

# Pre-menarche adolescent girls' menstrual knowledge and preparedness to menarche in North Shewa zone of Amhara region, Ethiopia

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## Research

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# Abstract

**Background:** Many adolescent girls in Ethiopia attain menarche without adequate knowledge and preparation which could have a distressing negative impact on their psychosocial, physical, and emotional wellbeing. This study aimed to assess pre-menarche adolescent girls' menstrual knowledge and preparedness to menstruation and associated factors in the North Shewa Zone of the Amhara region.

**Methods:** A school-based cross-sectional study was conducted on participants selected through a multi-stage sampling technique. Data collected through a self-administered questionnaire were entered into Epi Data and exported to SPSS for analysis. Bi-variable and multivariable logistic regressions were computed to identify factors associated with the good menstrual knowledge and preparedness to menarche. An odds ratio with 95%CI was computed to measure the magnitude of the association. Variables with a p-value of <0.05 on multivariable analysis were considered statistically significant factors associated with the outcome variable.

**Results:** From a total of 424 pre-menarche adolescent girls included in the study, 166(39.2%) had good menstrual knowledge and about a quarter 110(25.9%) had good preparedness towards menarche. An increase in the school grade level of adolescent girls, the educational status of the mother, and occupation of the father (government employment) were positively associated with good menstrual knowledge. Having good menstrual knowledge increased the preparedness of pre-menarche girls to menarche by over 13-fold than poorly knowledgeable girls.

**Conclusions:** Menstrual knowledge and preparedness to menarche of pre-menarche adolescent girls were low in the North Shewa Zone of the Amhara region. The level of preparedness to menarche was also highly dependent on girls' menstrual knowledge. Thus, the school's health program and teachers should address the problem by delivering age-appropriate menstrual information to equip adolescent girls with accurate and adequate menstrual knowledge before the onset of menarche.

## Plain English Summary

Many adolescent girls in Ethiopia experience their first menstruation without adequate knowledge and preparation which could have a distressing negative impact on their future life. This study assessed menstrual knowledge and preparedness for menstruation and associated factors of adolescent girls who not ever had menstruation in the North Shewa Zone of the Amhara region. Data were collected from 424 non-menstruating adolescent female students selected from primary and secondary schools found both in urban and rural areas. We found that 166(39.2%) had good knowledge about menstruation and 110(25.9%) had better preparedness for their first menstruation. Those girls' knowledge about menstruation and preparedness for the first menstruation was low in the North Shewa Zone of the Amhara region. The level of preparedness to first menstruation was highly reliant on girls' menstrual knowledge. Thus, the school's health program and teachers should address the problem by delivering

age-appropriate menstrual information to equip adolescent girls with accurate and adequate menstrual knowledge before the onset of menarche.

## Introduction

Adolescence is a period of transition from childhood to adulthood characterized by rapid physical, psychological, and mental development and maturity. It is also the time of rapid development of secondary sexual characteristics including the initiation of menstruation for girls. Menstruation is the physiological process of releasing blood from the uterus through the vagina as part of the menstrual cycle experienced by adolescent girls and women in reproductive age (1–3). This is the periodic shedding of the inner lining of endometrium, which was prepared to support the growth of the fertilized egg, in the absence of fertilization of egg with sperm. The onset of menstruation for the first time is known as menarche, which usually occurs during early adolescence (10–14 years of age) (4).

Although menstruation is a natural phenomenon, it is surrounded by socio-cultural and religious beliefs and taboos in low and middle-income countries (LMICs) including Ethiopia. Because of these harmful beliefs and taboos, menstruation is considered as embarrassing, shameful and something that has to be hidden which restrict adolescent girls to discuss menstruation and reproductive health with their parents or other family members, friends and teachers. These restrictions create barriers to access accurate and comprehensive information about menstruation and related hygienic management for adolescent girls. This in turn leads to a misconception of adolescent girls about menstruation (1, 2, 5–7).

