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Original article

Factors Associated with Early Menarche and Menstrual Cycle Irregularity among Adolescent Girls in Sabratha, Libya

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Abstract
Early menarche is an important marker of pubertal development and may be associated with adverse menstrual, nutritional, and psychological outcomes. However, evidence regarding its prevalence and associated factors among adolescent girls in Libya remains limited. This study aimed to determine the prevalence of early menarche among adolescent girls in Sabratha, Libya, and to examine its associations with body mass index (BMI), familial history, lifestyle factors, menstrual health, and psychological well-being. A cross-sectional study was conducted among 644 adolescent girls attending selected educational institutions in Sabratha, Libya. Data were collected on sociodemographic characteristics, age at menarche, menstrual patterns, anthropometric measures, family history, lifestyle behaviors, sleep, dietary habits, and psychological factors. BMI-for-age was classified according to the World Health Organization 2007 growth reference standards. Data were analyzed using R software (version 4.3.2), and multivariable logistic regression was performed to identify factors associated with early menarche. Early menarche, defined as menarche before 12 years of age, was reported in 47.4% of participants, while 52.6% experienced menarche at 12 years or older. Compared with normal-weight participants, overweight adolescents had higher odds of early menarche (adjusted odds ratio [aOR] = 2.43), while those with obesity had substantially higher odds (aOR = 5.34). Physical activity was associated with lower odds of early menarche (aOR = 0.33). Dysmenorrhea was reported by 77.0% of participants, and school absenteeism due to menstrual pain was reported in 51.0% of those affected. Menstrual irregularity was particularly common among girls who experienced menarche before 11 years of age, reaching 75.6%. Frequent stress or anxiety was reported by 48.3% of participants, and 50.2% perceived that psychological stress affected their menstrual timing. Menstruation-related sleep disturbances were also associated with psychological burden (aOR = 3.18). Early menarche was common among adolescent girls in Sabratha and was associated with higher BMI, familial predisposition, and lifestyle factors. The high burden of dysmenorrhea, menstrual irregularity, psychological distress, and school absenteeism highlights the need for school-based health education and multidisciplinary support. Interventions promoting healthy weight, regular physical activity, menstrual health literacy, and access to psychological and gynecological counseling may help improve adolescent girls' health and quality of life.
Keywords. Early Menarche, Adolescents, Body Mass Index, Menstrual Disorders, Dysmenorrhea.

Introduction

Adolescence is a critical transitional period characterized by rapid physical and reproductive maturation. During this stage, menarche—defined as the first menstrual period—serves as a primary clinical indicator of female pubertal development, reflecting the functional maturation of the reproductive system [1]. In recent decades, the age at menarche has shown a declining trend globally, a shift that is significantly associated with changes in nutritional status and elevated Body Mass Index (BMI) [1]. The negative correlation between age at menarche and BMI is well-documented in recent literature, demonstrating that earlier menarche is a strong explanatory factor for higher BMI in adolescent populations [2]. While this early onset and its association with overweight carries long-term health risks, evidence suggests that socio-economic factors do not significantly alter the timing of menarche itself [3].

Beyond nutritional implications, early menarche has profound effects on overall menstrual health. Clinical evaluations indicate that girls who experience menarche before the age of 12 are significantly more likely to suffer from prolonged menstrual flow and severe dysmenorrhea, irrespective of their BMI [4]. In addition to physical health, the psychological burden of early menarche is substantial and requires a holistic approach. The immediate psychological response to menarche is heavily influenced by the adolescent's age, perception, and health literacy, often leading to acute distress if unguided [5]. This psychological impact is not transient; early menarche has been closely linked to a higher prevalence of generalized anxiety symptoms that can persist well into early adulthood [6]. In the regional context, the interplay between psychological stress and menstrual abnormalities is particularly evident among young females. Recent cross-sectional studies conducted in Syria and Iraq have consistently demonstrated that moderate to high perceived stress acts as a major risk factor for severe dysmenorrhea, premenstrual syndrome (PMS), and heavy bleeding [7,8].

Despite the extensive global and regional literature, specific data regarding the intersection of BMI, menstrual health, and psychological factors among adolescents in Libya remains limited. Therefore, this study aims to evaluate the prevalence of early menarche among adolescents in Sabratha, investigating its direct association with BMI, menstrual disorders, and underlying psychological stress.

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Methodology

Study Design and Population

This study employed a cross-sectional design to investigate the age at menarche, its associated factors, and menstrual cycle regularity among adolescent girls in Sabratha. The target population comprised adolescent and young females aged 11–16 years residing in Sabratha. Participants were recruited from four educational institutions representing different educational levels: Al-Kharsan Girls' School and Nusaiba Bint Ka'ab School at the primary level, Khadija Bint Khuwaylid School at the preparatory/secondary level, and Sabratha Girls' Secondary School at the secondary level.

The study included female students aged 11–16 years who had already experienced menarche, were currently enrolled in one of the selected schools, and provided informed consent to participate. Females who had not yet experienced menarche, those with a diagnosed chronic illness, those currently using contraceptives or medications intended to regulate menstruation, and pregnant participants were excluded from the study.

Anthropometric Assessment

Anthropometric measurements were performed to assess the nutritional status of the participants. Height and weight were measured using standardized techniques, and body mass index (BMI) was calculated by dividing body weight in kilograms by the square of height in meters (kg/m^2). Based on their BMI values, participants were classified into four anthropometric categories: thinness, normal weight, overweight, and obesity. These categories were subsequently incorporated into bivariate and multivariable logistic regression analyses to examine the associations between nutritional status, particularly excess body weight, and early menarche as well as menstrual cycle irregularity.

Result

Data were analyzed using R statistical software (version 4.3.2; R Foundation for Statistical Computing, Vienna, Austria). Continuous variables were summarized as means and standard deviations (mean ± SD), whereas categorical variables were presented as frequencies and percentages. Early menarche was defined as age at menarche ≤12 years, while >12 years was classified as non-early menarche. Menstrual cycle regularity was analyzed as a binary outcome (regular vs irregular). Bivariate comparisons were performed using appropriate statistical tests according to the type of variable.

Multivariable logistic regression analysis was subsequently conducted to identify factors independently associated with early menarche (<12 years) and menstrual cycle irregularity. Adjusted odds ratios (aORs) with 95% confidence intervals (CIs) were reported. An aOR >1 indicated higher odds of the outcome, whereas an aOR <1 indicated lower odds relative to the reference category. Statistical significance was defined as $P < 0.05$, with all tests being two-sided.

As shown in (Table 1), the study included 644 adolescent girls, with a mean age of 14.57 ± 1.22 years. The participants were predominantly from urban areas (80.0%) and were mainly enrolled at the preparatory and secondary educational levels (45.5% and 49.4%, respectively). Nearly all participants were single (98.1%), consistent with the adolescent age profile of the study population. The mean height, weight, and BMI were 157.95 ± 5.88 cm, 58.11 ± 12.55 kg, and 23.25 ± 4.57 kg/m^2, respectively. Normal weight was the most prevalent BMI category (52.2%); however, 27.2% were overweight, and 15.8% were obese, indicating that 42.9% of participants had excess weight. This anthropometric profile provides an important context for examining the relationship between nutritional status and the timing of menarche in subsequent analyses.

