

SHORT COMMUNICATION

Sugar craving and stress levels during different phases of menstrual cycle among university students

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ABSTRACT

Introduction: The menstrual cycle in women is often associated with appetite control, mood, and behavioural changes due to hormonal imbalance. However, levels of sugar craving and stress during pre- and post-menstrual periods have not been thoroughly studied. This cross-sectional study aimed to compare levels of stress and sugar cravings during different phases of menstrual cycle among university students. **Methods:** Participants aged 19–25 years were assessed for sugar craving and stress during pre- and post-menstrual periods. They were requested to fill out the Sugar Craving Assessment Tool (SCAT) and Perceived Stress Scale (PSS-10) questionnaires on the first day of menses (the pre-menses phase) by recalling how they felt throughout the past seven days. The participants completed the same set of questionnaires again two days after their menses ended (post-menses phase) by recalling how they felt within the previous two days. **Results:** Ninety-three students participated in the study. Pre-menstrual SCAT score (40.0 ± 19.6) was higher than post-menstrual SCAT score (32.1 ± 19.4), $t(91)=4.82$, $p<0.001$. Mean PSS-10 score was also higher before menstruation (22.8 ± 6.2) than after menstruation (17.5 ± 6.1), $t(91)=6.26$, $p<0.001$. There was no significant difference in mean sugar craving scores of different stress categories, either during pre-menses [$F(2,90)=1.39$, $p=0.256$] or post-menses [$F(2,90)=0.89$, $p=0.415$]. **Conclusion:** The findings indicate that levels of sugar craving and stress were higher during pre-menstrual phase compared to post-menstrual phase in young adults. However, whether sugar cravings are linked to stress during the menstrual cycle is inconclusive and requires further investigation.

Keywords: menstrual cycle, post-menses, pre-menses, stress, sugar cravings

INTRODUCTION

The menstrual cycle in women is often associated with appetite control, mood, and behavioural changes that are caused by hormonal imbalance. The effect of hormone imbalance occurs

most during the few days before menstruation, known as pre-menstrual syndrome (PMS). Women during the pre-menstrual period are reported to have an increased appetite and cravings for sweet foods, such as chocolate, as well

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as cravings for salty flavours compared to the post-menstrual period (Gorczyca *et al.*, 2016). In a case-control study among participants with and without PMS ($n=69$), it was found that total energy and carbohydrate intakes were higher during the luteal (pre-menstrual) phase in comparison to the follicular (post-menstrual) phase (Gallon *et al.*, 2021).

Indeed, obesity prevalence among women has been reported to be consistently higher than that among men throughout the National Health and Morbidity Survey series conducted in Malaysia over the years (Institute of Public Health (IPH), 2020; IPH, 2015; IPH, 2011). These might be attributed to various factors, such as an unhealthy diet and lifestyle. However, natural physiology, specifically the menstrual cycle, may also play a role. Most women experience PMS before menstruation, causing them to be more prone to food cravings and increased consumption of high-fat foods, which may ultimately lead to weight gain over time. The term “PMS” is very synonymous with negative emotions that affect mood regulation and stress sensitivity in women, which is believed to be due to hormone levels fluctuating throughout the menstrual cycle. Research indicates that emotion dysregulation induces psychological distress, which promotes emotional eating, hence the tendency to crave comfort foods for stress relief (Guerrini-Usubini *et al.*, 2023).

In addition, sugar is a potentially addictive substance that induces the release of dopamine, a neurotransmitter that enhances pleasure and “reward-motivated behaviour” in the body (Westwater, Fletcher & Ziauddeen, 2016). This can be supported by the fact that women usually consume foods that are rich in carbohydrates, as well as fat, such as chocolates and ice cream, around the onset of menstruation

(Gallon *et al.*, 2021). However, the degree of sugar cravings in relation to different stress levels during a menstrual cycle has not been widely investigated. Thus, this study was conducted to determine the levels of sugar cravings and stress during the luteal and follicular phases of the menstrual cycle in young female adults.

MATERIALS AND METHODS

Study design and participants

Female students at a university in Pahang, Malaysia, were conveniently selected based on a few inclusion criteria. These included individuals who were single (unmarried), had regular menstrual cycle, and were not experiencing any menstrual irregularities. On the other hand, individuals who were married, had irregular menstrual cycles, on medications that would affect appetite or menses or both, consuming oral contraceptives, on a weight-reducing diet, or diagnosed with type 2 diabetes mellitus were excluded from the study. Based on a 40% population prevalence of sweet cravings in women (Yanovski, 2003), a sample size calculation using one single proportion formula yielded a total of 92 study participants.

The protocol of the study was approved by the International Islamic University Malaysia Research Ethics Committee (Reference No. 504/14/11/2/2019-105). A written informed consent was obtained from each respondent before they participated in the study.