As a result, a substantial number of adolescent girls in LMICs attain menarche without adequate knowledge and preparation about menstruation and its hygienic management (1, 5, 8). Studies in India (9), Gambia (10) and Benin (11) revealed that less than two-thirds of girls were informed about menstruation before its occurrence and most of them felt unprepared for menarche. Unpreparedness was more frequently reported by girls who experienced menarche at a relatively early age. In Ethiopia, the proportion of adolescent girls who had menstrual knowledge before menarche ranges from 27.1–51.4% (7, 12–14).

In addition to harmful beliefs and taboos in the community, for adolescent girls who lack knowledge and unpreparedness to menstruation, menarche will be a distressing experience of fear, anxiety, embarrassment, tension, and shame (9, 11, 12, 15, 16). Inability to manage menstruation with dignity in public spaces like schools intensifies these feelings and increase school absenteeism, school dropout, and poor academic performance of adolescent girls (1, 5, 17). On the other hand, good menstrual knowledge and preparation for menstruation before menarche effectively improves positive experience to menarche, attitude towards menstruation, and proper menstrual hygienic practice (13, 18, 19). Thus, menarche is one of the most crucial sudden events of adolescent girls which potentially might profound negative impact on the psychosocial, physical, and emotional wellbeing of adolescent girls and their future lives (1, 6, 15).

Almost all local studies in Ethiopia were focused on menstrual hygiene management and few of them addressed menstrual knowledge and preparedness before menarche by measuring it retrospectively on post-menarche adolescent girls. As the evidence showed, most adolescent girls considered menarche as a triggering factor to learn about menstruation (1). This knowledge learned after menarche and their menstrual experience could affect their response leading to the overestimation of menstrual knowledge and preparedness to menstruation before menarche. Therefore, this study aimed to assess pre-menarche adolescent girls' menstrual knowledge and preparedness to menstruation and associated factor in North Shewa zone of Amhara region, Central Ethiopia

## **Methods**

### **Study setting and period**

The study was conducted from January 16, 2019, to March 30, 2019, in North Shewa zone. North Shewa zone is one of the eleven zones found in the Amhara national regional state of Ethiopia. The zone is divided into twenty-four woreda and three town administrations. Debre Birhan is zonal administrative town of North Shewa zone which is 130 km northeast of the capital city Addis Ababa at latitude of 9°46'8.4"N and longitude 39°40'4.8"E.

### **Study design and population**

An institute based cross-sectional study was conducted among pre-menarche adolescent school girls. Pre-menarche adolescent female students from grade 5 to 10 who attended education at public school were our study population. Those students found from grade 5 to 10 but aged less than 10 years or greater than 19 years were excluded from the study. Similarly, students with visual or hearing impairment and from private schools were not involved in this study.

### **Sample size and sampling procedure**

We used Epi Info version 7.1.5.0 software to determine the required sample size. The sample size for descriptive study on Epi Info was computed by considering the following assumptions: source population of the study less than 10,000, 77.1% prevalence of menstrual knowledge of adolescent girls before menarche (20), 5% confidence limits, 95% confidence level and 1.5 design effect for a single cluster. From the computed value of 407 by adding a 10% non-response rate we got 448 as the final sample size. A multistage sampling technique was employed to get these study participants. First, we selected four woreda administrations (Debre Sina, Basona Werena, Hagere Mariam, and Jiru Enuari) through the lottery method. Second, we chose three schools, each from rural 2nd cycle primary schools (grade 5–8), urban 2nd cycle primary schools, and high schools (grade 9–10) randomly using lottery method to include a total of 12 schools in the study. Finally, study participants were selected by proportionate systematic random sampling after listing out of all pre-menarche adolescent girls from those schools.

### **Data collection procedures and tools**

Data were collected using a semi-structured self-administered questionnaire. The questionnaire was developed by reviewing different pieces of literature and contextually adapted to the socio-cultural norms

of the area. The questionnaire was divided into three sections designed to assess pre-menarche adolescent girls' socio-demographic characteristics, menstrual knowledge, and preparedness to menarche. Selected students were appointed to come back to school on the class free time of the next day for data collection. At the same time, those consent minors ( $\leq 15$  years of age) were informed to get oral consent from their parents. Data collectors instruct study participants on how to fill the questionnaire and facilitate the data collection process. The questionnaire took on average 20–25 minutes.

