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Physical, Psychological, and Behavioral Symptoms of Premenstrual Syndrome in Relation to Body Size and Shape

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ABSTRACT

Introduction: This study aimed to evaluate potential relationships between the frequency of physical, and psychological or behavioral symptoms of premenstrual syndrome (PMS) in relation to body mass index (BMI) and body shapes in young women.

Methods: In total, 22 of the most common PMS symptoms were assessed using a questionnaire, as well as self-reported height, weight, and body shape (using five silhouette types). A total of 6697 women aged 18–30 was included in the final statistical analysis. Symptom frequencies were measured using a 5-point Likert scale, and the mean frequency of occurrence (MFO) was calculated for all symptoms. Statistical analyses included analysis of variance (ANOVA), univariate logistic regression, and stepwise regression.

Results: PMS symptom prevalence ranged from 61.0% to 97.2%. Overall, MFO of all physical PMS symptoms ($M \pm SD = 3.12 \pm 0.75$) was lower than the MFO of all psychological and behavioral symptoms ($M \pm SD = 3.29 \pm 0.96$; $p < 0.001$). Women with overweight or obesity, also those with an apple-shaped body, reported the highest symptom frequencies (MFO = 3.20–3.35), while underweight and rectangular-shaped women had the lowest MFO (2.98–3.25; $p < 0.001$). Stepwise analysis showed BMI and body shape were more strongly associated with physical symptoms than psychological or behavioral ones.

Conclusions: These results highlight the importance of body size and shape in understanding individual differences in PMS symptoms, suggesting that higher BMI and an apple-shaped body are more associated with PMS symptoms. Therefore, special attention should be paid to women with this body type, and they should be examined more thoroughly in order to take preventive measures in a timely manner.

1 | Introduction

Premenstrual disorders are generally assumed to be a group of physical, psychological, and behavioral symptoms that occur or intensify during the luteal phase of the menstrual cycle and resolve spontaneously within a few days of the onset of menstruation (Qiao et al. 2012; Ryu and Kim 2015; Walsh et al. 2015). In recent decades, focus has been on establishing diagnostic criteria that are crucial for distinguishing between normal, relatively mild premenstrual symptoms and more severe manifestations

Abbreviations: ACOG, American College of Obstetricians and Gynecologists; BDNF, Brain-derived neurotrophic factor; BMI, Body mass index; DSM-V, American Psychiatric Association diagnostic criteria; MFO, Means frequency of occurrence; OR, Odds ratio; PMDD, Premenstrual dysphoric disorder; PMS, Premenstrual syndrome; RAAS, Renin-angiotensin-aldosterone system; WHO, World Health Organization.

such as premenstrual syndrome (PMS) and premenstrual dysphoric disorder (PMDD) (O'Brien et al. 2011). More than 300 symptoms of various origin have been reported to be associated with PMS. This multifaceted condition encompasses a spectrum of physical manifestations including but not limited to breast tenderness and swelling, abdominal bloating and severe pain, as well as fatigue, while behavioral alterations include mood swings, oversensitivity, irritability, and tension (stress) (American College of Obstetricians and Gynecologists 2016; American Psychiatric Association 2013; Ryu and Kim 2015). Due to the lack of precise, universally used classification and because of different interpretations of significant premenstrual symptoms, overall prevalence of PMS varies widely around the world (10%–99.5%) (Delara et al. 2013; Direkvand-Moghadam et al. 2014; Ezeh and Ezeh 2016). The etiology of PMS remains partly unknown, but a relationship with hormonal changes prior to the mid-luteal phase has been established (Dilbaz and Aksan 2021; Direkvand-Moghadam et al. 2014; Ryu and Kim 2015; Schmidt et al. 1991; Schmidt et al. 1998).

The severity of PMS is influenced by interactions between various genetic and lifestyle factors. Some studies have shown that women with a higher body mass index (BMI) or body fat percentage are more likely to experience more severe PMS symptoms, while others have shown the opposite (Bertone-Johnson et al. 2010; Farpour et al. 2023; Haghighi et al. 2015; Masho et al. 2005; Mizgier et al. 2019; Mohammadi et al. 2013; Mostafa et al. 2023; Shahrjooye Haghighi and Koushkie Jahromi 2019; Thakur et al. 2022). Low levels of serotonin before menstruation and a deficiency of its precursor (tryptophan) in the diet may cause symptoms of PMS (Lin et al. 2014; Menkes et al. 1994). Mood disorders and premenstrual dysphoric disorder are associated with brain-derived neurotrophic factor (BDNF), which demonstrates elevated levels in PMDD patients during the luteal phase (Martinowich and Lu 2008; Oral et al. 2015). The gut microbiota-brain axis is being investigated for its possible link to premenstrual symptoms as well (Takeda 2023; Takeda et al. 2022). Increased adiposity may be linked to PMS through its effects on vitamin D levels and the renin-angiotensin-aldosterone system (RAAS), which could result in symptoms of fluid retention (Bertone-Johnson et al. 2010; Rahmouni et al. 2005).

