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ORIGINAL ARTICLE

Association between Body Mass Index and Menstrual Disorders in Adolescent Girls: A Cross-Sectional Study

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ABSTRACT

Background: Menstrual disorders are common among adolescent girls and may significantly affect physical, psychological, and social well-being. Body Mass Index (BMI) has been identified as a potential modifiable risk factor influencing menstrual patterns; however, evidence among adolescents remains inconsistent. This study aimed to assess the prevalence of menstrual disorders and examine their association with BMI in adolescent girls.

Study Design: A Cross-Sectional study.

Place and Duration of the Study: The study was conducted at the Department of Obstetrics and Gynecology, Mardan Medical Complex, Mardan, over a period of six months, from January 2022 to June 2022.

Materials and Methods: Data were collected from 220 adolescent girls aged 10–19 years. Data were collected using a structured questionnaire covering sociodemographic characteristics, menstrual history, lifestyle factors, and family history. Height and weight were measured to calculate BMI, which was categorized as underweight, normal, overweight, and obese. Menstrual disorders included irregular cycles, abnormal cycle length, menorrhagia, dysmenorrhea, and premenstrual syndrome (PMS). Statistical analysis was performed using chi-square tests and multivariable logistic regression. Adjusted odds ratios (AORs) with 95% confidence intervals (CIs) were calculated, and $p < 0.05$ was considered statistically significant.

Results: The mean age of participants was 15.4 ± 2.1 years, and the mean BMI was 22.8 ± 4.1 kg/m². Overall, 50% of participants reported at least one menstrual disorder. Irregular cycles were observed in 38.6%, dysmenorrhea in 72.7% (moderate–severe: 39.1%), and menorrhagia in 20.5% of participants. Overweight (AOR = 2.15; 95% CI: 1.14–4.05; p = 0.018) and obese adolescents (AOR = 2.94; 95% CI: 1.18–7.32; p = 0.021) had significantly higher odds of menstrual disorders compared to those with normal BMI. Low physical activity (AOR = 1.92; p = 0.024) and positive family history (AOR = 2.36; p = 0.006) were also significant predictors.

Conclusion: Menstrual disorders are highly prevalent among adolescent girls and are significantly associated with higher BMI. Overweight and obesity increase the likelihood of menstrual irregularities and dysmenorrhea. Early screening, lifestyle modification, and weight management strategies may help reduce menstrual health problems in this population.

Keywords: Menstrual disorders, Body Mass Index, Adolescents, Dysmenorrhea, Menstrual irregularity, Cross-sectional study.

INTRODUCTION

Adolescence represents a critical transitional phase characterized by rapid physical, hormonal, and psychological changes. One of the most significant milestones during this period is the establishment of regular menstrual cycles following menarche. Although menstrual irregularities are common during early adolescence due to immaturity of the hypothalamic–pituitary–ovarian (HPO) axis, persistent disturbances may indicate underlying physiological or metabolic abnormalities[1]. Menstrual disorders such as oligomenorrhea, polymenorrhea, menorrhagia, dysmenorrhea, and premenstrual syndrome (PMS) are frequently reported among adolescent girls and can negatively affect academic performance, social participation, and overall quality of life[2].

Globally, the prevalence of menstrual disorders among adolescents ranges from 30% to 75%, depending on the population studied and diagnostic criteria used[3]. Dysmenorrhea is reported as the most common complaint, affecting nearly half to two-thirds of adolescent girls, while irregular cycles and heavy menstrual bleeding are also widely observed[4]. Despite their high prevalence, menstrual disorders are often underreported due to sociocultural taboos, lack of awareness, and limited access to adolescent-friendly health services[5].

Body Mass Index (BMI) has emerged as an important modifiable factor influencing menstrual health. Both undernutrition and excess body weight may disrupt normal reproductive hormone balance. Low BMI has been associated with hypothalamic dysfunction leading to delayed menarche and oligomenorrhea, whereas overweight and obesity are linked to hyperinsulinemia, altered estrogen metabolism, and increased androgen production, contributing to menstrual irregularities[6]. Adipose tissue plays an active endocrine role by secreting leptin, adipokines, and inflammatory mediators, which can influence ovarian function and ovulatory cycles[7].

The global rise in adolescent overweight and obesity has intensified concerns regarding its reproductive health implications. Studies have demonstrated that overweight and obese adolescents are at increased risk of irregular cycles, heavy menstrual bleeding, and severe dysmenorrhea compared to their normal-weight peers[8]. Conversely, underweight adolescents may also experience menstrual disturbances due to energy imbalance and hormonal suppression[9]. However, findings across different populations remain inconsistent, highlighting the need for further context-specific research.

