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# Exploring the Factors Influencing Premenstrual Syndrome and Its Severity: The Role of Lifestyle Determinants

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## Abstract

**Background:** Women experience at least one of the Symptoms of Premenstrual Syndrome (PMS) during the menstrual cycle. The present study aimed to determine the factors that influence PMS occurrence and its severity in the medical students.

**Methods:** This cross-sectional study was carried out on 369 undergraduate female students of Maragheh University of Medical Sciences, Iran, between September 2021 and April 2022. The sampling method was random and participants were recruited through public announcements. The collected data included the provisional diagnosis of premenstrual syndrome, the Iranian version of Premenstrual Syndrome Screening Tool (PSST), the International Physical Activity Questionnaire (IPAQ), Food Frequency Questionnaire (FFQ), and the self-reported measurement of weight and height. All data and questionnaires were designed and then completed online by participants. The multivariable logistic regression analysis determined the potential predictors of PMS, and p-values less than 0.05 were considered significant.

**Results:** About 70% of participants had PMS. According to the PSST, 69% of them were positive in terms of the severity of PMS. There was a significant correlation between PMS and the severity of PMS symptoms ($p<0.001$), BMI ($p=0.031$), and dietary fat ($p=0.013$). The odds ratio for PMS, BMI, and dietary fat was 10.314, 1.073, and 1.008, respectively.

**Conclusion:** The present study demonstrated that among lifestyle factors, dietary fat and BMI play a significant role in premenstrual syndrome. Future studies are needed to identify other factors influencing its occurrence and to propose approaches for improving the quality of life of female medical students during their lifespan.

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## Introduction

Premenstrual syndrome (PMS) is a psycho-neuro-endocrine disorder associated with physical, mental, and behavioral symptoms. PMS appears during the luteal phase as the second half of the menstrual cycle and resolves during the follicular phase a few days after menstruation begins (1, 2). Based on the American College of Obstetricians and Gynecologists (ACOG), suffering from at least one physical and emotional symptom about 5 days before the onset of menstruation in each of three previous menstrual cycles is defined as PMS (3). According to a systematic review and meta-analysis, the prevalence of PMS in Iranian reproductive-age women was

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70.8% and in subgroups analysis, the prevalence was 68.9% in university students (4). This rate in Iranian adolescents and young girls was reported in the range of 16 to 78.4% (5). Most women experience at least one of the symptoms of this syndrome during their menstrual cycle (6).

Breast tenderness, headache, fatigue, tension and anxiety, anger or idiopathic irritability, depression, sleep disorders, edema of the extremities, changes in sexual desire, lack of energy, appetite changes, aggressiveness, and suicidal tendencies are the most prevalent emotional and physical symptoms of PMS (7). Women with PMS may experience serious chronic problems in the future such as cardiovascular diseases, osteoporosis, infertility, and type 2 diabetes (8).

Due to the complexity and multifactorial properties of PMS, various theories are raised regarding its etiology. The imbalance in the homeostasis of estrogen and progesterone, the effect of progesterone on the circulatory neurotransmitters such as GABA, serotonin, opioids, catecholamine, increased concentration of prostaglandin and prolactin, aldosterone, hypoglycemia, insulin resistance, nutritional deficiencies, alternation of glucose metabolism, disturbance of fluid and electrolytes balance, altered function of the hypothalamic-pituitary-adrenal axis, and psychological factors are considered the most important causes of this syndrome (9, 10).

Due to the limited usefulness of pharmaceutical interventions for PMS, there is a crucial need to recognize modifiable risk factors. Excess body weight and obesity may play a vital role in the etiology of menstrual problems. Increasing the intake of calories from nutrients, especially fats and carbohydrates, worsens the premenstrual syndrome symptoms (11, 12). Increasing adipose tissue due to weight gain disrupts the homeostasis of steroid hormones such as sex hormone-binding globulin (SHBG), androgens, and estrogen (6, 13). Estrogen production which is involved in body weight and fat content is influenced by obesity. Different lipid molecules stored in the adipose tissue metabolize steroids such as androgens (14). The results of studies about the interaction between obesity and PMS were inconsistent. According to Amiri et al.'s study, female students with BMI >25 $kg/m^2$ had a 3.5 times higher chance of having PMS compared with groups with BMI <25 $kg/m^2$ (2). In contrast, Kritz-Silverstein et al.'s study showed no statistically significant relationship between obesity and the prevalence of premenstrual syndrome (15).