Table 1. Sociodemographic and anthropometric characteristics of the participants (N = 644)

Variable	Overall, N = 644
Age, years	14.57 ± 1.22
Age group, n (%)	
11- 12	33(5.1)
13- 14	228(35.4)
15- 16	38 3(59.5)
Place of residence, n (%)	
Urban	515 (80.0)
Rural	129 (20.0)
Educational level, n (%)	
Primary	33 (5.1)
Preparatory	293 (45.5)
Secondary	318 (49.4)
Marital status, n (%)	
Single	632 (98.1)
Married	12 (1.9)
Height, cm	157.95 ± 5.88
Weight, kg	58.11 ± 12.55
BMI, kg/m^2	23.25 ± 4.57

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BMI category, n (%)	
Thinness	31 (4.8)
Normal	336 (52.2)
Overweight	175 (27.2)
Obesity	102 (15.8)

The distribution of age at menarche was concentrated mainly between 11 and 14 years, with 40.4% of participants reporting menarche at 11–12 years and 48.9% at 12–13 years. Menarche before 11 years was reported by 7.0% of participants. Menstrual cycles were regular in 67.1%, whereas 32.9% reported irregular cycles. Regarding cycle characteristics, 45.5% reported a cycle length of 21–35 days, while 26.2% had cycles shorter than 21 days and 28.3% had cycles longer than 35 days. Most participants reported menstrual bleeding lasting 3–7 days (61.8%). Dysmenorrhea was highly prevalent, affecting 77.0% of participants; among those reporting dysmenorrhea, moderate pain was most common (57.7%), followed by severe pain (33.1%). Furthermore, 51.0% of participants with dysmenorrhea reported school absenteeism due to menstrual pain, indicating a considerable functional and educational burden. These menstrual characteristics are summarized in (Table 2).

Table 2. Menstrual characteristics of the participants (N = 644)

Variable	Overall, n (%)
Age at menarche	
Less than 11 years	45 (7.0)
11–12 years	260 (40.4)
12–13 years	315 (48.9)
13 years or More	24 (3.7)
Menstrual cycle regularity	
Regular	432 (67.1)
Irregular	212 (32.9)
Cycle length	
<21 days	169 (26.2)
21–35 days	293 (45.5)
>35 days	182 (28.3)
Duration of menstrual bleeding	
<3 days	46 (7.1)
3–7 days	398 (61.8)
>7 days	200 (31.1)
Dysmenorrhea	
Yes	496 (77.0)
No	148 (23.0)
Dysmenorrhea severity*	
Mild	46 (9.3)
Moderate	286 (57.7)
Severe	164 (33.1)
School absenteeism due to menstrual pain*	
Yes	253 (51.0)
No	243 (49.0)

Note: Percentages for dysmenorrhea severity and school absenteeism are calculated among participants with dysmenorrhea (n = 496), not among the total sample of 644.

The distribution of family, lifestyle, sleep, dietary, and psychological characteristics of the participants is presented in (Table 3). Half of the participants had mothers with an average age at menarche of 12–14 years (50.5%), while 24.2% reported maternal menarche before 12 years. Among participants with sisters (n = 606), 23.4% reported that their sisters had experienced menarche before 12 years. Lifestyle characteristics showed that 66.5% of participants reported very low physical activity, while 62.7% reported no regular exercise.

In addition, 60.6% reported more than 6 hours of sedentary time per day. Regarding sleep characteristics, 42.9% reported sleeping for ≥8 hours per day, while 15.8% reported sleeping for <5 hours. Although 64.4% considered their sleep restful and sufficient, 67.7% reported sleep difficulties or early awakening, and 71.1% reported that menstruation affected their sleep. Regarding dietary habits, 50.2% reported consuming three meals per day, while 59.2% did not regularly eat breakfast. Fast-food consumption more than three times per week was reported by 39.6% of participants.

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Regular consumption of dairy products and fruits/vegetables was reported by 42.1% and 35.7% of participants, respectively. Psychologically, 48.3% reported frequent stress or anxiety, and 50.2% reported that stress or anxiety caused changes in menstrual timing. Most participants described their relationship with family and friends as average (69.7%).

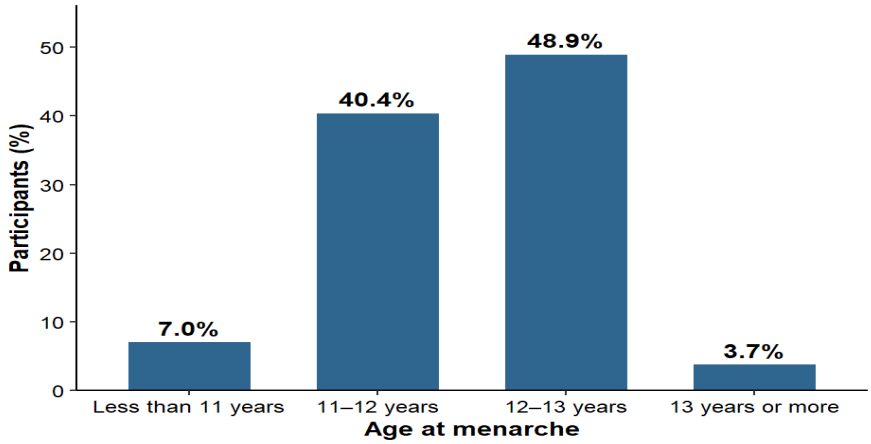

Figure 1. Distribution of age at menarche among adolescent girls in Sabratha, Libya.

The distribution of age at menarche was concentrated predominantly between 11 and 13 years. Almost half of the participants (48.9%) reported menarche at 12–13 years, followed by 40.4% at 11–12 years. Menarche before 11 years was reported by 7.0% of participants, while 3.7% experienced menarche at 13 years or more. Overall, the distribution shows that most participants experienced menarche between 11 and 13 years, with a smaller proportion reporting menarche before 11 years or at 13 years or more.

Table 3. Family history, lifestyle, sleep, dietary, and psychological characteristics of the participants (N = 644)

Variable	Overall, n (%)
Family history	
Mother's age at menarche	
Early (<12 years)	156 (24.2)
Average (12–14 years)	325 (50.5)
Late (>14 years)	163 (25.3)
Sisters' age at menarche*	
Early (<12 years)	142 (23.4)
Average (12–14 years)	234 (38.6)
Late (>14 years)	230 (38.0)
Physical activity	
Very low	428 (66.5)
Moderate	164 (25.5)
Active	52 (8.1)
Exercise frequency	
No	404 (62.7)
Sometimes (1–2 times/week)	172 (26.7)
Regularly (≥3 times/week)	68 (10.6)
Sedentary time/day	
<3 hours	72 (11.2)
3–6 hours	182 (28.3)
>6 hours	390 (60.6)
Sleep duration	
<5 hours	102 (15.8)
5–7 hours	266 (41.3)
≥8 hours	276 (42.9)
Restful and sufficient sleep	
Yes	415 (64.4)
No	229 (35.6)
Sleep difficulty/early awakening	
Yes	436 (67.7)
No	208 (32.3)

