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## Menstrual irregularity and associated factors among female adolescents in Somali region high schools Ethiopia 2023

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Menstrual irregularity is a common health concern among female adolescents, with potential impacts on their family life, social participation, academic performance, and overall well-being. Therefore, this study aims to assess the prevalence of menstrual irregularity and identify its associated factors among female high school students in the region. A multicenter, facility-based cross-sectional study was conducted among 714 female students from 11 high schools, selected using a multistage sampling technique. Data were collected through a pre-tested, self-administered questionnaire, entered into EpiData version 4.6, and analyzed using statistical package for the social sciences version 26. Descriptive statistics were used to summarize participant characteristics. Binary logistic regression was performed to assess the association between independent variables and menstrual irregularity, with crude odds ratios and 95% confidence intervals. Variables with a  $p$  value  $< 0.25$  in the bivariable analysis were included in a multivariable logistic regression model. Model fitness was assessed using the Hosmer-Lemeshow goodness-of-fit test, and multicollinearity was evaluated using variance inflation factor (VIF) and tolerance tests. Statistical significance was determined at  $p < 0.05$ . The prevalence of menstrual irregularity was 29.10% (95% CI 25.90–32.50%). Significant factors associated with menstrual irregularity included: age 18–19 years [AOR 3.08, 95% CI 1.15–8.28], early menarche ( $\leq 12$  years) [AOR 2.60, 95% CI 1.45–4.67], sleeping  $\leq 5$  h per night [AOR 3.65, 95% CI 1.02–13.09], perceived moderate stress [AOR 2.04, 95% CI 1.05–3.98], and perceived high stress [AOR 3.52, 95% CI 1.60–7.76]. The prevalence of menstrual irregularity in this study was lower than that observed in previous studies. Significant factors associated with menstrual irregularity included age, early menarche, insufficient sleep, and high stress levels. It is recommended that school-based health education and stress management programs be strengthened to help reduce menstrual irregularities among female students

**Keywords** Menstrual disorders, Adolescents, Schools, Somali region, Ethiopia

### Abbreviations

AOR	Adjusted odds ratio
CI	Confidence interval
COR	Crude odds ratio
WHO	World Health organization
PSS	Perceived stress scale
SPSS	Statistical package for social science

Menstruation is a cyclical process of uterine bleeding caused by endometrial shedding due to hormonal interactions, primarily through the hypothalamo-pituitary-ovarian axis<sup>1</sup>. A typical menstrual cycle lasts 28 days, beginning on the first day of menstruation and ending on the first day of the next cycle<sup>2</sup>. Menstrual irregularities involve deviations in onset, frequency, flow, duration, or volume<sup>3</sup>. It is estimated that 14–25% of

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women experience irregular cycles, with periods that are heavier or lighter, or cycles lasting longer than 35 days or shorter than 21 days<sup>4</sup>.

Globally, an estimated 500 million people experience menstrual-related issues<sup>5</sup>. This problem is widespread among female students, with prevalence rates ranging from 23% to 76.6%, reflecting an increasing trend in both developing and developed countries<sup>6–8</sup>. In Africa, menstrual irregularities among female adolescents vary between 12.5% and 55%<sup>9,10</sup>. Additionally, the United Nations Educational, Scientific and Cultural Organization reports that in Sub-Saharan Africa, one in ten girls misses school during their menstrual period, which can result in missing up to 20% of the school year<sup>11</sup>. In Ethiopia, 26.5% to 32.6% of females report experiencing menstrual irregularities<sup>12,13</sup>. Similarly, in Ethiopia, one in four girls miss one or more days of school due to menstruation<sup>14</sup>. Menstrual irregularities are most prevalent in females under the age of 23 years<sup>15</sup>.