Physical activity and exercise promote hormonal balance by various mechanisms and reduce the severity of premenstrual syndrome symptoms. Women who are more physically active usually complain less about the symptoms of this syndrome. Generally, aerobic exercises such as walking reduces tension, anger, depression, pain, and the severity of premenstrual syndrome (16). The results of studies on the effect of physical activity on the severity of premenstrual syndrome symptoms were inconsistent. Rezaei et al. investigated the effect of eight weeks of aerobic exercise on the concentration of sexual hormones and the symptoms of premenstrual syndrome, showing an improvement in the physical and psychological symptoms related to the premenstrual syndrome as well as a positive effect on the estrogen and progesterone balance (17). Najafi-Sharjabad et al. did not detect a significant relationship between physical activity and premenstrual syndrome in students (18). Sehati Shafaie and Zoodfekr also reported that in 360 athletes and non-athlete female students, there was no significant differences in terms of PMS, dysmenorrhea, and oligomenorrhea, although the role of physical activity in improving PMS symptoms was greater in athletes (19).

One of the main non-pharmacological treatment strategies for alleviating the syndrome's symptoms is a healthy diet (20). Eating a variety of fruits and vegetables in adequate amounts and avoiding the consumption of fast foods containing high levels of calories, salt, and sugar are considered healthy dietary habits (21, 22). Indeed, adherence to a healthy diet could alleviate the symptoms of premenstrual syndrome by regulating the secretion of neurotransmitters, balancing the menstrual cycle-related hormones, and providing essential vitamins. Taking dietary components such as plant seeds, grains, legumes, fruits, vegetables, and complex carbohydrates and reducing the consumption of salt, sugar, caffeine, and alcohol maintain hormonal homeostasis (23). In line with this hypothesis, Novak et al. reported that a high-protein and low-fat diet containing complex carbohydrates and reducing the consumption of caffeine and alcohol could relieve the symptoms of premenstrual syndrome in 49 women with MPS (24). In Murakami et al.'s survey, the carbohydrate intake in 604 women with PMS could effectively reduce the symptoms of PMS by enhancing the concentration of serotonin in the brain (25). In

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another study, it was reported that carbohydrate and fiber intake did not affect PMS occurrence (26). Premenstrual syndrome has detrimental effects on women's quality of life, emotions, and performance and can deprive women of obtaining the optimal efficiency in performing duties at home and society. This underscores the importance of further investigation on this disorder.

Considering the high prevalence of PMS in medical students and the lack of studies in the region, as well as inconsistent findings about the relationship between PMS and lifestyle factors, it was hypothesized that dietary components, physical activity levels, and anthropometric measurements, along with the severity of PMS, may independently influence the occurrence of PMS. Therefore, the present study aimed to determine the relationship between dietary habits, physical activity, anthropometric measurements, and severity of PMS in female students of Maragheh University of Medical Sciences.

## Methods

This analytical cross-sectional study was conducted on 369 undergraduate female students of Maragheh University of Medical Sciences in Maragheh city, Iran, between September 2021 and April 2022. The participants were undergraduate females studying medical sciences who were randomly recruited into the study.

The ethics committee of Maragheh University of Medical Sciences approved the protocol of the study (IR.MARAGHEHPHC.REC.1400.003). The research has followed the principles set out in the Helsinki Declaration of 1975. To protect privacy and confidentiality, an ID number was allocated to each person. After explaining the structure of the study, subjects were recruited into the study voluntarily and completed a consent form. The sampling method was random and participants were recruited through public announcements. The inclusion criteria were female students eager to participate in the study. The exclusion criteria include students with a menstrual cycle of fewer than 22 days or more than 35 days, taking any type of drug and hormone therapy to diminish PMS symptoms, married students, users of contraceptive agents, individuals taking sedatives, and those suffering from psychological illnesses and reproductive diseases. Additional exclusions were applied to students with systemic and physical diseases, those using alcohol or cigarettes, individuals on a weight loss diet, and those experiencing significant stress in the past three months. The collected data included the provisional diagnosis of premenstrual syndrome, the Iranian version of Premenstrual Syndrome Screening Tool (PSST), the International Physical Activity Questionnaire (IPAQ), Food Frequency Questionnaire (FFQ), and the self-reported measurement of weight and height. All data and questionnaires were designed and completed online by the study participants. The provisional diagnosis of premenstrual syndrome consists of 11 questions. Participants are considered positive for PMS if they answer affirmatively to at least five questions (symptoms) of 11 questions, with at least one of those positive responses originating from the first four symptoms (27).