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Usual bedtime	
Before 10:00 PM	53 (8.2)
10:00 PM–12:00 AM	209 (32.5)
After 12:00 AM	382 (59.3)
Menstruation affects sleep	
Yes	458 (71.1)
No	186 (28.9)
Dietary habits	
Meals/day	
<2 meals	96 (14.9)
3 meals	323 (50.2)
>3 meals	225 (34.9)
Regular breakfast	
Yes	263 (40.8)
No	381 (59.2)
Fast-food consumption	
Rarely	153 (23.8)
1–2 times/week	236 (36.6)
>3 times/week	255 (39.6)
Regular dairy consumption	
Yes	271 (42.1)
No	373 (57.9)
Regular fruit/vegetable consumption	
Yes	230 (35.7)
No	414 (64.3)
Psychological characteristics	
Frequent stress/anxiety	
Yes	311 (48.3)
No	333 (51.7)
Stress/anxiety causes menstrual timing changes	
Yes	323 (50.2)
No	321 (49.8)
Family/friend relationship	
Very good	128 (19.9)
Average	449 (69.7)
Poor	67 (10.4)

** Percentages are based on participants who had sisters (n = 606).*

A clear pattern of variation in the distribution of early menarche was observed across several demographic, anthropometric, familial, and lifestyle characteristics (Table 4). Age was significantly associated with early menarche (P < 0.001), with early menarche observed in 100.0% of participants aged 11 and 12 years, compared with 63.1% among those aged 13 years, 44.8% among those aged 14 years, 38.1% among those aged 15 years, and 41.2% among those aged 16 years. Educational level was also significantly associated with early menarche (P < 0.001), with early menarche observed in 93.9% of participants at the primary level, 51.9% at the preparatory level, and 38.4% at the secondary level.

BMI category was significantly associated with early menarche (P < 0.001). The proportion of early menarche was 32.9% among participants with thinness, 41.8% among those with normal BMI, 56.9% among those who were overweight, and 82.1% among those with obesity. Maternal menarcheal timing was also significantly associated with early menarche (P < 0.001), with early menarche observed in 68.6% of participants whose mothers had experienced early menarche, compared with 41.8% among those whose mothers had average-age menarche and 38.0% among those whose mothers had late menarche. Sister's menarcheal category was significantly associated with early menarche (P = 0.017), with the proportion ranging from 28.9% among participants with no sisters to 53.0% among those whose sisters had average-age menarche.

Lifestyle characteristics also showed significant associations with early menarche. Physical activity level was significantly associated with early menarche (P < 0.001), with early menarche observed in 56.1% of participants reporting very low physical activity, compared with 30.5% among those reporting moderate activity and 28.8% among those classified as active. Exercise frequency was also significantly associated with early menarche (P = 0.026), with early menarche observed in 50.0% of participants reporting no exercise, 47.1% among those exercising sometimes (1–2 times/week), and 32.4% among those exercising regularly (≥3 times/week). Usual bedtime was significantly associated with early menarche (P = 0.011), with early menarche observed in 66.0% of participants who usually went to sleep before 10:00 PM, 48.3% among those going to sleep between 10:00 PM and 12:00 AM, and 44.2% among those going to sleep after midnight. Menstruation

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affecting sleep was also significantly associated with early menarche (P < 0.001), with early menarche observed in 54.8% of participants whose sleep was affected by menstruation, compared with 29.0% among those whose sleep was not affected.

Among dietary characteristics, the number of meals consumed per day was significantly associated with early menarche (P = 0.024), with early menarche observed in 44.8% of participants consuming fewer than two meals per day, 43.0% among those consuming three meals, and 54.7% among those consuming more than three meals per day. In contrast, regular breakfast consumption, fast-food consumption, regular dairy consumption, and regular fruit and vegetable consumption were not significantly associated with early menarche (P > 0.05).

No statistically significant associations were observed between early menarche and place of residence, sedentary time, sleep duration, restful and sufficient sleep, sleep difficulty or early awakening, frequent stress or anxiety, perceived stress-related changes in menstrual timing, or family/friend relationships (P > 0.05). Overall, the bivariate analysis identified age, educational level, BMI category, maternal and sister's menarcheal timing, physical activity, exercise frequency, usual bedtime, menstruation-related effects on sleep, and number of meals per day as variables significantly associated with early menarche. These variables may therefore be considered for further evaluation in multivariable logistic regression analysis.

Table 4. Characteristics of participants according to early menarche status

Variable	Early menarche, n (%)	Non-early menarche, n (%)	P-value
Age group, years			<0.001*
11	10 (100.0)	0 (0.0)	
12	23 (100.0)	0 (0.0)	
13	65 (63.1)	38 (36.9)	
14	56 (44.8)	69 (55.2)	
15	83 (38.1)	135 (61.9)	
16	68 (41.2)	97 (58.8)	
Place of residence			0.782
Urban	242 (47.0)	273 (53.0)	
Rural	63 (48.8)	66 (51.2)	
Educational level			<0.001*
Primary	31 (93.9)	2 (6.1)	
Preparatory	152 (51.9)	141 (48.1)	
Secondary	122 (38.4)	196 (61.6)	
BMI category			<0.001*
Thinness	24 (32.9)	49 (67.1)	
Normal	161 (41.8)	224 (58.2)	
Overweight	74 (56.9)	56 (43.1)	
Obesity	46 (82.1)	10 (17.9)	
Mother's menarche category			<0.001*
Early (<12 years)	107 (68.6)	49 (31.4)	
Average (12–14 years)	136 (41.8)	189 (58.2)	
Late (>14 years)	62 (38.0)	101 (62.0)	
Sister's menarche category			0.017*
No sister	11 (28.9)	27 (71.1)	
Early (<12 years)	59 (41.5)	83 (58.5)	
Average (12–14 years)	124 (53.0)	110 (47.0)	
Late (>14 years)	111 (48.3)	119 (51.7)	
Physical activity			<0.001*
Very low	240 (56.1)	188 (43.9)	
Moderate	50 (30.5)	114 (69.5)	
Active	15 (28.8)	37 (71.2)	
Exercise frequency			0.026*
No	202 (50.0)	202 (50.0)	
Sometimes (1–2 times/week)	81 (47.1)	91 (52.9)	
Regularly (≥3 times/week)	22 (32.4)	46 (67.6)	
Sedentary time/day			0.643
<3 hours	34 (47.2)	38 (52.8)	
3–6 hours	81 (47.1)	91 (52.9)	
>6 hours	190 (48.7)	200 (51.3)	