It is known that BMI deviations are themselves associated with various health risks, but the topography of body fat is also very important, especially, which can be attributed to the opposite biological sex, for example, in women—central (on the trunk) and visceral fat accumulation are often associated with different health risks (Dang et al. 2022; Després et al. 2008; Farpour et al. 2023). Thus, it would be worth investigating whether PMS symptoms are related not only to BMI, but also to body shapes, which usually reflect the topography of adipose tissue. However, there is a lack of data on the relationship between body shape and PMS severity. In several previous studies, a correlation has been established between waist circumference and certain PMS symptoms, particularly, food cravings (Dang et al. 2022), also between abdominal fat and severity of PMS symptoms (Bertone-Johnson et al. 2010; Farpour et al. 2023). This suggests a potential accumulation of visceral fat, which is commonly linked with an apple-shaped physique. Establishing such connections would help to foresee potential health risks, predicting whether body shape is an independent factor associated with PMS, or simply dependent, possibly related to other diseases that can cause the manifestation of PMS symptoms. However, no work linking a woman's overall body shape to the frequency and severity of PMS symptoms was found. This study hypothesizes that a woman's BMI and body shape are significantly associated with the frequency and type of PMS symptoms—physical, psychological, and behavioral. Specifically, it is expected that certain body size and shape profiles are more likely to be linked with more frequent or severe PMS symptoms.

The aim of this study was to evaluate the potential relationship between the frequency of physical, psychological, and behavioral PMS symptoms and a woman's BMI, as well as her body shape. To address this aim and test the hypothesis, the following tasks were formulated: (1) to determine the general body size and shape of young women, and assess the prevalence and frequency of various PMS symptoms; (2) to examine the relationship between different categories of PMS symptom frequency and body size, also shape characteristics; (3) to calculate the odds ratios for experiencing different PMS symptoms based on body size and shape; (4) to identify complex associations between clusters of PMS symptoms and body size, also shape using multivariate analysis.

2 | Materials and Methods

The cross-sectional study was conducted in April 2019 (before the start of the COVID-19 pandemic). Data were collected using an anonymous questionnaire using the snowball method on online social media platforms (Facebook and Instagram), with no restrictions placed on participants' geographic location or age range. The survey was conducted in Lithuania and hosted on *Google Forms*. Participants provided informed consent electronically by clicking the "Go to Survey" button on the initial page before proceeding to the questionnaire.

In total, more than 10000 women answered the questionnaire during the allotted time (April 2019). The criteria for inclusion in the present study were: to be between 18 and 30 years old, to fill out the entire questionnaire, and not to use contraceptives at the time of filling out the questionnaire. The exclusion criteria were: incomplete questionnaire, not meeting age criteria and the use of contraceptives. After excluding, women who did not meet the inclusion criteria, 6697 women (65.8%) were included in the final analysis.

Several validated questionnaires are utilized for diagnosing PMS or PMDD. Therefore, a comprehensive literature review was conducted, and the most frequently reported symptoms (recommended in various literature sources) were incorporated into the original survey.

Different questionnaires assessing premenstrual disorders use slightly different sets of premenstrual period related symptoms. On the one hand, the criteria of American College of Obstetricians and Gynecologists (ACOG) are more lenient, since even one symptom of unspecified severity present during the 5 days before menses may indicate a PMS (Mohammadi et al. 2013). However, current American Psychiatric Association

TABLE 1 | Most common physical, also psychological and behavioral symptoms measured using a 5-point Likert scale.

How often before every menstrual period you experience these physical symptoms?	Occurrence rate	How often before every menstrual period you experience these psychological and behavioral symptoms?	Occurrence rate
1. Breast tenderness and swelling	1, 2, 3, 4, 5	1. Confusion	1, 2, 3, 4, 5
2. Abdominal bloating	1, 2, 3, 4, 5	2. Anger	1, 2, 3, 4, 5
3. Weight gain	1, 2, 3, 4, 5	3. Mood swings	1, 2, 3, 4, 5
4. Headache	1, 2, 3, 4, 5	4. Helplessness	1, 2, 3, 4, 5
5. Fatigue	1, 2, 3, 4, 5	5. Restlessness	1, 2, 3, 4, 5
6. Heart palpitations	1, 2, 3, 4, 5	6. Lack of self-control	1, 2, 3, 4, 5
7. Severe abdominal pain	1, 2, 3, 4, 5	7. Oversensitivity	1, 2, 3, 4, 5
8. Increased appetite	1, 2, 3, 4, 5	8. Irritability	1, 2, 3, 4, 5
9. Specific food craving (sugar, salt)	1, 2, 3, 4, 5	9. Tension (stress)	1, 2, 3, 4, 5
10. Muscle and joint pain	1, 2, 3, 4, 5	10. Forgetfulness	1, 2, 3, 4, 5
11. Sleep changes (insomnia, hypersomnia)	1, 2, 3, 4, 5	11. Sadness	1, 2, 3, 4, 5

Note: 1—"symptom never occurred"; 2—"rarely occurred"; 3—"sometimes occurred"; 4—"often occurred"; 5—"always occurred."

diagnostic criteria (DSM-V) for PMDD require that at least five of the 11 specified symptoms (including one major mood symptom) be present only during the luteal phase and disappear during menstruation and have a significant impact on work, family and social relationships (American Psychiatric Association 2013).

Such variability led to the decision to create an original questionnaire which included PMS symptoms most common in women and most frequently discussed in clinical practice, also in scientific articles (Freeman et al. 2011; Hofmeister and Bodden 2016; Padmavathi et al. 2014) (Table 1): A total of 11 physical symptoms (physical symptom group) as well as 11 psychological and behavioral symptoms (psychological and behavioral symptom group). Participants were asked to rate on a 5-point Likert scale (1—never, 2—rarely, 3—sometimes, 4—often, 5—always) how often they experienced a suggested physical as well as psychological and behavioral symptom before each menstrual period.

In addition, the original questionnaire included questions about height, weight, and body shape. There were more questions, but they were not included in this study and are analyzed in other studies (questions related to education, professional status, contraceptive use, social media, smoking, alcohol use, physical activity, and sleep). In order to more accurately determine the body shape (figure), pictures (silhouettes) representing five female body types (rectangular, inverted triangle, pear, hourglass, apple) were presented (Sizecharter 2017) and women could choose the silhouette most similar to their figure.