The Iranian version of PSST consisting of 19 questions in two parts was used to assess the severity of PMS. The first part included 14 questions related to mood, physical and psychological symptoms, and the second part had five questions related to the effect of these symptoms on life situations. The scoring of the questionnaire was based on four distinct options; none, mild, moderate, and severe each assigned a numerical value ranging from zero to three for every question.The moderate or severe PMS was defined as meeting three criteria simultaneously: A) a moderate or severe response to at least the first four questions; B) in addition to criterion A, a minimum of four responses among the first 14 questions must be rated as moderate or severe; and C) at least one response from the last five questions must also be rated as moderate or severe (28). IPAQ, a short version of International Physical Activity Questionnaire,was used to determine the physical activity level (29). IPAQ categorizing was based on both frequency and duration. "Low activity" shows "one day a week or less" or "one hour a week or less". "Two to three days a week" or "two to three *hr* a week" represents "moderate activity" and "high activity" shows "four days a week or more" or "four *hr* a week or more".

FFQ contained 147 items designed to determine the dietary intake of participants, encompassing all food groups. In analyzing FFQ, the individuals' answers were converted into grams based on their weekly food consumption. The data regarding energy, macronutrients (carbohydrate, protein, and fat), and dietary fiber were extracted using the Nutritionist IV software (30). Previous studies confirmed the validity and reliability of the questionnaires (27, 31, 32). BMI was calculated based

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on the formula of weight ($kg$) and height ($m^2$). The heights and weights were recorded through self-reporting. The sample size was calculated using the primary variable from the survey conducted by Mohammadi et al. (6), which reported a severity of premenstrual syndrome at 71%. Considering a 95% confidence interval and a 10% margin of error, the final calculated sample size was 321 participants.

***Statistical analysis:*** The SPSS software version 21 (IBM, USA) was used to analyze and interpret data. The normal distribution of data was checked using the Kolmogorov-Smirnov and the Shapiro–Wilk tests. The quantitative data were reported as mean and standard deviation and qualitative data were reported as frequency and percentage. Independent-samples t-test or its non-parametric equivalent, the Mann-Whitney U-test, was used to investigate the difference between two groups (positive and negative premenstrual syndrome). The Chi-square test was used for qualitative variables. Multivariable logistic regression analysis using "best" subsets was used to determine the relationship between premenstrual syndrome and factors such as menstrual intensity, dietary habits, physical activity level, and anthropometric indices (33). Values less than 0.05 were considered significant.

## Results

The results showed that the mean (SD) age of female medical students in the positive premenstrual syndrome group was 21.97 (1.42) years and in the negative premenstrual syndrome group was 21.88 (1.13) years. There was no significant difference regarding the age between the groups. Participants' fields of study were food sciences, health, nutrition, nursing, midwifery, and laboratory sciences. There was no significant difference in terms of the participant's field of study. About 61% of participants in cases had a BMI between 18.5 and 25 $kg/m^2$, compared to 54% in the control group. Of 369 female students, 282 were suffering from premenstrual syndrome. Among the participants with positive premenstrual syndrome, 81% tested positive on screening and nearly 30% with negative premenstrual syndrome also tested positive. According to the results, 40% of students with positive premenstrual syndrome were inactive (Table 1). However, this rate in students with negative premenstrual syndrome was 33%. There was a significant statistical difference between premenstrual syndrome and the severity of premenstrual syndrome symptoms in the two groups ($p<0.001$).

