FACTORS INFLUENCING MENARCHE AGE AND MENSTRUAL PROBLEMS IN ADOLESCENT GIRLS IN ADDIS ABABA, ETHIOPIA

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ABSTRACT

INTRODUCTION: Menarche, the onset of menstruation, is a significant turning point for teenage girls globally. The age of menarche and associated menstrual health challenges have far-reaching implications for the physical, emotional, and social well-being of young women. Despite the importance of this topic, there is limited research on the factors influencing teenage girls' menarche age and menstruation issues in Addis Ababa, Ethiopia. This study aimed to address this gap by exploring the determinants of menarche age and the prevalence of menstrual problems in this population.

METHODS: An institution-based cross-sectional study was conducted among 380 randomly selected adolescent high school girls from government and private schools in Addis Ababa. Data were collected via a self-administered, semi-structured questionnaire and analyzed using SPSS version 20. Statistical significance was set at $p < 0.05$.

RESULTS: The mean menarche age was 13.42 ± 1.35 years. Attending private schools (AOR = 2.0; 95% CI: 1.28–3.12; p = 0.001) and higher family income (AOR = 4.0; 95% CI: 22.02–72.01; p = 0.002) were significant predictors of earlier menarche. Lower menarcheal age increased the risk of menstrual pain (AOR = 6.92; 95% CI: 3.7–12.89; p = 0.001) and school absenteeism (AOR = 2.74; 95% CI: 1.34–5.62; p = 0.005). However, maternal education (AOR = 0.56; 95% CI: 0.37–1.84; p = 0.006), smaller family size (AOR = 0.65; 95% CI: 0.40–1.05; p = 0.08), physical activity (AOR = 1.60; 95% CI: 0.01–2.56; p = 0.06), and vegetable intake (AOR = 0.99; 95% CI: 0.67–1.47; p = 0.97) were not associated with menarche age.

CONCLUSION: These findings highlight the complex, multifaceted factors influencing the onset of puberty and the menstrual experiences of adolescent girls in Ethiopia. Comprehensive interventions addressing sociocultural, economic, and educational barriers are crucial to empower girls and promote their overall health and educational outcomes.

KEYWORDS: Adolescent girls; Menarche; Menstrual pain; Ethiopia

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INTRODUCTION

Menarche, the onset of menstruation, marks a critical transition in the lives of adolescent girls, influencing their physical, emotional, and social well-being. Over the past several decades, the global average age of menarche has declined, now ranging between 12 and 13 years, due to factors such as improved nutrition, environmental influences, and changing physical activity levels[1,2]. While earlier menarche can have health implications, including increased risks of reproductive cancers and metabolic disorders, its impact varies across different populations[3].

In Africa, the age of menarche varies significantly across countries and socioeconomic groups[4]. Studies from sub-Saharan countries such as Ghana, Nigeria, and Kenya report an average menarche age between 12 and 14 years, similar to global trends, but with rural populations often experiencing a later onset due to nutritional and environmental factors[4,5]. Additionally, menstrual health challenges—including dysmenorrhea, menorrhagia, irregular cycles, and inadequate access to hygiene products—are widespread across the region and contribute to school absenteeism and social stigma[6,7].

Ethiopia, with its diverse socioeconomic and cultural landscape, provides a unique case for studying these challenges. Studies indicate that Ethiopian girls experience menarche between 13 and 15 years of age, influenced by nutritional status, physical activity, and cultural practices[8,9,10]. Similar to other sub-Saharan African countries, menstrual health problems are prevalent, exacerbated by poverty, limited healthcare access, and persistent social taboos[11,12].

Despite the significance of this issue, research on menarche age and menstrual health problems among adolescent girls in Addis Ababa is limited. This study aimed to explore the determinants of menarche age and the prevalence of menstrual health challenges among adolescent girls in Addis Ababa, Ethiopia. By identifying key factors, the findings can inform public health policies and interventions to improve menstrual health and well-being among Ethiopian adolescents.

