Patterns of premenstrual syndrome in collegiate women: a cross-sectional study

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Abstract

Background

Premenstrual syndrome (PMS) has a wide variety of symptoms. The classification of these symptoms into several patterns is useful for more effective tailor-made treatment. Therefore, our study aimed to examine the patterns of PMS by analyzing multiple factors to identify the characteristics of each pattern.

Methods

This is a cross-sectional study. A total of 165 women (18.9 ± 1.0 years) was investigated by using of questionnaire about PMS, nutrition, physical activity, and other lifestyle traits. Then, the factor analysis was performed to classify the premenstrual symptoms, that is, the pattern of PMS. Additionally, logistic regression analysis was performed to identify the characteristics of each pattern, adjusted for age, body mass index, sleep duration, and caffeine intake.

Results

As the result, PMS was classified into three patterns. The type related to psychological symptoms such as depression, physiological symptoms such as abdominal pain, and intermingled type were labeled as affected, somatic, and mixed types, respectively. From the result of logistic regression analysis, self-rating depression scale scoring was marginally associated with affective type ($p = 0.067$), physical activity was significantly associated with the mixed type ($p = 0.049$), and physical activity (OR = 0.006) and some nutrients (OR = 0.015–0.041) were significantly associated with the somatic type.

Conclusions

To understand of PMS and management of these complicated symptoms has been difficult. From the results of this study, the complicated symptoms were categorized into simpler patterns. Our findings may contribute to the understanding and possible management adjusted for each categorized case of PMS.

Background

Premenstrual syndrome (PMS) is a common cyclic disorder in reproductive-aged women, occurring during the late luteal phase of the menstrual cycle and vanishes soon after the onset of menstruation [1]. Changes on body composition over the course of their menstrual cycle is a risk factor of PMS. For example, peaking of menstrual edema and weight gain occur at the onset of flow. Moreover, the impact of menstrual cycle phase on athletes' performance was investigated because female sex hormone affects to the muscle strength and power [2]. When clinically reviewing women for PMS, symptoms are diagnosed by prospectively recording using a symptom diary [3]. Approximately 80% of female

adolescents and young adults experience some uncomfortable symptoms during the premenstrual phase [4]. The global prevalence of PMS is reported as 47.8%, and the prevalence tends to increase [5]. Moreover, about 90.1% of women aged 20–29 years, experience some form of PMS in Japan [6]. PMS affects the daily lives of women, interfering in one's social or work life [7, 8] and posing a potential economic burden [9]. Meanwhile, more severe symptoms than PMS, including severe depression, irritability, and tension, are defined as premenstrual dysphoric disorder (PMDD) [10]. In general, it is known that women have approximately 480 menstrual cycles in their lifetime. Experiencing PMS or PMDD during each menstrual cycle decreases the quality of life of women [11, 12].

There are various premenstrual symptoms, and the etiology of PMS is complicated, causing difficulty in treatment. For example, premenstrual symptoms vary from physical symptoms to affective and behavioral symptoms [1]. Over 200 symptoms have been reported, such as headache, breast tenderness, anxiety, irritability, and so forth [4, 13]. The American College of Obstetricians and Gynecologists (ACOG) practice guidelines specify the symptoms as affective and somatic patterns [14]. The degree and type of symptoms vary according to lifestyle factors such as sleep, diet, stress management, and exercise [13]. For example, it was reported that the intake of thiamine and riboflavin from food sources was inversely associated with the incidence of PMS [15]. Moreover, lifestyle and nutritional factors such as sleeping time, caffeine consumption, alcohol intake, and smoking are strongly associated with PMS [16, 17]. Furthermore, daily physical activity and mental aspects were associated with the severity of PMS [18, 19]. Thus, it is desirable to establish a tailor-made treatment method according to the type of symptoms. However, these previous researches investigated the association of each factor and PMS. The survey that investigate the association between PMS and various factors in an analysis have been needed to reveal the degree of association between PMS and each factor from various factors.

