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Association Between Physical Activity, Menstrual Cycle Characteristics and Body Weight in Adolescent Girls in Western Nepal

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ABSTRACT

Background: Adolescent girls frequently experience menstrual irregularities that are affected by multiple factors, including body mass index (BMI), exercise habits, nutrition, and sleep routines. This study sought to investigate the relationships among BMI, menstrual cycle disruptions, and lifestyle elements such as exercise, eating habits, and sleep patterns in a group of teenage girls between 13 and 16 years of age.

Method: We conducted a cross-sectional investigation of 301 teenagers. The study gathered information on body mass index, menstrual health, exercise habits, eating patterns, and sleep duration. Statistical analyses, including chi-square tests and logistic regression models, were used to examine the relationships between these variables and menstrual irregularities.

Result: Participants had a mean age of 14.65 ± 0.86 years. Significant correlations were identified between BMI and factors such as ethnicity, tea intake, and exercise level ($p \leq 0.05$). Although no direct link was established between BMI and menstrual irregularity ($p = 0.454$), certain lifestyle choices were strongly associated with irregular menstruation. These included insufficient physical activity (OR = 2.94, $p = 0.042$), regular dining out (more than three times weekly; OR = 9.08, $p = 0.045$), and inadequate rest ($p = 0.035$). Additionally, dysmenorrhea was significantly associated with menstrual irregularity ($p = 0.022$), suggesting a possible shared hormonal mechanism underlying both the conditions.

Conclusion: Although body mass index (BMI) did not show a direct correlation with menstrual irregularities, various lifestyle elements such as exercise habits, nutritional intake, and hours of sleep were found to be key factors influencing menstrual health. This underscores the crucial role of maintaining a wholesome lifestyle, encompassing regular physical activity, a well-balanced diet, and adequate rest in promoting normal menstrual cycles among teenage girls. Additional long-term research is required to investigate cause-and-effect relationships between these lifestyle factors and disruptions in menstrual patterns.

Key words: adolescent girls; body mass index; dysmenorrhea; menstrual irregularity; physical activity.

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INTRODUCTION

The onset of menstruation and menstrual cycle serve as key indicators of a woman's reproductive health and fertility. Among the most frequent issues reported by females are irregularities in menstrual cycles and primary dysmenorrhea.[1] It's worth noting that in the initial years following menarche, cycle durations may fall outside the normal range of 21-34 days, potentially being shorter than 20 days or extending beyond 45 days. Cycles of longer duration might be associated with a lack of ovulation, which can occur due to the underdeveloped state of the hypothalamic-pituitary-ovarian axis.[2] Although it is uncommon to discover a major underlying condition causing menstrual irregularities, changes in cycle patterns are not unusual at this age. Menstrual cycle characteristics can significantly affect a girl's future reproductive health, often leading to concern among patients and their families. To properly assess what constitutes an irregular cycle or abnormal flow, it is crucial for healthcare providers, young patients, and their parents to have a clear understanding of menstrual patterns. Frequently, adolescent patients seek medical advice for menstrual irregularities that actually fall within the range of normal variation.[3] The prevalence of obesity is increasing as a significant public health concern, contributing to increased morbidity and mortality in various diseases. Furthermore, obesity is associated with a higher likelihood of developing gynecological issues, including fertility problems and menstrual irregularities.[2,4] While some studies have indicated a connection between obesity and irregular, prolonged menstrual cycles or amenorrhea in younger women, the relationship between body

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mass index (BMI) and heavy menstrual bleeding remains understudied among women of reproductive age. A cross-sectional study found that overweight women using the Mirena intrauterine system experienced a longer duration before being diagnosed with amenorrhea, suggesting that higher BMI may be associated with heavier menstrual flow .[5] Moreover, Asian women typically have lower BMIs than their Caucasian counterparts.[6] Research has shown that women with significant weight deviation from the norm experience more frequent menstrual cycle irregularities and anovulation. Studies indicate that higher levels of obesity correlate with increased likelihood of irregular menstrual patterns.[1,7] There are rising trends in childhood obesity prevalence, earlier onset of puberty and menarche, and ethnic and racial variations in how BMI affects young females' reproductive characteristics.[8,9] Body weight, particularly body fat content, is a crucial factor contributing to menstrual disorders.[10] The nutritional status of young women can potentially disrupt their reproductive health. Food and nutrition types influence reproductive performance. Fluctuations in weight, whether overweight, obese, or underweight, related to energy balance changes are believed to cause ovulation disorders.[11-13] Persistent obesity into adulthood is associated with earlier sexual maturation and irregular menstrual cycles.[9] This study aimed to investigate the association between obesity and menstrual irregularities in teenage girls aged 13–16 years attending 14 private schools in Pokhara Metropolitan City. This study aimed to explore the relationship between physical activity, menstrual cycle patterns, and body weight. Furthermore, it aimed to analyze how socioeconomic factors, lifestyle habits, and levels of physical activity influence obesity and menstrual health in this population.