All questions were presented in a clear and straightforward manner using explanations or illustrations (for body shapes). Validation of the primary questionnaire was carried out. The initial questionnaire was evaluated by three experts, all of whom were physicians specializing in women's health. A pilot survey was subsequently conducted online with a limited sample of participants ($n = 100$) under identical age and inclusion criteria as the main study. A principal components analysis was then performed and a four-factor solution was found (labeled Psychological PMS Symptoms, Physical PMS Symptoms, Digestive and Gastrointestinal Symptoms, and PMS-Related Pain). Factors including physical symptoms of PMS, also digestive and gastrointestinal symptoms, and PMS-related pain were combined into one because they were essentially all physical symptoms of PMS. Then internal consistency of questions was checked. A Cronbach's alpha of 0.78 for physical symptoms and 0.92 for psychological symptoms indicated good reliability. Thus, the questionnaire was found to be valid and reliable to measure PMS related symptoms.

Height and weight data were self-reported, BMI was calculated and categorized according to WHO recommendations as follows (World Health Organization 2023):

< 18.5	=	Underweight
$18.5 - 24.9$	=	Normal weight
$25.0 - 29.9$	=	Pre-obesity (Overweight)
> 30.0	=	Obesity (OB)

Statistical analysis was carried out using IBM SPSS 28.0 software. Quantitative variables (BMI, body shape) were described using numbers and percentage, while qualitative variables (PMS-related symptoms) were presented as frequencies, means and standard deviations. For each of the 22 PMS symptoms, the mean frequency of occurrence (MFO) was calculated across all participants. Furthermore, for each woman, the total mean frequency score of all PMS symptoms was calculated, along with mean scores for physical PMS symptoms, as well as psychological and behavioral PMS symptoms. One-way ANOVA was used to examine differences in mean frequency scores of physical, as well as psychological and behavioral PMS

TABLE 2 | General characteristics of the studied women.

BMI category	*n* (%)	Body shape	*n* (%)
Underweight	603 (9.0%)	Hourglass	2849 (42.5%)
Normal weight	4469 (66.7%)	Pear	1492 (22.3%)
Overweight	1125 (16.8%)	Rectangular	919 (13.7%)
Obesity	500 (7.5%)	Apple	881 (13.2%)
		Inverted triangle	556 (8.3%)

symptoms across groups categorized by BMI and body shape. Univariate logistic regression analysis was performed to evaluate the association between BMI and body shape with the likelihood of experiencing physical, as well as psychological and behavioral PMS symptoms. The dependent variables were BMI and body shape, which were transformed to dichotomous variables. Each BMI category was coded to have values: 1—has that BMI category (underweight, overweight, etc.), 0—does not have that BMI category. Body shape categories were coded in the same manner: 1—has that body shape (pear, rectangular, etc.), 0—does not have that body shape. Normal weight group served as the reference for BMI, and the hourglass shape for body shape. Also, stepwise linear regression analysis was conducted, where the outcome variables were physical PMS symptoms or psychological and behavioral PMS symptoms. No covariates were included. Statistical significance was set at $p < 0.05$.

Present study is part of research "Phenotypic variety of Lithuanian inhabitants, its prenatal and postnatal factors in a changing environment" which was approved by Lithuanian Bioethical Committee (updated: 06/02/2017, No. 6B-17-21) and was performed in accordance with the Declaration of Helsinki.

3 | Results

3.1 | General Body Size and Shape, Prevalence and Frequency of Different PMS Symptoms in Young Women

The average height of participants in the study was 168.38 ± 6.18 (min–max = 135–197) cm, average weight—65.27 ± 13.21 (min–max = 38–147) kg, and average BMI—22.99 ± 4.32 (min–max = 14.20–57.13). Two-thirds of the women in this survey reported being of normal weight (66.7%); 9.0% were underweight, and 7.5% were obese (Table 2). The most common body shapes were hourglass and pear (42.5% and 22.3%, respectively), the least common (8.3%)—inverted triangle.

Physical symptoms of PMS were less likely to be reported in comparison to psychological and behavioral symptoms (Table 3). The prevalence of all symptoms assessed ranged from 61% to 97.2%. Irritability and mood swings were the most common psychological and behavioral symptoms of PMS, with prevalence rates of 97.2% and 96.5%, respectively, whereas, fatigue—the most common physical PMS symptom (93.8%). Muscle and joint pain, heart palpitations and confusion were the least commonly reported symptoms occurring during PMS in this study (61.0%–65.0%) (Table 3).

Overall (Table 3) mean frequency of all PMS symptoms for all women studied was 3.21 ± 0.78. Mean frequency of occurrence (MFO) of physical PMS symptoms (M ± SD = 3.12 ± 0.75) was lower than the MFO of psychological and behavioral symptoms (M ± SD = 3.29 ± 0.96; $p < 0.001$), among which mood swings (M ± SD = 4.12 ± 1.09) and irritability (M ± SD = 4.04 ± 1.05) had the highest MFO ($p < 0.001$).

3.2 | Association Between Different PMS Symptom Frequency, Body Size and Shape Categories

Based on the results of ANOVA test, it was found that obese women (3.21) and overweight women (3.2) had the highest average score of physical symptoms, while underweight women (2.98) had the lowest average score of physical symptoms ($p < 0.001$). Likewise, obese women (3.34) and overweight women (3.32) had the highest average score of psychological and behavioral PMS symptoms, while underweight women (3.23) had the lowest average score of psychological and behavioral symptoms (not significant) (Table 4).