In terms of management, there are many different treatments for PMS. In addition, different management strategies could be available for managing different symptoms of PMS. For example, the lower serum calcium levels in PMS subjects and statistically significant evidence of the effectiveness of calcium in reducing premenstrual symptoms has been reported [20, 21]. Furthermore, the lower serum magnesium of PMS subjects was observed and various treatment items recommended magnesium supplementation for anxiety-related symptoms [22, 23], selective serotonin reuptake inhibitors (SSRIs) for predominantly emotional symptoms such as irritability and anxiety [24], cognitive behavioral therapy for disruptive thoughts, behaviors, nervousness, and pain [25], aerobic exercise for menstrual symptoms [26], and vitamin B6 for both psychological and physical symptoms [27]. Vitamin D supplementation was effective in ameliorating PMS symptoms [28]. From these previous studies, it is clear that the intake of nutrients is important for PMS symptoms. On the other hand, there are multiple and complicated management strategies for each premenstrual symptom because of the variety. Hence, it is useful to classify these various symptoms into patterns.

Previous studies have investigated the association between some factors such as nutrients and PMS (not certain symptoms) or specific symptom. Since the symptoms of PMS are diverse, we thought that a tailor-made treatment divided into patterns would be better in order to simplify the clinical PMS treatment.

In addition, the patients did not suffer from only a single symptom, although ACOG specified the pattern of PMS as affective and somatic patterns and recommended the management of PMS according to the International Society for Premenstrual Disorders consensus [3]. Some suffer from headache and depression, while others complain of breast tenderness and abdominal bloating. In case the symptoms overlap, making a strategy for the management of PMS is challenging. In our hypothesis, there may be some pattern of overlapping symptoms. The classification of these symptoms into several patterns can deal with the difficulty of treatment and is useful for more effective tailor-made treatment for PMS. Therefore, classification of these premenstrual symptoms into certain patterns was performed to find out the possibility to simplify these various symptoms in this study. After that, investigation of association between the PMS pattern and some factors were performed to examine the usefulness of the classify.

Methods

This is a cross-sectional study by using of demographic data and answer of self-questionnaire about PMS and life style from collegiate women.

Participants

In this study, participants recruited from a university in Nara prefecture, were medical-related students. We asked the participants to answer a questionnaire about PMS and lifestyle at a school event in April 2015.

First, all students who attended the school event received written and oral information about the study, particularly its purpose, methods, and ethical considerations. Then, the participants who agreed to participate in the current study were asked about their menstrual cycle and the possibility of being pregnant for checking the inclusion criteria, which was a regular cycle of menstruation. The days of menstrual cycle and length of the menstrual period were regular according to the participants' answers. All participants met the inclusion criteria. Written informed consent was obtained from each participant in accordance with the guidelines approved by the Kyoto University Graduate School of Medicine and the Declaration of Human Rights, Helsinki, 1975. The protocol was approved by the Ethics Committee of Kyoto University Graduate School of Medicine (protocol approval E-2110). Finally, we received 181 answers and after excluding 16 because of missing answers, the analysis set contained 165 answers (91.2%). The characteristics of all participants are summarized in Table 1. The average age of the participants was 18.9 ± 1.0 years, and the average body mass index (BMI) was 21.8 ± 13.8. There were no smokers in the current study.

Table 1
Participants Characteristic

	All Participants (n = 165)
Age (y)	18.9 ± 1.0
BMI [a] (kg/m^2)	21.8 ± 3.8
Sleep duration (min)	364.5 ± 55.9
Caffeine beverage (g/day)	334.5 ± 292.5
[a] BMI : Body Mass Index	

Experimental protocol

The following information was investigated for analyzing the factors that are related to the PMS patterns.

Demographic data

We collected data on age, height, weight, sleep duration, caffeine intake, and smoking habits. BMI was calculated by dividing the weight by the square of the height. Participants reported sleep duration (in minutes) per day. Smoking habit was assessed through the question: “Do you addictively smoke?” and answer choice was either “Yes” or “No.” Questions on the intake of caffeine were included in a brief self-administered diet history questionnaire and the nutrition index [29]. The harmful effect of caffeine and alcohol is already clear as to avoid caffeine and alcohol was recommended in ACOG [30]. Thus, these factors were used as an adjustment variable in the logistic regression analysis.