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Sleep duration			0.301
<5 hours	51 (50.0)	51 (50.0)	
5–7 hours	133 (50.0)	133 (50.0)	
≥8 hours	121 (43.8)	155 (56.2)	
Restful and sufficient sleep			0.736
Yes	194 (46.7)	221 (53.3)	
No	111 (48.5)	118 (51.5)	
Sleep difficulty/early awakening			1.000
Yes	206 (47.2)	230 (52.8)	
No	99 (47.6)	109 (52.4)	
Usual bedtime			0.011*
Before 10:00 PM	35 (66.0)	18 (34.0)	
10:00 PM–12:00 AM	101 (48.3)	108 (51.7)	
After 12:00 AM	169 (44.2)	213 (55.8)	
Menstruation affects sleep			<0.001*
Yes	251 (54.8)	207 (45.2)	
No	54 (29.0)	132 (71.0)	
Meals/day			0.024*
<2 meals	43 (44.8)	53 (55.2)	
3 meals	139 (43.0)	184 (57.0)	
>3 meals	123 (54.7)	102 (45.3)	
Regular breakfast			0.993
Yes	124 (47.1)	139 (52.9)	
No	181 (47.5)	200 (52.5)	
Fast-food consumption			0.245
Rarely	67 (43.8)	86 (56.2)	
1–2 times/week	107 (45.3)	129 (54.7)	
>3 times/week	131 (51.4)	124 (48.6)	
Regular dairy consumption			0.507
Yes	133 (49.1)	138 (50.9)	
No	172 (46.1)	201 (53.9)	
Regular fruit/vegetable consumption			0.466
Yes	104 (45.2)	126 (54.8)	
No	201 (48.6)	213 (51.4)	
Frequent stress/anxiety			0.506
Yes	152 (48.9)	159 (51.1)	
No	153 (45.9)	180 (54.1)	
Stress/anxiety causes menstrual timing changes			0.816
Yes	151 (46.7)	172 (53.3)	
No	154 (48.0)	167 (52.0)	
Family/friend relationship			0.252
Very good	69 (53.9)	59 (46.1)	
Average	205 (45.7)	244 (54.3)	
Poor	31 (46.3)	36 (53.7)	

P-values were obtained using Pearson's chi-squared test; Yates' continuity correction was applied automatically by R for 2×2 tables. Percentages are calculated within each category of the corresponding variable. Early menarche was defined using the corrected classification (Early_Menarche_corrected).

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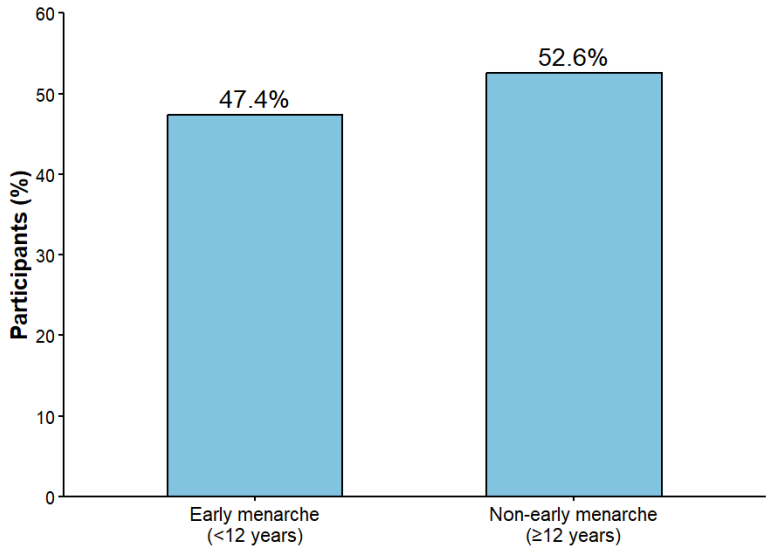

Figure 2. Distribution of Menarche by Early (< 12 years) and Non-Early (≥12 years) Onset Among Adolescent Girls in Sabratha, Libya

Note: Early menarche (<12 years) was observed in 47.4% of participants, while 52.6% experienced menarche at 12 years or older. This distribution indicates that nearly half of the participants experienced menarche before the age of 12 years.

Menstrual cycle regularity was significantly associated with several menstrual, anthropometric, sleep-related, and behavioral characteristics (Table 5). The distribution of cycle regularity varied significantly according to age at menarche (P < 0.001), with regular cycles increasing from 24.4% among participants who experienced menarche before 11 years to 62.5% among those with menarche at 13 years or older. Educational level was also significantly associated with menstrual cycle regularity (P = 0.002), with regular cycles reported by 18.2% of participants at the primary level, 44.4% at the preparatory level, and 49.4% at the secondary level.

BMI category showed a significant association with menstrual cycle regularity (P < 0.001). Regular cycles were reported by 52.1% of underweight participants and 50.6% of those with normal weight, compared with 33.1% of overweight participants and 30.4% of those with obesity. Thus, the proportion of irregular cycles was higher among participants with overweight or obesity than among those with lower BMI categories.

Exercise frequency was significantly associated with menstrual cycle regularity (P = 0.039). Regular cycles were reported by 50.0% of participants who reported no exercise, 47.1% of those exercising 1–2 times per week, and 32.4% of those exercising regularly (≥3 times/week). Sleep duration was also significantly associated with cycle regularity (P = 0.001), with regular cycles reported by 50.0% of participants sleeping <5 hours, 50.0% of those sleeping 5–7 hours, and 43.8% of those sleeping ≥8 hours.

Menstruation-related sleep effects were significantly associated with menstrual cycle regularity (P < 0.001). Regular cycles were observed in 41.3% of participants whose sleep was affected by menstruation, compared with 55.9% among those whose sleep was not affected. Dietary and psychological characteristics also showed selected associations: fast-food consumption was significantly associated with cycle regularity (P < 0.001), dairy consumption showed a significant association (P = 0.034), and frequent psychological stress or anxiety was significantly associated with cycle regularity (P < 0.001).

In contrast, age group, place of residence, maternal and sister's age at menarche, overall physical activity level, sedentary time, restful and sufficient sleep, sleep difficulty or early awakening, usual bedtime, number of meals per day, regular breakfast consumption, fruit and vegetable consumption, stress-related menstrual timing changes, and family/friend relationships were not significantly associated with menstrual cycle regularity at the bivariate level (P > 0.05).

Overall, the bivariate analysis identified age at menarche, educational level, BMI category, exercise frequency, sleep duration, menstruation-related sleep effects, fast-food consumption, dairy consumption, and frequent psychological stress/anxiety as variables significantly associated with menstrual cycle regularity. These variables may therefore be considered for further evaluation in multivariable analyses.

Table 5. Characteristics of participants according to menstrual cycle regularity (N = 644)

Variable	Regular, n (%)	Irregular,n (%)	P-value
Age group, years			0.149
11	1 (10.0)	9 (90.0)	
12	7 (30.4)	16 (69.6)	
13	47 (45.6)	56 (54.4)	
14	62 (49.6)	63 (50.4)	
15	99 (45.4)	119 (54.6)	

