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Research Article

The Association of Body Mass Index, Eating Habits, And Physical Activity on Menstrual Health among Female Students Aged 14 to 16 Years Old at SMK Shah Alam, Malaysia

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ABSTRACT

This cross-sectional study examined the association between Body Mass Index (BMI), eating habits and patterns, physical activity levels, and menstrual health in 237 female students aged 14 to 16 at SMK Shah Alam. BMI-for-age was determined using anthropometric measures, and validated Malay versions of the Eating Behaviour and Pattern Questionnaire (EBPQ), International Physical Activity Questionnaire (IPAQ), and Menstrual Disorder of Teenagers (MDOT) questionnaire were used to evaluate dietary behaviour, physical activity, and menstrual health, respectively. BMI-for-age and menstrual health were significantly correlated (χ^2=11.221, p=0.024), with higher prevalence of menstrual disorders observed among students classified as thin or severely thin. A substantial correlation was found between eating habits and menstrual health (χ^2=10.978, p=0.004), with students with good dietary patterns reporting fewer menstruation problems. Physical activity level, as measured by IPAQ, was substantially correlated with menstrual health overall (χ^2=7.148, p=0.028). The results highlight how crucial it is to maintain a healthy weight, have good eating behaviour, and exercise regularly to promote adolescents' reproductive health. These findings are helpful in directing school-based health initiatives and educating parents, teachers, and medical professionals on how to promote the long-term health of teenage females.

INTRODUCTION

According to the World Health Organization (WHO), adolescence is between the ages of 10 and 19, marked by significant physical and psychological changes that prepare a person for adulthood. During this phase, girls start ovulation and menstruation, which is also seen as the development of secondary sexual features, sexual development, and sexual maturity (Azhary *et al.* 2022).

Previous studies show that up to 30% may experience changes in the volume or pattern of menstrual blood flow (Critchley *et al.* 2020). According to research by Mariappen *et al.* (2022), dysmenorrhea (30.9%) was the most frequent menstrual condition in the study population, followed by heavy menses bleeding (28.1%), oligomenorrhea (4.5%), and amenorrhea (0.4%). Thus, it is essential to determine lifestyle factors that might affect menstrual health, especially in student populations where early intervention may eventually have positive benefits.

According to past research by Taheri *et al.* (2020), teenagers with a Body Mass Index (BMI) that is higher than normal are more likely to experience irregular menstruation due to hormonal imbalances caused by adipose tissue. Aside from that, nutrition is important in controlling menstrual health, as a lack of vital nutrients such as protein, vitamins B3, B5, and K can exacerbate menstrual diseases (Güzeldere *et al.* 2024). Besides the hormonal effects caused by excess adipose tissue, exposure to environmental Endocrine Disrupting Chemicals (EDCs) such as Bisphenol A (BPA), phthalates, and Persistent Organic Pollutants (POPs), which accumulate in fat, can further disturb reproductive hormone

balance and lead to irregular menstrual cycles in adolescents with elevated BMI. These chemicals may trigger chronic inflammation and epigenetic modifications in fat cells, affecting estrogen and insulin signaling pathways essential for normal menstruation.

In addition, it has been demonstrated that moderate physical activity can normalize menstrual periods. Intense physical activity, however, may raise the chance of irregular menstruation, especially for athletes who participate in demanding sports (Paolo *et al.* 2024). Other than that, research by Cholbeigi *et al.* (2022), which investigated the relationship between lifestyle choices, pain levels, and menstrual distress, has proven that improving a healthy diet and exercise regimen together helps reduce the severity of pain associated with dysmenorrhea.

There is a dearth of such studies on the association of BMI, food habits, and physical activity with the effect of menstrual health among Malaysian girls in this age group. The lack of adequate local evidence limits the development of culturally and suitable preventative and intervention strategies. As a result, relying on findings from other populations may lead to recommendations that do not accurately reflect Malaysian adolescents' dietary patterns, lifestyle behaviours, and environmental influences, potentially reducing the efficacy of health promotion efforts and early interventions.