PMS

We investigated the severity of 18 premenstrual symptoms (physical and psychological), of which 10 were used for diagnosis of PMS by the ACOG [31] and the remaining eight were selected based on frequency of occurrence, as reported in previous studies, in descending order (Supplemental Fig. 1) [6, 32, 33]. The 18 symptoms included breast tenderness or pain, headache, abdominal bloating, abdominal pain, swelling of hands or feet, increased appetite, fatigability, low back pain, drowsiness, skin problems, depression, irritability, confusion, anger outbursts, anxiety, social withdrawal, poor concentration, and poor motivation. Based on the diagnostic criterion of ACOG, participants were asked whether they experienced any of the 18 selected symptoms in the 5 days before menstruation for all three consecutive menstrual cycles. Participants could answer with a “No,” “Yes, but a little,” or “Yes, it affects my daily life.” Those who answered with the latter were considered as participants experiencing PMS, in accordance with the diagnostic criterion of ACOG. In the current study, PMS and PMDD were not discriminated.

Nutrition

We used a brief self-administered diet history questionnaire (BDHQ) as the nutrition index [29]. The BDHQ is a short version of the dietary history questionnaire (DHQ) developed by Sasaki et al. [34]. Participants were requested to answer a food intake frequency of about 79 items over the past month. The food intake frequency was questioned by “How often have you eaten each food over the past month?” and answered by 7 or 8 categories from “never” to “every day.” It took about 10–15 minutes to answer, and the daily intake of approximately 30 nutrients was calculated by a dedicated program. Both the BDHQ and DHQ have already been validated in the Japanese population [29].

Physical activity

The International Physical Activity Questionnaire-Short Form (IPAQ-SF) was used to assess daily physical activity [35]. First, we assessed the average physical activity per day for one week by metabolic equivalents (METs) unit using IPAQ-SF. Next, we calculated physical activity by kcal unit using the following expressions to consider a person’s constitution.

Physical activity (kcal) = 1.05 × amount of physical activity (METs) × time of physical activity (hours) × weight (kg)

Depression

We additionally investigated mental health problems using the questionnaire. To assess depression, we used the self-rating depression scale (SDS) [36]. In this questionnaire, participants answered 20 items about depression by “hardly,” “sometimes,” “often,” and “always.” The points of each answer were rated 1–4 from “hardly” to “always.” We added up the points of each item to obtain the SDS sum score and used the sum score.

Statistical analysis

First, factor analysis was performed to classify the PMS symptom 1–18. Any of the 18 selected premenstrual symptoms in the 5 days before menstruation for at least three consecutive menstrual cycles were checked by Yes or No. Then, all participants were classified according to the extracted pattern. To justify performing the factor analysis, Bartlett’s test of sphericity and the Kaiser-Meyer-Olkin (KMO) test were performed to determine whether there were sufficient significant correlations among these 18 symptoms. Factors were extracted by the generalized least-square method and rotated using the varimax method. The number of factors is determined by the rule that the eigenvalues are greater than one. Additionally, logistic regression analysis was performed to identify the characteristics of each PMS pattern, adjusted for age, BMI, sleep duration, and the quantity of caffeine. There were no smokers in our sample. For this analysis, each lifestyle factor, including nutrition, physical activity, food habit, and SDS sum score, was an independent variable, whereas the presence or absence of each PMS pattern was a dependent variable. The odds ratios (ORs) with 95% confidence intervals (95% CIs) were presented. The demographic data were compared in each PMS pattern by *t-test*. Statistical analyses were carried out using SPSS version 20.0 (IBM Corp, Armonk, New York), with $p < 0.05$ accepted as significant.

Results

In the factor analysis, Bartlett's test of sphericity was highly significant ($p < 0.01$), indicating that the 18-item correlation matrix was not an identity matrix. In addition, the KMO value of 0.910 met Kaiser's middling criteria, which was > 0.6. These findings showed strong correlations between the individual items and that the correlation matrix was factorable. The results of the factor analysis are summarized in Table 2, resulting in classifying premenstrual symptoms into three types. The first type included anxiety, confusion, depression, social withdrawal, angry outbursts, and skin problems. The second included poor motivation, poor concentration, fatigability, abdominal bloating, drowsiness, low back pain, swelling of the hands or feet, and increased appetite. The third type included irritability, breast tenderness or pain, abdominal pain, and headache (Table 2).