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16	77 (46.7)	88 (53.3)	
Age at menarche			<0.001*
Less than 11 years	11 (24.4)	34 (75.6)	
11–12 years	87 (33.5)	173 (66.5)	
12–13 years	180 (57.1)	135 (42.9)	
>13 years	15 (62.5)	9 (37.5)	
Place of residence			0.451
Urban	230 (44.7)	285 (55.3)	
Rural	63 (48.8)	66 (51.2)	
Educational level			0.002*
Primary	6 (18.2)	27 (81.8)	
Preparatory (Middle School)	130 (44.4)	163 (55.6)	
Secondary (High School)	157 (49.4)	161 (50.6)	
BMI category			<0.001*
Underweight	38 (52.1)	35 (47.9)	
Normal weight	195 (50.6)	190 (49.4)	
Overweight	43 (33.1)	87 (66.9)	
Obesity	17 (30.4)	39 (69.6)	
Mother's age at menarche			0.065
Early (<12 years)	67 (42.9)	89 (57.1)	
Average (12–14 years)	139 (42.8)	186 (57.2)	
Late (>14 years)	87 (53.4)	76 (46.6)	
Sister's age at menarche			0.525
No sister	18 (47.4)	20 (52.6)	
Early (<12 years)	61 (43.0)	81 (57.0)	
Average (12–14 years)	115 (49.1)	119 (50.9)	
Late (>14 years)	99 (43.0)	131 (57.0)	
Physical activity			0.516
Very low	188 (43.9)	240 (56.1)	
Moderate	79 (48.2)	85 (51.8)	
Active	26 (50.0)	26 (50.0)	
Exercise frequency			0.039*
No	202 (50.0)	202 (50.0)	
Sometimes (1–2 times/week)	81 (47.1)	91 (52.9)	
Regularly (≥3 times/week)	22 (32.4)	46 (67.6)	
Sedentary time/day			0.067
<3 hours	34 (47.2)	38 (52.8)	
3–6 hours	81 (47.1)	91 (52.9)	
>6 hours	190 (48.7)	200 (51.3)	
Sleep duration			0.001*
<5 hours	51 (50.0)	51 (50.0)	
5–7 hours	133 (50.0)	133 (50.0)	
≥8 hours	121 (43.8)	155 (56.2)	
Restful and sufficient sleep			0.347
Yes	194 (46.7)	221 (53.3)	
No	99 (43.2)	130 (56.8)	
Sleep difficulty/early awakening			0.183
Yes	206 (47.2)	230 (52.8)	
No	87 (41.8)	121 (58.2)	
Usual bedtime			0.988
Before 10:00 PM	35 (66.0)	18 (34.0)	
10:00 PM–12:00 AM	101 (48.3)	108 (51.7)	
After 12:00 AM	157 (41.1)	225 (58.9)	
Menstruation affects sleep			<0.001*
Yes	189 (41.3)	269 (58.7)	
No	104 (55.9)	82 (44.1)	
Meals/day			0.121
<2 meals	46 (47.9)	50 (52.1)	

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3 meals	157 (48.6)	166 (51.4)	
>3 meals	90 (40.0)	135 (60.0)	
Regular breakfast			0.155
Yes	124 (47.1)	139 (52.9)	
No	169 (44.8)	208 (55.2)	
Fast-food consumption			<0.001*
Rarely	67 (43.8)	86 (56.2)	
1–2 times/week	107 (45.3)	129 (54.7)	
>3 times/week	119 (46.7)	136 (53.3)	
Regular dairy consumption			0.034*
Yes	133 (49.1)	138 (50.9)	
No	160 (42.9)	213 (57.1)	
Regular fruit/vegetable consumption			0.194
Yes	113 (49.1)	117 (50.9)	
No	180 (43.5)	234 (56.5)	
Frequent stress/anxiety			<0.001*
Yes	115 (37.0)	196 (63.0)	
No	178 (53.5)	155 (46.5)	
Stress/anxiety causes menstrual timing changes			0.070
Yes	135 (41.8)	188 (58.2)	
No	158 (49.2)	163 (50.8)	
Family/friend relationship			0.984
Very good	59 (45.9)	69 (54.1)	
Average	204 (45.4)	245 (54.6)	
Poor	30 (44.8)	37 (55.2)	

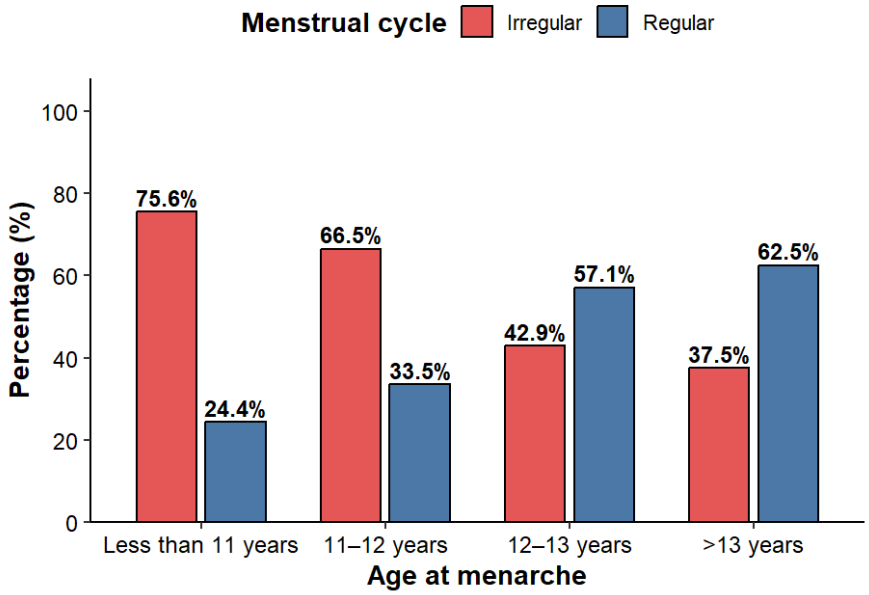

Figure 3. Distribution of Regular and Irregular Menstrual Cycles among Adolescent Girls in Sabratha, Libya

Note. Menstrual cycle regularity varied across age-at-menarche categories. The proportion of regular cycles increased from 24.4% among participants who experienced menarche before 11 years to 33.5% among those with menarche at 11–12 years, 57.1% among those with menarche at 12–13 years, and 62.5% among those with menarche 13 years or older. Conversely, the proportion reporting irregular cycles decreased across these categories, from 75.6% to 37.5%. The association between age at menarche and menstrual cycle regularity was statistically significant ($P < 0.001$).

Multivariable logistic regression analysis

The multivariable logistic regression analysis identified several factors that were statistically associated with early menarche among adolescent girls in Sabratha, Libya (Table 6). After adjustment for the other variables included in the

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model, significant associations were observed for educational level, BMI category, maternal age at menarche, some physical-activity measures, and the extent to which menstruation affected sleep.

BMI showed a clear association with early menarche. Compared with participants with normal weight, those who were overweight had higher odds of early menarche (OR 2.43, 95% CI: 1.41–4.21; P = 0.001), while those with obesity had substantially higher odds (OR 5.34, 95% CI: 2.41–11.84; P < 0.001). In contrast, underweight was not significantly associated with early menarche (OR 0.69, 95% CI: 0.37–1.30; P = 0.252).

Maternal age at menarche was also associated with the outcome. Participants whose mothers experienced menarche before 12 years had higher odds of early menarche than those whose mothers experienced menarche at 12–14 years (OR 2.92, 95% CI: 1.81–4.70; P < 0.001). Maternal late menarche was not statistically significant (OR 0.94, 95% CI: 0.59–1.48; P = 0.775).

Regarding sister-related reproductive history, participants whose sisters experienced menarche at 12–14 years had higher odds of early menarche compared with participants without sisters (OR 3.29, 95% CI: 1.36–7.96; P = 0.008). The associations for sisters with early menarche and late menarche were not statistically significant (P = 0.305 and P = 0.054, respectively).

Educational attainment was significantly associated with early menarche. Compared with participants at the primary educational level, those at the preparatory (middle-school) level had lower odds of early menarche (OR 0.14, 95% CI: 0.04–0.54; P = 0.004), as did those at the secondary (high-school) level (OR 0.07, 95% CI: 0.02–0.25; P < 0.001).