ANOVA test showed that women with apple body shape (3.22) had the highest average score of physical symptoms, while those with rectangular body shape (2.98) had the lowest average score of physical symptoms ($p < 0.001$). Similarly, women with apple body shape (3.35) had the highest average score of psychological and behavioral PMS symptoms, while those with rectangular body shape (3.25) had the lowest average score of psychological and behavioral symptoms (not significant) (Table 4).

3.3 | Odds Ratio for Different PMS Symptoms According to Body Size and Shape

When comparing women in different weight categories to those of normal weight (reference group), higher BMI was associated with increased odds of approximately one-third of physical PMS symptoms. Among obese women, this included weight gain (OR = 1.80; $p < 0.001$), heart palpitations (OR = 1.44; $p < 0.001$), sleep changes (OR = 1.43; $p < 0.001$), and headache (OR = 1.29; $p < 0.01$). Similar odds were observed for overweight women when compared to the reference group. A similar pattern was observed for several psychological and behavioral PMS symptoms, with higher BMI associated with increased odds of these symptoms. Among obese women, forgetfulness (OR = 1.23; $p < 0.05$)

TABLE 3 | Prevalence of physical, psychological, and behavioral PMS symptoms by frequency of occurrence.

	How many women experienced the symptom		Prevalence of each PMS symptom of varying frequency: 1—"symptom never occurred"; 2—"rarely occurred"; 3—"sometimes occurred"; 4—"often occurred"; 5—"always occurred"					Mean frequency of occurrence (MFO) of each PMS symptom	
PMS symptom	***n***	**%**	**1 (%)**	**2 (%)**	**3 (%)**	**4 (%)**	**5 (%)**	**M**	**SD**
Irritability[a]	6510	97.2	2.8	6.3	16.8	31.7	42.3	4.04	1.05
Mood swings[a]	6465	96.5	3.5	6.0	14.6	26.5	49.4	4.12	1.09
Fatigue[b]	6281	93.8	6.2	12.2	26.2	27.7	27.6	3.58	1.19
Oversensitivity[a]	6190	92.4	7.6	8.5	19.2	25.9	38.8	3.80	1.25
Sadness[a]	6120	91.4	8.6	12.8	23.1	25.2	30.2	3.56	1.27
Tension (stress)[a]	6118	91.4	8.6	12.3	26.1	26.1	26.9	3.50	1.25
Severe abdominal pain[b]	6064	90.5	9.5	12.9	17.1	21.9	38.7	3.68	1.35
Increased appetite[b]	5993	89.5	10.5	9.8	19.8	23.9	36.0	3.65	1.33
Abdominal bloating[b]	5984	89.4	10.6	15.8	25.0	27.1	21.5	3.33	1.27
Breast tenderness and swelling[b]	5906	88.2	11.8	14.5	21.4	26.1	26.2	3.40	1.33
Anger[a]	5903	88.1	11.9	13.0	22.7	24.4	28.1	3.44	1.33
Sleep changes (insomnia/ hypersomnia)[b]	5603	83.7	16.3	13.9	22.2	21.7	25.9	3.27	1.40
Specific food craving (sugar/salt)[b]	5600	83.6	16.4	10.8	17.9	20.1	34.8	3.46	1.46
Restlessness[a]	5459	81.5	18.5	18.9	27.6	19.2	15.8	2.95	1.32
Forgetfulness[a]	5054	75.5	24.5	21.9	24.1	13.6	15.8	2.74	1.38
Lack of self-control[a]	5043	75.3	24.7	17.7	23.9	17.0	16.8	2.84	1.41
Weight gain[b]	4985	74.4	25.6	18.9	21.2	17.6	16.7	2.81	1.42
Helplessness[a]	4954	74.0	26.0	17.8	22.3	15.0	18.9	2.83	1.45
Headache[b]	4879	72.9	27.1	23.4	24.4	15.0	10.0	2.57	1.30
Confusion[a]	4351	65.0	35.0	22.7	22.4	9.2	10.6	2.38	1.33
Heart palpitations[b]	4269	63.7	36.3	24.6	22.3	10.8	6.1	2.26	1.22
Muscle and joint pain[b]	4087	61.0	39.0	20.1	20.4	10.5	10.0	2.32	1.35
Mean frequency of occurrence (MFO) of all (total) PMS symptoms								3.21	0.78
Mean frequency of occurrence (MFO) of physical PMS symptoms								3.12	0.75
Mean frequency of occurrence (MFO) of psychological and behavioral PMS symptoms								3.29	0.96

[a]Psychological or behavioral PMS symptom.
[b]Physical PMS symptom.

and mood swings (OR = 1.21; $p < 0.05$) were significantly more likely, whereas in overweight women, only forgetfulness showed a significant increase (OR = 1.15; $p < 0.05$) (Table 5). Conversely, several physical symptoms were less likely among underweight women when compared with women of normal weight: specific food craving (OR = 0.82; $p < 0.05$), abdominal bloating (OR = 0.80; $p < 0.01$), and increased appetite (OR = 0.58; $p < 0.001$) all decreased significantly with lower BMI. Likewise, underweight women were significantly less likely to experience anger (OR = 0.81; $p < 0.05$) compared to those of normal weight (Table 5).

Apple-shaped women (Table 6) were significantly more likely than hourglass-shaped women (reference group) to experience weight gain (OR = 1.86; $p < 0.001$). They also exhibited the highest odds to suffer from several psychological and behavioral symptoms, including irritability (OR = 1.24; $p < 0.01$), anger (OR = 1.21; $p < 0.05$), and restlessness (OR = 1.20; $p < 0.05$). With

TABLE 4 | Mean frequency of PMS symptoms in relation to BMI and body shape category.

