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Association of Nutritional Status and Anthropometric Indices with Menstrual Disorders among College Students: A Cross-Sectional Study in Paschim Midnapore District

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Abstract

Menstrual disorders are among the most prevalent reproductive health concerns in young women and are often influenced by nutritional status and anthropometric parameters. This study investigates the relationship between these factors and menstrual irregularities among college-going women in the Paschim Midnapore district.

A cross-sectional study was conducted among 95 female students aged 18–26 years. Anthropometric measurements—including body mass index (BMI), waist circumference (WC), waist-hip ratio (WHR), and body adiposity index (BAI)—were recorded using standardized protocols. Dietary intake and menstrual characteristics were assessed via structured questionnaires. Socioeconomic status was evaluated using the modified Kuppuswami scale. Statistical analysis was performed using ANOVA and linear regression.

Results indicated that 71.58% of participants reported dysmenorrhea, and 86.32% experienced at least one symptom of premenstrual syndrome (PMS). Obesity (BMI $\geq$ 25) and indicators of central adiposity were significantly associated with a higher prevalence of menstrual disorders ($p < 0.05$). Macronutrient intake—particularly dietary fat—was also statistically linked to menstrual irregularities. Additionally, WHR and waist circumference correlated with the severity of symptoms.

The findings underscore the significant influence of nutritional status and anthropometric indicators on menstrual health among young women. Targeted public health interventions focusing on balanced nutrition and healthy weight management are essential for promoting reproductive well-being.

Keywords: Menstrual disorders, Nutritional status, Body Mass Index (BMI), Polycystic Ovary Syndrome (PCOS), Anthropometry, Premenstrual Syndrome (PMS), Waist-Hip Ratio (WHR),Obesity, Reproductive health

1. Introduction

Menstrual disorders are common among adolescent and young adult women, often manifesting as dysmenorrhea, oligomenorrhea, menorrhagia, and premenstrual syndrome (PMS). These conditions can significantly affect physical, emotional, and reproductive health, frequently leading to a reduced quality of life, impaired academic performance, and increased psychological stress (1,2).

Among the underlying etiologies, Polycystic Ovary Syndrome (PCOS) is one of the most prevalent endocrinological disorders in women of reproductive age. It is clinically characterized by hyperandrogenism, ovulatory dysfunction, and polycystic ovarian morphology. Beyond reproductive implications, PCOS is increasingly recognized for its complex metabolic and psychological dimensions (3,4). Recent evidence suggests that insulin resistance and compensatory hyperinsulinemia are central to its pathogenesis, promoting excessive ovarian androgen production and contributing to menstrual irregularities (5,6).

Nutritional status and body composition are emerging as key modifiable determinants of menstrual health. Both undernutrition and obesity can disrupt the hypothalamic–pituitary–ovarian (HPO) axis, resulting in hormonal imbalances that affect menstrual cycle regularity (7,8). Anthropometric measures such as Body Mass Index (BMI), Waist-Hip Ratio (WHR), and skinfold thickness are commonly used to evaluate these associations. Notably, obesity—especially central adiposity—has been strongly correlated with increased risks of PCOS, infertility, and menstrual irregularities (9–11).

Despite extensive global research, regional data exploring the interrelationship between nutritional status, anthropometric parameters, and menstrual disorders in rural and semi-urban Indian populations remain scarce. Therefore, this cross-sectional study was undertaken among young female college students in the Paschim Midnapore district to examine the association between dietary intake, anthropometric indices, and menstrual characteristics and disorders.

2. Materials and Methods

2.1 Study Design and Participants

A cross-sectional study was conducted among 95 female college students aged 18–26 years from Paschim Midnapore district, West Bengal, India. Participants were recruited through voluntary response sampling from various health sciences departments. Inclusion criteria were: (a) age between 18 and 26 years, (b) history of menstruation for at least two years, and (c) willingness to provide informed consent. Exclusion criteria included current pregnancy or lactation, use of hormonal contraceptives or intrauterine devices, and a self-reported history of diabetes mellitus, thyroid dysfunction, cardiovascular disorders, or hysterectomy (1,2).