Physical activity was also significantly associated with early menarche. Compared with participants reporting very low physical activity, those reporting moderate activity had lower odds of early menarche (OR 0.34, 95% CI: 0.22–0.54; P < 0.001), as did those reporting active physical activity (OR 0.33, 95% CI: 0.15–0.73; P = 0.007). Similarly, regular exercise three or more times per week was associated with lower odds of early menarche compared with the reference category (OR 0.40, 95% CI: 0.19–0.80; P = 0.010).

A strong association was also observed between menstruation affecting sleep and early menarche. Participants who reported that menstruation affected their sleep had higher odds of early menarche compared with those who reported no effect (OR 3.18, 95% CI: 2.05–4.93; P < 0.001). In contrast, the measures of sleep duration, perceived sleep sufficiency, and usual bedtime were not statistically significant in the adjusted model.

Several other variables were not statistically associated with early menarche after adjustment, including place of residence, sedentary time, meal frequency, breakfast consumption, fast-food intake, dairy consumption, fruit and vegetable consumption, and the other included lifestyle and psychosocial variables (P > 0.05).

Overall, the adjusted analysis showed that early menarche was statistically associated with higher BMI, maternal early menarche, and menstruation-related sleep disturbance, while higher educational level and greater physical activity were associated with lower odds of early menarche. These findings represent adjusted associations rather than causal effects. Because the study was observational, the observed relationships should not be interpreted as evidence that these factors cause earlier menarche.

Table 6. Multivariable logistic regression analysis of factors associated with early menarche among adolescent girls in Sabratha, Libya

Variable	OR	95% CI	P-value
Place			
Rural vs Urban	1.106	0.688–1.779	0.678
Education			
Preparatory vs Primary	0.143	0.038–0.544	0.004
Secondary vs Primary	0.066	0.018–0.251	<0.001
BMI category			
Underweight vs Normal weight	0.694	0.372–1.296	0.252
Overweight vs Normal weight	2.434	1.406–4.212	0.001
Obesity vs Normal weight	5.337	2.406–11.840	<0.001
Mother's age at menarche (B1)			
Early (<12 years) vs Average	2.916	1.810–4.699	<0.001
Late (>14 years) vs Average	0.936	0.593–1.476	0.775
Sister's age at menarche (B2)			
Early (<12 years) vs No sister	1.624	0.643–4.101	0.305
Average (12–14 years) vs No sister	3.295	1.363–7.963	0.008
Late (>14 years) vs No sister	2.404	0.985–5.870	0.054
Physical activity (C1)			
Moderate vs Very low	0.342	0.216–0.540	<0.001
Active vs Very low	0.328	0.146–0.735	0.007
Exercise frequency (C2)			
Sometimes vs No	0.904	0.585–1.398	0.650

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Regularly vs No	0.396	0.195–0.804	0.010
Sedentary time (C3)			
3–6 hours vs <3 hours	0.924	0.475–1.797	0.816
>6 hours vs <3 hours	0.975	0.529–1.797	0.935
Sleep duration (C4)			
5–7 hours vs <5 hours	1.595	0.911–2.794	0.102
≥8 hours vs <5 hours	1.207	0.686–2.125	0.514
Restful sleep (C5)			
No vs Yes	0.990	0.649–1.510	0.963
Difficulty sleeping (C6)			
Yes vs No	1.018	0.670–1.546	0.934
Usual bedtime (C7)			
10 PM–12 AM vs Before 10 PM	0.605	0.279–1.310	0.202
After 12 AM vs Before 10 PM	0.539	0.253–1.149	0.109
Menstruation affects sleep (C8)			
Yes vs No	3.177	2.048–4.929	<0.001
Meals per day (D1)			
3 meals vs <2 meals	0.735	0.423–1.280	0.277
>3 meals vs <2 meals	0.869	0.471–1.604	0.653
Regular breakfast (D2)			
No vs Yes	1.005	0.665–1.518	0.981
Fast food frequency (D3)			
1–2 times/week vs Rarely	0.995	0.610–1.622	0.984
>3 times/week vs Rarely	0.784	0.460–1.338	0.373
Milk/dairy consumption (D4)			
No vs Yes	0.818	0.546–1.227	0.332
Fruit/vegetable consumption (D5)			
No vs Yes	1.196	0.782–1.828	0.410
Psychological stress/anxiety (E1)			
Yes vs No	0.981	0.627–1.534	0.932
Stress-related menstrual changes (E2)			
Yes vs No	1.000	0.641–1.558	0.999
Relationship with family/friends (E3)			
Average vs Very good	0.792	0.491–1.278	0.339
Poor vs Very good	0.819	0.404–1.659	0.579

Notes: Adjusted ORs were obtained from a multivariable logistic regression model. The dependent variable was early menarche (1 = early, 0 = non-early). OR >1 indicates higher odds of early menarche, whereas OR <1 indicates lower odds. The model included 644 participants. The University category was not included because there were no participants in this category. Age at menarche was not included as a predictor because the early-menarche outcome was derived from age at menarche. Bold P-values indicate statistical significance at P < 0.05.

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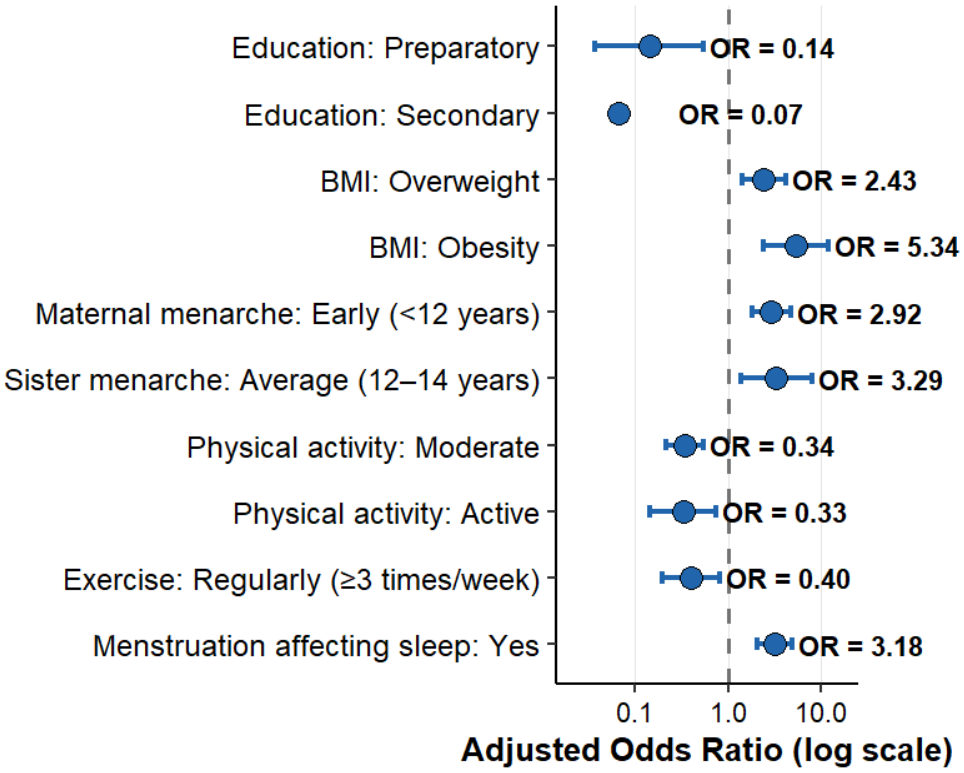

Figure 4. Adjusted odds ratios for factors associated with early menarche among adolescent girls in Sabratha, Libya.