Method
Study Setting
The study was carried out in Addis Ababa, the capital city of Ethiopia. With 10 sub-cities, the metropolis is home to an estimated 4.6 million people, with an annual growth rate of 3.8%[13]. According to the 2015/2016 Addis Ababa City Government Education Bureau report, the city's schools are categorized into primary (grades 1–8), secondary (grades 9–10), and preparatory (grades 11–12). There were 217 secondary schools (66 governmental and 151 private) in the city, with a total of 105,440 first-cycle high school students, of whom 58,147 (55%) were female. On average, each classroom had 47 students in government schools and 30 students in private schools[14].

Study Design
The study employed an institution-based cross-sectional design.

Source and Study Population
The source population consisted of all female students in Addis Ababa who attended grades 9 and 10 during the 2017/18 school year. The study population included female adolescents who were enrolled in grades 9 and 10 in daytime classes at the randomly selected schools during the same academic year.

Eligibility Criteria
The study included all female students attending regular classes. Students who had not begun menstruation and those absent during data collection were excluded.

Sample Size Determination and Sampling Procedure
The sample size was determined using the single population proportion formula, assuming a 95% confidence level, 5% margin of error, and 55%

prevalence of menarche between ages 13 and 14, based on a previous study[4]. The estimated sample size was 380, and with a 10% non-response rate considered, the final sample size was 418.

A stratified random sampling technique was employed. Both government and private schools offering grades 9–10 (secondary first cycle) were considered. From the total of 217 schools, two private and two government schools were randomly selected. The total sample of 418 participants was proportionally allocated based on school type, reflecting a 1:4 student ratio (22% private and 78% government). Accordingly, 84 students were selected from private schools and 334 from government schools. Sections from each selected school were chosen randomly via the lottery method. Student lists were obtained from class teachers, and participants were randomly selected from each section.

Study Variables
Dependent Variable:
- Mean age at menarche

Independent Variables:
- Personal factors: grade level, school type (private/government), sleep duration, physical activity, dietary habits
- Family factors: family size, parental education, and socioeconomic status

Data Collection Tool and Procedures
A structured, self-administered questionnaire was used for data collection. The questionnaire was adapted from existing literature on similar studies. It was prepared in English and pretested on 20 students at a different school to ensure clarity and consistency.

Two diploma nurses with prior data collection experience were hired as data collectors. The principal investigator supervised the process. Questionnaires were reviewed for completeness and consistency immediately after data collection, and issues were addressed on the spot.

Data Entry and Analysis
Data were entered into SPSS version 20 for management and analysis. Descriptive statistics and logistic regression were used to summarize and assess the data. The mean age at menarche was the dependent variable, and sociodemographic variables were analyzed as independent factors. A 95% confidence interval and p-value < 0.05 were considered statistically significant.

Data Quality Management
Two female diploma nurses with previous experience were trained for one day before data collection. A pretest was conducted to ensure the appropriateness and clarity of the tool.

Ethical Considerations
Ethical approval was obtained from the Addis Ababa University Department of Obstetrics and Gynecology Research and Publication Committee. Permission was also secured from the school administration. During data collection, confidentiality was maintained, students' rights were respected, and a comfortable environment was provided to encourage honest participation.

Results

Socio-demographic characteristics of the study participants
Out of the 418 questionnaires distributed, 38 were discarded due to incomplete information regarding the month of birth and/or month and year at menarche. Consequently, 90% response rate data were analyzed. The age of study participants extended from 13 years to 19 years, with a mean age of 16.38 ± 1.11 years. Majority of the students, 222 (58.4%), were in grade 9, while 158 (41.6%) were in grade 10. Most of the participants, 304 (80%), attended governmental schools, and 76 (20%) attended private schools.

The family size varied, with 109 (28.7%) having 1-4 members, 233 (61.3%) having 5-8 members, and 38 (10.0%) having more than 8 members. The

educational status of the parents showed that 183 (52.1%) of fathers and 219 (60.8%) of mothers had education up to grade 8, while 168 (47.9%) of fathers and 141 (39.2%) of mothers had education grade 9 and above. Regarding the socioeconomic status, based on the wealth index, indicated that 96 (26.4%) and 49 (13.5%) of the families were in the low and high-income class category, respectively (Table 1).