2.2 Ethical Considerations

The study protocol was approved by the institutional research ethics committee of Midnapore College (Autonomous). All participants provided written informed consent prior to participation. Anonymity and confidentiality were maintained throughout the study in accordance with the Declaration of Helsinki (12).

2.3 Data Collection Tools and Procedures

Anthropometric Measurements

Anthropometric assessments were conducted by trained personnel using standardized procedures (13). Height was measured using a wall-mounted stadiometer to the nearest 0.1 cm, and weight was recorded using a calibrated digital scale to the nearest 0.1 kg. Body Mass Index (BMI) was calculated as weight in kilograms divided by height in meters square. Waist and hip circumferences were measured using a non-stretchable tape and used to compute Waist-Hip Ratio (WHR). Additional measurements included wrist circumference, thigh circumference, and skinfold thickness (triceps, subscapular, and suprailiac), using Harpenden calipers. The Body Adiposity Index (BAI) was calculated using the formula:

BAI = [(Hip Circumference in cm) / (Height in m)^1.5] – 18 (14,15).

Dietary Assessment

Nutritional intake was assessed using a modified semi-quantitative Food Frequency Questionnaire (FFQ), adapted from a validated Iranian FFQ tool (16), and customized to reflect local dietary patterns. Trained dietitians recorded the frequency and portion size of food items consumed over the past year. Nutrient composition (energy, protein, carbohydrate, and fat intake) was estimated using Indian food composition tables and household measures (17).

Menstrual Health Assessment

Menstrual patterns were evaluated using a self-administered questionnaire covering age at menarche, cycle length, duration and flow of menstruation, dysmenorrhea, and symptoms of premenstrual syndrome (PMS). PMS was identified based on at least one of the following symptoms occurring 7–10 days before menstruation and resolving with its onset: mood changes, abdominal cramps, leg cramps, breast tenderness, and headache (18,19). Blood loss volume was estimated based on the number of sanitary pads used per day.

Socioeconomic Status

Socioeconomic status (SES) was determined using the Modified Kuppuswamy Scale, incorporating education, occupation of the family head, and monthly per capita income adjusted using the All India Consumer Price Index for Industrial Workers (20).

2.4 Statistical Analysis

Data were analyzed using SPSS version 21. Descriptive statistics were expressed as mean ± standard deviation (SD). Group comparisons were made using one-way ANOVA and chi-square tests. Pearson correlation and linear regression analyses were used to examine associations between anthropometric and dietary variables with menstrual disorders. A p-value < 0.05 was considered statistically significant (21).

3. Results

3.1 Participant Characteristics

A total of 95 female college students aged between 18 and 26 years (mean age: 21.64 ± 1.82 years) participated in the study. The mean height and weight of participants were 155.36 ± 5.82 cm and 52.12 ± 8.14 kg, respectively, with a mean BMI of 21.60 ± 3.25 kg/m². The average waist and hip circumferences were 80.56 ± 8.94 cm and 90.27 ± 7.65 cm, respectively. Most participants (60%) had a normal BMI, while 13.68% were underweight, 9.47% overweight, and 16.84% obese (Table 1, 3).

3.2 Socioeconomic Status

Based on the Modified Kuppuswamy Socioeconomic Scale, the majority of participants belonged to the middle class (65.26%), followed by the upper-middle class (29.47%) and upper-lower class (5.26%) (Table 2).

3.3 Menstrual Characteristics

3.3.1 Menstrual irregularities were prevalent among participants:

82.11% reported a menstrual cycle length of more than 28 days.16.84% experienced menstrual bleeding for more than 5 days.71.58% reported dysmenorrhea.86.32% experienced at least one symptom of premenstrual syndrome (PMS), with abdominal cramps (66.32%), leg cramps (58.95%), and rapid mood changes (51.58%) being the most common (Table 4).

3.3.2 Anthropometric and Nutritional Association with PMS:

Participants with at least one PMS symptom had slightly lower mean BMI (21.48 ± 3.08 kg/m²) and fat intake (55.65 ± 6.8 g) than those without PMS, and the difference in fat intake was statistically significant ($p < 0.05$) (Table 5). No significant differences were observed in carbohydrate or protein intake.