Understanding the association between BMI and menstrual disorders is particularly important during adolescence, as early identification of risk factors may help prevent long-term reproductive and metabolic complications, including polycystic ovary syndrome (PCOS), infertility, and cardiovascular risks[10]. Therefore, this study aimed to determine the prevalence of menstrual disorders and examine their association with Body Mass Index among adolescent girls in a cross-sectional setting.

MATERIALS AND METHODS

Study Design and Setting: A cross-sectional study was conducted among adolescent girls to assess the prevalence of menstrual disorders and their association with Body Mass Index (BMI). The study was carried out in selected schools and colleges of Mardan city to ensure representation of adolescents across early (10–13 years), middle (14–16 years), and late adolescence (17–19 years).

Study Population and Sample Size: The study included 220 adolescent girls aged 10–19 years who had attained menarche at least one year prior to participation. The sample size was determined to provide adequate power to detect an association between BMI categories and menstrual disorders in a cross-sectional framework.

Sampling Technique: A stratified random sampling technique was used to ensure proportional representation across age groups

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(10–13, 14–16, and 17–19 years). Eligible participants were selected from attendance lists using simple random sampling within each stratum.

Inclusion and Exclusion Criteria: Adolescent girls aged 10–19 years who had experienced menarche for at least one year and consented to participate were included in the study. Participants with known chronic systemic illnesses, diagnosed endocrine disorders (such as thyroid disease or diabetes mellitus), polycystic ovary syndrome under treatment, or those using hormonal medications were excluded to minimize confounding effects.

Data Collection Tool and Procedure: Data were collected using a pretested structured questionnaire. The questionnaire included sections on sociodemographic characteristics, menstrual history (cycle regularity, duration, interval, flow characteristics, dysmenorrhea, and premenstrual symptoms), lifestyle factors (physical activity, dietary habits, and sleep pattern), and family history of menstrual or endocrine disorders. Data collection was conducted in a private setting to ensure confidentiality and encourage accurate reporting.

Anthropometric Measurements and BMI Classification: Height and weight were measured using standard procedures. Weight was recorded to the nearest 0.1 kg using a calibrated digital weighing scale, and height was measured to the nearest 0.1 cm using a stadiometer with participants barefoot and standing upright. BMI was calculated as weight in kilograms divided by height in meters squared (kg/m²). Participants were categorized as underweight (<18.5 kg/m²), normal weight (18.5–24.9 kg/m²), overweight (25.0–29.9 kg/m²), or obese (≥30.0 kg/m²).

Definition of Study Variables: Menstrual disorder was defined as the presence of one or more of the following: irregular menstrual cycles, abnormal cycle length (<21 days or >35 days), prolonged menstrual bleeding (>7 days), heavy menstrual flow, or moderate-to-severe dysmenorrhea. The primary independent variable was BMI category, while other covariates included age group, residence, socioeconomic status, physical activity level, and family history.

Statistical Analysis: Data were entered and analyzed using Statistical Package for the Social Sciences (SPSS) version 25. Descriptive statistics were expressed as means ± standard deviations for continuous variables and frequencies with percentages for categorical variables. The chi-square test was applied to assess associations between BMI categories and menstrual disorders. Variables with $p < 0.20$ in bivariate analysis were entered into multivariable logistic regression to determine independent predictors. Adjusted odds ratios (AORs) with 95% confidence intervals (CIs) were calculated, and a p-value < 0.05 was considered statistically significant.

Ethical Considerations: Ethical approval was obtained from the Institutional Review Board prior of Medical Teaching Institution Mardan to commencement of the study. Written informed consent was obtained from all participants, and parental/guardian consent was secured for minors. Confidentiality and anonymity were strictly maintained throughout the study.

RESULTS

Table 1 shows that the majority of participants were aged 14–16 years, with a mean age of 15.4 ± 2.1 years, indicating that mid-adolescence was the most represented group. Most girls belonged to urban areas and middle socioeconomic status. The mean BMI was 22.8 ± 4.1 kg/m², with more than half of participants falling within the normal BMI range; however, a considerable proportion were either overweight or obese, and a smaller group was underweight. The majority attained menarche between 12–13 years. Low physical activity levels were common, and nearly one-quarter reported a positive family history of menstrual or endocrine problems. Overall, the table reflects a relatively balanced distribution of BMI categories with notable lifestyle and familial factors that may influence menstrual health.

Table 2 indicates that menstrual disorders were common among the study population, with half of the participants reporting at least one disorder. Irregular cycles were observed in over one-third of adolescents, while abnormal cycle lengths and prolonged bleeding were also present in a notable proportion. Dysmenorrhea was highly prevalent, with a significant percentage experiencing moderate to severe pain. Premenstrual syndrome affected nearly two-fifths of participants. These findings suggest that menstrual disturbances represent a substantial health concern in this age group and highlight the need for increased awareness and supportive interventions.