METHODS

Design, location, and time

A cross-sectional and quantitative research methodology was conducted to investigate the association between body mass index, eating behaviour and physical activity on menstrual health among adolescents. This study was conducted at Sekolah Menengah Kebangsaan (SMK) Shah Alam, located at Persiaran Anjung Seri, Seksyen U8/80, Bukit Jelutong Timur, 40150 Shah Alam, Malaysia. The study conducted between January and July 2025.

Ethical approval was then obtained from the Research Ethics Committee, UiTM (Ref: FERC/FSK/MR/2025/0025), followed by approval from the Ministry of Education through the eRAS system (Ref: KPM.600-3/2/3-eras (23033)), and the Selangor State Education Department (Ref: JPNS.SPD 600-1/1/2 JLD. 51(52)). Permission was also obtained from SMK Shah Alam. Following that, consent and assent forms were distributed to students and parents. Data collection involved three validated questionnaires while students' weight and height also measured using a digital scale and stadiometer to calculate BMI.

Sampling

Eligible respondents were female students aged 14 to 16 years who are currently enrolled at SMK Shah Alam and have begun menstruation. In addition, both students and their parents must provide consent in order to participate in the study. However, the respondents must not include male students, students with medical conditions, or students who do not obtain parental consent.

This research employed convenience sampling to enable effective and timely recruitment of the respondents. The method allowed the selection of easily reachable respondents during the data collection period, making the process more practical within the school setting. The sample size was calculated using Raosoft Software with 5% margin of error (E), a 95% confidence level (Z), and an estimated proportion (p) of 0.5. As a result, the minimum sample size for this study is 203 female respondents from the total population of 432 female students.

Data collection

The respondents' weight was measured using a SECA Robusta 813 digital weighing scale while the height was measured using a SECA 213 portable stadiometer. To calculate each respondent's z-score for BMI-for-age, the WHO AnthroPlus Version 1.0.4 software was utilized. The BMI values were then categorized based on the WHO Growth Reference 2007 using the BMI-for-age classification for individuals aged 5 to 19 into categories such as severe thinness, thinness, normal weight, overweight, and obesity.

This study utilized the Modified-Malay Eating Behaviour and Pattern Questionnaire (EBPQ), translated and validated by Supramaniam *et al.* (2023). It consists of 36-item questions divided into seven constructs related to lifestyle, snacking behaviour, emotional eating, low-fat eating, meals, and snacking trends. Responses were rated on a Likert-type scale and scores were classified as poor, moderate and excellent eating behaviour. The questionnaire demonstrated

strong internal consistency, with an overall Cronbach's alpha of 0.90 and construct values ranging from 0.72 to 0.82.

The short and Malay version of International Physical Activity Questionnaire (IPAQ) with 7 questions from the official IPAQ site was utilized in this study. It measured the frequency, duration, and intensity of physical activity, both moderate and vigorous, as well as sedentary time. Physical activity was measured weekly in MET-minutes, with standard values of 3.3 for walking, 4.0 for moderate activity, and 8.0 for vigorous activities. Physical activity levels were divided into low, moderate, and high categories based on total MET-minutes. The questionnaire shows acceptable test-retest reliability, with ICC values ranging from 0.54 to 0.92.

This Menstrual Disorders of Teenagers (MDOT) Questionnaire seeks to record menstrual cycle characteristics, such as menstrual flow duration, amount of menstrual flow, length, premenstrual syndrome, and dysmenorrhoea. This study utilized the same 9-item questionnaire as the study by Azhary *et al.* (2022), which consisted of 9 questions related to menstrual issues. The reliability of the MDOT questionnaire's symptom-related items was confirmed, with a Cronbach's Alpha of 0.763 suggesting good internal consistency.

