

Full Length Research Paper

Change in appetite and food craving during menstrual cycle in young students

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The change in appetite and food cravings before, during and after menstruation and the relationships between each premenstrual symptom and change in appetite and type of food with increased intake were investigated. This study was conducted by a self-administered questionnaire in 311 female students of health sciences. It was found that the proportion of students who increased the appetite was 70.4% during the menstruation cycle, and the highest period was before menstruation (85.8%). Sweets had the highest intake in all menstrual phases followed by junk food. It was found that increased appetite was significantly associated with depression and sleepiness. Moreover, increased intake of sweets was associated with depression, anger and sleepiness, while intake of junk food was associated with irritability and depression. In conclusion, the relationships between increased appetite for sweets and junk food and premenstrual symptoms indicate the need for promoting proper menstruation-related eating habits.

Key words: Premenstrual symptoms, change in appetite, food craving, sweets, junk food.

INTRODUCTION

Many women of reproductive age experience physical or emotional symptoms associated with the menstrual cycle, and the symptoms occurred before menstruation are called premenstrual symptoms. Premenstrual symptom severity varies from normative, mild premenstrual molimina, to severe and disabling symptoms (Yonkers and Simoni, 2018). The American Psychiatric Association published criteria for a severe clinical syndrome, premenstrual dysphoric disorder (PMDD), in its Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (American Psychiatric Association, 2013). In

these references, mental symptoms such as irritability, anger, depressed mood, anxiety, insomnia, change in appetite, overeating and specific food craving and physical symptoms such as breast tenderness, muscle pain and bloating are stated. Many studies on premenstrual symptoms have been conducted worldwide. In Japan, it has been reported that 70-80% of women at reproductive age have premenstrual symptoms (Japan Society of Obstetrics and Gynecology, 2019). In Turkey, the prevalence of premenstrual symptoms among health science students was 84.5%, and tiredness and angry

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bursts were the most frequent symptoms (Isik et al., 2016). In Saudi Arabia, 96.6% of college-aged women experienced at least one premenstrual symptom (Rasheed and Al-Sowielem, 2003).

According to the hormone phase of the menstruation, the progesterone effect to increase appetite and food intake in the presence of estrogen has been reported (Hirschberg, 2012). A high prevalence of symptoms related to increased appetite along with other common premenstrual symptoms was found in some studies. A study in 18-44-year-old women in the USA showed that there were significant increases in appetite, craving for chocolate and sweets in general, and craving for a salty flavor during the late luteal phase (Gorczyca et al., 2015). In Brazil, it was shown that the desire for foods rich in sugar, salt and fat was increased during the premenstrual period among university students (Souza et al., 2018). In Japan, 98% of nursing university students (mean age: 20.1 years) reported a desire for sweets and overeating as well as irritability and depression as the most frequent symptoms (Fukuoka et al., 2017). Another study showed that 64.6% of high school students aged 15-19 years suffered from premenstrual symptoms and that the prevalences of anxiety/tension, anger/irritability, and overeating/food cravings were high (Takeda et al., 2010).

Few studies have been focused on eating habits as risk factors for aggravation of premenstrual symptoms. It was shown that bad eating habits such as fast food consumption increased the risk for premenstrual syndrome (PMS) among Turkish students (Isik et al., 2016). In Japan, a study showed that dietary fat may be associated with premenstrual symptoms (Nagata et al., 2004). Relationships of sweets containing refined sugar with PMS have also been reported. The desire to eat highly sweet foods and sweet-food cravings during the late-luteal phase of the menstrual cycle were increased in women with PMDD (Yen et al., 2018). However, there has been a limited number of studies on the transition of symptoms related to increased appetite during the menstruation cycle. Moreover, little is known about the interrelations between increased appetite and other premenstrual symptoms. The objective of this study was to investigate the change in appetite and food cravings before, during and after menstruation and the relationships between each premenstrual symptom and change in appetite and type of food with increased intake.