METHODS

A descriptive cross-sectional study was conducted involving adolescent girls aged 13-16 years in 14 private schools within the Pokhara metropolitan area, Kaski. The study focused on wards 29, 30, and 32 of the 33 wards in the Pokhara metropolitan area. These specific wards were chosen purposively due to their high concentration of schools, similar population characteristics, and geographical features, representing 50% of Lekhnath City's wards. Data were collected from September 2019 to December 2019 following the acquisition of informed consent. The study participants were female adolescents enrolled in grades 9 and 10 in private secondary-level schools. Research conducted in Bharatpur Metropolitan City revealed a 63.9%[14] prevalence of menstrual cycle irregularity. Using this figure, along with a 95% confidence interval and a 5% margin of error, the sample size was determined to be 355 using the formula $n= z^2pq/e^2$. This study employed a population proportionate-to-size technique for sample selection. Ethical clearance was obtained from the Pokhara University Research Council (PURC) Institutional Review Committee and Institutional Review Board (IRC) (Ref. 170/075/076). Initially, data collection approval was secured from school principals. Parental consent was obtained using forms available in both English and Nepali, detailing the study. Eligible participants were given these forms to return to their parental signatures the following day. Only students who provided parental permission were included in this study. A self-structured questionnaire was distributed to the students who had experienced menstruation. Each question was explained in Nepali, and time was allocated to answer. Body weight was measured using a weight machine, while height was assessed using a scale with the participants in a standing position. The survey instrument included questions about demographic information, such as age, home address, paternal occupation, and earnings. It also inquired about menstrual health, including the onset of menstruation, date of the most recent period, and specifics of the menstrual cycle. These details encompassed the duration of the cycle, number of days of menstrual flow, and intensity of bleeding (categorized as light, moderate, or heavy). The questionnaire also gathered information on the presence or absence of menstrual pain as well as premenstrual symptoms such as headaches, dizziness, leg cramps, and abdominal discomfort. Additionally, respondents were asked to report any other symptoms

such as diarrhea or vaginal discharge. Individuals who were married, experienced primary or secondary amenorrhea, underwent genital tract surgery, received chemotherapy or radiotherapy, or used oral contraceptive pills (OCP) were not included in the study. Height and weight were measured. The body mass index (BMI) was determined using the formula: BMI (kg/m ^{2}) = Weight (kg) / Height ^{2} (m^2)[3,15,16]. Data entry and analysis were performed using the SPSS 20. The analysis used both descriptive and inferential statistical tools. For categorical variables in the descriptive statistics, frequencies and percentages were calculated. For inferential statistics, the chi-square test was used to determine associations. Statistical significance was set at a P-value <0.05.

RESULTS

A study of 355 adolescent girls revealed an average age of 14.65 ±0.86 years. The majority of the participants were from Bramin/Chhetri backgrounds (45.2%) and lived in nuclear families (69.1%). Mothers were primarily housewives (66.4%), whereas fathers mostly worked abroad (40.5%). Dietary habits indicated that 91.7% of participants were non-vegetarian, with 83.7% consuming vegetables daily. Physical activity was low, with only 21.9% of participants engaging in vigorous exercise. Sleep patterns showed that 61.8% slept for 6–8 hour per day. Of the 355 participants, 54 had not yet commenced menstruation. The average age at menarche was 12.04 ± 0.65 years. Regarding menstrual health, 82.7% reported regular cycles and 45.2% experienced dysmenorrhea. The BMI classification showed that 64.1% were normal weight, 23.3% were underweight, and 12.6% were overweight.