Data analysis

Quantitative data analysis was conducted using the Statistical Package for Social Science software (SPSS). First, demographic data and significant variables were compiled using descriptive statistics, which provided details about the sample's diet behaviour, levels of physical activity, and BMI-for-age distribution. The Chi-Square test was used to assess the associations between BMI, eating behavior and physical activity on menstrual health. A significance level of $p<0.05$ was considered statistically significant.

RESULTS AND DISCUSSION

A total of 237 valid questionnaire were collected from the respondents in this study. Table 1 shows the demographic and socio-economic characteristics of the respondents. More than half were 16 years old (52.3%), followed by 15 years old (30.8%) and 14 years old (16.9%). The majority of respondents were Malay (96.6%) , with the rest being Chinese (2.1%), Indian (0.8%), and other ethnicities (0.4%).

Regarding living arrangements, 89.0% lived with their families, while 11.0% stayed in dorms. In terms of parental education, more than half of dads (50.2%) had a PhD, Master's, or Bachelor's degree, with 39.7% holding STPM, Diploma, or A-Level qualification. Only 9.7% finished secondary and 0.4% finished primary school. Similarly, 53.6% of mothers had a PhD, Master's, or Bachelor's degree, 35.9% had completed STPM, Diploma, or A-Level, 9.3% had secondary school, and 1.3% had primary education.

Fathers' jobs included 34.2% government employment, 29.1% private-sector employment, 16.9% self-employment, 16.5% retirement, and 3.4% unemployment. Among mothers, 33.3% working for the government, 24.5% self-employed, 21.1% working in the private sector, 12.2% unemployed, and 8.9% retired.

The average monthly household income was RM6,511.51±RM3,691.64. Almost half of the households (47.7%) were classed as M40 (RM4,850−RM10,959), followed by 34.6% in T20 (>RM10,959) and 17.7% in B40 (<RM4,850). The average household size was 4.80±2.21 members, with 42.6% having under five people, 37.1% having five to seven members, and 20.3% having more than eight members. The majority lived with family (89.0%) and came from households with relatively high parental education and income levels, reflecting middle- to upper-income urban families. These sociodemographic factors can influence nutritional knowledge, access to food, and lifestyle choices, which are relevant for adolescent menstrual health.

As shown in Table 1, 237 respondents were evaluated for their anthropometric measurements. The mean body weight was 48.75±7.25 kg, while the average height was 161.03±3.83 cm. The average BMI was 18.78±2.63 kg/m², with a mean BMI-for-age Z-score of 0.53±1.56. According to the BMI-for-age classification, 53.2% were within the normal weight range. 23.2% were overweight, while 17.3% were obese. On the other end of the scale, 3.4 % were classed as thin, while 2.9% were severely thin.

Table 1 shows that the average weekly MET-minutes for vigorous activity were 159.73±188.49, while moderate activities had a higher average of 173.33±370.75. Walking accounted for 210.18±484.76 MET-minutes per

Table 1. Sociodemographic, anthropometric, and lifestyle characteristics of the respondents