Table 1: Socio-demographic profile of the study participants, Addis Ababa, Ethiopia.

Variable	Subgroups	Number (%)
Age	<15	49(12.9)
	≥15	331(87.1)
Grade	9	222(58.4)
	10	158(41.6)
Ethnicity	Oromo	93(24.5)
	Amhara	150(39.5)
	Tigray	33(8.7)
	Gurage	96(25.3)
	Others	8(2.1)
Religion	Orthodox	294(77.4)
	Islam	54(14.2)
	Protestant	29(7.6)
	Catholic	3(0.8)
Live with	Both parents	211(55.5)
	Only Mother	66(17.4)
	Only Father	11(2.9)
	Brother/sister	21(5.5)
	Other relatives	69(18.2)
	Alone/Friends	2(0.6)
Family size	1-4	109(28.7)
	5-8	233(61.3)
	>8	38(10.0)
Father's educational status	Up to grade 8	188(49.5)
	grade 9 & above	172(45.3)
Mother's educational status	Up to grade 8	229(60.3)
	grade 9 & above	151(39.7)
Mother's job	House wife	183(48.2)
	Private work	105(27.6)
	Gov. employer	87(22.9)
Father's job	Private works	257(67.6)
	Gov. employer	97(25.5)
	Daily laborer	46(12.1)
Wealth status (index)	High income	54(14.2)
	Low income	102(26.8)
	Middle income	224(58.9)

Age at menarche

The mean age at menarche among the participants was 13.42 ± 1.35 years, with a median age of 13.45 years. This was 13.64 ± 1.32 years for girls attending governmental schools, while it was 12.56 ± 1.13 years for private schools, showing a mean age difference of 1.08 years. Half of the girls reached menarche at the age of 12 or 13 years. Assuming no grade repetition, 329 (86.5%) of the girls began menstruating while in primary school, with about 50% starting at grade 7 or below. The 25th percentile of age at menarche was 12.5 years, and the 75th percentile was 14.33 years. The onset of menstruation was fairly distributed throughout the academic calendar, with a slight peak in September (13.7%).

Menstruation history and menstruation related health problems

The time period of menstrual days fluctuated between two to eight in 87.2% of the girls, while 12.8% experienced periods lasting more than eight days. The menstrual cycle length was normal (21-35 days) in 77.9% of the girls, with 51.8% having cycles every 21-28 days and 26.1% having cycles every 28-35 days. However, 17.1% had irregular menstrual cycles, with 7.1% experiencing periods longer than 35 days and 10% experiencing cycles shorter than 21 days.

Awareness about menstruation before menarche was reported by 89.2% of the girls. A total of 349 (91.8%) had at least one person who advised them about menstruation, with mothers (34.5%), sisters (19.7%), and teachers (17.4%) being the most common sources of information. Fathers and brothers were the least consulted, with only 9 (2.4%) of the girls communicating with their fathers about menstruation.

The participants were asked to identify their preferred sources of advice regarding menstruation. The majority (52.9%) indicated their mothers, followed by 14.2% who chose their sisters, and 12.1% who preferred their friends. Only 7.9%

opted to seek information from teachers, health professionals, or through reading.

The emotional reactions of adolescents at the time of menarche varied significantly. Approximately 49.5% of the adolescents reported a neutral feeling, while 6.8% felt joyful. A notable 24.7% experienced confusion and uncertainty about what to do. Additionally, 11.1% of the adolescents cried, and 5% felt embarrassed. Extreme emotional reactions, such as fainting, were reported by 1.8% of the adolescents.

