1%)	34/123 (27.6%)	6/57 (10.5%)
Exercise			
Almost everyday	79/468 (16.9%)	29/125 (23.2%)	9/57 (15.8%)
2-3 times a week	89/468 (19.0%)	21/125 (16.8%)	15/57 (26.3%)
Almost never	300/468 (64.1%)	75/125 (60.0%)	33/57 (57.9%)
Breakfast			
Almost everyday	396/470 (84.3%)*	95/123 (77.2%)	39/56 (69.6%)
2-3 times a week	32/470 (6.8%)	14/123 (11.4%)	8/56 (14.3%)
Almost never	42/470 (8.9%)	14/123 (11.4%)	9/56 (16.1%)
Stress Experience			
Yes	370/470 (78.7%)	109/125 (87.2%)***	55/57 (96.5%)****
No	100/470 (21.3%)	16/125 (12.8%)	2/57 (3.5%)
Stress Coping			
Yes	191/369 (51.8%)	55/108 (50.9%)	19/52 (36.5%)
No	178/369 (48.2%)	53/108 (49.1%)	33/52 (63.5%)
Diet Experience			
Yes	74/466 (15.9%)**	26/125 (20.8%)	17/57 (29.8%)
No	392/466 (84.1%)	99/125 (79.2%)	40/57 (70.2%)

* p<0.005 vs PMDD ** p<0.01 vs PMDD
*** p<0.005 vs Non-PMS/PMDD **** p<0.01 vs Non-PMS/PMDD

night (89.5%), a smaller percentage of exercise almost everyday (15.8%), a smaller percentage of eat breakfast everyday (69.6%), a higher percentage of almost never eat breakfast (16.1%) and a higher percentage of having diet experience (29.8%) as compared to other groups.

Stress experience in non-PMS/PMDD, PMS and PMDD group was 78.8%, 87.2% and 96.5%, respectively. Moreover, the percentages of students who report the ability to cope with stress were 51.8%, 50.9% and 36.5%, respectively. The percentage of students who report stress experience in PMS group and PMDD group, respectively, were significantly higher as compared to non-PMS/PMDD group (87.2% vs. 78.8%, p<0.05%; 96.5% vs. 78.8%, p<0.01). Diet experience in non-PMS/PMDD, PMS and PMDD group was 15.9%, 20.8% and 29.8%, respectively. The percentage of students who reported of having diet experience in PMDD group was significantly higher as compared to non-PMS/PMDD group (p<0.01).

4. STAI

The mean score of STAI-I (state anxiety) was 46.1 and the mean score of STAI-II (trait anxiety) was 52.0. There were no significant differences in the mean score of the first grade, the second grade and the third grade, respectively, in state anxiety and trait anxiety (45.80 vs. 45.51 vs. 46.05; 51.35 vs. 52.06 vs. 52.03). Furthermore, there were significant differences in mean scores of non-PMS/PMDD, PMS and PMDD group, respectively, in state anxiety and trait anxiety (45.1 vs. 46.1 vs. 52.7, p<0.01; 51.2 vs. 52.7 vs. 58.4, p<0.01). PMDD group has a significantly higher mean score of STAI (p<0.01) as compared to other groups.

5. Health Difficulties

The percentage of students suffered from

Table 7. Health Difficulties in The Three Groups (Non-PMS/PMDD, PMS, and PMDD)

	Non-PMS/PMDD (N=472)	PMS (N=125)	PMDD (N=57)
Dizziness			
Yes	291/470 (61.9%)	88/123 (71.5%)***	39/56 (69.6%)
No	179/470 (38.1%)	35/123 (28.5%)	17/56 (30.4%)
Stiff Shoulder			
Yes	287/471 (60.9%)	83/125 (66.4%)	41/57 (71.9%)
No	184/471 (39.1%)	42/125 (33.6%)	16/57 (28.1%)
Chilliness			
Yes	215/472 (45.6%)*	67/125 (53.6%)	34/57 (59.6%)
No	257/472 (54.4%)	58/125 (46.4%)	23/57 (40.4%)
Headache			
Yes	344/466 (73.8%)	107/124 (86.3%)****	48/56 (85.7%)
No	122/466 (26.2%)	17/124 (13.7%)	8/56 (14.3%)
Migraine			
Yes	41/344 (11.9%)*	17/107 (15.9%)	12/48 (25.0%)
No	303/344 (88.1%)	90/107 (84.1%)	36/48 (75.0%)