In the multivariable logistic regression analysis, several factors were significantly associated with menstrual cycle irregularity after adjustment for the variables included in the model (Table 7). Compared with participants at the primary educational level, those at the preparatory and secondary levels had lower odds of menstrual cycle irregularity, with adjusted ORs of 0.22 (95% CI: 0.07–0.57; P = 0.003) and 0.17 (95% CI: 0.06–0.43; P < 0.001), respectively. Overweight was associated with higher odds of menstrual cycle irregularity compared with normal weight (aOR 1.86, 95% CI: 1.12–3.10; P = 0.017), whereas neither underweight nor obesity showed a statistically significant association.

Regarding family reproductive history, participants whose mothers had experienced menarche after 14 years had lower odds of menstrual cycle irregularity compared with those whose mothers had experienced menarche at 12–14 years (aOR 0.62, 95% CI: 0.41–0.95; P = 0.027). No statistically significant associations were observed for the categories of sister's age at menarche.

Among behavioral factors, exercising 1–2 times per week was associated with higher odds of menstrual cycle irregularity compared with no exercise (aOR 1.73, 95% CI: 1.15–2.61; P = 0.009). However, regular exercise ≥3 times per week was not significantly associated with the outcome. Similarly, 3–6 hours of sedentary time per day was associated with lower odds of menstrual cycle irregularity compared with less than 3 hours per day (aOR 0.50, 95% CI: 0.27–0.94; P = 0.031), whereas more than 6 hours was not statistically significant.

Sleep duration was also significantly associated with menstrual cycle irregularity. Compared with participants who reported sleeping less than 5 hours per night, those sleeping ≥8 hours had lower odds of menstrual cycle irregularity (aOR 0.37, 95% CI: 0.22–0.64; P < 0.001). In contrast, sleep duration of 5–7 hours was not significantly associated with the outcome. Perceived sleep sufficiency, sleep difficulty or early awakening, and usual bedtime were not statistically significant after adjustment.

Participants who reported that menstruation affected their sleep had higher odds of menstrual cycle irregularity than those who reported no effect (aOR 1.67, 95% CI: 1.13–2.47; P = 0.010).

Overall, the adjusted analysis identified educational level, overweight status, maternal age at menarche, exercise frequency, sedentary time, sleep duration, and menstruation-related effects on sleep as statistically significant correlates of menstrual cycle irregularity. The findings indicate associations between these factors and menstrual cycle irregularity but do not establish causality because of the observational nature of the study.

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Table 7. Multivariable logistic regression analysis of factors associated with menstrual cycle irregularity among adolescent girls in Sabratha, Libya

Variable	Adjusted OR (95% CI)	P-value
Place of residence		
Urban (reference)	1.00	—
Rural	0.97 (0.63–1.52)	0.909
Educational level		
Primary (reference)	1.00	—
Preparatory	0.22 (0.07–0.57)	0.003*
Secondary	0.17 (0.06–0.43)	<0.001*
BMI category		
Normal weight (reference)	1.00	—
Underweight	1.05 (0.59–1.86)	0.865
Overweight	1.86 (1.12–3.10)	0.017*
Obesity	1.69 (0.86–3.43)	0.136
Mother's menarche category		
Average (12–14 years) (reference)	1.00	—
Early (<12 years)	0.81 (0.52–1.27)	0.361
Late (>14 years)	0.62 (0.41–0.95)	0.027*
Sister's menarche category		
No sister (reference)	1.00	—
Early (<12 years)	1.13 (0.50–2.57)	0.766
Average (12–14 years)	0.76 (0.35–1.66)	0.494
Late (>14 years)	1.01 (0.45–2.24)	0.976
Physical activity		
Very low (reference)	1.00	—
Moderate	0.88 (0.58–1.34)	0.560
Active	0.74 (0.37–1.48)	0.387
Exercise frequency		
No (reference)	1.00	—
Sometimes (1–2 times/week)	1.73 (1.15–2.61)	0.009*
Regularly (≥3 times/week)	1.17 (0.63–2.17)	0.625
Sedentary time/day		
Less than 3 hours (reference)	1.00	—
3–6 hours	0.50 (0.27–0.94)	0.031*
More than 6 hours	0.74 (0.41–1.31)	0.309
Sleep duration		
Less than 5 hours (reference)	1.00	—
5–7 hours	0.74 (0.43–1.25)	0.261
≥8 hours	0.37 (0.22–0.64)	<0.001*
Restful and sufficient sleep		
Yes (reference)	1.00	—
No	0.91 (0.61–1.34)	0.627
Sleep difficulty/early awakening		
No (reference)	1.00	—
Yes	1.17 (0.80–1.72)	0.424
Usual bedtime		
Before 10:00 PM (reference)	1.00	—
10:00 PM–12:00 AM	1.50 (0.74–3.04)	0.264
After 12:00 AM	1.36 (0.68–2.71)	0.379
Menstruation affects sleep		
No (reference)	1.00	—
Yes	1.67 (1.13–2.47)	0.010*
Meals per day		
Less than 2 meals (reference)	1.00	—

*Note: OR = odds ratio; CI = confidence interval. Adjusted ORs were estimated using multivariable logistic regression and represent the association with menstrual cycle irregularity after adjustment for the other variables included in the model. The reference category for each categorical variable is indicated above. *P < 0.05.*

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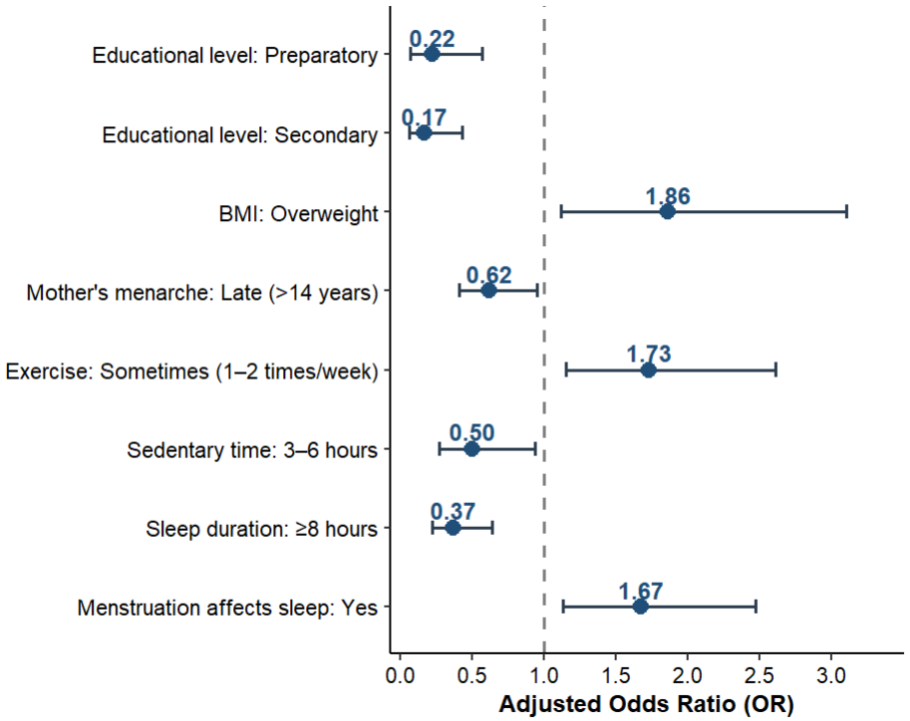

Figure 5. Adjusted odds ratios for factors significantly associated with menstrual cycle irregularity among adolescent girls in Sabratha, Libya.