Table 2
Factor loading of each PMS symptom

	Factor 1	Factor 2	Factor 3
Anxiety	**0.910**	0.183	0.177
Confusion	**0.781**	0.224	0.306
Depression	**0.645**	0.328	0.474
Social Withdrawal	**0.625**	0.439	-0.016
Angry Outbursts	**0.573**	0.337	0.330
Skin Problems	**0.386**	0.216	0.240
Poor Motivation	0.256	**0.831**	0.045
Poor Concentration	0.281	**0.721**	0.156
Fatigability	0.312	**0.567**	0.432
Abdominal Bloating	0.209	**0.560**	0.273
Drowsiness	0.222	**0.472**	0.394
Low Back Pain	0.090	**0.453**	0.380
Swelling of the Hands or Feet	0.269	**0.433**	0.280
Increased Appetite	0.313	**0.428**	0.273
Irritability	0.420	0.288	**0.648**
Breast Tenderness or Pain	0.282	0.027	**0.517**
Abdominal Pain	0.038	0.361	**0.450**
Headache	0.299	0.172	**0.440**
Contribution Ratio	43.70%	8.18%	7.05%
Bartlett's test of sphericity and Kaisar-Meyer-Olkin (KMO) test were done to determine whether there were sufficient significant correlations among the items.			
Bartlett's test of sphericity was highly significant ($p < 0.01$), indicating that the 18-item correlation matrix was not an identity matrix.			
In addition, the KMO value of 0.910 met Kaiser's middling criteria', which is > 0.6.			

Subsequently, the participants were classified into three patterns. We labeled the three types as a matter of convenience (Fig. 1). The first type was labeled as "affective type," because most of its symptoms were psychological. The second type was labeled as "mixed type" because the symptoms were mixed type of psychological and physiological. The third type was named as "somatic type" because

physiological occupied most of its symptoms and factor loading was not observed. The characteristics of each type are listed in Supplemental Table 1. The number of participants in affective, mixed, and somatic types were 23, 36, and 42, respectively. Thus, some participants were categorized into all three types at the same time and some were categorized into none. However, none of symptoms of each pattern was same as shown in the result and Table 2. The name of each pattern was just decided from the characteristic of each grouping of these patterns. In the logistic regression analysis, the unique characteristics of each type were observed (Table 3). After adjusting for age, BMI, sleep duration, and the quantity of caffeine, SDS score was marginally associated with affective type of PMS (OR: 1.08, 95% CI: 0.99–1.16, p = 0.07); physical activity was significantly associated with mixed type of PMS (OR: 1.13, 95% CI: 1.00-1.28, p = 0.049); and physical activity (OR: 1.20, 95% CI: 1.05–1.36, p = 0.006) and some nutrients, including manganese (OR: 0.56, 95% CI: 0.31–0.97, p = 0.041), folic acid (OR: 1.00, 95% CI: 0.99-1.00, p = 0.031), vitamin C (OR: 0.99, 95% CI: 0.99-1.00, p = 0.039), and dietary fiber (OR: 0.89, 95% CI: 0.80–0.97, p = 0.015) were significantly associated with somatic type of PMS (Table 3). To sum up, the possibility of the association of depression score and affective type and the statistically significant association of some nutrients and somatic type was observed. Additionally, physical activity was associated with both mixed and somatic types. In other words, excessive physical activity was associated with a high prevalence of these two types.