The study revealed that menstruation was associated with various health problems, abnormal emotional reactions, absenteeism from school, and perceived negative impacts on academic performance. About 62.1% of the adolescents reported experiencing health problems at the time of menarche. The most common adverse event was abdominal pain or backache, affecting 45% of the girls, followed by irregular bleeding in 13.6% of the girls. Other adverse health events included depression, headaches, and other symptoms with varying proportions. The severity of pain was also assessed, with 26.3% of students experiencing severe pain that led to school absenteeism, and 17.9% experiencing moderate pain that required medication for restricted activity due to the pain.

Absenteeism from school was reported by 38.4% of the girls. The primary reason for school absenteeism was adverse health problems associated with menarche, accounting for 85.6% of the cases. Additionally, the absence of facilities such as private toilets, changing rooms, and water was cited as reasons for school absenteeism by 14.4% of the girls (3.4%, 8.2%, and 2.7%, respectively). Furthermore, 21.4% of the girls believed that menstruation-related problems negatively affected their academic performance. During adverse events related to menstruation, the majority (63.6%) of the girls sought help from their families, while only 21.1% sought help from health institutions or professionals. Additionally, 12.1% used self-prescribed drugs, and 3.2% utilized traditional healers' support.

Table 2. Menstruation history and menstruation related health problems in Addis Ababa, Ethiopia

Variable	Subgroups	Number (%)
Menarche	<13	131(34.5)
	13-15	200(52.6)
	> 15	49(12.9)
Menstrual pattern	Regular	315(82.9)
	Irregular	65(17.1)
Number of days of menstrual pattern	2-7 days	331(87.2)
	> 8 days	49(12.8)
Academic season when menarche started	1st semester	126(33.2)
	2nd semester	190(50)
	End of 2nd semester vacation	64(16.8)
Reactions when you experienced menses for the first time	Neutral feeling	188(49.5)
	Joyful	26(6.8)
	Confused	94(24.7)
	Cry	42(11.1)
	Embarrass	19(5)
	Fainting	7(1.8)
	Hide it	4(1.1)
Menstrual knowledge before menarche	Yes	339(89.2)
	No	41(10.8)
Preferred source of information	Family members	255(67.1)
	Friends	46(12.1)
	Teacher and reading	30(7.9)
	Media	49(12.9)
Health problem during menstruation	Yes	236(62.1)
	No	144(37.9)
Health problems (n=236)	Irregularity	32(13.6)
	Excess flow	22(9.3)
	Abdominal/back ache	106(44.9)
	Headache	28(11.9)
	Mood change/ depression	28(11.9)
	Sleep disorder	20(8.5)
Severity of pain	Mild	212(44.2)
	Moderate	68(17.9)
	Severe	100(26.3)
Menstruation related absenteeism	Yes	146(38.4)
	No	234(61.6)
Reason for absenteeism (n=146)	no private toilet	5(3.4)
	no change room	12(8.2)
	no water	4(2.7)
	due to health problems	125(85.6)
Perceived effects of menstruation on school performance	Yes	81(21.4)
	No	299(78.6)

Association between sociodemographic factors and age at menarche

The binary logistic regression analysis revealed that several sociodemographic factors were significantly associated with age at menarche. Specifically, type of school (private vs. government), wealth index (high vs. low/middle), family education (above grade 9 vs. up to grade 8), and sleeping hours (≥ 10 hours vs. < 10 hours) were found to have p-values less than the commonly used significance level of 0.025. Given the multiple statistically significant associations identified in the initial binary logistic regression, a subsequent multivariable logistic regression analysis was warranted to further examine the independent effects of these sociodemographic factors on age at menarche, while controlling for potential confounding variables. Accordingly, this study identified significant differences in the age at menarche among respondents based on socio-demographic variables.

Notably, adolescent girls attending government schools had 0.50 times (or 50% lower odds) of experiencing menarche at early age compared to students attending private schools (AOR= 0.5; 95% CI: 0.32-0.78; p=0.001). Similarly, girls from middle (OR= 2.1; 95% CI: 018.32-72.08; p=0.003) and high-income (AOR= 4.0; 95% CI: 22.02-72.01; p=0.002) families experienced menarche at a younger age compared to those from low-income families. Furthermore, students who slept for 10 hours or more had 2.22 times higher odds of experiencing menarche at early age compared to students who slept for less than 10 hours (AOR= 2.22; 95% CI: 1.21-4.07; p=0.001).