Table 1. Association between Body mass index (BMI) and different variables. (n=301)

Variables	BMI n(%)			p-value
	Underweight	Normal	Overweight	
Ethnicity				
Janajati	18(14)	84(65)	28(21)	0.000*
Others	52(30)	109(64)	10(6)	
Family type				
Nuclear	52(25)	131(62)	25(12)	0.545
Joint	18(19)	62(68)	13(14)	
Food types				
Vegetarian	7(23)	15(60)	3(13)	0.824
Eggitarian				
Non Vegetarian	63(23)	178(64)	35(13)	
Consumption of tea				
Yes	44(25)	106(59)	28(16)	0.046
No	26(21)	87(71)	10(8)	
Vigorous intensity activity				
yes	9(13)	46(70)	11(17)	0.038
No	61(26)	147(63)	27(11)	
International wealth Index				
Lowest quintile	10(21)	30(64)	7(15)	0.668
Second quintle	9(18)	32(62)	10(20)	
Middle quintle	18(30)	37(62)	5(8)	
Forth quintle	19(26)	47(63)	8(11)	
Highest quintle	13(20)	44(68)	8(12)	
Physical activity				
Low	5(20)	17(47)	14(39)	0.000*
Moderate	37(24)	103(67)	14(9)	
High	28(25)	73(66)	10(9)	

The Table 1 demonstrates a notable correlation between BMI and factors such as ethnicity, tea intake, and exercise habits, which could potentially impact menstrual cycle regularity. An ethnic background (P = 0.000) indicates that Janajati people exhibit a higher incidence of excess weight compared to other groups, possibly stemming from cultural practices or dietary habits. Consumption of tea (P = 0.046) and insufficient physical activity (P = 0.000) were linked to increased rates of overweight individuals, highlighting the impact of lifestyle choices on BMI control. Intense physical exercise (P = 0.038) and elevated activity levels were associated with a lower prevalence of overweight status, underscoring their significance in maintaining a healthy BMI, which is crucial for regular menstruation. Although family structure, dietary preferences, and economic status showed no significant associations, the findings emphasize that both elevated BMI (overweight) and reduced BMI (underweight) may disrupt menstrual patterns owing to hormonal fluctuations. These results suggest the need for targeted strategies to promote exercise and balanced nutrition to optimize BMI and potentially enhance menstrual health.

The associations between menstrual irregularity and various factors, including ethnicity, family type, diet, physical activity, and lifestyle behaviors, are presented in Table 2. A significant correlation was found between

physical activity and menstrual cycle irregularity (p = 0.042). Women with low levels of physical activity were almost three times more likely to experience menstrual irregularity (OR = 2.94) than those with high activity levels, underscoring the significance of an active lifestyle. Dietary habits also showed notable associations. Women who dined out frequently (>3 days/ week) had a considerably higher chance of menstrual irregularity (OR = 9.08, p = 0.045) than those who ate out less often, suggesting a potential link between diet quality and menstrual health. Sleep duration was also a crucial factor (p = 0.035). Compared to women sleeping > 8 hours, those sleeping less than 6 hours daily had increased odds of irregular menstruation (OR = 1.23), while those sleeping 6–8 hours showed even higher odds (OR = 2.42), indicating the role of sufficient sleep quality in maintaining menstrual regularity. No significant correlations were observed for ethnicity (p = 0.653), family type, tea consumption, frequency of junk food intake (p = 0.751), or regular vegetable consumption (p = 0.545). Additionally, the wealth index categories did not exhibit a significant relationship with menstrual cycle irregularity (p = 0.294).

Table 2. Association between menstrual irregularity and different variables. (n=301)

Variables	Mensuration n(%)		OR	p-value
	Regular	Irregular		
Ethnicity				
Janajati	109(84)	21(16)		0.653
Others	140(82)	31(18)		
Food types				
Vegetarian	20(80)	5(20)		
Non Vegetarian	229(83)	47(17)		0.707
Consumption of tea				
Yes				
No				
Vigorous intensity activity				
Yes	58(88)	8(12)		0.21
No	191(81)	44(19)		
International wealth Index				
Lowest quintile	41(87)	6(13)		
Second quintle	43(84)	8(16)		
Middle quintle	44(73)	16(27)		
Forth quintle	61(82)	13(18)		
Highest quintle	56(86)	9(14)		0.294
Physical activity				
Low	25(69)	11(31)	2.94	
Moderate	128(83)	26(17)	1.18	0.042
High	96(86)	15(14)	Ref.	
Consumption of vegitables				
Daily consumtion	207(82)	45(18)		0.545
Irregular consumption	42(86)	7(14)		
Eating outside per weeks				
> 3days	47(78)	12(30)	9.08	0.045
≤ 3days	168(81)	39(19)	8.93	
Some time	34(97)	1(3)	Ref.	
Frequency of junk food consumption				
Regular	157(82)	34(18)		0.751
Irregular	92(84)	18(16)		
Sleep time a day				
<6 Hours	58(88)	8(12)	1.23	0.035
6-8 Hours	147(79)	39(21)	2.42	
>8 Hours	44(90)	5(10)	Ref.	