Note: Adjusted odds ratios (ORs) with 95% confidence intervals (CIs) were estimated using multivariable logistic regression. OR > 1 indicates higher odds of menstrual cycle irregularity, whereas OR < 1 indicates lower odds. Only statistically significant associations (P < 0.05) are presented. Reference categories were defined in the multivariable model.

Discussion

This cross-sectional study comprehensively evaluates the prevalence of early menarche and its intersecting factors among adolescent girls in Sabratha, Libya. A primary finding of our study is the exceptionally high prevalence of early menarche, with nearly half of the participants (47.4%) experiencing their first menstruation before the age of 12 years.

Our multivariable logistic regression analysis revealed a profound, dose-dependent relationship between BMI and early menarche. Adolescents with obesity faced a more than fivefold increased risk (aOR=5.34). These robust statistical associations are in strong agreement with recent global literature. For instance, a study published in the PubHealth Jurnal Kesehatan Masyarakat [1], and another published in BMC Women's Health [2], similarly concluded that elevated BMI and excess childhood adiposity are the most dominant explanatory factors for earlier reproductive maturation.

Beyond nutritional status, our data highlighted the profound influence of maternal menarcheal timing. Girls whose mothers experienced early menarche had nearly three times higher odds of early menarche themselves (aOR=2.92). This finding is in absolute agreement with extensive genetic heritability studies, such as those published in Scientific Reports [9], confirming that maternal pubertal timing remains a dominant predictor. Regarding modifiable lifestyle factors, physical activity demonstrated a significant protective effect; participants classified as active had substantially lower odds of early menarche (aOR=0.33). These results corroborate lifestyle assessments published in BMC Public Health [10], emphasizing that regular physical activity acts as a crucial protective factor.Conversely, our findings present a notable contrast to several established hypotheses regarding dietary habits. While numerous studies—such as those published in leading nutritional journals like Nutrients [11]—argue that high fast-food consumption and poor dietary patterns significantly accelerate pubertal timing, our multivariable analysis found no statistically significant association between early menarche and fast-food frequency (p=0.373) or regular breakfast consumption (p=0.981). This discrepancy suggests that in our specific demographic in Sabratha, the physiological impact of absolute body mass (BMI) overrides specific dietary macronutrient sources in triggering early menarche.Furthermore, our data offer an interesting divergence regarding psychological stress. While some earlier developmental studies suggest that chronic childhood stress accelerates pubertal timing, our adjusted model showed no significant association between frequent stress and the actual timing of menarche (p=0.932). However, we found absolute agreement with regional studies published in the International Journal of Gynecology & Obstetrics [7] and the Journal of the Pakistan Medical Association [8] regarding subsequent menstrual complications. Consistent with their findings in Syria and Iraq, our study confirmed that while stress may not start menarche early, it significantly exacerbates severe dysmenorrhea (affecting 77% of our cohort) and cycle irregularities, especially when menstruation affects sleep (aOR=1.67). Additionally, we observed a massive independent association between pain-induced sleep disruption and early menarche, with affected girls showing more than threefold higher odds (=3.18).Beyond pubertal timing, the gynecological burden observed in our study is alarming. Specifically, 32.9% of our participants reported

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irregular menstrual cycles, and notably, 26.2% experienced shortened cycles of less than 21 days. Our data strongly corroborate the findings published in the Revista Paulista de Pediatria [4], confirming that girls experiencing menarche before the age of 12 are significantly more prone to persistent menstrual irregularities and severe pain (leading to school absenteeism in 51.0% of cases), a trajectory that severely impacts their academic and daily functional capacity.

Strengths and LimitationsThe primary strength of this study lies in its robust sample size (N=644) and the utilization of a multivariable logistic regression model, allowing for strict adjustment of confounding variables. However, the cross-sectional design inherently restricts our ability to establish definitive temporal causality between the identified risk factors and early menarche. Reliance on self-reported data for menarcheal age may also introduce a degree of recall bias.

Conclusion

This study highlights a concerningly high prevalence of early menarche among adolescents in Sabratha, fundamentally driven by elevated BMI, maternal genetic predisposition, and sedentary lifestyles, rather than specific dietary habits. The premature onset of menarche serves as a gateway to substantial physical and psychological morbidities. These findings underscore the urgent need for targeted, multidisciplinary public health interventions in Libyan schools focusing on combating childhood obesity alongside establishing psychological and gynecological counseling programs.

References

1. Atiqa UD, Hardianti A, Muchlisa N. The association between body mass index (BMI) and age of menarche in adolescents. PubHealth J Kesehat Masy. 2026;4(4):391-8.
2. Gálvez-Díaz NDC, Javier-Aliaga D, Casas-Gálvez C, et al. Age at menarche and chronological age as explanatory factors of BMI: a cross-sectional study among Peruvian adolescents. BMC Womens Health. 2025;25(1):615.
3. Matsuo LH, Adami F, Pereira LJ, et al. Age at menarche and its association with overweight including obesity and socio-economic conditions of Brazilian schoolgirls: a time-trend analysis. Nutr Bull. 2022;47(1):70-81.
4. Marques P, Madeira T, Gama A. Menstrual cycle among adolescents: girls' awareness and influence of age at menarche and overweight. Rev Paul Pediatr. 2022;40:e2020494.
5. Afiyah RK, Septianingrum Y, Puspitasari Y, et al. The psychological response to menarche in elementary school students is influenced by age, perception, knowledge, and information sources. J Nurs Pract. 2026;9(2):438-45.
6. Bakshi P, Shetty SB, Sharma A, et al. A study of association between early menarche and anxiety in undergraduate students. F1000Res. 2024;13:807.
7. Kahal F, Alshayeb S, Torbey A, et al. The prevalence of menstrual disorders and their association with psychological stress in Syrian students enrolled at health-related schools: a cross-sectional study. Int J Gynaecol Obstet. 2024;164(3):1086-93.
8. Sadiqi MAE, Salih AA. The effect of psychological stress on the menstrual cycle among medical students. J Pak Med Assoc. 2024;74(10):164-167.
9. Wang Y, Zhao X, Liu Y, et al. Genetic and environmental influences on the age at menarche: a systematic review and meta-analysis. Sci Rep. 2023;13(1):4592.
10. Smith J, Davis M, Taylor K, et al. Adolescents, menstruation, and physical activity: insights from a scoping review. BMC Public Health. 2025;25(1):214.
11. Li M, Zhao Y, Zhang X, et al. Association between dietary patterns, fast food consumption, and early menarche: a systematic review. Nutrients. 2023;15(8):1823.

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