Other variables such as parents' educational level, family size, physical exercise, and frequency of consuming fruits and vegetables, did no show significantly significant association with age at menarche (p>0.05) (Table 3).

Table 3: Association between sociodemographic factors and age at menarche in Addis Ababa, Ethiopia.

Independent variable	Subgroups	Ages of Menarche		AOR	95%CI	P value
		< 13	≥ 13			
Type of school	Private	10(12.6)	66(87.4)		1	
	Government	341(13.6)	265(86.4)	0.50	0.32-0.78	0.001*
Wealth index	Low income	14(13.5)	88(86.5)		1	
	Middle income	30(13.6)	194(86.4)	2.1	18-43	0.003*
	High income	7(12.8)	47(87.2)	4.0	22-72	0.002*
Mothers' education	Up to grade 8	219(95.6)	10(4.4)		1	
	Above grade 9	141(96.0)	10(4.0)	0.56	0.37-1.84	0.006
Fathers' education	Up to grade 8	183(97.3)	5(2.7)		1	
	Above grade 9	165(95.9)	7(4.1)	0.47	0.30-0.73	0.001*
Family size	≤ 3 members	38(34.9)	71(65.1)		1	
	>3 members	241(88.9)	30(11.1)	0.65	0.40-1.05	0.08
Diet	Vegetable diet 2/3/week	148(59.7)	100(40.3)	0.99	0.67-1.47	0.976
	No vegetable diet/week	56(42.4)	76(57.6)		1	
Exercise	Yes	117(95.1)	6(4.9)	1.60	0.01-2.56	0.06
	No	250(97.3)	7(5.4)			
Sleeping hours	≥ 10 hours	78(91.8)	7(8.2)	2.22	1.21-4.07	0.01*
	< 10 hours	279(94.6)	16(5.5)		1	

*p < 0.05 is considered significant

Association between menarcheal age and menstrual characteristics of respondents

Previous unawareness about menstruation was associated with school absenteeism, perceived negative impact on school performance, and emotional reactions at the time of menarche. Students who did not know about menses before menarche had 2.74 times higher odds of being absent from school during menstruation days compared to those who knew about menses before menarche (AOR= 2.74; 95% CI: 1.34-5.62; p=0.005). Moreover, menstrual characteristics, including frequency, duration, and related health problems, had association on school absenteeism and perceived academic impact. Girls whose menstrual periods lasted more than eight days or more were more likely to be absent from school compared to those with shorter periods. This extended duration also significantly affected their academic performance or grades.

Table 4: Factors associated with school absenteeism during menstruation days in Addis Ababa, Ethiopia.

Independent variable	Subgroup	School absenteeism		AOR	95%CI	P value
		Yes	No			
Knew about menses before menarche	Yes	119(35.1)	220(64.9)		1	
	No	27(65.9)	14(34.1)	2.74	1.34-5.62	0.005
Menstrual health problem	Yes	131(56.0)	103(44.0)	6.92	3.7-12.89	0.001
	No	17(11.6)	129(88.4)		1	
Duration of menses	< 8 days	39(26.0)	111(74.0)		1	
	≥ 8 days	211(91.7)	19(8.3)	4.14	2.15-7.98	0.001
Severity of pain	Severe	97(85.1)	17(14.9)	6.25	2.10-10.67	0.001
	moderate	67(69.8)	29(30.2)	4.25	2.19-8.24	0.001
	Mild	23(13.5)	147(86.5)		1	

*p < 0.05 is considered significant

Discussion

This study aimed to identify factors influencing age at menarche and menstrual problems among adolescent girls in Addis Ababa, Ethiopia. The mean age at menarche was similar to findings from previous studies conducted in Mekele[7], Gondar[8], North Wollo[10], Sawla town[4], and the Amhara region[12]. The results were also comparable, with no more than a one-year difference, to studies from other countries, including Sudan[9], Ghana[15], Malaysia[16], Iran[17], and Portugal[18].