Table 3 demonstrates a clear pattern between BMI categories and menstrual health outcomes. Adolescents with normal BMI had the highest proportion of regular cycles, whereas overweight and obese participants showed higher percentages of irregular cycles and moderate-to-severe dysmenorrhea. Underweight participants also exhibited increased irregularity compared to normal-weight peers. The findings suggest that deviations from normal BMI—particularly overweight and obesity—are associated with greater menstrual disturbances, supporting the hypothesis that body weight influences reproductive function.

Table 4 reveals that overweight and obese adolescents had significantly higher adjusted odds of experiencing menstrual disorders compared to those with normal BMI, even after controlling for age, residence, socioeconomic status, physical activity, and family history. Low physical activity and a positive family history were also identified as significant independent predictors. Although underweight and low socioeconomic status showed increased odds, these associations were not statistically significant. Overall, the regression analysis confirms that elevated BMI and certain lifestyle and hereditary factors independently contribute to the risk of menstrual disorders among adolescent girls.

Table-1: Demographic and baseline characteristics of participants (N = 220)

Variable	Category / Summary	n (%)
Age group (years)	10–13	60 (27.3)
	14–16	110 (50.0)
	17–19	50 (22.7)
Age (years)	Mean ± SD	15.4 ± 2.1
Residence	Urban	140 (63.6)
	Rural	80 (36.4)
Socioeconomic status	Low	80 (36.4)
	Middle	110 (50.0)
	High	30 (13.6)
Education level	Middle school	70 (31.8)
	High school	120 (54.5)
	College (early)	30 (13.6)
Age at menarche (years)	≤ 11	40 (18.2)
	12–13	130 (59.1)
	≥ 14	50 (22.7)
Age at menarche (years)	Mean ± SD	12.6 ± 1.1
Body Mass Index (BMI, kg/m²)	Mean ± SD (range)	22.8 ± 4.1 (15.2–34.9)
BMI category	Underweight (<18.5)	35 (15.9)
	Normal (18.5–24.9)	120 (54.5)
	Overweight (25.0–29.9)	45 (20.5)
	Obese (≥30.0)	20 (9.1)
Physical activity level	Low	120 (54.5)
	Moderate	70 (31.8)
	High	30 (13.6)
Diet pattern	Balanced/mixed	95 (43.2)
	High fast-food/processed	80 (36.4)
	High sugary beverages/snacks	45 (20.5)
Sleep duration (hours/night)	<6 hours	55 (25.0)
	6–8 hours	135 (61.4)
	>8 hours	30 (13.6)
Family history of menstrual/endocrine issues	Yes	50 (22.7)
	No	170 (77.3)

Table -2: Prevalence and Types of Menstrual Disorders (N = 220)

Variable	Category	n (%)
Menstrual cycle regularity	Regular	135 (61.4)
	Irregular	85 (38.6)
Cycle length	<21 days (Polymenorrhea)	30 (13.6)
	21–35 days (Normal)	140 (63.6)
	>35 days (Oligomenorrhea)	50 (22.7)
Duration of menstrual flow	<3 days	25 (11.4)
	3–7 days (Normal)	150 (68.2)
	>7 days (Menorrhagia)	45 (20.5)
Dysmenorrhea (painful menstruation)	None	60 (27.3)
	Mild	75 (34.1)
	Moderate	60 (27.3)
	Severe	25 (11.4)
Premenstrual syndrome (PMS)	Yes	95 (43.2)
	No	125 (56.8)
Any menstrual disorder (overall)	Yes	110 (50.0)
	No	110 (50.0)

Table-3: Association between BMI Categories and Menstrual Disorders (N = 220)

BMI Category	Total (n)	Regular Cycle n (%)	Irregular Cycle n (%)	Dysmenorrhea (Moderate–Severe) n (%)
Underweight (n=35)	35	18 (51.4)	17 (48.6)	15 (42.9)
Normal (n=120)	120	85 (70.8)	35 (29.2)	40 (33.3)
Overweight (n=45)	45	22 (48.9)	23 (51.1)	20 (44.4)
Obese (n=20)	20	10 (50.0)	10 (50.0)	11 (55.0)
Total (N=220)	220	135 (61.4)	85 (38.6)	86 (39.1)

Table-4: Binary Logistic Regression Analysis of Factors Associated with Menstrual Disorders (N = 220)

Variable	Category	Adjusted OR	95% CI	p-value
BMI Category	Underweight	1.82	0.95 – 3.48	0.071
	Overweight	2.15	1.14 – 4.05	0.018*
	Obese	2.94	1.18 – 7.32	0.021*
	Normal	Reference	—	—
Age Group	10–13 years	1.46	0.82 – 2.61	0.198
	17–19 years	1.28	0.69 – 2.37	0.432
	14–16 years	Reference	—	—
Residence	Rural	1.37	0.81 – 2.33	0.236
	Urban	Reference	—	—
Socioeconomic Status	Low	1.74	0.96 – 3.16	0.067
	High	0.89	0.38 – 2.06	0.781
	Middle	Reference	—	—
Physical Activity	Low	1.92	1.09 – 3.39	0.024*
	Moderate	1.21	0.63 – 2.33	0.562
	High	Reference	—	—
Family History	Yes	2.36	1.28 – 4.35	0.006*
	No	Reference	—	—