Various factors have been associated with menstrual irregularities in previous studies. Hormonal imbalances are a primary cause, influencing symptoms such as fatigue, stress, and anxiety, which in turn affect academic performance and social functioning<sup>16</sup>. Menstrual-related problems, particularly dysmenorrhea, are well-known for contributing to school absenteeism and reduced academic performance<sup>17</sup>. Additionally, studies have shown that menstrual irregularities can have long-term effects on health, including infertility, cardiovascular disease, and gestational diabetes mellitus<sup>18–20</sup>.

Despite the availability of studies reporting a high prevalence of menstrual irregularities<sup>13,21</sup>, particularly in urban settings, there is a notable gap in research focused on pastoral and agro-pastoral communities, including the Somali Region. To date, no studies have specifically examined menstrual irregularities among female students in this region. Therefore, this study aimed to assess the prevalence of menstrual irregularity and its associated factors among adolescent girls in high schools in Jigjiga, Somali Region, Ethiopia.

## Method and materials

### Study design, area and period

A multicenter, school-based cross-sectional study was conducted in Jigjiga City, the capital of the Somali Regional State in Eastern Ethiopia. The study was carried out from May 22 to June 8, 2023. Jigjiga has seven governments and 13 non-government high schools, with a total high school student population of 24,559 comprising 13,866 males and 10,693 females (Jigjiga City Administration Education Bureau, 2023). This setting was selected to ensure diverse representation of high school female students across the city.

### Eligibility criteria

The study included adolescent girls aged 13 to 19 years who were enrolled in selected high schools, had reached menarche, and were willing to provide informed consent (and assent, along with parental or guardian consent where required). Students were excluded if they had known chronic illnesses such as diabetes, thyroid disorders, or polycystic ovary syndrome; were currently using hormonal medications that could affect the menstrual cycle; were pregnant or had been pregnant in the past; had not yet experienced menarche; or submitted incomplete or inconsistent responses to the questionnaire.

### Sample size determination

The sample size was calculated using Epi Info with the following assumptions: a 95% confidence level, 80% power, and proportions of menstrual irregularity among exposed (sleep duration  $\leq 5$  h) at 40.9% and unexposed at 28.7%, based on a previous study conducted among undergraduate students at Debre Berhan University, Ethiopia<sup>12</sup>. The variable “sleep duration” produced the largest sample size among the considered predictors. A design effect of 2 was applied to account for the multistage sampling technique, and a 10% non-response rate was added. This resulted in a final sample size of 760 participants.

### Sampling procedure

A multi-stage sampling technique was used to select participants. Total schools in Jigjiga were first stratified into public and private, and then 11 schools (4 governmental and 7 private) were randomly selected. Eligible students were identified based on inclusion criteria, and participants were chosen from each school using systematic random sampling, proportionate to the number of eligible students.

### Data collection instrument

A self-administered questionnaire, adapted from previous studies<sup>12,22–25</sup> was used to collect data. The questionnaire was primarily prepared in English and translated to Somali and Amharic, and Afan Oromo using bilingual person and back translated to English to maintain the consistency. The questionnaire was divided into four sections: The first section gathered socio-demographic information, including age, school type, religion, parents' educational status and occupations, and a family history of menstrual irregularities. The second section addressed lifestyle and behavioral factors such as physical activity, alcohol and coffee consumption, smoking, sleep duration, and stress levels. The third section focused on menstrual-related details, including age at menarche, contraceptive use, menstrual duration, amount, frequency, and pain during menstruation. The final section involved measuring the participants' weight and height. Seven experienced female midwives were recruited as data collectors, and two health officers (one female and one male) served as supervisors for the study.

### Data collection procedure

Data were collected using a self-administered questionnaire, with respondents being informed about the purpose of the study and the importance of their participation. The questionnaire collected detailed information from the selected respondents on socio-demographic factors, reproductive health, lifestyle, and behavioral factors related to menstrual irregularity.

## Variables and measurements

The dependent variable in the study was menstrual irregularity, while the independent variables included nutritional status (underweight, normal, overweight/obese), socio-demographic factors (such as age, place of residence, and family education), age at menarche, stress levels, alcohol consumption, smoking, high-intensity physical activity, sleep duration, family history of menstrual irregularity, female genital mutilation, sexually transmitted diseases, goitre, and head injuries.