Group of PMS symptoms	Body size or shape category	Mean frequency of PMS symptoms			Statistically significant p[a]	
		M	SD	*n*		
Mean scores of physical symptoms	Underweight	2.98	0.72	603	Underweight vs. normal weight	**<0.001**
					Underweight vs. overweight	**<0.001**
					Underweight vs. obesity	**<0.001**
	Normal weight	3.11	0.74	4469	Normal weight vs. overweight	**<0.01**
	Overweight	3.20	0.76	1125	Overweight vs. underweight	**<0.001**
					Overweight vs. normal weight	**<0.01**
	Obesity	3.21	0.77	500	Obesity vs. underweight	**<0.001**
	Rectangular	2.98	0.74	919	Rectangular vs. pear	**<0.01**
					Rectangular vs. hourglass	**<0.001**
					Rectangular vs. apple	**<0.001**
	Inverted triangle	3.08	0.76	556	Inverted triangle vs. apple	**<0.01**
	Pear	3.10	0.73	1492	Pear vs. apple	**<0.01**
					Pear vs. rectangular	**<0.01**
	Hourglass	3.15	0.74	2849	Hourglass vs. rectangular	**<0.001**
	Apple	3.22	0.77	881	Apple vs. rectangular	**<0.001**
					Apple vs. inverted triangle	**<0.01**
Mean scores of psychological and behavioral symptoms	Underweight	3.23	0.92	603	Statistically insignificant	
	Normal weight	3.29	0.96	4469		
	Overweight	3.32	0.95	1125		
	Obesity	3.34	0.98	500		
	Rectangular	3.25	0.96	919	Statistically insignificant	
	Pear	3.27	0.94	1492		
	Hourglass	3.29	0.96	2849		
	Inverted triangle	3.31	0.96	556		
	Apple	3.35	0.99	881		

Note: Statistically significant values are in bold.
[a]Post hoc ANOVA tests were applied.

the exceptions of confusion (OR = 1.21; $p < 0.05$) among women with an inverted triangle figure and helplessness (OR = 1.24; $p < 0.01$) among rectangle-shaped women, other PMS symptoms—physical, psychological and behavioral—were less likely to be experienced by women of all shapes when compared with the reference group. Specifically, women with a rectangular figure were less likely to report 7 physical symptoms (weight gain (OR = 0.55; $p < 0.001$), heart palpitations (OR = 0.82; $p < 0.05$), headache (OR = 0.85; $p < 0.05$), breast tenderness and swelling (OR = 0.84; $p < 0.05$), fatigue (OR = 0.82; $p < 0.05$), specific food craving (OR = 0.81; $p < 0.01$), and increased appetite (OR = 0.72; $p < 0.001$)) and one psychological and behavioral symptom (mood swings (OR = 0.82; $p < 0.01$)) compared to hourglass-shaped women. Pear-shaped women were also less likely than the reference group to experience heart palpitations (OR = 0.87; $p < 0.05$), sleep changes (OR = 0.87; $p < 0.05$), and fatigue (OR = 0.83; $p < 0.01$) (Table 6).

3.4 | Complex Association of PMS Symptom Clusters With Body Size and Shape at the Multivariate Level

Starting with 4 BMI groups and five body shape categories as predictors of physical PMS symptoms, a stepwise regression model reduced them to 5, which were: rectangular shape,

TABLE 5 | Odds ratios of PMS symptoms in relation to BMI.

PMS symptom	Underweight[a]		Overweight[a]		Obesity[a]	
	OR (95% CI)	*p*	OR (95% CI)	*p*	OR (95% CI)	*p*
Physical symptoms of PMS[b]						
Weight gain	**0.29** (0.24–0.35)	**<0.001**	**1.79** (1.56–2.06)	**<0.001**	**1.80** (1.48–2.19)	**<0.001**
Heart palpitations	1.07 (0.90–1.27)	0.474	**1.24** (1.08–1.41)	**<0.01**	**1.44** (1.20–1.74)	**<0.001**
Sleep changes (insomnia/hypersomnia)	1.04 (0.88–1.23)	0.695	**1.28** (1.12–1.45)	**<0.001**	**1.43** (1.19–1.72)	**<0.001**
Headache	1.12 (0.95–1.33)	0.193	**1.14** (1.00–1.30)	**<0.05**	**1.29** (1.08–1.56)	**<0.01**
Specific food craving (sugar/salt)	**0.82** (0.69–0.97)	**<0.05**	1.08 (0.95–1.24)	0.240	0.93 (0.77–1.12)	0.449
Abdominal bloating	**0.80** (0.67–0.95)	**<0.01**	1.02 (0.90–1.16)	0.790	0.96 (0.80–1.16)	0.706
Breast tenderness and swelling	**0.79** (0.67–0.94)	**<0.01**	**0.74** (0.65–0.75)	**<0.001**	**0.61** (0.50–0.73)	**<0.001**
Increased appetite	**0.58** (0.48–0.68)	**<0.001**	1.07 (0.94–1.23)	0.305	1.13 (0.93–1.36)	0.246
Psychological and behavioral symptoms of PMS[b]						
Forgetfulness	0.95 (0.80–1.13)	0.602	**1.15** (1.01–1.31)	**<0.05**	**1.23** (1.02–1.48)	**<0.05**
Mood swings	0.92 (0.78–1.10)	0.363	1.08 (0.95–1.24)	0.230	**1.21** (1.00–1.45)	**<0.05**
Oversensitivity	0.91 (0.76–1.08)	0.274	**0.87** (0.76–0.99)	**<0.05**	0.92 (0.76–1.11)	0.373
Anger	**0.81** (0.68–0.96)	**<0.05**	1.12 (0.99–1.28)	0.088	0.97 (0.80–1.16)	0.706

[a]Reference group: Normal weight (BMI 18.5–24.9).
[b]Statistically significant values are in bold.

underweight, and normal weight as protectors from physical PMS symptoms, while apple and hourglass shape as risk factors. Likewise, for psychological and behavioral PMS symptoms, stepwise model reduced the aforementioned predictors to only one, which was apple shape as a risk factor for increased PMS symptoms (Table 7).