3.3.3 Association with BMI Classification

PMS was reported in 84.62% of underweight, 89.47% of normal BMI, and 80% of obese participants.Dysmenorrhea was most frequent in the normal BMI group (75.44%), followed by obese (64%) and underweight (69.23%).Heavier menstrual blood loss (>80 ml) was more common in overweight and obese participants (Table 6).

3.3.4 Association with Waist-Hip Ratio (WHR)

75.79% of participants had a moderate WHR risk (0.80–0.95), and 13.68% had a high-risk WHR (>0.95).PMS prevalence was highest among the moderate risk group (88.89%).Increased WHR was associated with longer cycles and greater blood loss, though the difference was not statistically significant ($p > 0.05$), except for low blood loss being significantly lower in moderate WHR ($p < 0.01$) (Table 7).

3.3.5 Association with Waist Circumference

63.16% had central obesity (WC ≥80 cm).Those with central obesity had a slightly higher prevalence of PMS (88.33%) and heavier menstrual bleeding (16.67%) compared to those with normal WC (Table 8).

3.3.6 Association with Socioeconomic Status

PMS symptoms were more common in upper-middle-class participants (92.86%) compared to middle-class (82.26%) and upper-lower-class (100%) groups.

Rapid mood changes were significantly more prevalent in the upper-middle-class group than in the middle class ($p < 0.01$) (Table 9).

Table 1: The physical characteristics of the participants (n = 95)

Variables	Mean±SD
Age (years)	21.64±1.82
Height (cm)	155.36±5.82
Weight (kg)	52.12±8.14
BMI (kg/m2)	21.60±3.25
Waist Circumference (cm)	80.56±8.94
Hip Circumference (cm)	90.27±7.65
WHR	0.89±0.07
WHtR	0.58±0.05
C-index	1.28±0.09
BAI	28.69±4.24
Thigh circumference (cm)	46.04±4.22
Triceps skinfold (mm)	6.68±3.15
Suprailiac skinfold(mm)	6.86±2.54
Subscapular skinfold(mm)	7.35±2.27
Carbohydrate (g)	161.68±17.80
Protein (g)	77.35±5.68
Fat (g)	56.21±6.75
Energy (kcal)	1462.02±108.73

Table 2: Socioeconomic status of the participants according to modified Kuppuswami Scale

Socioeconomic Status Class	Score	f (%)
Upper Class	>25	-
Upper Middle Class	16-25	28 (29.47)
Middle Class	11-15	62 (65.26)
Upper Lower Class	5-10	5 (5.26)
Lower Class	<5	-

Table 3: Frequency and percentage of participants of different obesity indicators (n = 95)

	Classification	f	%
BMI (kg/m^2)	Underweight : <18.5	13	13.68
	Normal : 18.5–22.9	57	60.0
	Overweight : 23–24.9	9	9.47
	Obese : ≥25	16	16.84
W/H ratio	Low risk : <0.8	10	10.53
	Moderate risk : 0.8-0.95	72	75.79
	High risk : >0.95	13	13.68
WC Classification	Normal : <80 cm	35	36.84
	Central obese : ≥80 cm	60	63.16

Table 4: Various menstrual disorders of the participants (n = 95)

Variables		f	%
Menstrual blood flow duration	3 - 5 days	79	83.16
	>5 days	16	16.84
Length of the menstrual cycle	≤ 28 days	17	17.89
	> 28 days	78	82.11
Amount of blood loss (ml)	< 70 ml	3	3.16
	70 – 80 ml	80	84.21
	> 80 ml	12	12.63
Dysmenorrhea	No	27	28.42
	Yes	68	71.58
Premenstrual syndrome (PMS)	With at least one disorder	82	86.32
	No	13	13.68
Premenstrual syndrome (PMS)	Abdominal cramps	63	66.32
	Depression	5	5.26
	Headache	17	17.89
	Leg cramps	56	58.95
	Rapid mood change	49	51.58
	Blotting/Swelling of the abdomen	3	3.16
	Painful / Tender breast	18	18.95