*Irregular menstrual cycle* is characterized by any of the following: Long cycle—a cycle that occurs once every 38 days to less than 3 months; Short (frequent) cycle—a cycle that occurs once every less than 24 days; Prolonged duration—lasting 8 days or more; Heavy cycles—requiring 5 or more sanitary/vulvar pads per day; Scant cycles—requiring 2 or fewer pads per day; or a cycle-to-cycle variance of more than 10 days<sup>13,26</sup>.

*Measurements of amount of menstrual blood flow per a day* are Scanty (1–2 pads/day), Moderate (3–5 pads/day), Heavy (> 5 pads/day)<sup>26–28</sup>.

*Sleep duration* is categorized into three categories based on the National Sleep Foundation's recommendation of sleep time as follows: Short sleep duration: sleeping less than seven hours of sleep per night, Normal (optimal) sleep duration: seven to nine hours per night and Long sleep duration: sleeping more than nine hours per night<sup>29</sup>.

*Physical activity* as any bodily movement produced by skeletal muscles that requires energy expenditure<sup>30</sup>. Regular physical activity: High intensity physical activity is consider as regular if respondents perform it for more than or equal to 3 days per week for  $\geq 20$  min<sup>31</sup>, while Irregular physical activity: if it is performed for less than 3 days per week<sup>31</sup>.

## Perceived stress scale

The Perceived Stress Scale (PSS) is a widely used 10-item multiple-choice self-report questionnaire designed to assess stress perception. Each response is scored from 0 to 4, and the total PSS score is calculated by summing all items, yielding a range from 0 to 40, with higher scores indicating greater perceived stress. Scores of 0–13 indicate low stress, 14–26 indicate moderate stress, and 27–40 indicate high perceived stress<sup>32</sup>.

## Data quality control

Data quality was ensured using a self-administered questionnaire translated into Amharic, Somali, and Afan Oromo. Data collectors and supervisors received two days of training on study procedures and data handling. A pretest involving 5% of the sample was conducted outside the study area to validate the tool. Supervisors monitored data collection to ensure proper participant guidance and accurate anthropometric measurements. The principal investigators and supervisors continuously oversaw the process to ensure data completeness and accuracy.

## Data processing and analysis

The collected data were cleaned, coded, and entered into EpiData version 4.6 software, then exported to SPSS version 26 for analysis. Descriptive analysis was conducted to summarize the characteristics of the study participants, with the results presented in text, tables, and figures. Binary logistic regression was performed to examine the association between each independent variable and the outcome variable, using crude odds ratios with a 95% confidence interval. Variables with a  $p$  value less than 0.25 were included in a multivariable logistic regression model. The model's fitness was assessed using the Hosmer-Lemeshow goodness-of-fit test, and multicollinearity was evaluated using the variance inflation factor and tolerance tests. A  $p$  value of less than 0.05 in the multivariable analysis was considered statistically significant for identifying associations.

## Results

### Sociodemographic characteristics of study participants

A total of 714 female students participated in this study, achieving a response rate of 93.9%. The participants' ages ranged from 15 to 19 years, with a mean age of 18.09 years (SD:  $\pm 0.80$ ). The majority of the participants were Muslim 640, (89.6%) and single 677, (94.8%). In terms of parental education, 237 (33.2%) of participants' fathers and 292 (40.9%) of participants' mothers had no formal education. Most mothers were housewives 445, (62.3%), while the largest proportion of fathers were merchants 198, (35.9%). Additionally, nearly all participants 707, (99.0%) resided in urban areas (Table 1).