Characteristics (n=237)	n (%)
Children age (years) (mean±SD)	15.35±0.75
14	40 (16.9)
15	73 (30.8)
16	124 (52.3)
Ethnicity	
Malay	229 (96.6)
Chinese	5 (2.1)
Indian	2 (0.8)
Others	1 (0.4)
Living arrangement	
With family	211 (89.0)
Dormitory	26 (11.0)
Anthropometric measurement (mean±SD)	
Weight (kg)	48.75±7.25
Height (m)	161.03±3.83
BMI (kg/m^2)	18.78±2.63
BMI-for-age Z-score	0.53±1.56
BMI-for-age classification	
Severe thinness	7 (2.9)
Thinness	8 (3.4)
Normal	126 (53.2)
Overweight	55 (23.2)
Obese	41 (17.3)
Physical activity types (mean±SD)	
Vigorous (MET-min/week)	159.73±188.49
Moderate (MET-min/week)	173.33±370.75
Walking (MET-min/week)	210.18±484.76
Total (MET-min/week)	543.25±685.83
Physical activity category	
Low	191 (80.6)
Moderate	39 (16.4)
High	7 (3.0)
Father's education level	
PhD/Master/Bachelor	119 (50.2)
STPM/Diploma/A-Level	94 (39.7)
Secondary school	23 (9.7)
Primary school	1 (0.4)
Mother's education level	
PhD/Master/Bachelor	127 (53.6)
STPM/Diploma/A-Level	85 (35.9)
Secondary school	22 (9.3)
Primary school	3 (1.3)
Father's occupation	
Government employee	81 (34.2)
Private sector employee	69 (29.1)
Self-employed	40 (16.9)
Retired	39 (16.5)
Unemployed	8 (3.4)
Mother's occupation	
Government employee	79 (33.3)
Private sector employee	50 (21.1)
Self-employed	58 (24.5)
Retired	21 (8.9)
Unemployed	29 (12.2)
Monthly household income* (mean±SD)	6511.51±3691.64
B40 (<RM4,850)	42 (17.7)
M40 (RM4,850–RM10,959)	113 (47.7)
T20 (>RM10,959)	82 (34.6)
Household size (mean±SD)	4.80±2.21
<5	101 (42.6)
5–7	88 (37.1)
>8	48 (20.3)

*Classification of monthly household based on the Department of Statistics Malaysia; Phd: Doctor of Philospophy; STPM: Sijil Tinggi Persekolahan Malaysia; A-Level: Advanced Level; B40: Bottom 40% household income group (<RM4,850); M40: Middle 40% household income group (RM4,850–RM10,959); T20: Top 20% household income group (>RM10,959); RM: Ringgit Malaysia. The conversion of RM to US Dollars (US$) is based on the average exchange rate from January to July 2025, which is approximately RM4.36=US$1 according to Bank Negara Malaysia; BMI: Body Mass Index

week, resulting in a total physical activity level of 543.25±685.83 MET-min/week across all activities.

According to the total MET-minutes and IPAQ scoring guidelines, the majority of individuals (80.6%) were classified as having low physical activity levels. A lesser percentage (16.4%) were classed as moderate physical activity, while just 3.0% met the criteria for high physical activity. These results showed a general trend toward low-intensity and infrequent physical activity.

These results align with earlier national and international research. According to Shahril *et al.* (2023), only 20% of Malaysian teenagers between the ages of 13 and 17 engaged in the required 60 minutes of moderate-to-intense physical activity per day. Regular and moderate exercise will improve blood circulation, which can help with period cramps and dysmenorrhea symptoms (Sari *et al.* 2021). On the other hand, Knight *et al.* (2022) reported that over 70% of Southeast Asian secondary school students were physically inactive, and Guthold *et al.* (2020) discovered that over 80% of teenagers worldwide did not engage in adequate amounts of physical activity.

Table 2 illustrates the distribution of respondents by EBPQ categories. For lifestyle

and behavioural eating, 13.5% were classified as having poor eating behaviour, 63.3% as moderate, and 23.2% as excellent. In terms of emotional influence, 30.8% were rated as poor, 53.2% as moderate, and 16.0% as excellent.

Regarding snacking behaviour, 31.2% were poor, 53.6% were moderate, and 15.2% were excellent. In the haphazard planning category, 13.9% had poor eating habits, 36.7% were moderate, and 49.4% were excellent. In the meal-skipping category, 30.8% were poor, 48.1% were moderate, and 21.1% were excellent.

In terms of low-fat eating, 13.9% were rated as poor, 79.7% as moderate, and 6.3% as excellent. Regarding snacking habits, 31.2% were poor, 53.6% were moderate, and 15.2% were excellent. Overall, based on the total EBPQ score, 3.0% had poor eating habits, 92.8% were moderate, and only 4.2% were rated excellent.