4 | Discussion

PMS symptoms depend on both internal and external factors (Bakhshani et al. 2013; Bertone-Johnson et al. 2008; Direkvand-Moghadam et al. 2014; Kwon et al. 2022; Rapkin and Akopians 2012). This study showed that prevalence of various PMS symptoms among participants ranged from 61% to 97.2%. This is in line with several other studies (Delara et al. 2013; Direkvand-Moghadam et al. 2014; Ezeh and Ezeh 2016). It was found that physical symptoms of PMS were less commonly reported than psychological and behavioral symptoms, and the Saudi Arabian study reported very similar results (Mostafa et al. 2023).

Body size and some indirect indicators of body shape have been linked to various PMS symptoms, however, findings across studies remain inconsistent, with some authors reporting significant associations and others observing no clear relationship (Mahishale and Mesquita 2019; Rad et al. 2018; Thakur et al. 2022). Our study examined the relationship between body size, body shape and physical, also psychological and behavioral symptoms of PMS in Lithuanian women aged 18–30: Women who were overweight and obese, also who had an apple-shaped figure were found to have the most frequent PMS symptoms. These findings are partially supported by studies in other populations (Bertone-Johnson et al. 2010; Haghighi et al. 2015; Masho et al. 2005; Mohammadi et al. 2013; Mostafa et al. 2023; Shahrjooye Haghighi and Koushkie Jahromi 2019; Thakur et al. 2022).

In this study, the likelihood of occurrence of almost all PMS symptoms examined increased with a higher BMI. In literature, higher BMI scores have also been associated with an increased risk of crying easily, mood changes or irritability, bloating, and food cravings (Bertone-Johnson et al. 2010). Higher levels of leptin, regulating gonadotropin secretion, may be observed in overweight/obese women. Adipose tissue is a source of estrogen and higher levels of estrogen have been associated with more severe PMS symptoms (Ismail and O'Brien 2005; Noviyanti et al. 2021; Schmidt et al. 1998). Another possible explanation for the link between body size and PMS symptoms is that adipose tissue produces pro-inflammatory cytokines (Bertone-Johnson et al. 2014; Kawai et al. 2021). On the other hand, studies found that women with a normal BMI were twice more likely to have PMS than overweight women (Shahrjooye Haghighi and Koushkie Jahromi 2019) or found no link between obesity and premenstrual symptoms at all (Kritz-Silverstein et al. 1999; Mizgier et al. 2019).

TABLE 6 | Odds ratios of PMS symptoms in relation to body shape.

PMS symptom	Pear[a]		Inverted triangle[a]		Rectangle[a]		Apple[a]	
	OR (95% CI)	*p*	OR (95% CI)	*p*	OR (95% CI)	*p*	OR (95% CI)	*p*
Physical symptoms of PMS[b]								
Weight gain	1.08 (0.95–1.23)	0.232	**0.54** (0.45–0.65)	**< 0.001**	**0.55** (0.47–0.63)	**< 0.001**	**1.86** (1.58–2.19)	**< 0.001**
Heart palpitations	**0.87** (0.77–0.99)	**< 0.05**	1.01 (0.84–1.22)	0.925	**0.82** (0.71–0.96)	**< 0.05**	1.14 (0.97–1.32)	0.108
Sleep changes (insomnia/ hypersomnia)	**0.87** (0.77–0.99)	**< 0.05**	0.95 (0.79–1.14)	0.610	0.89 (0.77–1.03)	0.129	1.12 (0.97–1.31)	0.133
Headache	0.89 (0.79–1.01)	0.079	0.95 (0.79–1.14)	0.578	**0.85** (0.73–0.98)	**< 0.05**	1.10 (0.94–1.28)	0.232
Breast tenderness and swelling	0.90 (0.79–1.01)	0.084	1.02 (0.85–1.23)	0.852	**0.84** (0.72–0.97)	**< 0.05**	**0.73** (0.63–0.85)	**< 0.001**
Fatigue	**0.83** (0.73–0.94)	**< 0.01**	0.99 (0.82–1.19)	0.888	**0.82** (0.71–0.95)	**< 0.05**	1.10 (0.94–1.28)	0.258
Specific food craving (sugar/ salt)	0.98 (0.86–1.11)	0.723	**0.83** (0.69–1.00)	**< 0.05**	**0.81** (0.70–0.94)	**< 0.01**	0.97 (0.84–1.13)	0.756
Increased appetite	0.96 (0.85–1.09)	0.577	**0.82** (0.69–0.99)	**< 0.05**	**0.72** (0.62–0.84)	**< 0.001**	1.02 (0.87–1.19)	0.812
Psychological and behavioral symptoms of PMS[b]								
Helplessness	1.05 (0.92–1.19)	0.500	1.15 (0.95–1.38)	0.161	**1.24** (1.06–1.44)	**< 0.01**	0.95 (0.82–1.11)	0.536
Irritability	1.01 (0.89–1.15)	0.897	0.98 (0.81–1.18)	0.851	0.87 (0.75–1.02)	0.083	**1.24** (1.07–1.45)	**< 0.01**
Confusion	0.99 (0.87–1.12)	0.820	**1.21** (1.01–1.45)	**< 0.05**	1.00 (0.86–1.17)	1.000	1.15 (0.98–1.33)	0.086
Anger	0.96 (0.85–1.09)	0.502	1.14 (0.95–1.37)	0.164	0.95 (0.82–1.10)	0.495	**1.21** (1.04–1.41)	**< 0.05**
Restlessness	0.92 (0.81–1.05)	0.236	1.05 (0.87–1.27)	0.631	0.93 (0.80–1.08)	0.368	**1.20** (1.02–1.40)	**< 0.05**
Mood swings	1.00 (0.88–1.13)	1.000	0.91 (0.75–1.09)	0.287	**0.82** (0.70–0.95)	**< 0.01**	1.06 (0.91–1.23)	0.488