* p<0.005 vs PMDD ** p<0.01 vs PMDD
*** p<0.005 vs Non-PMS/PMDD **** p<0.01 vs Non-PMS/PMDD

dizziness in PMS group was significantly higher as compared to non-PMS/PMDD (71.5% vs. 61.9%, p<0.005). There were no significant differences in percentages of non-PMS/PMDD, PMS and PMDD group, respectively, in stiff shoulder (60.9% vs. 66.4% vs. 71.9%, N.S). The percentage of students suffered from chilliness in PMDD group was significantly higher as compared to non-PMS/PMDD (59.6% vs. 45.6%, p<0.005).

The percentages of students who suffered from headache in PMS group was significantly higher as compared to non-PMS/PMDD (p<0.01). From those students who suffered from headache, as many as 11.9% in non-PMS/PMDD group, 15.9% in PMS group, and 25.0% in PMDD group could be classified as suffered from migraine. The percentages of students who suffered from migraine in PMDD group was significantly higher as compared to non-PMS/PMDD group (25.5% vs. 11.9%, p<0.005).

Discussion

This is the first report about the prevalence of PMDD in Japanese adolescent girls. The prevalence of PMDD in this study based on diagnosis criteria of PMDD from DSM-IV criteria was 8.4%, a similar result with those in older age. There was a few studies demonstrated the prevalence of PMDD among adolescents and not all of the studies used DSM-IV criteria for PMDD diagnosis. A prospective-longitudinal community survey of 1488 adolescents and young adults aged 14 to 24 in Germany reported a baseline 12-month prevalence of DSM-IV of 5.8%[9]. Another report with a population of 171 Turkish girls between the ages of 10 to 17 years showed that the prevalence of severe PMS based on diagnosis criteria of PMDD from DSM-IV criteria was 13.4%[11]. It was speculated that if the prevalence of PMDD in adolescents is similar to that in adults, between 5% to 10% of adolescents with PMS suffer from PMDD[7].

In this study, there were significantly differences in prevalence of the first grade, the second grade and the third grade, respectively, in PMDD (5.4% vs. 7.4% vs. 12.6%, p<0.05). Furthermore, PMDD prevalence in the third grade was the highest as compared to other grades. This result was along the lines of the percentage of the first grade, the second grade and the third grade, respectively, in establishment of regular menstruation (48.9% vs. 54.6% vs. 56.7%, p>0.05). It was reported that as many as 75% of adolescent girls experience some kind of problem associated with menstruation[12]. The age of onset of PMDD typically is in the early to mid-twenties, though it may begin at any time after menarche[8]. Irregular and anovulatory cycles are common during the first postmenarcheal years. During the first menstrual months, the hypothalamic-pituitary-ovarian (HPO) axis is immature, resulting in the secretion of only estrogens from the developing follicles; positive feedback to trigger ovulation develops later. Consequently, estrogen secretion is variable and unopposed by progesterone, which would normally be produced in ovulatory cycles[13]. With further maturation of the HPO axis a pattern of regular ovulatory cycles emerges[14]. PMDD was found more often in ovulation cycle. Taking these accounts into our finding, the increased prevalence of PMDD along the grade in high school students may be attributable to the increased ovulatory cycles of menstruation in them.

Irritability, abdominal bloating and depression were the most common symptoms reported by the students in this study. Previous studies which used DSM-IV criteria for PMDD reported various results. Derman et al[11] reported that the most common symptom was nervousness (87.6%), stress (87.6%) and negative affect in the form of mood swings (59.1%). Takeda et al[15] reported that the most common symptom was physical symptom

(81.2%), irritability (70.6%) and anxiety or tension (68.4%). Another study by Teng et al[16] reported that the most common symptom was physical symptom (75.9%), affect lability (59.8%), and anger or irritability (56.4%). The third grade students complained of more premenstrual symptoms compared to the first grade group.