### Lifestyle characteristics of study participant students

The study revealed key findings regarding the lifestyle and health characteristics of the respondents. A vast majority (98.9%) reported no alcohol consumption in the past 30 days, with minimal consumption of beer (0.4%), wine (0.3%), and only (1.0%) drinking monthly and (0.14%) weekly. Coffee consumption was reported by (16.7%) of respondents, with 4.9% consuming one cup daily, (10.2%) drinking 1–3 cups daily, and (0.3%) drinking more than 5 cups daily. In terms of sleep, 19% slept  $\leq 5$  h per day, (73%) slept 6–8 h, and 7.1% slept  $\geq 9$  h. Body mass index (BMI) classifications showed 60.1% of participants were of normal weight, 25.4% underweight, 11.5% overweight, and 3.15% obese. Physical activity levels were predominantly low (95.2%), with only 2.8% reporting moderate and 2.0% high-intensity activity. Perceived stress was low for 22.7% of respondents, moderate for 59.5%, and high for 17.8%. Almost all participants reported no history of sexually transmitted diseases (99.44%), goiter (99.9%), head injuries (97.1%), or smoking (99.6%).

### Menstrual patterns of the respondent

Out of all the study participants, 29.13% (95% Confidence Interval: 25.9% to 32.5%) reported experiencing an irregular menstrual cycle. Among those with menstrual irregularities, 231 participants (32.35%) described their menstrual flow as light, defined as using fewer than two sanitary pads or towels per day. Additionally,

Variable	Category	Frequency( <i>n</i> )	Percentage (%)
Age	15 to 17	100	14.00
	18 to 19	614	86.00
School grade	Grade 9	171	23.95
	Grade 10	157	22.00
	Grade 11	205	28.71
	Grade 12	181	25.40
School type	Public	488	68.35
	Private	226	31.70
Religion	Orthodox	62	8.70
	Muslim	640	89.64
	Protestant	12	1.70
Marital status	Single	677	94.82
	Married	37	5.20
Educational status of mother	No formal education	292	40.90
	Primary education	144	20.20
	Secondary education	148	20.73
	Vocational and technical education	85	11.90
	Higher education	45	6.30
Education status of father	No formal education	237	33.20
	Primary education	222	31.10
	Secondary education	129	18.10
	Vocational and technical education	25	3.50
	Higher education	101	14.10
Occupation of father	Government employee	179	25.10
	Private employee	198	27.70
	Merchant	198	35.90
	Farmer	50	7.00
	Others	31	4.30
Occupation of mother	Housewife	445	62.32
	Merchant	187	26.20
	Government employee	46	6.44
	Private employee	28	3.92
	Farmer	3	0.42
	Others	5	0.70
Residence	Urban	707	99.02
	Rural	7	1.00

**Table 1.** Sociodemographic characteristics of study participants (*n* = 714).

167 participants (23.4%) reported irregular onset, and 146 (20.45%) had cycles shorter than 24 days. Over the past three months, 647 participants (90.6%) reported experiencing long periods lasting eight days, while 430 (60.22%) had cycles within the normal range of 24 to 38 days. The average age at menarche was 13.53 years ( $SD \pm 1.455$  years).

Regarding menstrual hygiene, 528 participants (73.9%) reported using pads during menstruation. Pain during menstruation was common, with 442 (61.9%) experiencing it, and 299 (41.9%) reporting pain lasting 1–2 days. Furthermore, 245 participants (34.3%) used pain relief methods during menstruation. In terms of family history, 415 participants (58.1%) reported no family history of menstrual irregularities. Most participants (98.6%) did not use contraceptive methods during menstruation, and 604 (84.6%) reported being circumcised (Table 2).

### Factors associated with menstrual irregularity

In the bivariate analysis, factors such as the respondent's age, marital status, parents' education and occupation, age at menarche, sanitation materials, pain duration, family history, contraceptive use, circumcision type, head injury, coffee consumption, sleep duration, perceived stress, and obesity were found to be significantly associated with menstrual irregularity, with a *p* value < 0.25. These variables were therefore considered as candidates for multivariable analysis.