[a]Reference group: Hourglass shape.
[b]Statistically significant values are in bold.

TABLE 7 | Stepwise linear regression analysis for PMS symptoms in relation to BMI groups and body shapes.

Dependent variable	Model	*B*[a]	*p*[a]	*F*[a]	*p*[a]	R^2
Physical PMS symptoms	Rectangular	**−0.089**	**< 0.01**	**14.39**	**< 0.001**	0.011
	Apple	**0.090**	**< 0.01**			
	Underweight	**−0.150**	**< 0.001**			
	Normal weight	**−0.058**	**< 0.01**			
	Hourglass	**0.053**	**< 0.01**			
Psychological and behavioral PMS symptoms	Apple	**0.072**	**< 0.05**	**4.36**	**< 0.05**	0.001

[a]Statistically significant values are in bold.

Unfortunately, we did not find any articles on the relationship between PMS and body shapes in the published literature. Therefore, data comparison was only possible through parallel studies, which indirectly support our findings. Hourglass and pear-shaped bodies are often associated with a lower risk of heart disease and diabetes, as they typically indicate a subcutaneous rather than visceral distribution of body fat (Després et al. 2008). This study showed that women with a pear-shaped body were less likely to experience physical symptoms of PMS than women with other body shapes.

Women with apple-shaped body carry excess weight around their midsection. This body type is associated with a higher risk of heart disease and diabetes (Emdin et al. 2017; Peters et al. 2018). Additionally, increased abdominal fat has recently been linked to psychological symptoms of PMS (Shahrjooye Haghighi and Koushkie Jahromi 2019). In our study, women with apple body shape were more likely than others to report physical PMS symptoms. They had a significantly higher chance to experience weight gain, abdominal bloating, headache, heart palpitations, sleep changes, fatigue, irritability, anger, restlessness, and forgetfulness. Few other studies have shown a relationship between the severity of certain PMS symptoms and waist circumference, as well as abdominal fat (Bertone-Johnson et al. 2010; Dang et al. 2022; Farpour et al. 2023), which indirectly confirms the results of our study. The most frequent PMS symptoms experienced by apple-shaped females may be related to an increase in adipose tissue in the central areas of the body and possibly relatively higher levels of androgens (Eriksson et al. 1992; Pasquali 2006).

In addition, an association between temporal vulnerability to an increased food-related behavior during PMS and waist circumference was also established, possibly due to decreased levels of amino acids and lipid species during the luteal phase. Food cravings and changes in appetite are essential symptoms of PMS, and it is likely that higher BMI may be a consequence rather than a contributor of premenstrual symptoms (Dang et al. 2022). In our study, an association between a higher BMI and higher likelihood of having specific food cravings was also found, meanwhile thin and rectangular women were less likely to have a PMS food craving symptom.

However, stepwise regression analysis showed that apple shape body figure was significantly associated more with physical symptoms at the multivariate level than with psychological and behavioral symptoms. No similar studies were found for comparison, but these results suggest that, in general, psychological and behavioral symptoms are likely to depend on more than just the phase of the menstrual cycle. In addition, it is not clear whether there are overlapping effects of the menstrual cycle symptoms on women's mental health (Handy et al. 2022). For example, nutrient supplementation, dietary habits, and physical activity can also have alleviating or exacerbating effects on menstrual cycle symptoms (Al Sabbah et al. 2024; Ghazzawi et al. 2023; Kang et al. 2011; Kawabe et al. 2022).

Furthermore, it is not entirely clear which psychological and behavioral symptoms of PMS are associated with neuroticism in general throughout the menstrual cycle (Hamidovic et al. 2022). It is also very important to mention that young women's mental health is interrelated with their body image, as well as with their actual body size and shape, regardless of the phase of their menstrual cycle: Dissatisfaction with being overweight may be associated with symptoms of a depressive disorder (Soares Filho et al. 2021); young women often have body dissatisfaction, which negatively affects their self-esteem and mental health (Sudhir and D'Cunha 2018). In order to find out which psychological and behavioral symptoms are more characteristic of PMS, it is necessary to study the relationship between the occurrence of these symptoms in different phases of the menstrual cycle (not only the luteal phase). It is also necessary to analyze the complex relationship between these symptoms and depressive disorder, self-esteem and body image which is also related to actual body size and shape.