**Table 1.** Demographic characteristics of the participants

| Total number of students (369) | | | |
|---|---|---|---|
| **Variables** | **Premenstrual syndrome** | | **p-value** * |
| | **Yes (n=282)** | **No (n=87)** | |
| Body mass index ($kg/m^2$) | | | |
| <18/5 | 36 (12.8) | 9 (10.3) | 0.828 |
| 18/5-25 | 172 (61.0) | 54 (62.1) | |
| >25 | 74 (26.2) | 24 (27.6) | |
| PSST | | | |
| Yes | 229 (81.2) | 26 (29.9) | <0.001 |
| No | 53 (18.8) | 61 (70.1) | |
| Physical activity level | | | |
| Low | 95 (33.8) | 34 (39.1) | 0.474 |
| Moderate | 73 (25.9) | 16 (18.4) | |
| High | 114 (40.3) | 37 (42.5) | |

Data are presented as frequency (percentage)
* Chi-square test, $p<0.05$ was defined as significant

The mean (SD) energy intake of the positive premenstrual syndrome group was 2330.05 (733.04) kcal, and this rate was 1974.11 (625.74) kcal in the negative premenstrual syndrome group. The mean (SD) of carbohydrate intake in the positive premenstrual syndrome group was 266.48 (82.91) grams, while the negative premenstrual syndrome group consumed carbohydrate as much as 242.49 (79.04) grams. There was a significant difference in energy, carbohydrate, and fat variables between the two groups. Table 2 shows the results of the dietary intake of the subjects who participated in the study.

Based on the multivariable logistic regression analysis results, there was a significant relationship between premenstrual syndrome with the severity of PMS, BMI, and dietary fat. According to the results, the chance of PMS occurrence in positive PSST females was nearly ten times more than in females with negative PSST ($p<0.001$). One unit increase in BMI enhances the occurrence of PPST by 7% ($p=0.031$) and one gram change in fat intake increases the likelihood of PPST by about 1% ($p=0.013$). Table 3 shows the results of logistic regression analysis related to various factors that influenced premenstrual syndrome appearance.

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**Table 2.** Nutrition status of the participants in the study

| Total number of students=369 | | | |
|---|---|---|---|
| **Variables** | **Premenstrual syndrome** | | **p-value** |
| | **Yes (n=282)** | **No (n=87)** | |
| Energy (kcal) * | 2330.05 (733.04) | 1947.11 (625.74) | <0.001 |
| Protein (*gr*) ** | 78.84 (57.33-105.13) | 74.85 (60.46-101.72) | 0.743 |
| Carbohydrates (*gr*) * | 266.48 (82.91) | 242.49 (7.04) | 0.016 |
| Fat (*gr*) ** | 53.59 (38.18-92.87) | 51.94 (33.35-66.00) | 0.016 |
| Fiber (*gr*) ** | 52.65 (33.98-87.79) | 61.36 (36.84-85.62) | 0.364 |

* Data are presented as mean (SD). Independent-samples t-test
** Data is presented as median (25-75 percentile). Mann-Whitney U-test
p<0.05 was defined as significant

**Table 3.** Results of logistic regression for factors influencing PMS incidence in female students

| Total number of students=396 | | | |
|---|---|---|---|
| **Variables** | **OR** | **p-value** | **95%CI (lower to upper)** |
| PSST | 10.314 | <0.001 * | (5.759 to 18.473) |
| Energy (kcal) | 1.703 | 0.001 * | (1.245 to 2.332) |
| Fiber (*gr*) | 0.705 | 0.023 * | (0.521 to 0.953) |

OR: Odds ratio. Variables entered in the model: PSST, energy, carbohydrate, fat, fiber, and BMI
* p<0.05 was defined as significant