MATERIALS AND METHODS

This study was conducted between July and August in 2018. The subjects were 311 female students of the Faculty of Health Sciences, Tokushima University in Japan. Students for whom agreement for participation was obtained were asked to complete a questionnaire after explanation of the study at the end of a lecture, and questionnaires were collected on the same day. The questionnaire forms were anonymous and sufficient consideration was given to private information. We followed "Ethical Guidelines for Medical and Health Research Involving Human Subjects" of the

Tokushima University and the study was approved by the Ethics Committee of Tokushima University Hospital (approval number: 3200).

Questionnaire

A self-administered questionnaire was designed by the researchers. The first part of the questionnaire consisted of the demographic characteristics such as age, body height and weight, presence of menstrual cramp and stress. The second part consisted of self-assessment of premenstrual symptoms such as irritability, depression, anger, headache, heaviness in head, vertigo, sleepiness, superficial sleep, breast pain, breast tenderness, edema and anxiety. Symptoms were those that occurred 3 to 10 days before menstruation, during menstruation, and 2 to 5 days after menstruation for 2 or 3 consecutive recent menstrual cycles. The items were rated on a scale from 0 to 10 points with 0 points indicating no symptom and 10 points indicating severest symptoms. The third part consisted of questions related to changes in appetite and food intake: increased appetite, period when the appetite increased, type of foods (junk food such as snacks, sweets, salty food, fatty food, meats, fish, spicy food, bitter food, carbohydrates, instant food, fast food and fruits) with increased intake.

Statistical analysis

Statistical analyses were carried out using SPSS version 24 for Windows (IBM Corp., Armonk, NY). The menstruation cycle was divided into three periods: 3 to 10 days before menstruation (Phase B), during menstruation (Phase M), and 2-5 days after menstruation (Phase A). Chi-square statistics were used to compare the ratios of the presence of each premenstrual symptom in the three periods of the menstrual cycle and for analyzing the relationships of each symptom before menstruation with increase in appetite and increase in food intake. All *p* values less than 0.05 were considered to be statistically significant.

RESULTS

Demographic characteristics of the subjects

The total response rate was 76.2% (237/311). The mean (\pm SD) age of the students was 20.1 (\pm 2.3) years. The mean (\pm SD) height of the students was 152.8 (\pm 12.8) cm and their mean (\pm SD) weight was 45.2 (\pm 5.6) kg. The proportion of subjects who reported that they had menstrual cramps was 78.8% and 66.1% of those subjects were taking pain killers. Among the subjects, 67% were agreed that stress is caused by menstruation and premenstrual symptoms, while 62.1% reported that they felt stress regularly (date not shown).

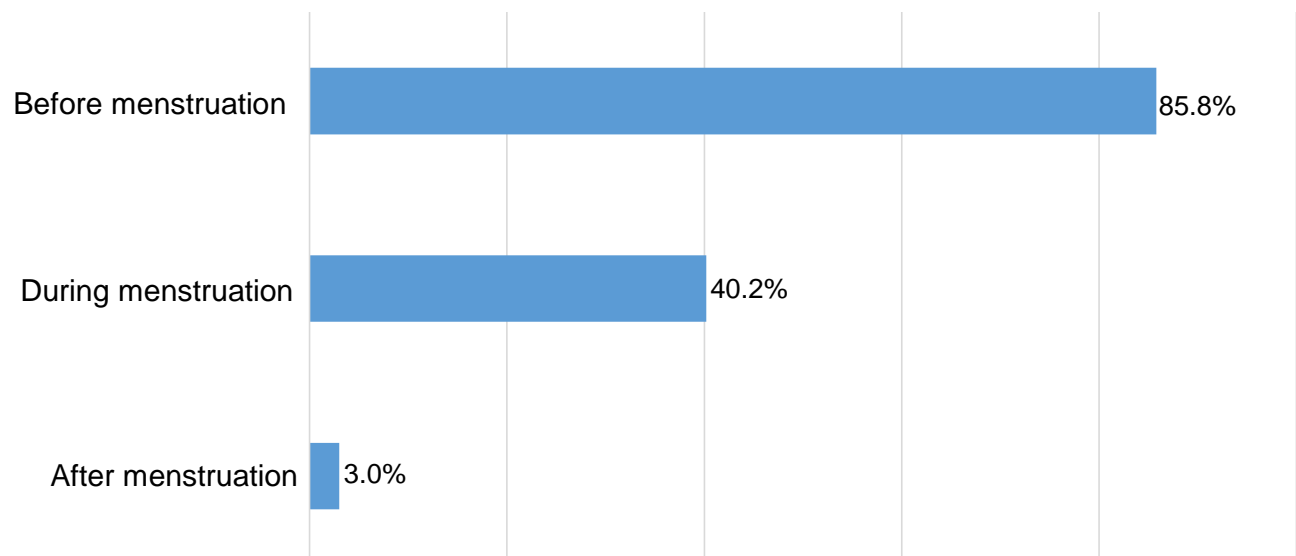
Prevalence of premenstrual symptoms in three periods of the menstrual cycle