According to Muhammad *et al.* (2023), adolescents' capacity to sustain regulated eating behaviors is frequently hampered by emotional and environmental pressures. The current study found that 31.2% of participants had poor snacking habits and 30.8% had poor eating-related emotional regulation, indicating a tendency to turn to food as a coping strategy when faced with social pressures, boredom, or academic stress.

Table 3 reveals the prevalence and characteristics of menstrual patterns and disorders among respondents. The average age of menarche was 11.72±1.59 years,slightly earlier than the global norm, with 70.9% experiencing it between the ages of 10 and 12, 25.7% between 13 and 15 years, and 3.4% before age 10. The findings from Sabah has a mean age for menarche of 12.2±1.1 (Azhary *et al.* 2022) while research from Klang Valley has the mean age for menarche of 12.14±1.11 years (Mariappen *et al.* 2022).

The mean duration of menstruation was 6.64±3.33 days, where the majority of respondents (74.3%) had menstruation lasting 3 to 7 days, 25.3% had bleeding that lasted 8 to 14 days, and 0.4% had bleeding for more than 14 days. In terms of flow, 60.0% reported light flow (≤4 pads/day), 35.4% had moderate flow (5−10 pads/day), and 4.6% experienced excessive bleeding (requiring two pads at once). A 83.6% reported having regular menstrual cycles, while 16.4% had irregular ones. Among those with regular periods, 32.9% had cycles less than 20 days, 63.6% had cycles between 21 and 35 days, and 3.5% had cycles longer than 35 days.

Menorrhagia was reported by 11 individuals (2.8%), followed by oligomenorrhea in 6 (1.5%), and polymenorrhea in 57 (14.6%). Dysmenorrhea, or menstrual discomfort, was common, affecting 179 responders (75.5%). Among them, 44.1% reported light pain, 48.1% moderate pain, and 7.8% severe pain. A total of 133 respondents (56.1%) reported missing school due to menstrual pain, with 69 (29.1%) requiring pain relief medication.

A study also found that around 71.1% of adolescents and young women worldwide suffer from dysmenorrhea, according to a systematic review and meta-analysis. Of those, 20.1% miss school or university because of menstrual pain, and 40.9% report difficulty focusing or performing well in school as a result (Armour *et al.* 2019).

Table 3 also depicts the prevalence of several menstruation symptoms reported by respondents. Mood swings were the most common, with 74.3%, followed by tiredness, which was reported by 70.9%. Headaches affecting 49.4%, while 43.5% reported with appetite changes and 37.1% experienced with pelvic pain. Bloating was reported by 29.5%.

Table 2. Distribution of respondents according to Eating Behaviour and Pattern Questionnaire (EBPQ) categories

Eating behaviour	n % (n=237)		
	Poor	Moderate	Excellent
Lifestyle and behavioural eating	32 (13.5)	150 (63.3)	55 (23.2)
Emotional influence	73 (30.8)	126 (53.2)	38 (16.0)
Snacking behaviour	74 (31.2)	127 (53.6)	36 (15.2)
Haphazard planning	33 (13.9)	87 (36.7)	117 (49.4)
Meal skipping	73 (30.8)	114 (48.1)	50 (21.1)
Low-fat eating	33 (13.9)	189 (79.7)	15 (6.3)
Snacking pattern	74 (31.2)	127 (53.6)	36 (15.2)
Overall eating behaviour and pattern	7 (3.0)	220 (92.8)	10 (4.2)

Table 3. Prevalence and characteristics of menstrual patterns and disorders among respondents