This study has significant strengths. First, it includes almost 3% of women in Lithuania of the appropriate age (18–30 years), which strengthens the statistical power of the study and increases the statistical reliability of the analysis of complex associations between individual subgroups of women (by body size and body shape) in relation to different PMS symptoms. Furthermore, this study is the first of its kind in Northern Europe, filling a knowledge gap and making a substantial contribution to the field of women's health in this specific geographic context, laying the groundwork for future research in other regions. In addition, present analysis of a wide range of physical and psychological or behavioral PMS symptoms highlights the complexity of this syndrome and reveals the not entirely clear nature of the syndrome, especially when it comes to psychological symptoms. The application of multivariate statistical analyses showed slightly different links between body size and shape in relation to the occurrence of certain physical or psychological and behavioral PMS symptoms. This leads to the idea to continue investigations of psychological and behavioral symptoms, traditionally associated with PMS, at the other periods of the menstrual cycle, in order to clarify whether the occurrence of these symptoms depends more on the phase of the menstrual cycle, or whether other, more psychological factors of the personality are important.

Moreover, this study has valuable clinical implications. One of them is that a detailed analysis of the overall prevalence of PMS-related symptoms and the frequency of occurrence of each symptom can help health care providers to better understand the general structure of PMS. More frequent occurrence of psychological and behavioral than physical symptoms of PMS, as well as a stronger association of the group of physical than psychological symptoms with body size and shape suggests that family doctors and gynecologists should not attribute the occurrence of psychological symptoms to the menstrual cycle phase alone, but should consult with psychologists and even psychiatrists in order to uncover other reasons for such a high prevalence of psychological and behavioral PMS symptoms.

In addition, the study should encourage doctors to recommend lifestyle changes to patients in order to prevent PMS symptoms, as women who reported more frequent psychological and behavioral PMS symptoms were considered to have very frequent PMS. Likewise, a very important finding of this study—the association between apple-shaped figure and a stronger manifestation of PMS (especially physical symptoms)—may help to

predict a higher risk of PMS and to plan additional health examinations to rule out co-morbidities.

This study showed that the manifestation of PMS phenomenon is clearly underestimated not only in clinical practice, but also in general, on the scale of society. The results of the present study can also help female patients to better understand the nature of PMS phenomenon and seek targeted medical help not only because of poorer well-being in the premenstrual period. Therefore, in the future, after publication of the data in a scientific journal, the plan is to announce the results of this study to the general public through various means of communication (in medical institutions, also in the space of social networks).

The main limitation of this study may be related to the fact that in the preamble of the study it was expected that only relatively healthy women (with no history of chronic diseases) were to participate in the study and clearly indicate those diseases or the treatment applied. On the other hand, according to the data of Lithuanian Department of Statistics, it can be seen that young women of this age (about 18–30 years old) very rarely suffer from such diseases (only up to 3%), which could act as independent (confounding) factors, also related to the corresponding changes in the body shape (Statistics Lithuania 2023). Bearing in mind that about 10 000 women participated in this study (which is almost 3% of Lithuanian women of this age), the existence of the mentioned diseases (if they were present) should not have significantly distorted the main results. Of course, further sophisticated research linking cardiovascular disease, diabetes, dyslipidaemia (traditionally thought to have a strong association with the apple-shaped figure) and different body shapes, also the occurrence of PMS, would be very welcome. Another limitation of current study is that physical activity and diet can also have an effect on the occurrence of PMS symptoms, therefore, research examining the latter relationships would be most welcome and expected. Finally, because the population of this study was predominantly white, its findings may not be generalizable to women of other ethnicities, although it is unlikely that the physiologic relationship between obesity and PMS may differ significantly among populations.

5 | Conclusions

- The prevalence of various PMS symptoms ranged from more than half to nearly all women, and overall, physical PMS symptoms were even less common than psychological and behavioral symptoms. Family doctors, gynecologists, and other specialists should pay more attention to this phenomenon, and it needs to be talked about more broadly at the public level.
- Obese women, also those with an apple-shaped figure were more likely to have physical, also psychological, and behavioral symptoms of PMS: This should encourage doctors to recommend lifestyle changes to patients to prevent PMS symptoms as well. In addition, the association between an apple-shaped figure and more severe PMS symptoms may help predict a higher risk of this syndrome, also plan additional health checks to avoid co-morbidities such as the risk of cardiovascular disease, diabetes, dyslipidaemia and others that also change body shapes to an apple-type figure.
- The odds of having more severe most of PMS symptoms increased with increasing obesity as well as with an apple-shaped figure, however, multivariate analysis indicated that psychological and behavioral symptoms likely have other important causes as well. This highlights the complexity of PMS syndrome rather than its entirely clear nature, and suggests further research into the psychological and behavioral symptoms (traditionally associated with PMS) at other stages of the menstrual cycle to see if the occurrence of these symptoms is more dependent on the phase of the menstrual cycle or if other, more psychological personality factors, are important.

Author Contributions

J.T. and M.S. designed the study. G.S., M.S., and J.R. contributed to the data collection. J.T., R.S.-R., D.R., and S.G. conducted data analysis. J.T., M.S., and S.G. drafted the manuscript. All authors were involved in writing the manuscript, participated in data interpretation and critical review of the manuscript, and approved the final version. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

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The authors have nothing to report.

Ethics Statement

Present study is part of research "Phenotypic variety of Lithuanian inhabitants, its prenatal and postnatal factors in a changing environment" which was approved by Lithuanian Bioethical Committee (updated: 06/02/2017, No. 6B-17-21) and was performed in accordance with the Declaration of Helsinki.

Consent

The participants were informed on the first page of the survey about its' length, who the investigators were, the purpose, data collection methods, data usage, protection and anonymity of the study. Consent indicated after respondents clicked the "Go to Survey" button from *Google Forms* page, where the survey was hosted.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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