Two sets of each of the Sugar Craving Assessment Tool (SCAT) and Perceived Stress Scale (PSS-10) questionnaires were given to the research participants. A clear guideline was given to them before they completed the questionnaires. The expected start and end dates of menses were recorded for each respondent for follow-up purposes. The study participants were requested to complete

one set of the questionnaires on the first day of menses, as it was expected that they would have experienced the pre-menstrual symptoms earlier. They needed to recall their feelings throughout the past seven days before menstruation started when answering the questionnaires. The study participants were requested to complete the same set of questionnaires again two days after their menses ended by recalling how they felt throughout the previous two days.

Anthropometry measurements

Self-reported height and weight measurements were collected from the study participants. The body mass index (BMI) value for each respondent was calculated using the formula: weight in kilograms divided by height in meters squared. The values were interpreted using the BMI classification adapted from the World Health Organization (WHO) (WHO, 1995).

Instruments

Sugar Craving Assessment Tool (SCAT)

The SCAT is a self-reported questionnaire for measuring cravings in individuals towards specific food types, including sweets, high fats, carbohydrates, starches, and fast foods (Wan Fathin Fariza & Nik Mazlan, 2017). The respondents were requested to scale each item listed in the questionnaire as A=Never, B=Rarely, C=Sometimes, D=Often, or E=Always/almost every day. The score for craving frequency was determined as A=0, B=1, C=2, D=3, and E=4, with the total score ranging from 0 to 120. The total score was then used to identify the craving status, where any value from 0 to 44 was categorised as “not craving”, whereas 45 to 120 was considered as “craving”.

Perceived Stress Scale (PSS-10)

The PSS-10 was developed by Cohen, Kamarck & Mermelstein (1983) to

measure stress by assessing an individual's feelings and thoughts in the past month. It is a self-reported questionnaire in which study participants were asked how frequently they felt and thought in a certain way in the previous seven days. The total score ranged from 0 to 40. Stress levels were determined based on the PSS-10 score range: low (0 to 13), moderate (14 to 26), and high (27 to 40).

Statistical analysis

The data of this study were analysed using IBM SPSS Statistics for Windows, version 21 (IBM Corporation, Armonk, New York, USA). The demographic data were presented using descriptive analysis. Paired samples *t*-test was used to compare the means of SCAT and PSS-10 scores, while one-way analysis of variance (ANOVA) was used to determine the difference in mean SCAT scores among the different categories of stress level during pre-menses and post-menses. The statistical significance value was set at $p < 0.05$.

RESULTS

Demographic data

Female students aged 19–25 years from medical and health sciences faculties participated in the study. Two-thirds of the study participants ($n=62$) had a normal BMI, while 16% ($n=15$) were underweight and 17% ($n=16$) were overweight or obese. The menarche age ranged from 9 to 15 years, with three-quarters ($n=70$) of the participants started menstruating between the ages of 11 and 13 years. A total of 86% ($n=80$) of the participants reported a menstrual cycle duration of 28–30 days.

Sugar craving and stress levels during pre- and post-menses

During pre-menses, 63.4% of the study participants reported having no sugar

cravings, while about one-third ($n=34$) were found to crave sugar (Table 1). Meanwhile, about three-quarters of the respondents ($n=71$) reported having post-menstrual sugar cravings (i.e., during the two days after menstruation ended), while the rest indicated no sugar cravings. Three-quarters of the respondents experienced moderate stress level ($n=69$, 74.2%) while 18 (19.4%) had high stress level during the pre-menstrual period. Only a small number of them experienced low stress level ($n=6$, 6.5%) during this specific time. On the other hand, stress assessment during post-menses revealed that about two-thirds of the respondents recorded a moderate stress level ($n=64$, 68.8%), 23.7% ($n=22$) respondents encountered a low stress level, and the rest of the respondents (7.5%) experienced a high stress level (Table 1).

The mean SCAT score during pre-menses was found to be higher (40.0 ± 19.6) compared to during post-menses (32.1 ± 19.4), $t(91)=4.82$, $p<0.001$, although both means fell within the same category (not craving). This indicated that the study participants experienced higher sugar cravings during the pre-menstrual period compared to the post-menstrual period. Similarly, the study participants also reported an increased

stress level during pre-menses, as shown by higher PSS-10 mean score (22.8 ± 6.2), than during post-menses (17.5 ± 6.1), $t(91)=6.26$, $p<0.001$, with both means indicating a moderate stress level.

The mean SCAT score among study participants who were categorised into low, moderate, and high stress categories showed no significant difference during pre-menstrual and post-menstrual phases (Table 2).