DISCUSSION

The present cross-sectional study demonstrated that menstrual disorders are highly prevalent among adolescent girls, with half of the participants reporting at least one menstrual abnormality. Irregular cycles, dysmenorrhea, and menorrhagia were the most commonly observed conditions. These findings are consistent with previous epidemiological studies reporting a high burden of menstrual disturbances during adolescence due to ongoing maturation of the hypothalamic–pituitary–ovarian axis[11]. Similar prevalence rates have been documented in school-based studies, where menstrual irregularities ranged between 35% and 55% among adolescents[12].

Dysmenorrhea emerged as one of the most frequent complaints in this study, affecting a substantial proportion of participants. This aligns with earlier reports indicating that primary dysmenorrhea affects more than half of adolescent girls globally and represents a leading cause of school absenteeism[13]. The biological mechanism underlying dysmenorrhea is largely attributed to increased prostaglandin production, which leads to uterine hypercontractility and pain[14]. The high prevalence observed in this study reinforces the need for early screening and supportive interventions within school health programs.

A key finding of this study was the significant association between higher BMI (overweight and obesity) and menstrual disorders. Overweight and obese adolescents had significantly increased odds of menstrual irregularities compared to those with normal BMI. These findings are in agreement with previous research demonstrating that excess adiposity disrupts normal endocrine function and contributes to anovulatory cycles and irregular menstruation[15]. Adipose tissue functions as an active endocrine organ, influencing estrogen metabolism and insulin resistance, which may impair ovulatory regulation[16].

Hyperinsulinemia and increased peripheral conversion of androgens to estrogens in obese individuals have been proposed as mechanisms linking obesity to menstrual disturbances[17]. Several studies have reported that overweight and obese adolescents are more likely to experience oligomenorrhea and heavy menstrual bleeding compared to their normal-weight peers[18]. The findings of the current study support this evidence and emphasize the reproductive consequences of the growing obesity epidemic among adolescents.

Interestingly, underweight participants also showed a trend toward increased menstrual irregularities, although the association was not statistically significant after adjustment. Previous studies have shown that low BMI may lead to hypothalamic suppression due to energy deficiency, resulting in oligomenorrhea or amenorrhea[19]. This suggests that both extremes of BMI may negatively affect menstrual health, highlighting the importance of maintaining optimal nutritional status during adolescence.

Low physical activity and positive family history were identified as independent predictors of menstrual disorders in this study. Sedentary behavior has been associated with increased adiposity and hormonal imbalance, potentially exacerbating menstrual irregularities[20]. Additionally, genetic and familial predisposition to endocrine or reproductive disorders may increase susceptibility to menstrual disturbances[21]. These findings underscore the multifactorial nature of menstrual disorders, involving biological, lifestyle, and hereditary components.

From a public health perspective, menstrual disorders during adolescence may have long-term implications, including increased risk of polycystic ovary syndrome (PCOS), infertility, metabolic syndrome, and cardiovascular disease[22]. Early identification of at-risk individuals—particularly those with abnormal BMI—provides an opportunity for preventive strategies such as lifestyle modification, nutritional counseling, and physical activity promotion.

Overall, the findings of this study contribute to the growing body of evidence linking BMI with menstrual health in adolescents. However, as a cross-sectional study, causal relationships cannot be established. Longitudinal studies are recommended to further explore temporal associations and underlying mechanisms. Nevertheless, the results highlight the importance of integrating menstrual health education and weight management programs into adolescent healthcare services.

CONCLUSION

In conclusion, this study demonstrates that menstrual disorders are highly prevalent among adolescent girls and are significantly associated with Body Mass Index. Overweight and obese adolescents were at greater risk of experiencing menstrual irregularities and moderate-to-severe dysmenorrhea compared to their normal-weight peers, while underweight participants also showed a tendency toward menstrual disturbances. These findings highlight the important role of optimal nutritional status and healthy lifestyle behaviors in maintaining menstrual health during adolescence. Early identification of BMI abnormalities, promotion of physical activity, and implementation of school-based reproductive health education programs may help reduce the burden of menstrual disorders and prevent potential long-term reproductive and metabolic complications.

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Authors Contribution

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Drafting: Huma Gul

Data Analysis: Fatima Rehman

Critical Review: Huma Gul, Fatima Rehman

Final Approval of Version: Hemasa Gul

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