Table 1 shows the self-recognized prevalence rates of each premenstrual symptom in the three periods. In Phase B, the prevalence rate of sleepiness was the

Table 1. Prevalence rates of symptoms in the three periods of the menstrual cycle.

Symptom	Phase B (%)		Phase M (%)		Phase A (%)		P value
Irritability	77.6	184/237	80.2	190/237	38.8	92/237	<0.001
Depression	72.2	171/237	73.3	173/236	37.0	88/238	<0.001
Anger	75.0	177/236	70.2	165/235	33.2	78/235	<0.001
Anxiety	50.8	121/238	47.7	113/237	27.7	66/238	0.002
Headache	46.8	111/237	54.7	128/234	22.7	54/238	<0.001
Heaviness in head	43.0	101/235	53.0	123/232	19.2	45/234	<0.001
Vertigo	32.5	77/237	42.6	100/235	20.3	48/236	0.002
Sleepiness	79.1	186/235	81.2	190/234	46.8	110/235	<0.001
Superficial sleep	65.3	154/236	70.5	165/234	53.0	125/236	0.034
Breast pain	57.0	135/237	46.6	109/234	18.6	44/237	<0.001
Breast tenderness	60.4	143/236	52.8	123/233	18.3	43/235	<0.001
Edema	37.0	87/235	35.5	82/231	23.2	54/233	0.064

Phase B: 3 to 10 days before menstruation; Phase M: during menstruation; Phase A: 2-5 days after menstruation.

**Figure 1.** Proportions of the subjects who have increased appetite before, during and after menstruation.

highest (79.1%), followed by irritability, anger, depression and superficial sleep. In Phase M, prevalence rate of sleepiness was also the highest (81.2%), followed by irritability, depression, superficial sleep and anger. In Phase A, the prevalence rate of superficial sleep was the highest (53.0%), followed by sleepiness, irritability, depression and anger. Prevalence rates of all symptoms reported in Phase B were decreased in Phase A. The prevalence of some symptoms including anger, anxiety, breast pain and breast tenderness decreased significantly from Phase B to Phase M. Some symptoms including sleepiness, irritability, and depression were highly prevalent in Phase B and remained slightly increased in Phase M. Prevalence of all symptoms except edema was significantly associated with the

menstrual cycle.

Change in appetite and food cravings before, during and after menstruation

Among the subjects, 70.4% (n=169) reported that they had increased appetite during the menstruation cycle, and 85.8% of those subjects reported an increase in appetite in Phase B. The proportions of such subjects decreased to 40.2% in Phase M and to 3.0% in Phase A (Figure 1). Foods for which there was increased intake during the menstruation cycle are shown in Table 2. In Phase B, the percentage of subjects with increased intake of sweets was the highest (68.3%), followed by

Table 2. Types of food for which there was increased consumption in the three periods of the menstrual cycle.

Type of food	Phase B (%)	Phase M (%)	Phase A (%)
Junk food such as snacks	40.4	23.0	8.8
Sweets	68.3	47.9	16.7
Salty food	23.4	13.3	9.6
Fatty food	20.8	13.3	10.4
Meat	29.6	17.2	14.2
Fish	12.5	10.0	10.0
Spicy food	12.9	6.3	6.3
Bitter food	4.2	0.4	2.1
Carbohydrates	35.4	25.4	15.4
Instant food	15.4	9.2	4.6
Fast food	21.3	11.3	5.0
Fruits	19.6	18.8	10.0

Phase B: 3 to 10 days before menstruation; Phase M: during menstruation; Phase A: 2-5 days after menstruation.

junk food, carbohydrates and meat. In Phase M, the percentage of subjects with increased intake of sweets was also the highest (47.9%), followed by carbohydrates and junk food. In Phase A, the percentage of subjects with increased intake of sweets was also the highest, followed by carbohydrates and meat.