Table 5: Anthropometric indices and macronutrients intake in participants with or without menstrual disorders:

Variable	Premenstrual syndrome (PMS)	
	Without disorders (n = 13)	With at least one disorder (n = 82)
Age (years)	21.54±2.11	21.66±1.78
Height (cm)	155.35±5.71	155.36±5.87
Weight (kg)	53.92±10.11	51.84±7.82
BMI (kg/m2)	22.39±4.26	21.48±3.08
Waist Circumference (cm)	82.38±12.2	80.27±8.37
Hip Circumference (cm)	90.85±9.61	90.18±7.36
WHR	0.91±0.08	0.89±0.07
WHtR	0.59±0.06	0.58±0.05
C-index	1.28±0.1	1.28±0.09
BAI	28.97±5.08	28.65±4.13
Thigh circumference (cm)	46.46±5.56	45.98±4
Triceps skinfold (mm)	7.54±4.35	6.55±2.92
Suprailiac skinfold(mm)	7.38±3.07	6.78±2.45
Subscapular skinfold(mm)	7.62±2.9	7.3±2.18
Carbohydrate (g)	161.92±9.47	161.65±18.82
Protein (g)	77.31±4.39	77.35±5.88
Fat (g)	59.77±5.37	55.65±6.8*
Energy (kcal)	1494.85±77.61	1456.82±112.37

*$p < 0.05$

Table 6: Various menstrual disorders of the participants across BMI classification

Variable		Underweight (n = 13)	Normal (n = 57)	Obese (n = 25)
Menstrual blood flow duration	3 - 5 days	12 (92.31)	45 (78.95)	22 (88)
	>5 days	1 (7.69)	12 (21.05)	3 (12)
Length of the menstrual cycle	≤ 28 days	3 (23.08)	11 (19.30)	3 (12)
	> 28 days	10 (76.92)	46 (80.70)	22 (88)
Amount of blood loss (ml)	< 70 ml	1 (7.69)	0 (0.00)	2 (8)
	70 – 80 ml	12 (92.31)	49 (85.96)	19 (76)
	> 80 ml	0 (0.00)	8 (14.04)	4 (16)
Dysmenorrhea	No	4 (30.77)	14 (24.56)	9 (36)
	Yes	9 (69.23)	43 (75.44)	16 (64)
Premenstrual syndrome (PMS)	With at least one disorder	11 (84.62)	51 (89.47)	20 (80)
	No	2 (15.38)	6 (10.53)	5 (20)
Premenstrual syndrome (PMS)	Abdominal cramps	8 (61.54)	37 (64.91)	18 (72)
	Depression	1 (7.69)	3 (5.26)	1 (4)
	Headache	3 (23.08)	12 (21.05)	2 (8)
	Leg cramps	8 (61.54)	33 (57.89)	15 (60)
	Rapid mood change	7 (53.85)	29 (50.88)	13 (52)
	Blotting/Swelling of the abdomen	1 (7.69)	2 (3.51)	0 (0.00)
	Painful / Tender breast	3 (23.08)	11 (19.30)	4 (16)

Table 7: Various menstrual disorders of the participants across WHR classification