A relationship between the onset of PMDD with the number of premenstrual symptoms was suggested. It could be speculated that if a woman suffered from many premenstrual symptoms and a decreasing level of Quality of Life (QOL) is identified, she may suffered from PMS or PMDD. Number of symptoms is one of the factors that modestly but significantly correlated with medical help-seeking. PMDD symptoms of anger and irritability have been most clearly linked to dysregulation of central serotonergic transmission as demonstrated by a tryptophan depletion study and an elegant recent cross-over study using low-dose metergoline (a serotonin receptor-selective antagonist) in women treated with fluoxetine[17]. However, the great majority of women with PMDD do not seek medical help for their illness[18].

This study supports the possibility of the influence of life rhythm (stay awake late at night), exercise, stress experience, and eating pattern to the morbidity of PMDD. PMDD group has a significantly higher percentage of stay awake late at night (89.5%) compared to other groups. A greater percentage of students who reported exercising were noted in PMDD (42.1%) than in PMS (40%) and non-PMS/PMDD group (35.9%). This study supports finding from earlier study (Deuster et al[19]) speculating that women with PMDD were aware that exercise may be effective in attenuating their symptoms and had initiated exercise for this reason. Breakfast consumption significantly contributes to whole-diet nutrient adequacy. Skipping breakfast is typically more prevalent in girls and has been associated with other lifestyle factors such as smoking, infrequent exercise, and dieting or concerns about body weight[20].

Stress experience was found in a high percentage in PMS and PMDD group (87.2% and 96.5%, respectively). A relationship between stress and the incidence of PMS and PMDD was recognized. The lowest percentage of students who able to cope with stress was in PMDD group (36.5%) as compared to other groups. It was also recognized that students with stress experience but they did not have adequate stress coping would suffered from more symptoms. Fontana & Palfai (1994) reported that women with premenstrual dysphoria (PMD) appraised daily stressors as being more stressful, undesirable, and changeable premenstrually than postmenstrually as compared to controls[21]. Other studies suggested that the number of stressors may be no greater for PMDD women, but their perception of the stressfulness, unpleasantness, or impact of the stressors is significantly greater during the luteal phase, and that their cognitive coping strategies are impaired during this phase relative to control subjects[22]. It was speculated that the endocrine changes during the premenstrual and menstrual period lower the threshold of stress tolerance and precipitate the manifestation of predispositions, for instance to migraine, depression or anxiety[23].

In general, the STAI score in high school students in this study was high, which is in level IV (high level of stress). It was suggested that high school period was a difficult time. Many students experience the anxiety and it makes an unstable condition. The mean score of STAI-I (state anxiety) and STAI-II (trait anxiety) showed a significantly higher in PMDD group as compared to non-PMS/PMDD group. In contrary, the mean score of state anxiety and trait anxiety in non-PMS/PMDD was no significantly differ from PMS group. It was suggested that stress has a strong relationship with PMDD but not with

PMS. STAI score of the third grade student was the highest compared to other grades. There were possibilities that many students were in stress situation in their daily life.

Previous studies have reported that menstrually related migraine starts at menarche in 33% of affected women[24]. The percentage of students who suffered from headache was higher in PMS and PMDD group compare to non-PMS/PMDD group. The highest percentage of students who suffered from migraine was in PMDD group. The pathophysiology of migraine has several components. A vasomotor component which is mediated by constriction or dilation of arteries within and outside the brain has been identified. Activation of the trigeminal vascular system has also been described. Additionally, serotonergic neurons of the dorsal raphe have been implicated as a midbrain trigger of migraine. Serotonin release stimulates production of vasodilatory substances that cause headache[31]. The percentage of students who suffered from migraine in the third grade was 16.1% while in PMDD group was 25.0%. Migraine may be associated not only with menstruation, but also with PMS and PMDD, especially PMDD.

In conclusion, it seems likely that the prevalence of PMDD in adolescent girls is similar with those in adult women. Furthermore we have demonstrated the possibility of the influence of stay awake late at night, exercise, stress experience, eating pattern, complication of headache and migraine to the morbidity of PMDD and the strong relationship between stress and PMDD. In high school institutions, the management of taking care of students suffered from PMDD should be improved in order to decrease the incidence of PMDD and to minimize the effect of PMDD to QOL. Modification of life rhythm, exercise, eating pattern and stress management are recommended. This study also suggested the necessity of giving a proper information and appropriate health guidance to decrease premenstrual symptoms. Further study with larger number of sample may provide further evidence of adolescents with PMS and PMDD.

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