Relationships of premenstrual symptom with increased appetite and type of food with increased intake in Phase B (3 to 10 days before menstruation)

The relationship between each symptom in Phase B and increased appetite and the type of food with increased intake is shown in Table 3. We divided the students into three groups with low, mediate and high, according to intensities of the symptoms of irritability, depression, anger, sleepiness and superficial sleep, which were most prevalent symptoms in this study. It was found that depression, anger and sleepiness were significantly associated with increased appetite ($p=0.001$, $p=0.016$ and $p=0.002$, respectively), while irritability and superficial sleep tended to be related to increased appetite ($p=0.068$ and $p=0.062$, respectively). Regarding the type of food with increased intake, it was also found that irritability was significantly associated with increased intake of junk food ($p=0.013$). Depression was significantly associated with increased intake of sweets ($p=0.032$), junk food ($p=0.005$), and meat ($p=0.022$). Sleepiness was also significantly associated with increased intake of sweets ($p=0.049$).

DISCUSSION

In this study, we found that 70.4% of the students had

increased appetite around menstruation and that 85.8% of those students had increases appetite 3 to 10 days before menstruation and drastically decreased at the time menstruation started. In Japanese high school female students aged 15 to 19 years, the rate of prevalence of overeating or food craving from before to during menstruation was 46.6% (Takeda et al., 2010) and 52.8% (Tadakawa et al., 2016). The prevalence rate in our study was higher than that in their study. The difference of the prevalence is due to different target group.

It was found that sweets had higher intake than that of other types of food in all menstrual phases. These results are similar to results of previous studies for increase in appetite (Gorczyca et al., 2015) and craving for sweets (Souza et al., 2018). We found significant associations of increased intake of sweets with depression, anger and sleepiness, being consistent with the results of a previous study showing that intake of sweets is linked with depressive symptoms (Knuppel et al., 2017). A previous study showing that impulsivity and irritability in women with premenstrual dysphoric disorder (PMDD) during the late luteal phase are associated with increased desire to eat sweet foods rather than fatty and salty foods to alleviate their symptoms (Yen et al., 2018), however we could not find a significant association between increased intake of sweets and irritability.

Increased consumption of junk food and carbohydrates were also found in this study. Junk food, which contains high contents of fat and salt, had the second-highest frequency of intake in Phase B and the third-highest frequency of intake in Phase M, but its intake was drastically decreased in Phase A. We found that irritability and depression were associated with intake of junk food. A study in Korea showed that stress and depression could aggravate by consumption of junk food among adolescence (Park et al., 2016).

Table 3. Relationship between each premenstrual symptom and increased appetite and type of food with increased intake, 3 to 10 days before menstruation.