Knowledge of pre-menarche adolescent girls about menstruation was measured used a series of close-ended 10-item questions developed after reviewing related literature (5, 10, 18, 21, 22) and by consulting senior researchers who were more familiar to the area. Each correct response got one mark whereas any wrong or don't know response got no mark. The sum score of knowledge questions was calculated out of 10 points. Those who scored  $\geq 7$  were categorized as having good knowledge about menstruation.

The preparedness of pre-menarche adolescent girls was measured with 8-item questions. The response of each item was scored as "1" for correct response and "0" for wrong or don't know responses. The total sum score of the tool ranges from 0 to 8 and those who scored  $\geq 5$  were considered as well prepared for menarche.

### **Data quality assurance**

The questionnaire, which was initially prepared in the English language, was translated to local (Amharic) language then re-translated back to English to check its consistency. The Amharic version of the questionnaire was pre-tested on 5% of the study subjects to ensure its understandability, internal consistency and ability to address the study objectives. According to the pre-test result, few modifications to the expression of terminologies were made. Besides, the internal consistency (reliability) of items in the menstrual knowledge and preparedness measurement tools was determined using Cronbach's alpha. It was 0.626 and 0.561 for knowledge and preparedness measurement tools. A one-day training about the objective of the study, methods of participant selection and data collection tool, and procedure for four female data collectors and one supervisor. Daily monitoring and supervision of the data collection, checking for completeness and consistency of collected data was carried out by supervisors. The principal investigator also examined the collected data for completeness and consistency before data entry.

### **Data analysis procedures**

Collected data were entered Epi Data version 3.1 software and exported to SPSS version 24 for analysis. Both descriptive and analytical statistics were performed and presented using tables and graphs. Variables found to have a p-value of  $< 0.2$  on bi-variable analysis were included in the multivariable binary logistic regression analysis. Multivariable binary logistic regression analyses were carried out to identify socio-demographic factors associated with menstrual knowledge and to see the effect of menstrual knowledge on preparedness to menarche of pre-menarche adolescent girls. Odds ratios with 95% confidence intervals were computed and a p-value of  $< 0.05$  was used to declare the presence of a statistically significant association between the covariates and dependent variable.

# Results

## Demographic profile of study participants

Out of 448 pre-menarche adolescent girls selected for study, 424 were involved in this study giving the response rate of 94.6%. Table 1 demonstrates the demographic characteristics of the study participants. The mean ( $\pm$  SD) age of study participants was 13 ( $\pm$  1.4) years. Adolescent girls aged 10–14 years were 358 (84.4%), while 64 (15.6%) were 15–19 years of age. Most 380 (89.6%) and 402 (94.8%) participants were grade 5–8 students and orthodox religion followers respectively. Regarding parents' educational status, 136 (34.0%) mothers and 60 (14.9%) fathers were illiterate. Majority 242 (58.5%) of mothers were housewives and 300 (74.3%) of fathers were farmers. The mean ( $\pm$  SD) family size of study participants was 4.9 ( $\pm$  1.6) (Table 1).

Table 1  
Socio-demographic characteristics of study participants in the North Shewa  
Zone, 2019 (n = 424).

Variables		Frequency	Percent (%)
Age	10–14 years	358	84.4
	15–19 years	66	15.6
School type	Elementary school	380	89.6
	High school	44	10.4
Grade	Grade 5	124	29.2
	Grade 6	98	23.1
	Grade 7	100	23.6
	Grade 8	58	13.7
	Grade 9	34	8.0
	Grade 10	10	2.4
Residence	Rural	258	60.8
	Urban	166	39.2
Religion	Orthodox	402	94.8
	Muslim	15	3.5
	Protestant	7	1.7
Ethnicity	Amhara	414	99.5
	Oromo	2	0.5
Household head	Male	322	77.8
	Female	92	22.2
Mother's education	Illiterate	136	34.0
	Primary school	228	57.0
	Secondary school	16	4.0
	College and above	20	5.0
Father's education	Illiterate	60	14.9
	Primary school	280	69.7
	Secondary school	38	9.5