## Discussion

The present study investigated the relationship between the severity of premenstrual syndrome, dietary habits, physical activity, and anthropometric measurements with the occurrence of premenstrual syndrome among participants recruited from Maragheh University of Medical Sciences in Iran. According to the results, about 70% had premenstrual syndrome, and there was a significant relationship between premenstrual syndrome and its severity, BMI, and dietary fat. Previous studies about premenstrual syndrome prevalence have considered different factors. In line with the present study, Cross et al. showed that of 144 overweight women, almost 60% had premenstrual syndrome. A significant relationship was detected between premenstrual syndrome and fat intake (p<0.05), and simple sugar intake (p<0.001). The dietary protein intake was significantly less in positive premenstrual syndrome participants (p< 0.001) (11). Hasanpoor-Azghady et al. conducted a study on 500 students living in the dormitory and the results showed nine individuals experienced premenstrual syndrome with moderate symptoms. Among the participants, 47 students had a BMI greater than 25 $kg/m^2$. In this study, there was a significant positive relationship between BMI and the risk of premenstrual syndrome (2.43 times) (34). Mohammadi et al. conducted a study on 365 students which revealed that 30% of the participants had moderate to severe premenstrual syndrome, while 40% were mildly affected. There was a significant relationship between waist circumference, waist-to-hip circumference ratio, and waist circumference to height with PMS. On the contrary, no significant relationship was observed between the variables with menstrual intensity (6). Hannani et al. surveyed 112 operating room technologists and the results showed that 57.1% of the participants had moderate or severe premenstrual syndrome. There was a significant correlation between premenstrual syndrome with the type of exercise (p=0.027) as well as occupational factors (p=0.005). However, no meaningful relationship was detected between BMI, training, and regular exercise with premenstrual syndrome (35).

In Cheng et al.'s study, the results showed that nearly 40% of 1699 participating students in the study were categorized in the PMS group. There was a significant positive relationship between consuming foods containing egg yolk, alcohol consumption, poor sleep quality, mental illnesses, family history of dyslipidemia, and high blood cholesterol (36).

One of the leading causes of high BMI in people with premenstrual syndrome is the reduction of serotonin levels in the brain during the premenstrual period. Serotonin, as a neurotransmitter, is effective in regulating mood and appetite (27). High energy intake, especially from carbohydrates could involve the production of serotonin in the brain by increasing the ratio of tryptophan to large amino acids. Tryptophan, a precursor of serotonin

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in the brain competes with large amino acids to cross the blood-brain barrier, enter the brain, and increase serotonin production (37). According to the Association of Reproductive Health Professionals (ARHP) and the American College of Obstetricians and Gynecologists (ACOG), taking small portions of complex carbohydrates improves the incidence and severity of PMS because of high fiber content and low levels of simple sugar (26, 38). Other nutritional factors affecting the occurrence of premenstrual syndrome are high-fat, salty, and caffeine-containing foods with low fiber content (39). Similar to our study, this type of dietary pattern aggravates the symptoms of premenstrual syndrome by disrupting the hormonal balance and increasing the estrogen level (40).

Sex hormone disorders are mentioned as causes of PMS. In premenstrual syndrome women, an increase in the ratio of estrogen to progesterone has been reported. One of the functions of adipose tissue is converting androgens into estrogens. High fat mass, especially abdominal fat, is related to hyperandrogenism and hyperinsulinemia (41, 42). Overweight and obese people due to a high level of subcutaneous fat have a high concentration of estrogen (35). However, obese and overweight women have a reduced ability to bind estrogen to sex hormone binding globulin, leading to increased production of inactive estrogen and ultimately resulting in elevated serum-free estradiol levels (43).

Lifestyle modifications such as maintaining optimal BMI, adherence to healthy dietary habits, regular physical activity, and healthy food intake could improve PMS manifestations. To the best of our knowledge, this study was carried out for the first time among female students of Maragheh City. The simultaneous effects of various lifestyle factors including physical activity, dietary habits, and anthropometric indices on the occurrence of PMS and its severity can be considered the main strength of the study. However, the study had some limitations. Confining data gathering to undergraduate students and lack of direct measurements of weights and heights were considered the main limitations. Future studies are needed to determine other factors affecting the occurrence of premenstrual syndrome and its severity.

## Conclusion

This study, which was done on 369 undergraduate female students, showed a significant correlation between PPST and PMS. Among lifestyle factors, dietary fat and BMI had a substantial role in premenstrual syndrome incidence. Considering that social, cultural, and environmental factors along with heredity can be influential in the occurrence of PMS (44), it is suggested to conduct future studies to identify other causes besides the factors investigated in this study influencing the syndrome. By identifying these factors, practical approaches should be taken to manage the complications associated with this syndrome and improve women's quality of life.

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## Conflict of Interest

Authors declare that there is no conflict of interest.

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