Variable	Irritability				Depression				Anger				Sleepiness				Superficial sleep			
	Low (n=76)	Mediate (n=86)	High (n=75)	p value	Low (n=74)	Mediate (n=84)	High (n=79)	p value	Low (n=84)	Mediate (n=69)	High (n=83)	p value	Low (n=71)	Mediate (n=74)	High (n=90)	p value	Low (n=82)	Mediate (n=81)	High (n=73)	p value
Increased appetite	50.0 (38)	59.3 (51)	73.3 (55)	0.068	41.9 (31)	56.0 (47)	83.5 (66)	0.001	48.8 (41)	56.5 (39)	75.9 (63)	0.016	47.9 (34)	59.5 (44)	73.3 (66)	0.002	45.1 (37)	66.7 (54)	71.2 (52)	0.062
Type of food with increased intake																				
Sweets	61.8 (47)	70.9 (61)	73.3 (55)	0.68	52.7 (39)	70.2(59)	82.3 (65)	0.032	57.1(48)	68.1 (47)	80.7 (67)	0.084	57.7 (41)	73.0(54)	73.3(66)	0.049	57.3(47)	80.2 (65)	69.9 (51)	0.146
Junk food such as snacks	32.9 (25)	34.9 (30)	54.7(41)	0.013	27.0 (20)	34.5(29)	59.5 (47)	0.005	27.4 (23)	37.7(26)	55.4 (46)	0.053	32.4 (23)	36.5 (27)	50.0 (45)	0.674	30.5 (25)	39.5 (32)	54.8 (40)	0.284
Carbohydrates	34.2 (26)	31.4 (27)	41.3 (31)	0.382	23.0(17)	34.5(29)	48.1 (38)	0.111	27.4(23)	33.3 (23)	45.8(38)	0.221	29.6 (21)	36.5(27)	40.0 (36)	0.339	26.8 (22)	38.3 (31)	42.5 (31)	0.243
Meat	27.6 (21)	26.7(23)	36.0 (27)	0.722	18.9(14)	25.0(21)	45.6 (36)	0.022	22.6 (19)	29.0 (20)	38.6 (32)	0.239	21.1(15)	32.4 (24)	33.3(30)	0.601	18.3 (15)	33.3 (27)	38.4(28)	0.126
Salty food	19.7 (15)	18.6 (16)	34.7(26)	0.377	12.2(9)	21.4 (18)	38.0(30)	0.055	15.5 (13)	21.0 (12)	38.6 (32)	0.079	16.9 (12)	18.9(14)	34.4(31)	0.179	21.0(17)	21.0 (17)	31.5 (23)	0.429

Eating a meal typically reduces arousal and irritability and increases calmness and has a positive effect (Gibson, 2006). In the present study, we found significant associations of depression, anger, and sleepiness with increased appetite. There was no significant association of irritability or superficial sleep with increased appetite, and more data will be needed in the future to explain this result.

Over the past several decades in Japan, eating habits become more westernized with increasing consumption of meat, animal fat, high-sugar and low-fibre foods. An increase in sodium intake and water retention when eating salty junk food might cause physiological symptoms such as headache, increase in body weight and edema. Promoting awareness of appropriate eating habits, including reduced consumption of salty snacks and junk food, may lead to an improvement in physical premenstrual symptoms (Tadakawa et al., 2016).

Strong cravings for sweets and junk food before menstruation and bad eating habits may cause an increase in body weight and may increase the risk of lifestyle-related diseases. Although long-term prospective studies have not been carried out, we speculate that bad eating habits when young may lead to increased lifestyle-related diseases such as diabetes and hypertension at an older age. The

prevalence of common psychological symptoms such as irritability, depression and anger before menstruation in the present study were similar to those previously reported in Japan (Takeda et al., 2006; Fukuoka et al., 2017). However, the prevalence of these symptoms may be different depending on the study conditions. A study conducted in China showed a high prevalence of irritability (91%) in women aged 18-45 years (Qiao et al., 2012), while another study in Spain showed a much lower prevalence of irritability (58%) in women aged 15-49 years (Duenas et al., 2011). Little is known about the transition of symptoms before, during and after menstruation. With regard to the transition of psychological symptoms in this study, we found that the prevalence of all symptoms decreased significantly from Phase M to Phase A.

This study has several limitations. Since this study has a cross-sectional nature, there is not sufficient evidence to make a confirmative conclusion. The subjects in the present study were students who have basic health knowledge. The contents regarding menstrual regularity and medication history such as taking contraceptive pills and antidepressants were not included in the questionnaire. The degree of appetite and sugar in sweets also needs to be standardized. A future

study needs to target various kinds of students or women of various ages.

In conclusion, the proportion of students whose appetite increased during the menstruation cycle was high, especially before menstruation. The premenstrual symptoms in younger generations may be associated with bad eating habits and high consumption of sweets and junk foods. The relationships between increased appetite for sweets and junk food and premenstrual symptoms found in this study indicate the need for promoting proper eating habits to improve premenstrual symptoms and for prevention of lifestyle-related diseases. It is necessary to provide health education regarding eating habits for young women in cooperation with teachers, parents, and public health staff. Further studies are needed to determine the cause and effect relationships between premenstrual symptoms and increased appetite as well as the impact of health education on eating habits on the prevalence of premenstrual symptoms.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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