Variables		Frequency	Percent (%)
	College and above	24	6.0
Mother's occupation	Housewife	242	58.5
	Farmer	80	19.3
	Merchant	46	11.1
	Government employee	24	5.8
	Private employee	18	4.3
	Others	4	1.0
Father's occupation	Farmer	300	74.3
	Government employee	44	10.9
	Merchant	38	9.4
	Private employee	10	2.5
	Others	12	3.0
Family size	≤ 4	156	36.8
	> 4	268	63.2

### Menstrual knowledge of pre-menarche adolescent girls

Based on the 10-items questions used to measure menstrual knowledge, 166 (39.2%) pre-menarche adolescent girls had good menstrual knowledge and 258 (60.8%) had poor menstrual knowledge. Over two-third 292 (68.9%) of pre-menarche adolescent girls heard of menstruation from various sources. School teachers 108 (37.0%) and mothers 100 (34.2%) were frequently mentioned primary source of information. Over half 214 (50.5%), 232 (54.7%), and 221 (52.1%) pre-menarche adolescent girls knew the common age of menarche, average length of a menstrual cycle and average duration menstrual blood flow respectively. Over two-third 296 (69.8%) recognized that menstruation is unique to females and 214 (50.5%) considered it as sign of sexual maturity. Nearly half 210 (49.5%) pre-menarche adolescent girls did not know the cause of menstruation, while 118 (27.8%) and 28 (6.6%) mentioned biological process and hormonal effect as the cause of menstruation respectively. Regarding the origin of menstrual blood; 121 (28.7%) said uterus, 203 (48.1%) abdomen, and 67 (15.9%) didn't know (Table 2).



Table 2  
Menstrual knowledge of study participants in the North Shewa Zone, 2019 (n = 424).

Variables		Frequency	Percent (%)
Heard about menstruation before	Yes	292	68.9
	No	132	31.1
Menstruation is a natural phenomenon?	Yes	146	34.4
	No	226	53.3
	Don't know	52	12.3
Cause of menstruation	Biological	118	27.8
	Hormonal	28	6.6
	Disease	8	1.9
	Curse of god	48	11.3
	Don't know	210	49.5
	Others	12	2.8
Source organ of menstrual blood	Uterus	121	28.7
	Abdomen	203	48.1
	Vagina	26	6.2
	Don't know	67	15.9
	Others	5	1.2
Common age of menarche	10–15 years	214	50.5
	Don't know	188	44.3
	Others	22	5.2
Average duration of a menstruation cycle	21–35 days	232	54.7
	Don't know	173	40.8
	Others	19	4.5
Average duration of menstrual flow	4–7 days	221	52.1
	Don't know	180	42.5
	Others	23	5.4
Menstruation is sign of sexual maturity	Yes	214	50.5
	No	184	43.4

Variables		Frequency	Percent (%)
	Don't know	26	6.1
Menstruation is unique to females	Yes	296	69.8
	No	128	30.2
Can pregnant women menstruate	Yes	98	23.1
	No	304	71.7
	Don't know	22	5.2
Primary source of information about menstruation	Mother	100	34.2
	Elder sister	54	18.5
	School teacher	108	37.0
	Mass media	16	5.5
	others	14	4.8
Level of menstrual knowledge	Good	166	39.2
	Poor	258	60.8

### Preparedness to menarche

A large proportion of pre-menarche adolescent girls 249 (58.7%) didn't feel they are prepared for menarche. Hundred sixty-seven (39.4%) thought they knew what to do at the time of menarche, and 132 (31.1%) believed they knew what to do if they start to see menarche at school. About one-fourth (24.1%) participants considered telling someone when they experience menarche. Only one of ten pre-menarche adolescent girls (10.4%) was willing to ask help from school teachers if menarche started while at school. Over half 228 (54.3%) and 215 (50.7%) of the study participants heard about menstrual hygiene management and disposable sanitary pads respectively. However, 113 (26.7%) of participants believed they knew how to use absorbent materials during menstruation. From 102 participants who considered telling to someone when they experience menarche, majority 57 (55.9%) preferred mothers followed by 25 (24.5%) sisters and 11 (10.8%) friends. Generally, only a quarter 110 (25.9%) of study participants had good preparedness towards menarche (Table 3).