However, in the multivariable logistic regression analysis, respondents aged 18–19 years, those with early menarche ( $\leq 12$  years), those who slept  $\leq 5$  h, and those experiencing moderate to high perceived stress were found to have a significant association with menstrual irregularity, with a 95% confidence level and *p* < 0.05.

Variables	Category	Frequency (n)	Percentage (%)
Frequent of the cycle	Less than 24 days /frequent	157	22.00
	24 to 38 days(normal)	463	64.80
	Greater than 38 days/in frequent	94	13.20
Duration of flow	Less than or equal to 8(normal)	636	88.10
	Greater than 8 days(prolonged)	78	10.90
Inter menstrual bleeding	Yes	111	15.55
	No	603	84.50
Regularity of onset	Regular	547	76.60
	Irregular	167	23.40
Menstrual bleed flow	Less than 2 sanitary pad per day	231	32.35
	2 to 4 sanitary pad per day	314	43.98
	Greater than 4 sanitary pad per day	169	23.67
Long period stays	Non	2	0.30
	≤ 8 days	647	90.60
	> 8 days	65	9.10
Average long cycle	Less than 24 days	146	20.45
	24 to 38 days	430	60.22
	Greater than 38 days	138	19.33
Overall menstrual cycle	Regular	506	70.87
	Irregular	208	29.13
Age menarche	Medium/average menarche	393	55.00
	Early menarche	133	18.60
	Late/Delayed menarche	188	26.30
Materials for sanitation	Pad	528	74.00
	Cloth	186	26.00
Pain during menstruation	Yes	442	61.90
	No	272	38.10
Duration pain	1 to 2 days	299	41.90
	3 to 7 days	139	19.50
	Greater than 7 days	14	2.00
Family history	Yes	172	24.10
	No	415	58.10
	I don't know	127	17.80
Contraceptive methods	Yes	13	1.80
	No	701	98.20
Circumcision	Yes	604	84.60
	No	110	15.41
Types of circumcision (n = 623)	Clitoridectomy	411	57.60
	Excision, and infibulation	212	34.03

**Table 2.** Reproductive Health related characteristics of the study participants (n = 714).

The study identified that students aged 18–19 years were three times more likely to experience irregular menstruation [AOR 3.08, 95% CI (1.15–8.28)] compared to those aged 15–17 years. Additionally, participants who experienced early menarche ( $\leq 12$  years) had a 2.6 times higher more likely [AOR 2.60, 95% CI (1.45–4.67)] of menstrual irregularity compared to those with medium or average menarche (13–14 years). Furthermore, individuals who slept  $\leq 5$  h per night were 3.6 times more likely [AOR 3.65, 95% CI (1.02–13.09)] to have menstrual irregularity compared to those who slept  $\geq 9$  h. Moderate stress was also found to be a significant factor, with participants reporting moderate stress being twice as likely [AOR 2.04, 95% CI (1.05–3.98)] to experience menstrual irregularity compared to those with low stress. Finally, those who experienced high perceived stress were 3.5 times more likely [AOR 3.52, 95% CI (1.60–7.76)] to have menstrual irregularity than those with low stress (Table 3).

## Discussion

This study aimed to evaluate the prevalence and determinants of menstrual irregularities among female adolescent high school students in Jigjiga. The findings revealed that the prevalence of menstrual irregularities was 29.1%. Significant factors associated with menstrual irregularities included being aged 18–19 years, experiencing early menarche, having a sleep duration of 5 h or less, and reporting moderate to high levels of perceived stress.