Table 3. Association between mensuration irregularity and dysmenorrhea and overweight. (n= 301)

Variables	Mensuration n(%)		p-value	OR
	Regular	Irregular		
Dysmenorrhea				
Yes	120(48)	16(31)	0.022	0.45
No	129(52)	36(69)		
BMI				
Underweight	57(23)	13(25)	0.454	
Normal	163(65)	30(58)		
Overweight	29(12)	9(17)		

Table 3 illustrates the connection between menstrual irregularity and two factors, dysmenorrhea and BMI. The analysis revealed a statistically significant association between dysmenorrhea and menstrual cycle irregularity (p = 0.022). Women with dysmenorrhea were found to have a a reduced likelihood of regular menstrual cycles (OR = 0.454), demonstrating a robust correlation between painful periods and cycle irregularities. This finding implies that dysmenorrhea could potentially be used as a clinical indicator to identify women who may be at risk of menstrual irregularities, possibly due to common underlying physiological or hormonal factors. Conversely, no statistically significant association was found between BMI and menstrual cycle irregularity (p = 0.454). The BMI category distribution among women experiencing irregular menstrual cycles was 25% underweight, 58% normal-

weight, and 17% overweight. This distribution was similar to that observed in women with regular cycles, with percentages of 23%, 65%, and 12%.

DISCUSSION

The objective of this study was to investigate the association between Body Mass Index (BMI), menstrual irregularity, and various lifestyle factors, including exercise habits, eating patterns, and sleep duration in teenage girls aged 13-16. Our findings revealed a nuanced interaction among these variables, with physical activity levels, dietary practices, and sleep routines emerging as key influencers of menstrual health. Although BMI itself did not demonstrate a statistically significant direct link to menstrual irregularity (p = 0.454), several lifestyle aspects, particularly exercise habits, eating patterns (notably the frequency of dining out), and sleep duration, were significantly associated with menstrual disturbances. These outcomes are consistent with prior research but also indicate that the impact of BMI on menstrual health may be moderated by a wider range of lifestyle choices rather than BMI in isolation. The connection between body mass index (BMI) and menstrual irregularities has been extensively studied, with multiple studies indicating that excess weight and obesity are linked to menstrual disturbances in adolescent girls. For example, Dars et al. (2014) demonstrated that increased BMI in teenage females was associated with menstrual irregularities, potentially due to hormonal imbalances such as elevated insulin and androgen levels, which can interfere with the menstrual cycle.[3] Likewise, Mustaqeem et al. (2015) discovered that obesity is a notable risk factor for menstrual disorders, with obese girls being more susceptible to conditions such as polycystic ovary syndrome (PCOS), which is known to cause irregular periods.[6,15] Individuals with irregular menstruation exhibited higher obesity rates, elevated total cholesterol, triglycerides, and LDL-C levels, and a greater prevalence of diabetes mellitus and metabolic syndrome compared to those with regular menstruation (BMI of mentrual irregularity 22.9±0.2, regularity was 22.3±0.2, p= 0.001) .[17] However, our investigation did not reveal a statistically significant correlation between BMI and menstrual irregularity ((BMI of menstrual irregularity 20.973.49, regularity 21.644.67, p= 0.001, p = 0.454). The absence of a direct link could be attributed to the relatively low proportion of overweight adolescents in our sample (12.6%). Zohora et al. (2021) noted that the influence of BMI on menstrual irregularity may be more evident in populations with a higher prevalence of overweight and obesity. [8] Furthermore, our study sample may have been insufficient to detect subtle effects of BMI on menstrual health. Tang et al. (2020) proposed that the impact of BMI on menstrual irregularity might be moderated by other lifestyle factors, such as diet and physical activity .[4] Consequently, BMI alone may not fully account for menstrual irregularities in adolescents; instead, a combination of factorsincluding lifestyle and metabolic healthmay play a more crucial role. Our study revealed a notable correlation between physical activity and menstrual cycle regularity. Women engaging in minimal physical activity were almost three times more likely to experience menstrual irregularities (OR = 2.94) than their highly active counterparts were. The study showed that girls with low physical activity levels had a higher probability of irregular menstruation (p = 0.042), consistent with existing literature that emphasizes the role of exercise in maintaining hormonal equilibrium and regular menstrual cycles. Omidvar et al's research identified a significant relationship between BMI, socioeconomic status, and exercise habits. Interestingly, a larger proportion of overweight and obese females participated in physical activities, while a considerably higher percentage of underweight individuals led to sedentary lifestyles. Statistical analysis revealed a highly significant association between weight and lifestyle choices .[18] Hoppenbrouwers et al. (2016) observed that physical inactivity was linked to menstrual issues in adolescents, suggesting that encouraging an active lifestyle could be an effective strategy for promoting menstrual health .[1] The results of our study underscore the importance of encouraging physical activity as a component of a comprehensive approach to address menstrual irregularities and enhance the overall well-

being of teenage girls. The observed beneficial effects of exercise on hormone regulation and menstrual cycle consistency are in line with the research conducted by Singh et al. (2019), which emphasized the significance of physical activity in mitigating menstrual disorders .[7]