Table 3

Preparedness to menarche of study participants in the North Shewa Zone, 2019 (n = 424).

Variables		Frequency	Percent (%)
Do you feel prepared for menarche?	Yes	175	41.3
	No	249	58.7
Do you know what to do at time of menarche?	Yes	167	39.4
	No	257	60.6
Do you know what to do if menarche starts at school?	Yes	132	31.1
	No	292	68.9
Will you tell someone about your menarche?	Yes	102	24.1
	No	322	75.9
Will you ask your teachers for help if menarche starts at school?	Yes	44	10.4
	No	380	89.6
Have you heard about menstrual hygiene management?	Yes	228	54.3
	No	192	45.7
Have you heard about disposable sanitary pads?	Yes	215	50.7
	No	209	49.3
Do you think you know how to use sanitary pads or clothes?	Yes	113	26.7
	No	309	73.2
Primary source of information about disposable sanitary pads	Mother	66	30.7
	Sister	32	14.9
	Teacher	82	38.1
	Friends	19	8.8
	Mass media	16	7.4
Preference to discuss about your menarche	Mother	57	55.9
	Sister	25	24.5
	Relatives	7	6.9
	Friend	11	10.8
	Others	2	1.9

Variables		Frequency	Percent (%)
Preparedness to menarche	Good	110	25.9
	Poor	314	74.1

### Demographic factors associated with menstrual knowledge

Pre-menarche adolescent girls' school grade level, educational status of the mother, and occupation of the father were significantly associated with good menstrual knowledge. Menstrual knowledge of adolescent girls increased as their school grade level increases. For a unit increase in the school grade, pre-menarche adolescent girls' menstrual knowledge increased by the odds of 1.6 [AOR; 1.631 and 95%CI; (1.331–1.999)]. As compared to girls of illiterate mothers, those girls whose mothers had primary school education had two-fold higher menstrual knowledge [AOR; 2.104 and 95%CI; (1.261–3.510)]. Adolescent girls of government-employed fathers were nearly 4 times more knowledgeable than those whose fathers were farmers [AOR; 3.978 and 95%CI; (1.639–9.655)] (Table 4).

Table 4  
Factors associated with menstrual knowledge in the North Shewa Zone, 2019.

Variables	Menstrual Knowledge		COR(95%CI)	AOR(95%CI)	
	Good	Poor			
Grade	166	256	1.370 (1.180–1.590)	1.631 (1.331–1.999)*	
Age	≤ 14 years	138	220	1	1
	> 14 years	28	32	1.395 (0.805–2.418)	0.865 (0.352–1.449)
Residence	Rural	88	170	1	1
	Urban	78	88	1.712 (1.149–2.552)	1.088 (0.666–3.158)
Education of the mother	Illiterate	42	94	1	1
	Primary school	98	130	1.687 (1.077–2.642)	2.104 (1.261–3.510)*
	Secondary school	8	8	2.238 (0.787–6.366)	2.951 (0.926–9.405)
	College and above	12	8	3.357 (1.278–8.818)	1.769 (0.524–5.968)
Occupation of the father	Farmer	108	192	1	1
	Merchant	16	22	1.293 (0.651–2.567)	1.587 (0.684–3.679)
	Gov't employee	24	20	2.133 (1.127–4.040)	3.978 (1.639–9.655)*
	Private employee	4	6	1.185 (0.327–4.292)	1.775 (0.422–7.466)
	Others	4	8	0.889 (0.262–3.020)	0.913 (0.239–3.492)
* Statistically significant variables					