-Table 3-

	Affective type		Mixed type		Somatic type	
	OR	95%CI	OR	95%CI	OR	95%CI
Physical activity (100kcal/day)	1.04	0.91 - 1.19	1.13	1.00 - 1.28*	1.20	1.05 - 1.36**
SDS [c] score (points)	1.08	0.99 - 1.16	1.04	0.97 - 1.10	1.05	0.98 - 1.11
Protein (g/day)	1.00	0.98 - 1.01	1.00	0.98 - 1.00	0.99	0.97 - 1.00
Lipid (g/day)	1.00	0.98 - 1.01	1.00	0.98 - 1.01	0.99	0.97 - 1.00
Carbohydrate (g/day)	1.00	0.99 - 1.00	1.00	0.99 - 1.00	1.00	0.98 - 1.00
Sodium (mg/day)	1.00	1.00 - 1.00	1.00	1.00 - 1.00	1.00	0.99 - 1.00
Potassium (mg/day)	1.00	1.00 - 1.00	1.00	1.00 - 1.00	1.00	0.99 - 1.00
Calcium (mg/day)	1.00	0.99 - 1.00	1.00	0.99 - 1.00	1.00	0.99 - 1.00
Magnesium (mg/day)	1.00	0.99 - 1.00	1.00	0.99 - 1.00	1.00	0.99 - 1.00
Phosphorus (mg/day)	1.00	0.99 - 1.00	1.00	0.99 - 1.00	1.00	0.99 - 1.00
Iron (mg/day)	0.97	0.84 - 1.11	1.00	0.90 - 1.11	0.87	0.75 - 1.00
Zinc (mg/day)	0.96	0.83 - 1.11	0.98	0.87 - 1.09	0.92	0.80 - 1.04
Cuprous (mg/day)	0.70	0.21 - 2.29	0.91	0.36 - 2.27	0.37	0.11 - 1.14
Manganese (mg/day)	0.61	0.30 - 1.20	0.93	0.59 - 1.47	0.56	0.31 - 0.97*
Retinol (μg/day)	1.00	0.99 - 1.00	1.00	0.99 - 1.00	1.00	0.99 - 1.00
Vitamin D (mg/day)	0.99	0.94 - 1.03	1.00	0.96 - 1.02	0.98	0.93 - 1.01
α Tocopherol (mg/day)	0.97	0.84 - 1.11	1.00	0.90 - 1.11	0.87	0.75 - 1.00
Vitamin K (μg/day)	1.00	0.99 - 1.00	1.00	0.99 - 1.00	1.00	0.99 - 1.00

Vitamin B1 (mg/day)	0.65	0.17 - 2.46	0.88	0.32 - 2.37	0.44	0.13 - 1.45
Vitamin B2 (mg/day)	1.08	0.48 - 2.39	1.06	0.54 - 2.06	0.68	0.31 - 1.47
Niacin (mg/day)	0.98	0.92 - 1.04	0.99	0.95 - 1.03	0.97	0.92 - 1.02
Vitamin B6 (mg/day)	0.79	0.36 - 1.71	0.99	0.55 - 1.75	0.58	0.28 - 1.21
Vitamin B12 (μg/day)	0.98	0.91 - 1.04	1.00	0.94 - 1.04	0.97	0.91 - 1.02
Folic acid (μg/day)	1.00	0.99 - 1.00	1.00	0.99 - 1.00	1.00	0.99 - 1.00*
Pantothenic acid (mg/day)	1.01	0.85 - 1.18	1.00	0.87 - 1.13	0.92	0.78 - 1.06
Vitamin C (mg/day)	1.00	0.99 - 1.00	1.00	0.99 - 1.00	0.99	0.98 - 1.00*
Saturated fatty acid (g/day)	1.01	0.95 - 1.06	0.99	0.93 - 1.03	0.98	0.92 - 1.02
Monounsaturated fatty acid (g/day)	1.00	0.95 - 1.04	0.99	0.94 - 1.03	0.98	0.93 - 1.02
Polyunsaturated fatty acid (g/day)	0.99	0.91 - 1.07	0.98	0.91 - 1.05	0.95	0.87 - 1.02
Cholesterol (mg/day)	1.00	0.99 - 1.00	1.00	0.99 - 1.00	1.00	0.99 - 1.00
Dietary fiber (g/day)	0.98	0.89 - 1.07	1.01	0.93 - 1.08	0.89	0.80 - 0.97*
Sodium chloride (g/day)	0.96	0.83 - 1.09	0.96	0.85 - 1.06	0.92	0.81 - 1.03
Sucrose (g/day)	1.03	0.97 - 1.08	1.00	0.96 - 1.05	0.98	0.93 - 1.02
Daidzein (mg/day)	1.04	0.98 - 1.10	1.00	0.94 - 1.05	0.98	0.93 - 1.04
Genistein (mg/day)	1.02	0.98 - 1.06	1.00	0.96 - 1.03	0.99	0.95 - 1.02
Cryptoxanthin (μg/day)	1.00	0.99 - 1.00	1.00	0.99 - 1.00	1.00	0.99 - 1.00
β Tocopherol (mg/day)	0.81	0.03 - 1.81	0.24	0.01 - 4.22	0.25	0.01 - 4.43
γ Tocopherol (mg/day)	0.99	0.91 - 1.08	0.98	0.91 - 1.05	0.95	0.87 - 1.02

δ Tocopherol (mg/day)	1.07	0.75 - 1.52	0.96	0.70 - 1.31	0.84	0.60 - 1.17

The dependent variable was being each type.