Variable		Low risk (n = 10)	Moderate risk (n = 72)	High risk (n = 13)
Menstrual blood flow duration	3 - 5 days	10 (100)	58 (80.56)	11 (84.62)
	>5 days	0 (0)	14 (19.44)	2 (15.38)
Length of the menstrual cycle	≤ 28 days	1 (10)	14 (19.44)	2 (15.38)
	> 28 days	9 (90)	58 (80.56)	11 (84.62)
Amount of blood loss (ml)	< 70 ml	2 (20)	1 (1.39)**	0 (0.00)
	70 – 80 ml	8 (80)	61 (84.72)	11 (84.62)
	> 80 ml	0 (0)	10 (13.89)	2 (15.38)
Dysmenorrhea	No	3 (30)	19 (26.39)	5 (38.46)
	Yes	7 (70)	53 (73.61)	8 (61.54)
Premenstrual syndrome (PMS)	With at least one disorder	8 (80)	64 (88.89)	10 (76.92)
	No	2 (20)	8 (11.11)	3 (23.08)
Premenstrual syndrome (PMS)	Abdominal cramps	7 (70)	47 (65.28)	9 (69.23)
	Depression	1 (10)	4 (5.56)	0 (0.00)
	Headache	3 (30)	13 (18.06)	1 (7.69)
	Leg cramps	5 (50)	43 (59.72)	8 (61.54)
	Rapid mood change	8 (80)	35 (48.61)	6 (46.15)
	Blotting/Swelling of the abdomen	1 (10)	2 (2.78)	0 (0.00)
	Painful / Tender breast	3 (30)	14 (19.44)	1 (7.69)

**p < 0.01

Table 8: Various menstrual disorders across of the participants Waist Circumference classification

Variable		Normal (n = 35)	Central obese (n = 60)
Menstrual blood flow duration	3 - 5 days	31 (88.57)	48 (80.00)
	>5 days	4 (11.43)	12 (20.00)
Length of the menstrual cycle	≤ 28 days	7 (20.00)	10 (16.67)
	> 28 days	28 (80.00)	50 (83.33)
Amount of blood loss (ml)	< 70 ml	1 (2.86)	2 (3.33)
	70 – 80 ml	32 (91.43)	48 (80.00)
	> 80 ml	2 (5.71)	10 (16.67)
Dysmenorrhea	No	11 (31.43)	16 (26.67)
	Yes	24 (68.57)	44 (73.33)
Premenstrual syndrome (PMS)	With at least one disorder	29 (82.86)	53 (88.33)
	No	6 (17.14)	7 (11.67)
Premenstrual syndrome (PMS)	Abdominal cramps	20 (57.14)	43 (71.67)
	Depression	3 (8.57)	2 (3.33)
	Headache	8 (22.86)	9 (15.00)
	Leg cramps	20 (57.14)	36 (60.00)
	Rapid mood change	18 (51.43)	31 (51.67)
	Blotting/Swelling of the abdomen	2 (5.71)	1 (1.67)
	Painful / Tender breast	6 (17.14)	12 (20.00)

Table 9: Various menstrual disorders of the participants across BMI classification

Variable		Upper Middle Class (n = 28)	Middle Class (n = 62)	Upper Lower Class (n = 5)
Menstrual blood flow duration	3 - 5 days	25 (89.29)	49 (79.03)	5 (100)
	>5 days	3 (10.71)	13 (20.97)	0 (0)
Length of the menstrual cycle	≤ 28 days	5 (17.86)	11 (17.74)	1 (20)
	> 28 days	23 (82.14)	51 (82.26)	4 (80)
Amount of blood loss (ml)	< 70 ml	3 (10.71)	0 (0.00)	0 (0)
	70 – 80 ml	22 (78.57)	53 (85.48)	5 (100)
	> 80 ml	3 (10.71)	9 (14.52)	0 (0)
Dysmenorrhea	No	4 (14.29)	20 (32.26)	3 (60)
	Yes	24 (85.71)	42 (67.74)	2 (40)
Premenstrual syndrome (PMS)	With at least one disorder	26 (92.86)	51 (82.26)	5 (100)
	No	2 (7.14)	11 (17.74)	0 (0)
Premenstrual syndrome (PMS)	Abdominal cramps	21 (75.00)	39 (62.90)	3 (60)
	Depression	3 (10.71)	2 (3.23)	0 (0)
	Headache	6 (21.43)	9 (14.52)	2 (40)
	Leg cramps	20 (71.43)	34 (54.84)	2 (40)
	Rapid mood change	21 (75.00)	25 (40.32)**	3 (60)
	Blotting/Swelling of the abdomen	1 (3.57)	1 (1.61)	1 (20)
	Painful / Tender breast	7 (25.00)	11 (17.74)	0 (0)

**$p < 0.01$

4. Discussion

This cross-sectional study investigated the associations between nutritional status, anthropometric indices, and menstrual disorders among young adult women in the Paschim Midnapore district. The results revealed a high prevalence of menstrual irregularities, particularly premenstrual syndrome (PMS) and dysmenorrhea, which were significantly associated with body composition indicators and dietary fat intake.