Characteristics (n=237)	n (%)
Age of menarche (years) (mean±SD)	11.72±1.59
<10	8 (3.4)
10–12	168 (70.9)
13–15	61 (25.7)
Duration of menstruation (days) (mean±SD)	6.64±3.33
3–7	176 (74.3)
8–14	60 (25.3)
>14	1 (0.4)
Amount of menstrual flow	
Light (≤4 pads/day)	142 (60.0)
Moderate (5–10 pads/day)	84 (35.4)
Heavy (need two pads at a time)	11 (4.6)
Menstrual cycle	
Regular	173 (83.6)
Irregular	64 (16.4)
Length of menstrual cycle (n=173)	
≤20 days	57 (32.9)
21–35 days	110 (63.6)
≥35 days	6 (3.5)
Menorrhagia	
Yes	11 (2.8)
No	226 (97.2)
Oligomenorrhea	
Yes	6 (1.5)
No	231 (98.5)
Polymenorrhea	
Yes	57 (14.6)
No	180 (85.4)
Dysmenorrhea	
Yes	179 (75.5)
No	58 (24.5)
Severity of dysmenorrhea (n=179)	
Mild	79 (44.1)
Moderate	86 (48.1)
Severe	14 (7.8)
Missed school due to pain	
Yes	133 (56.1)
No	104 (43.9)
Need medication for pain	
Yes	69 (29.1)
No	168 (70.9)
Menstrual symptoms	
Tiredness	168 (70.9)
Mood swings	176 (74.3)
Headaches	117 (49.4)
Nausea/vomiting	29 (12.2)
Bloating	70 (29.5)
Pelvic pain	88 (37.1)
Appetite changes	103 (43.5)
Premenstrual symptoms	
Mood changes	148 (62.4)
Fatigue	80 (33.8)
Bloating	45 (19.0)
Breast tenderness	38 (16.0)

SD: Standard Deviation; Length of menstrual cycle was analyzed among participants with regular cycles only (n=173). Severity of dysmenorrhea was analyzed among participants who reported with dysmenorrhea only (n=179)

Only 12.2% experienced nausea or vomiting. National and worldwide research showing the high frequency and significance of physical and emotional symptoms during the menstrual cycle supports this trend (Hantsoo *et al.* 2022).

The most commonly reported premenstrual symptom was mood swings, reported by 62.4%. This was followed by fatigue, which is 33.8%, bloating by 19.0%, while breast discomfort with only 16.0% reporting it. Overall, more than half of the respondents reported having at least one form of premenstrual symptom, with mood changes being the most common.

Figure 1 displays the entire menstrual health status of the respondents. Of the total respondents, 51.9% respondents reported no menstrual problems, whereas 48.1% respondents had at least one type of menstrual disorder.

The data in Table 3 show that a significant number of respondents experienced menstrual disorders, with dysmenorrhea affecting 75.5% and irregular cycles reported by 16.4%. Menstrual issues can be influenced not only by biological factors but also by dietary habits and eating behaviors. Irregular eating patterns, such as skipping meals, frequent consumption of sugary snacks, or insufficient intake of essential nutrients, can disrupt hormonal balance and worsen menstrual symptoms like pain, fatigue, and mood changes (Hantsoo *et al.* 2022).

Moreover, behaviors such as inconsistent meal timing or high intake of processed foods can affect body weight and fat distribution, which may further impact menstrual regularity through hormonal mechanisms. Studies indicate that maintaining a balanced diet rich in whole grains, fruits, vegetables, and healthy fats is linked to lower severity and frequency of dysmenorrhea and premenstrual symptoms (Armour *et al.* 2019; Schrijvers *et al.* 2024).