Variable	Category	Menstrual irregularity		COR(95%CI)	AOR(95%CI)	p value
		Yes	No			
Age	15–17	11(11)	89(89.0)	1.00	1.00	
	18–19	197(32.1)	417(67.9)	3.82(1.99–7.31)	3.08(1.14–8.27)*	0.02
Marital status	Single	194(28.66)	483(71.34)	0.66(0.33–1.30)	0.39(0.13–1.16)	0.09
	Married	14(37.83)	23(62.17)	1.00	1.00	
Mother's education	No formal education	88(30)	204(70)	1.99(0.89–4.45)	1.26(0.38–4.16)	0.69
	Primary education	44(30.56)	100(69.44)	1.99(0.89–4.45)	1.16(0.33–4.07)	0.80
	Secondary education	41(27.7)	107(72.3)	1.77(0.76–4.12)	0.96(0.28–3.31)	0.95
	Vocational and technical education	27(31.8)	58(68.2)	2.15(0.88–5.24)	1.66(0.44–6.21)	0.44
	Higher education	8(17.8)	37(82.2)	1.00	1.00	
Father's education	No formal education	72(30.4)	165(69.6)	1.48(0.86–2.54)	1.11(0.45–275)	0.80
	Primary education	66(30)	156(70)	1.43(0.83–2.47)	1.04(0.42–2.58)	0.92
	Secondary education	40(31)	89(69)	1.52(0.84–2.76)	1.05(0.40–2.76)	0.91
	Vocational and technical education	7(28)	18(72)	1.31(0.49–3.54)	0.69(0.99–4.91)	0.71
	Higher education	23(22.8)	78(77.2)	1.00	1.00	
Occupation of father	Government employee	59(33)	120(67)	1.00	1.00	
	Private employee	61 (30.8)	137 (69.2)	0.90 (0.58–1.39)	1.017 (0.50–2.05)	0.96
	Merchant	64 (25)	192 (75)	0.67 (0.44–1.03)	0.77 (0.38–1.52)	0.45
	Farmer	15 (30)	35 (70)	0.87 (0.44–1.72)	0.69 (0.24–1.95)	0.49
	Others	9 (29)	22 (71)	0.83 (0.36–1.91)	1.14 (0.34–4.66)	0.82
Age menarche	Medium/average menarche	94 (23.9)	299 (76.1)	1.00	1.00	
	Early menarche	53 (39.8)	80 (60.2)	2.10 (1.38–3.19)	2.60 (1.44–4.66) *	0.00
	Late/Delayed menarche	61 (32.4)	127 (67.6)	1.52 (1.04–2.24)	1.09 (0.60–2.00)	0.76
Materials for sanitation	Mades	160 (30.3)	368 (69.7)	1.00	1.00	
	Cloth	48 (25.8)	138 (74.2)	0.80 (0.52–1.13)	0.63 (0.35–1.12)	0.12
Duration pain	1 to 2 days	84 (28.1)	215 (71.9)	1.00	1.00	
	3 to 7 days	50 (36)	89 (64)	1.43 (0.93–2.20)	0.137 (0.81–2.32)	0.23
	Greater than 7 days	7 (50)	7 (50)	2.56 (0.87–7.51)	2.15 (0.64–7.17)	0.21
Family history	Yes	58 (33.7)	114 (66.3)	1.10 (0.67–1.80)	0.99 (0.47–2.05)	0.98
	I don't know	110 (26.5)	305 (73.5)	0.78 (0.50–1.21)	1.02 (0.52–2.01)	0.94
	No	40 (31.5)	87 (68.5)	1.00	1.00	
Contraceptive methods	Yes	6 (46.2)	7 (53.8)	2.12 (1.04–13.34)	1.84 (0.33–10.14)	0.48
	No	202 (28.7)	499 (71.3)	1.00	1.00	
Head injury	Yes	9 (42.9)	12 (57.1)	1.86 (0.77–4.48)	2.36 (0.67–8.27)	0.17
	No	199 (28.7)	494 (71.3)	1.00	1.00	
Drink coffee	Yes	41 (34.5)	78 (65.5)	1.34 (0.88–2.04)	0.77 (0.41–1.45)	0.43
	No	167 (28.1)	428 (71.9)	1.00	1.00	
Sleep duration	≤ 5 h	62 (43.7)	80 (56.3)	4.16 (1.82–9.49)	3.64 (1.02–13.08)*	0.04
	6–8 h	138 (26.5)	383 (73.5)	1.93 (0.88–4.22)	1.71 (0.51–5.73)	0.38
	≥ 9 h	8 (15.7)	43 (84.3)	1.00	1.00	
Perceived stress	Low stress	26 (16.0)	136 (84.0)	1.00	1.00	
	Moderate stress	131 (30.8)	294 (69.2)	2.33 (1.46–3.71)	2.03 (1.04–3.97)*	0.03
	High perceived stress	51 (40.2)	76 (59.8)	3.51 (2.02–6.08)	3.52 (1.59–7.76)*	0.00
Body mass index	Normal	124 (28.9)	305 (71.1)	1.00	1.00	
	Underweight	58 (32)	123 (68)	1.16 (0.79–1.68)	0.93 (0.49–1.73)	0.81
	Overweight	26 (25)	78 (75)	0.96 (0.56–1.62)	0.64 (0.30–1.38)	0.26