### Effect of menstrual knowledge on preparedness to menarche

After controlling socio-demographic confounders on multivariable analysis, menstrual knowledge was strong association with preparedness for menarche. Having good menstrual knowledge increased preparedness to menarche by over 13-folds [AOR; 13.050 and 95%CI; (6.963–24.457)]. Besides, preparedness to menarche increased by odds of 1.8 for a unit increase in the school grade level of pre-

menarche girls [AOR = 1.804, 95%CI (1.240–2.624)]. As compared to girls of housewife mothers, those girls of government-employed mothers had 7.7 times higher odds of preparedness to menarche [AOR = 7.708, 95%CI (2.421–24.537)] (Table 5).

Table 5  
Factors associated with preparedness to menarche in the North Shewa Zone, 2019.

Variables	Preparedness to menarche		COR(95%CI)	AOR(95%CI)	
	Good	Poor			
Age	166	256	1.239(1.062–1.445)	0.940(0.682–1.298)	
Grade	166	256	1.546 (1.310–1.824)	1.804 (1.240–2.624)*	
School type	Primary school	88	290	1	1
	High school	22	24	3.021 (1.616–5.648)	1.047 (0.372–2.948)
Occupation of the father	Housewife	56	186	1	1
	Farmer	16	64	0.830 (0.445–1.550)	0.476 (0.211–1.074)
	Merchant	18	28	2.135 (1.100–4.144)	2.167 (0.926–5.071)
	Gov't employee	12	12	3.321 (1.414–7.803)	7.708 (2.421–24.537)*
	Private employee	2	6	0.415 (0.093–1.861)	0.469 (0.084–2.607)
Family size	≤ 4	30	116	1	1
	> 4	76	182	1.615 (0.997–2.616)	1.719 (0.910–3.244)
Menstrual knowledge	Poor	18	240	1	1
	Good	92	74	16.577 (9.389–29.265)	13.50 .963-24.457)*
* Statistically significant variables					

## Discussion

Menstruation is surrounded by taboos and cultural beliefs which consider menstruation as an embarrassing, shameful, and secret thing that restrict adolescent girls to discuss it freely. This limit adolescent girls from accessing accurate information about menstruation and a significant number of adolescent girls experience menarche with poor knowledge and misconception about menstruation (1, 2, 6, 7, 15, 22, 23). This study finding also indicated a similar result that 39.2% of pre-menarche adolescent girls had good general knowledge and 60.8% had poor knowledge about menstruation. Misconception about specific areas of menstruation was common like 48.1% and 6.2% of adolescent girls thought that menstrual blood originates from the abdomen and vagina respectively. Nearly one-fourth (23.1%) believed menstruation during pregnancy and 11.4% thought menstruation is caused by the curse of God.

The magnitude of 39.2% good knowledge about menstruation in this study is in line with 39.4% report in central India (24) but slightly higher than 31.7% and 31.4% report in Gedeo district of Southern Nations, Nationalities and Peoples' Regional states of Ethiopia (13) and Tumkur, India (25). This study finding is lower than 77.1%, 70.9%, and 51.4% study reports in Adama (20), Boset (26), and Harbu (14) districts of Ethiopia respectively. Studies in Rajasthan India (9) and Benin (11) also reported that 66% and 60.7% of adolescent girls had menstrual knowledge before menarche. This disagreement between those studies might be because of the difference in the definition of menstrual knowledge and the tool used to measure it. The difference in study participants' menstrual status at the time of investigation might also have an important role in the observed inconsistency. A study in the rural Gambia (10) revealed that 26.6% and 66.0% pre-menarche and post-menarche adolescent girls had good menstrual knowledge which indicates menarche is a triggering factor for girls to learn about menstruation. The knowledge and experience after menarche of post-menarche girls could affect their response to questions related to menstrual knowledge before menarche. Therefore, including post-menarche adolescent girls for the assessment of menstrual knowledge before menarche could lead to the overestimation of menstrual knowledge of adolescent girls before menarche.