Table 4 portrays the distribution of menstrual disorder status based on BMI-for-age

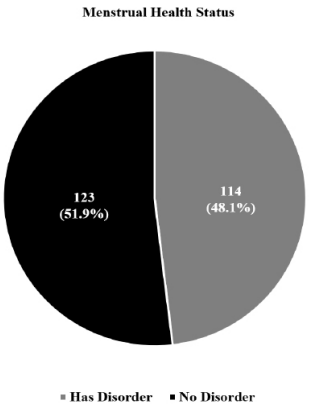

Figure 1. Distribution of menstrual health status of female students at SMK Shah Alam

classification among respondents. Individuals with severe thinness (71.4%) and thinness (62.5%) reported having menstrual disorders compared to those without. Individuals with a normal BMI had 55.6% of menstrual disorders, while those classified as overweight (34.5%) and obese (36.6%) had lower rates of menstrual disorders. These results are consistent with national data showing an increase in overweight and obesity among Malaysian teenagers, especially in urban areas (Lai *et al.* 2022; Zulfarina *et al.* 2022). On the other hand, rural areas like Sabah continue to have higher rates of undernutrition (Lai *et al.* 2024).

Menstrual health status and BMI-for-age were shown to be significantly correlated (χ^2=11.221, df=4, p=0.024), even though 40.0% of predicted cell counts were below five. In comparison to those with normal BMI (55.6%), overweight (34.5%), and obesity (36.6%), those with severe thinness (71.4%) and thinness (62.5%) reported higher proportions of menstruation problems. These results imply that a lower BMI can be associated with a higher chance of menstrual irregularities. It is worth mentioning, however, that four cells (40.0%) had predicted counts less than five, with a lowest expected count of 3.37. This partially contradicts the Chi-square assumption, potentially affecting the statistical inference's robustness. As a result, while the observed connection shows a significant link between BMI category and menstrual health, the findings should be interpreted cautiously. Despite this limitation, the results indicate that BMI-for-age is significantly associated with menstrual health status in this study population.

Table 4. Association between BMI-for-Age and lifestyle factors classification on menstrual health among respondents

Classification	Menstrual		χ^2	*p*
	No disorders	Has disorders		
	n (%) (n=237)			
BMI-for-age			11.221[a]	0.024
Severe thinness	2 (28.6)	5 (71.4)		
Thinness	3 (37.5)	5 (62.5)		
Normal	56 (44.4)	70 (55.6)		
Overweight	36 (65.5)	19 (34.5)		
Obese	26 (63.4)	15 (36.6)		
Eating habits			10.978[b]	0.004
Poor	2 (28.6)	5 (71.4)		
Moderate	111 (50.5)	109 (49.5)		
Excellent	10 (100.0)	0 (0.0)		
Physical activity			7.148[c]	0.028
Low	91 (47.6)	100 (52.4)		
Moderate	27 (69.2)	12 (30.8)		
High	5 (71.4)	2 (28.6)		

Statistical test: Chi-square, p-value significant if p<0.05; BMI: Body Mass Index

This is in line with earlier research showing that hormonal disturbance and limited energy availability make underweight teenagers more susceptible to menstrual irregularities including oligomenorrhea and amenorrhea (Paolo *et al.* 2024). Low BMI is frequently caused by insufficient calorie intake or extreme physical effort, which can delay menarche or cause amenorrhea. Paolo *et al.* (2024) noted that a lack of energy disturbs the HPO axis by reducing estrogen production, resulting in irregular menstrual periods.

Table 4 also portrays the association between eating behaviour and pattern category and respondents' menstrual health status. The majority of those with poor eating habits (71.4%) were reported to have menstrual problems. Additionally, nearly half (49.5%) of respondents with moderate eating habits reported menstruation difficulties, whereas the other half (50.5%) did not. Notably, none of the respondents who demonstrated excellent dietary habits reported having menstruation difficulties.

The chi-square test revealed a significant correlation between eating habits and menstrual health (χ^2=10.978, p=0.004). These findings imply that improved eating habits are connected with a lower frequency of menstruation problems. However, it is worth mentioning that three cells (50.0%) had predicted counts below 5, with a minimum expected count of 3.37.

According to Güzeldere *et al.* (2024), dysmenorrhea and irregular menstruation were more common in teenagers who ate nutrient-poor diets and had irregular eating habits. Ahmed and Mohammed Lotfy (2024) observed in another Egyptian study that women who experienced severe menstruation symptoms were less likely to follow the Mediterranean diet.