**Table 3.** Factors associated with menstrual irregularity among the study participants ( $n = 714$ ). Key: 1.00 = reference category, COR, crude odd ratio, AOR, adjusted odd ratio, CI, Confidence Interval, Others<sup>a</sup> = Daily laborer, Driver, Security guard and Religious leader, Statistical analysis was performed using binary and multivariable logistic regression. Variables with a  $p$  value  $< 0.05$  in the multivariable analysis were considered statistically significant (marked with \*).



The prevalence of menstrual irregularity in the current study was consistent with studies conducted in Delhi, India (29.1%) and Indonesia (34%)<sup>33,34</sup>. Similarly, studies conducted at Debre Berhan University reported magnitude of 32.6% and 33.4%<sup>13,21</sup>. The similarity in findings could be attributed to the use of similar measurement tools and comparable sample sizes across these studies. In contrast, there are a number of studies done in several countries which are higher magnitude than the current study. Evidences revealed that studies done in Al Neelain University in Sudan, Nepal, King Abdulaziz University in Jeddah, Saudi Arabia with magnitude of 55.0%, 76.6%, 48.2% respectively<sup>35–37</sup>. Also nearly similar study was done in Bahir Dar University, and it was reported that magnitude of menstrual irregularity was 46.2%<sup>38</sup>. The differences in menstrual irregularity magnitude between studies may be due to variations in study design, sample populations, and age groups.

On the other hand, several studies reported lower magnitude of menstrual irregularity compared to the current study. A study conducted in Ghana found 7.7%, while another study in Kerala, India reported 24%<sup>39,40</sup>. Similarly, a study conducted at Debre Berhan University in Ethiopia reported 14.6%<sup>41</sup>. The differences in prevalence rates may be due to variations in age distribution, definitions of menstrual irregularity, socio-economic and socio-cultural factors.

The study identified that students aged 18–19 years were three times more likely to experience irregular menstruation, this finding was consistent with the result of previous studies<sup>42,43</sup>. A similar study in Debre Berhan, Ethiopia, also linked being under 20 years old with menstrual irregularity<sup>21</sup>. This might be attributed to biological, environmental, and psychosocial factors. Late adolescence is a period of continued hormonal adjustments as the hypothalamic-pituitary-ovarian (HPO) axis matures, which may result in delayed stabilization of menstrual cycles. Additionally, older adolescents often face heightened academic pressures and social responsibilities, leading to increased stress levels that disrupt hormonal balance. Lifestyle factors such as poor sleep, irregular eating habits, and reduced physical activity further contribute to the observed irregularities<sup>44</sup>.

Additionally, participants who experienced early menarche ( $\leq 12$  years) had a 2.6 times more likely to experience menstrual irregularity compared to those with medium or average menarche (13–14 years). This finding is consistent with earlier studies conducted in Debre Berhan, Lebanon, and Korea<sup>21,45,46</sup>. However, it was contradicting with studies in Taiwan and Italy, where late menarche was identified as a risk factor for menstrual irregularity<sup>47,48</sup>. This might be due to prolonged exposure to hormonal fluctuations and the immature hypothalamic-pituitary-ovarian (HPO) axis during early adolescence. Early menarche can also reflect underlying genetic, nutritional, or environmental factors that influence hormonal regulation, potentially predisposing individuals to cycle irregularities later. Differences in findings across studies, such as those in Taiwan and Italy, may stem from variations in study populations, cultural factors, or definitions of menstrual irregularity<sup>49</sup>.