Our research revealed that eating habits significantly affected menstrual health. Girls who ate out frequently (more than three times a week) were at a higher risk of experiencing menstrual irregularities (OR = 9.08, p = 0.045). This finding is consistent with earlier research indicating that poor nutrition, including intake of processed or high-calorie foods, can adversely affect menstrual cycles. One study found a strong correlation between menstrual abnormalities and the consumption of refined grains, sweet snacks, baked goods, carbonated drinks, fast food, and processed beverages ($p \leq 0.05$). However, no link was established between menstrual abnormalities in adolescent girls and their consumption of salty snacks and frozen meat products ($p \geq 0.05$).[19] Furthermore, Guzeldere's research indicated that women with healthy menstrual cycles had a higher body mass index (BMI) compared to those with menstrual disorders. Women experiencing menstrual disorders were found to have lower intakes of protein, vitamin K, vitamin B3, vitamin B5, and sodium than their healthy counterparts.[20] Our findings support these conclusions by emphasizing the importance of dietary quality in menstrual health and suggesting that regular consumption of fast food or dining out may increase the likelihood of menstrual irregularities. Notably, although Zohora et al. (2021) reported that dietary habits, including vegetarian and non-vegetarian diets, could affect menstrual health, our study did not reveal a significant variation in menstrual irregularities between girls following vegetarian or non-vegetarian diets.[8] This contrast may be attributed to differences in regional and cultural dietary practices, indicating that the nutritional quality of the diet, rather than the specific food categories consumed, may play a more crucial role in influencing menstrual regularity. Our research revealed that sleep duration played a crucial role, with female adolescents who slept for less than 6 hours daily showing a higher likelihood of experiencing menstrual irregularities (p = 0.035). These results align with those of Hoppenbrouwers et al. (2016), who observed a connection between insufficient sleep and menstrual dysfunction in teenage girls. Disrupted sleep patterns interfere with the circadian rhythm of the body, which subsequently affects the production of hormones, including those involved in menstruation. Research has demonstrated that lack of sleep can hinder the production of reproductive hormones such as estrogen and progesterone, which are vital for regular menstrual cycles .[1] This underscores the necessity of encouraging proper sleep habits to prevent menstrual cycle irregularities in adolescents. The research also revealed a notable correlation between painful menstruation (dysmenorrhea) and irregular menstrual cycles (p = 0.022). Interestingly, females experiencing dysmenorrhea were more likely to have regular menstrual patterns. This finding contradicts the results reported by Mizgier et al. (2019), who proposed that menstrual pain could be a clinical sign of hormonal imbalance contributing to cycle irregularities.[11] These observations suggest that, in clinical settings, addressing dysmenorrhea may aid in identifying and treating females at risk of menstrual irregularities, especially when hormonal or metabolic factors are the underlying causes.

CONCLUSIONS

This study emphasizes the complex nature of menstrual irregularities among teenage girls. Although body mass index (BMI) was not directly linked to menstrual irregularity, lifestyle factors, including exercise, sleep patterns, and eating habits, were found to be significant indicators of menstrual health. These results emphasize the necessity of encouraging a wholesome lifestyle that incorporates regular physical activity, a well-balanced diet, and sufficient sleep to support normal menstruation in adolescent females. Additional studies should investigate the underlying biological mechanisms connecting these factors to menstrual health, and assess the efficacy of interventions targeting lifestyle behaviors to enhance menstrual outcomes in teenagers.

Limitations: This study has several limitations. The cross-sectional nature of this research hinders our capacity to establish cause-and-effect relationships among BMI, physical activity, and menstrual irregularities. Moreover, the use of self-reported information on menstrual health, eating patterns, and exercise habits may have led to recall bias. The statistical power of the study to detect significant associations between BMI and menstrual irregularities was also diminished due to the limited number of overweight participants in the sample. To further examine the causal connections between BMI, lifestyle factors, and menstrual health, future research, particularly long-term studies with larger participant cohorts, is necessary. Additionally, investigating the impact of other metabolic and endocrine factors, such as insulin resistance and inflammatory markers, could offer more comprehensive insights into the biological mechanisms connecting BMI to menstrual cycle irregularities.

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