Apart from that, table 4 also demonstrates how respondents' menstrual health status varies based on their amount of physical activity. More than half (52.4%) of women with poor physical activity reported menstruation abnormalities, with the remaining 47.6% having no menstrual disturbances. In contrast, only 30.8% of respondents in the moderate activity group and 28.6% of those with high activity levels reported menstruation abnormalities, indicating that menstrual health difficulties are less common among more physically active people.

A statistically significant connection (χ^2=7.148, df=2, p=0.028) was verified by a chi-square test, indicating that better menstrual health outcomes may be associated with more physical activity. It should be noted, however, that two cells (33.3%) had predicted counts less than five, which may have reduced the statistical inference's robustness. As a result, while the data show that increased physical activity may help to enhance menstrual health, they should be viewed with caution.

According to Tsai *et al.* (2024), regular aerobic, resistance, and relaxation workouts greatly reduced primary dysmenorrhea symptoms, especially after eight weeks of treatment. Similarly, regular physical exercise was linked to a lower severity of common menstruation symptoms, such as cramps, irregular bleeding, and premenstrual discomfort, according to a worldwide scoping review by Harvey *et al.* (2025).

The results demonstrate a clear link between adolescent menstrual health and lifestyle factors, including BMI, dietary habits, and physical activity. Underweight adolescents are at greater risk for irregular menstruation and dysmenorrhea due to energy insufficiency and hormonal disruption. Poor eating behaviors, including meal skipping and emotional eating, are associated with higher prevalence of menstrual disorders, highlighting the importance of structured, nutrient-dense diets. Low physical activity exacerbates menstrual discomfort, whereas regular exercise mitigates symptoms and supports reproductive health. Overall, these findings emphasize the need for multifaceted interventions promoting healthy body weight, balanced diets, and consistent physical activity to improve menstrual health and reduce the functional impacts of menstrual disorders among adolescents.

Future studies should consider using a longitudinal study, as opposed to cross-sectional research, allow respondents to be tracked throughout time, which improves the evaluation of temporal changes and causal conclusions. Future research is also encouraged to use objective measurement tools such as by using digital food diaries, wearable activity trackers, or mobile-based menstrual tracking apps to improve data reliability, as the current study's reliance on self-reported questionnaires may have introduced recall and social desirability biases. Incorporating psychosocial and mental health variables using instruments like the Depression, Anxiety, and Stress Scale (DASS-21) is another worthwhile endeavor, as they could serve as mediators in the relationship between lifestyle factors and menstruation outcomes. A greater understanding of the intricate relationship between reproductive function and mental health may be possible by taking into account the emotional components of adolescence.

CONCLUSION

The results revealed a significant frequency of menstrual problems among the respondents, with dysmenorrhea being the most commonly reported condition. The study found that students with severe thinness and those with thinness had the highest incidence of menstrual issues, followed by those with normal BMI, whereas those with overweight and obesity had lower rates. In addition, respondents with poor food habits reported a higher prevalence of menstruation issues than those with good or excellent eating behaviour and patterns. Notably, students with excellent dietary habits did not report any menstruation issues. Physical activity levels also had an impact, as students with low physical activity were more likely to have menstrual abnormalities than those with moderate and high activity levels. These findings emphasize the importance of maintaining a healthy BMI, eating balanced and consistent meals, and engaging in

regular physical activity to support menstrual health and, as a result, improve adolescent girls' overall quality of life. Given the significant impact that menstruation difficulties have on school attendance, academic performance, and psychological well-being, early and focused interventions in school settings are critical.

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DECLARATION OF CONFLICT OF INTEREST

The authors declare no conflict of interest.

DECLARATION OF GENERATIVE AI IN SCIENTIFIC WRITING

The authors declare that no generative AI tools were used in this study.

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