A notable finding was the significant difference in menarche age between private and government school girls. Girls attending private schools, who typically came from higher socioeconomic backgrounds, experienced earlier menarche than their government school counterparts. This aligns with previous studies suggesting that better nutrition and socioeconomic advantages contribute to earlier onset of puberty[19]. Additionally, larger family sizes were associated with delayed menarche, likely due to financial strain on nutritional resources, which is a common pattern in low-income Ethiopian households[20-25].

A novel finding of this study was the inverse association between sleep duration and age at menarche. Girls who slept less than nine hours per night experienced earlier menarche compared to those who slept more than ten hours. This relationship may be explained by the role of sleep deprivation in increasing psychosocial stress, which can activate the hypothalamic-pituitary-gonadal axis and accelerate puberty[5,26-28]. The potential impact of sleep-related hormonal changes on puberty warrants further longitudinal research to explore the mechanisms linking sleep and reproductive development.

This study reaffirmed that menstrual health problems, including dysmenorrhea, irregular cycles, and abdominal pain, are highly prevalent among adolescent girls, consistent with findings from prior studies[5,8,29]. The high rates of school absenteeism due to menstrual issues—particularly among government school girls—highlight the need for improved school-based menstrual health support. Differences in school infrastructure, hygiene facilities, and access to menstrual products may contribute to these disparities.

Additionally, 44% of girls reported a negative emotional response to their first period, with confusion, embarrassment, and even fainting being common. The reliance on family members, especially mothers, as the primary source of menstrual knowledge emphasizes the need to equip parents with accurate and supportive education to help girls navigate menarche with confidence.

Strength and Limitation

This study had a high response rate and explored various sociodemographic variables. However, the findings may not be representative of rural adolescent populations. Recall bias regarding age at menarche was another limitation, although menarche is generally considered a salient life event and can often be remembered with reasonable accuracy over short periods. The absence of official birth registration may also lead to underreporting of actual age. The cross-sectional design limits the ability to establish causal relationships between variables. Furthermore, the sensitive nature of menstrual health may have introduced social desirability bias, despite efforts to minimize it.

Conclusion

This study revealed that the mean age at menarche among adolescent girls in Addis Ababa was comparable to other regions in Ethiopia and several international contexts. However, socioeconomic disparities, particularly school type (private vs. government), parental education, and family income, played a significant role in influencing menarche timing. Additionally, insufficient sleep was identified as a novel factor associated with earlier puberty onset, highlighting the influence of lifestyle factors on reproductive health. Menstrual health challenges, including dysmenorrhea, irregular cycles, and school absenteeism, were highly prevalent—especially among government

school students—highlighting the urgent need for targeted interventions.

Recommendations

- Integrate comprehensive menstrual education and teacher training into both government and private school curricula.
- Ensure the availability of affordable or free sanitary products and adequate school sanitation facilities, especially in government schools.
- Promote balanced nutrition and healthy sleep habits to support normal pubertal development.
- Empower parents, particularly mothers, with accurate information to support their daughters' menstrual health and reduce stigma.

Declarations

Ethical Consideration

Ethical clearance, with a waiver for parental permission, was obtained from Addis Ababa University, Department of Obstetrics and Gynecology Research and Publication Committee (Date: November 19, 2018; Minute Nº: DRPC 2018/11/19-2). School directors were informed about the study objectives, and oral permission was obtained. A waiver of consent was granted for adolescents aged 14–17. Confidentiality was maintained by omitting names and addresses from the questionnaires. Participants were informed of their right to withdraw at any time or skip questions.

Availability of Data and Materials

All data generated or analyzed during this study are included in this published article.

Competing Interests

The authors declare that they have no competing interests.

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Authors' Contributions

The study was designed, prepared, and edited by Seid Arage and Dawit Worku. The manuscript was prepared by Ahmed Muhye. All authors have read and approved the final manuscript.

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