The overall prevalence of dysmenorrhea (71.58%) and PMS (86.32%) in this population aligns with findings from previous studies involving adolescent and young adult females both in India and globally (1,2). Abdominal cramps and leg pain were the most commonly reported symptoms of PMS, consistent with symptom patterns observed in similar demographic groups (22). These high prevalence rates may be influenced by factors such as academic stress, lack of awareness, and sedentary lifestyles.

A key finding was the statistically significant association between dietary fat intake and PMS. Participants reporting PMS symptoms had lower mean fat intake compared to asymptomatic individuals ($p < 0.05$). While this finding may appear counterintuitive, existing literature supports the notion that both excessive and insufficient dietary fat can impair prostaglandin synthesis and hormonal balance, thereby contributing to menstrual symptoms (23). Similar trends were reported by Indriasari et al., who found that deviations from recommended macronutrient intake were linked to menstrual irregularities in adolescent girls (24).

Anthropometric parameters, including BMI, waist circumference, and waist-hip ratio (WHR), were

significantly associated with the presence and severity of menstrual disorders. Obese participants (BMI ≥ 25) exhibited a higher prevalence of prolonged menstrual cycles, excessive menstrual bleeding, and intensified PMS symptoms. These observations are consistent with earlier research indicating that obesity contributes to hypothalamic-pituitary-ovarian (HPO) axis disruption and elevated levels of estrogen and androgens, leading to ovulatory dysfunction and menstrual irregularities (25). Carranza-Lira et al. similarly reported a positive correlation between higher BMI and increased menstrual blood loss (26).

Markers of central adiposity, such as waist circumference and WHR, followed patterns similar to BMI. Central obesity was associated with longer bleeding duration and increased PMS prevalence. These findings support the hypothesis that visceral adiposity contributes to insulin resistance, which can aggravate hyperandrogenism and menstrual disturbances, particularly among women with PCOS (27). Additionally, subcutaneous fat measures, including triceps and subscapular skinfold thickness, were higher in participants experiencing PMS, further underscoring the role of adiposity in menstrual dysfunction (28).

Interestingly, no statistically significant association was found between socioeconomic status (SES) and overall menstrual disorders, in line with findings by Patsa et al. (28). However, women from upper-middle-class backgrounds reported a higher incidence of rapid mood changes—an emotional symptom of PMS—which may reflect greater mental health awareness or potential reporting bias among individuals with higher SES and educational attainment.

Contrary to some earlier studies, this investigation did not identify significant associations between carbohydrate or protein intake and menstrual abnormalities. This discrepancy may result from methodological differences in dietary assessment, population-specific dietary habits, or limitations inherent to the localized Food Frequency Questionnaire (FFQ) used in this study (29).

Overall, the findings highlight the multifactorial nature of menstrual disorders and underscore the complex interplay between body composition, dietary habits, and menstrual health. While obesity remains a well-documented risk factor, the potential role of dietary components—particularly fat intake—warrants further investigation. Longitudinal and interventional studies are needed to better understand these relationships and inform targeted interventions aimed at improving menstrual and metabolic health in young women.

5. Conclusion

This study highlights a strong association between nutritional status, body composition, and menstrual disorders among young women. High prevalence of dysmenorrhea and premenstrual symptoms were observed, with significant correlations to anthropometric measures like BMI, waist circumference, and WHR. Fat intake also showed a notable link with menstrual disturbances. These findings underscore the importance of maintaining a healthy weight and balanced diet to promote menstrual and reproductive health. Targeted awareness programs and lifestyle interventions are essential to address modifiable risk factors and improve women's health outcomes.

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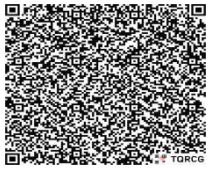	Website: www.ijcrims.com
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