Non-each type = 0, each type = 1.

The multivariate analysis was adjusted for BMI, sleeping time, alcohol and coffeine except for physical activitiy.

In physical activity, the multivariate analysis was adjusted for height, sleeping time, alcohol and coffeine

c SDS : self-depression scale

* : $p<0.05$ ** : $p<0.01$

Discussion

In the current study, we identified the patterns of PMS by factor analysis. We found three types of premenstrual symptoms: affective, mixed, and somatic. Furthermore, we revealed associations for each type. There were some positive associations between affective type and SDS score, mixed and physical activity, and somatic type and physical activity. There was a negative association between the somatic type and some nutrients (manganese, folic acid, vitamin C, and dietary fiber). Our new idea about the patterning of overlapping premenstrual symptoms may enable further understanding of PMS and be useful in developing strategies for its management.

The SDS score had a marginally positive association with the affective type, with the higher score correlated with the higher possibility of severe affective type symptoms. This type includes anxiety, confusion, depression, social withdrawal, anger outbursts, and skin problems. These psychological symptoms are similar to the symptoms of depression. In fact, SDS has evaluation items such as confusion and depression [37]. The SDS index of the affective type was 45.2 ± 6.7 points. In Japan, the mean SDS index of depressed patients is 61.9 ± 6.9 points, while that of normal controls is 36.5 ± 12.2 points [37]. The SDS index of this type is lower than that of depressed patients but higher than that of normal controls in Japan. Hence, the participants with this type might be not diagnosed as depressed. However, they have a higher level of depression than normal participants. Many reports recommend the use of SSRIs as the first-line treatment for PMS with predominantly emotional symptoms [38]. For the women suffering from affective symptoms, psychotherapy may be useful.

It is interesting that the symptoms of the mixed type show only the mixed symptoms between the affective and somatic types, while the affective type shows precisely the psychogenic symptoms. However, in the mixed type, “Poor motivation,” “Fatigability,” and “Drowsiness” show a low intention of activity, expressing the physical symptoms. “Abdominal bloating” and “Swelling of hands or feet” seem to

be the autonomic symptoms. In the somatic type, the symptoms (breast tenderness or pain, abdominal pain, and headache) are the physical symptoms predominating for pain. “Low back pain” is patterned in the mixed type, but the factor 3 score is 0.38 and the factor 1 score “Irritability” is 0.42. The associated factors seem to be similar between mixed and somatic types. For instance, physical activity is significantly positively associated with the mixed and somatic types. Moderate exercise, which is not strenuous, has been proposed as the first-line therapy for PMS [39, 40]. Additionally, female college athletes have a high prevalence of PMS due to the intense workload and severe physical stress [41]. As an example to explain this, the hypothalamic dysfunction associated with strenuous exercise can affect the female reproductive system [42]. Briefly, high and excessive physical activity is related to a high prevalence of PMS. Likewise, in this study, we observed that excessive exercise was associated with a high prevalence of these two types. In contrast, regular exercise improves PMS compared with the sedentary lifestyle [32]. PMS rates were reported to be higher in women with either low or high daily physical activity levels than in those with normal physical activity levels [18]. These results suggest that appropriate exercise may be needed. Women suffering from these two types may have to self-reevaluate their activities.

Although the associated factors are similar between the mixed and somatic types, there is a clear difference between them concerning nutrition. Some nutrients such as manganese, folic acid, vitamin C, and dietary fiber were significantly negatively associated with the somatic type. The average intake of these nutrients in this type was lower than those of the other types (Supplemental Table 2). Particularly considering manganese, vitamin C, and dietary fiber, the intake in this type is lower than the dietary reference intakes of Japanese women [43]. Thus, deficiencies of these nutrients may influence the somatic type of PMS. Regarding manganese, a study reported that lower dietary manganese increased pain symptoms of PMS [44], which is consistent with our results. Folic acid has a hematopoiesis function [45]. Vitamin C improves endothelial function, resulting in improvement of blood flow [46]. Hence, these two nutrients play a role in controlling blood flow. In addition, a relationship between the occurrence of headache and low blood flow has been reported [47]. Therefore, deficiency of folic acid and vitamin C might reduce blood volume and flow, resulting in painful symptoms. Dietary fiber is effective for constipation [48]. Therefore, we could presume that the deficiency of dietary fiber tends to increase constipation. One of the symptoms of constipation is abdominal pain [49]. In addition, constipation occurs around the menstrual cycle [50]. These might accelerate symptoms of the painful type. Thus, we assume that the function of these nutrients causes painful symptoms. However, the underlying mechanism is unclear and further examination is needed to reveal the relationship between PMS and these nutrients.