Previous studies on adolescent girls irrespective of their menstrual experience showed that menstrual knowledge depends on age adolescent girls. An increase in age leads to the onset of menarche which triggers adolescent girls to learn about menstruation. This means the onset of menarche is the intermediate variable between age and menstrual knowledge of adolescent girls. Perhaps, this might be the reason why, in our study, the age of pre-menarche girls was not associated with menstrual knowledge.

According to this study, menstrual knowledge of pre-menarche adolescent girls increased depends on their educational level. For a unit increase in school grade level, menstrual knowledge increased by 63.1%. Parents' education and occupation had also associated with pre-menarche adolescent girls knowledge about menstruation. This is consistent with a study in Denpasar City (27) reports that the level of education and surrounding people, from whom they acquire information, influences menstrual knowledge of girls.

According to the present study, about one-fourth 25.9% pre-menarche adolescent girls were better prepared and 74.1% were poorly prepared for menarche. This finding lower than the finding of a study in

Mexico (18) which reported 38% of adolescent females were badly prepared and 19% were well prepared for menarche. Similarly, 33% of adolescent girls were not well prepared for menarche in Gambia (10), and in the Udupi district of Karnataka (21), 47.5% had poor psychosocial preparation for menarche. This disagreement could be due to the study area's socio-cultural and demographic differences or variation in the measurement tools.

Menstrual knowledge of pre-menarche girls had a strong association with their preparedness for menarche. Having good menstrual knowledge increased the preparedness of pre-menarche girls to menarche by over 13-fold than poorly knowledgeable girls. Similarly, a study in Indonesia revealed (5) that lack of preparation for menarche of adolescent girls is due to insufficient menstrual knowledge.

As a cross-sectional study, this study has limitation in establishing causality based on the observed association between the covariates and the dependent variable. Not all adolescent girls attend school, so this study results can't be inferred to the total pre-menarche adolescent girls in the area. Despite several measures were taken to minimize, due to the sensitive nature of menstruation the possibility of social desirability bias by study participants is unavoidable. Addressing this sensitive issue using quantitative data only without triangulation with a qualitative approach is another limitation of this study. Therefore, further research with a mixed study design approach is recommended to exhaustively explore those sensitive variables related to menstrual knowledge and preparedness to menarche among pre-menarche adolescent girls.

## **Conclusions**

According to this study, menstrual knowledge and preparedness to menarche were very low. The cause and origin of menstrual blood were common misconceptions among pre-menarche adolescent girls. Maternal education, fathers' occupation, and girls' school grade level had an independent association with pre-menarche adolescent girls' menstrual knowledge. The level of preparedness to menarche was also highly dependent on girls' menstrual knowledge. Thus, adolescent girls should acquire accurate and adequate knowledge as early as possible; schools should deliver age-appropriate menstrual information.

## **List Of Abbreviations**

LMICs: Low and Middle Income countries

## **Declarations**

### **Ethics approval and consent to participate**

Ethical clearance was obtained from the Ethical Review Committee of Debre Berhan University. A letter of support written to participating Woreda was obtained from the zonal health office. Permission letter was also obtained from the Woreda education office and each selected school. Permission to proceed with the study was obtained from each participating school following an explanation of the objective of the study



for school directors. Data was collected after each study participants were adequately informed about the purpose, benefits, and risks of the study and their right to discontinue or refuse to participate in the study. Written consent was obtained from  $\geq 15$  years old study participants, and for those  $< 15$  years old verbal consent from parents and assent from participants was obtained. For confidentiality purpose, the names of participants and other personal identifiers related questions were excluded in the questionnaire. The collected data were stored in a safe place where no one can access it except the research teams.

### **Consent for publication**

Not applicable

### **Availability of data and materials**

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

### **Competing interests**

The authors declare that they have no competing interests

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### **Author Contributions**

AB designed the investigation, carried out the data analyses, interpreted the results and drafted the manuscript; MA facilitated the data collection, interpreted the results, and reviewed and revised the manuscript. All authors read and approved the final manuscript.

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