DISCUSSION

The present study indicated that stress level was reported to be higher during the luteal phase than during the follicular phase. In the pre-menstrual period, females usually experience negative emotions and are very sensitive to stressors or stressful conditions (Liu *et al.*, 2017). Most women undergo PMS a few days before menstruation begins. It is a psychological process where symptoms such as food cravings, mood swings, stress, and anger are presented. Stress during the luteal phase can be considered a normal physiological process that may be responded to differently by women (Lorenz, Gesselman & Vitzthum, 2017). Besides, the stress hormones cortisol and glucocorticoids play a significant role in regulating the body's response to stressful conditions. Stressors cause

Table 1: Sugar craving and stress levels during pre-menses and post-menses ($N=93$)

Category	Pre-menses		Post-menses		p-value ^a
	n (%)	Mean \pm SD	n (%)	Mean \pm SD	
Sugar craving ^b					
Not craving	59 (63.4%)	40.0 \pm 19.6	71 (76.3%)	32.1 \pm 19.4	<0.001
Craving	34 (36.6%)		22 (23.7%)		
Stress ^c					
Low	6 (6.5%)	22.8 \pm 6.2	22 (23.7%)	17.5 \pm 6.1	<0.001
Moderate	69 (74.2%)		64 (68.8%)		
High	18 (19.4%)		7 (7.5%)		

SD: Standard deviation

^a Comparison of means measured using paired *t*-test

^b Measured using SCAT

^c Measured using PSS-10

Table 2 Sugar craving scores according to the stress level categories during pre- and post-menses ($N=93$)

Stress level	<i>n</i>	Sugar craving scores, Mean \pm SD	<i>F</i> -statistics (<i>df</i>)	<i>p</i> -value ^a
Pre-menses				
Low	6	27.3 \pm 19.4	1.39 (2)	0.256
Moderate	69	40.6 \pm 19.8		
High	18	42.0 \pm 18.8		
Post-menses				
Low	22	27.4 \pm 15.6	0.89 (2)	0.415
Moderate	64	33.8 \pm 20.8		
High	7	31.6 \pm 16.4		

SD: Standard deviation

^a Comparison of means measured using one-way ANOVA test

an increase in cortisol levels in women during the luteal phase. Thus, women are observed to have higher sensitivity to stress during the luteal phase than during the follicular phase, as many studies found that the level of cortisol, the primary stress hormone, increases in response to stressful conditions (Liu *et al.*, 2017).

The current study also found that sugar craving level was significantly higher during the pre-menstrual period compared to the post-menstrual period. Macedo & Diez-Garcia (2014) conducted a study regarding high-sweet-fat food cravings in women with premenstrual dysphoric disorder and found that women with stress were susceptible to sweet cravings. In addition, a study by de Souza *et al.* (2018) reported that the craving for foods containing high amounts of simple carbohydrates, salt, and fat, such as sweets, pastries, snacks, sausages, and desserts, was significantly higher among their study participants during the follicular phase (measured between the 5th and the 9th day of the menstrual cycle) as compared to the luteal phase (between the 20th and the 25th day of the menstrual cycle). Sugar-rich foods, such as chocolate and chocolate-chip cookies, accounted for the most common food cravings during the pre-menstrual period. These are perceived as “comfort foods” because

they help to elevate and dampen stress-related responses. Comfort food is often suggested as a food that would give psychological and emotional well-being to the consumer and is often perceived as a food that contains high sugar and/or carbohydrate content (Westwater *et al.*, 2016). The appeal of sugar has been shown to increase under stressful conditions. With higher sensitivity towards stress during the luteal phase, females are more prone to have sugar cravings as it is perceived that sugar gives a comforting effect and may alleviate stress-related emotions (Macedo & Diez-Garcia, 2014).

Although this study demonstrated the possible effect of the menstrual cycle on sugar craving and stress levels, stress coming from external factors was not included as a potential confounder during analysis. Thus, future research should consider various environmental stressors for university students, such as academic performance pressure and financial or personal issues. In addition, the fact that there was an uneven distribution in the number of participants for each stress category (with some being very low compared to others) might have affected the current findings on sugar cravings and their potential connection with stress levels during the different phases of the menstrual cycle.

CONCLUSION

This study demonstrated that the levels of sugar craving and stress increased during pre-menses compared to post-menses, albeit within the same category (non-craving and moderate stress). PMS symptoms, such as mood swings, stress, and anger, are common in women due to hormonal imbalance. Thus, higher cravings for foods and beverages containing high sugar during that phase might indicate a natural response to manage the stressful period. However, whether sugar cravings are connected to stress levels (or vice versa) during the different menstrual phases is inconclusive and warrants further investigation.

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Authors' contributions

Nor Azwani MS, conceptualised the study, prepared the draft of the manuscript, reviewed, and revised the manuscript; Riyadhina Husniyati S, designed the study, collected, analysed and interpreted the data, assisted in drafting the manuscript; Wan Fathin Fariza WM, provided advice on data analysis and interpretation, and reviewed the manuscript.

Conflict of interest

The authors declare no conflict of interest.

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