There were several limitations to this study. First, the symptoms investigated in the current study were selected because they were the main symptoms, although over 200 symptoms have been reported [4, 13], and others remain under discussion. Moreover, the assessment for PMS was conducted retrospectively, although prospective assessment is recommended [3]. Thus, further studies using recommended diagnostic criteria and investigating various symptoms are required to support the results of this study. Second, participation was limited to medical collegiate women with the medium age of 18.9; therefore, it

may not be widely representative and we could not analyze the effect of alcohol. Simultaneously, we examined the relationship between various nutrition and each PMS pattern, although the sample size was smaller to detect them. Thus, larger studies expanding the sample range and sample size is required to support the results of the current study and reveal the detail relationships between the nutrition factors and PMS patterns. Third, the menstruation phase was not controlled, although the information was collected by self-report. Additionally, some of the participants who reported a normal menstrual cycle might have taken some management such as using contraceptives or diets. The possibility of affect by these menstrual cycle or management cannot be denied. Fourth, nutrition and physical activity information was collected via questionnaires and not through actual measurements. The cause and effect correlation between PMS and SDS score, physical activity, and each nutrient is unknown since this was a cross-sectional study. Hence, treatment strategies such as recommended nutrient intake cannot be suggested from the results of this study.

Despite these limitations, the following purposes in order to simplify the PMS treatment were accomplished. At first, it was revealed that various premenstrual symptoms can be classified into three patterns. In addition, the association between each PMS pattern and some factors which were related to daily life were revealed. It can be said that the patterning of a wide variety of PMS symptoms is useful for understanding the complicated PMS symptoms, and analyzing the factors associated with each pattern is useful in developing strategies for the management of PMS in the clinical field.

Conclusions

The present study showed three types of PMS—affective, mixed, and somatic, and identified the characteristics of each. We found associations between affective type and SDS score, mixed type and physical activity, somatic type and physical activity, and some nutrients. Many women have some or many premenstrual symptoms individually [33, 39]. Moreover, various treatment strategies for PMS have been suggested [25, 51–54]. Thus, understanding of PMS and, moreover, management of these complicated symptoms is difficult. From the results of the current study, the complicated symptoms might be categorized into simpler patterns. In addition, the possibility of a management strategy adjusted for each categorized case could be suggested.

Abbreviations

Premenstrual syndrome (PMS)

premenstrual dysphoric disorder (PMDD)

American College of Obstetricians and Gynecologists (ACOG)

selective serotonin reuptake inhibitors (SSRIs)

body mass index (BMI)

brief self-administered diet history questionnaire (BDHQ)

dietary history questionnaire (DHQ)

International Physical Activity Questionnaire-Short Form (IPAQ-SF)

metabolic equivalents (METs)

self-rating depression scale (SDS)

Kaiser-Meyer-Olkin (KMO)

odds ratios (ORs)

95% confidence intervals (95% CIs)

Declarations

Ethics approval and consent to participate

Written informed consent was obtained from each participant in accordance with the guidelines approved by the Kyoto University Graduate School of Medicine and the Declaration of Human Rights, Helsinki, 1975. The protocol was approved by the Ethics Committee of Kyoto University Graduate School of Medicine (protocol approval E-2110).

Consent for publication

Not applicable

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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The authors declare that they have no competing interests

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Authors' contributions

Saori Morino, Conceptualization; Data curation; Investigation; Methodology; Supervision; Visualization; Roles/Writing - original draft; Writing - review & editing

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Figures

Affective type	Mixed type	Somatic type
Anxiety	Less Motivation	Irritability
Confusion	Less Concentration	Breast Tenderness or Pain
Depression	Fatigability	Abdominal Pain
Social Withdrawal	Abdominal Tenderness	Headache
Angry Outbursts	Sleepiness	
Skin Problems	Low Back Pain	
	Swelling of the Hands or Feet	
	Increased Appetite	

Figure 1

The strategy of patterns of PMS symptoms

Supplementary Files

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