Furthermore, participants who slept  $\leq 5$  h per night were 3.6 times more likely [AOR 3.65, 95% CI (1.02–13.09)] to have menstrual irregularity compared to those who slept  $\geq 9$  h. This finding is consistent with studies conducted in Debre Berhan colleges, Debre Berhan universities, and Korea, which reported similar results<sup>13,21,50</sup>. Disruptions in the body's circadian rhythms and sleep-wake patterns, which regulate the secretion of hormones such as melatonin, cortisol, thyroid-stimulating hormone, and prolactin, may contribute to these menstrual irregularities<sup>51</sup>.

Furthermore, stress has been identified as a significant factor contributing to menstrual irregularity. This study found that individuals with high and moderate stress levels were more likely to experience menstrual irregularities compared to those with low stress. This aligns with findings from studies in Debre Berhan Colleges, Debre Berhan Universities, and research conducted in China, North America, and Korea<sup>13,17,21,52–54</sup>. Psychological stress may disrupt the HPO axis, affecting the coordinated functioning of key glands involved in menstrual regulation<sup>55</sup>.

### Strengths and limitations of the study

This study focused on high school adolescent girls, a population particularly vulnerable to menstrual irregularities, thereby addressing a significant gap in the existing literature, especially within the Somali Region of Ethiopia. The use of a multicenter, facility-based design with a multistage sampling technique across 11 high schools enhances the internal validity and representativeness of the findings within the region. However, the results may not be fully generalizable to the broader Ethiopian student population due to regional differences in lifestyle, socioeconomic status, and cultural practices. Furthermore, the cross-sectional design limits the ability to infer causal relationships between menstrual irregularity and associated factors. The reliance on self-reported data over the past three months also introduces the potential for recall bias, and the sensitive nature of the topic may have led to underreporting by some participants.

### Conclusion

The prevalence of menstrual irregularity in this study was lower than that observed in previous studies. The factors linked to menstrual irregularity include age (18–19 years), early menarche ( $\leq 12$  years), sleep duration of less than 5 h, and moderate to high perceived stress levels.

### Recommendation

Healthier lifestyle practices, including stress management and adequate sleep, are crucial for managing menstrual irregularities in adolescent girls. Regional health and education bureaus should promote strategies for healthy sleep, stress control, and menstrual health education. Students are encouraged to adopt these practices to improve menstrual health and academic performance. Further research is needed to explore causal factors and effective interventions.

# Data availability

The data sets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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## Author contributions

All authors (NH, KS, TYN, AAL, and HM) equally contributed to the conception of the research problem, initiated the research, wrote the research proposal, conducted the research, made data entry, analysis, and interpretation, and wrote and reviewed the final manuscript. All authors read and approved the final manuscript.

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## Declarations

## Competing interests

The authors declare no competing interests.

## Ethical approval

The study was conducted in accordance with the principles of the Declaration of Helsinki. Ethical clearance was obtained from the Institutional Health Research Ethics Review Committee of the College of Health and Medical Sciences, Haramaya University, (Reference Number: IHRERC/087/2023). and was subsequently delivered to the Somali Regional Education Bureau (SREB) and Jigjiga city administrations for their official approval. Letters were prepared and submitted to the local authorities of the selected schools. Signed, voluntary, written, Informed consent was obtained from each participant. For participants under the age of 18 years, informed, voluntary, written, and signed consent was obtained from their parents or guardians. Confidentiality was maintained at all levels of the study. Participant selection was based on their willingness to participate, and they were fully informed of the voluntary nature of the study, including their right to withdraw at any time.

## Additional information

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