ORIGINAL ARTICLE

AGE AT MENARCHE, FACTORS THAT INFLUENCE IT, AND MENSTRUAL PATTERN OF SECONDARY SCHOOL ADOLESCENTS IN ADDIS ABABA, ETHIOPIA

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ABSTRACT

Introduction: *Menarche is the first menstrual period of a girl. Age at menarche is a complex trait and has a strong genetic component. The mean age of menarche varies from population to population and is known to be a sensitive indicator of various characteristics of the population, including nutritional status, geographical location, environmental conditions, and magnitude of socioeconomic inequalities in society.*

Objectives: *To determine the mean age of menarche, and assess influencing factors and menstrual patterns of secondary school adolescent females in Addis Ababa, Ethiopia.*

Methods: *This is a cross-sectional study conducted from January to May 2017 in selected high schools in Addis Ababa, Ethiopia. Female adolescents in the selected schools who were in grades 9th and 10th and who fulfilled the eligibility criteria were included. A self-administered questionnaire tool was used to collect data. Data was cleaned, entered and analyzed using SPSS version 21.*

Results: *The mean and median ages at menarche in this study were 13.75 (±1.30) and 13 years, respectively. The mean age at menarche was 0.96 years younger for private school girls (12.82 years) compared to government school girls (13.78 years). The private school girls had about 4 times higher odds of having menarche at an earlier age (AOR 4.12; 95% CI 2.44-6.95). The most common perimenstrual symptoms experienced by the students were dysmenorrhea (abdominal cramps) 303 (75.8 %), backache 188 (47.0 %), and headache 16%. In this study, abnormal menstrual cycle lengths occurred in 25.1 % of our respondents. Of the total study population, 77 (19.3%) adolescents had a menstrual cycle length shorter than 21 days.*

Conclusion: *The mean age at menarche in this study was 13.26 ±1.319 years. This age at menarche was earlier than prior reports from Ethiopia. Socioeconomic status was identified as a factor significantly associated with the age at menarche. Dysmenorrhea was the commonest perimenstrual symptom.*

Key words: *Age at menarche, adolescents, perimenstrual symptom.*

INTRODUCTION

Menarche is the first menstrual bleeding and represents a major landmark event in the reproductive life of an adolescent girl. (1) It is the most accurately recalled indicator of puberty. (2) Age at menarche (AAM), as a result, is one of the most significant traits, which is commonly used in retrospective epidemiological studies of female sexual maturation. (3)

Menarche is part of the complex process of growing up. Its onset is preceded by a complex cascade of hormonal changes during puberty which is susceptible to various factors from the very beginning of prenatal life. (4) The mean age at menarche varies from population to population and is known to be a sensitive indicator of various characteristics of the population including nutritional status, geographical location, environmental conditions, and socioeconomic status. (5-7)

Studies suggest that menarche tends to appear earlier in life as the sanitary, nutritional, and economic conditions of a society improve. (8)

Over time, the age at menarche has been found to show a steady decline of about two to three months per decade in developed countries (9), and about six months per decade in developing countries. (10) The mean age at menarche in the United States of America is 12.55 and 12.0 years among black and white girls, respectively. (5) The reported ages at menarche in India were 15.9 and 15.6 years for rural and urban girls respectively. (11) Two studies done in rural Ethiopia revealed the mean age at menarche to be 15.8 ± 1 and 13.9 ± 1.2 years. (3, 12)

The normal range for menstrual cycles is between 21 and 35 days while the duration of menstrual flow ranges from two to seven days.

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Menstrual abnormalities are more common among younger girls, becoming less frequent as they grow older, 3–5 years after menarche. (13-17) For the first few years after menarche, irregular and longer cycles are common. (15-18) Menstruation may also be associated with various symptoms occurring before or during menstrual flow. A significant number of young students complain of dysmenorrhea, and this is more common among older girls with longer bleeding periods. (18)

Knowledge on age at menarche and pattern in menstrual cycles is necessary for patient education and to guide individualized clinical care. To our knowledge there is no published study in our country comparing age at menarche and menstrual patterns between different socioeconomic groups. The purpose of this study, hence, was to determine the age at menarche and patterns of menstruation among secondary school girls of different socioeconomic status in Addis Ababa.

METHODS

Study design: This is a cross-sectional study conducted from January through May 2017 in selected high schools in Addis Ababa, Ethiopia. Study setting: Addis Ababa has 10 administrative districts and sub-cities. The total number of secondary schools in the city was 212. Study population: Secondary school adolescents who have started to menstruate and attending secondary schools in Addis Ababa, Ethiopia.

Sample size: The sample size was determined using a single proportion formula with a level of significance of 5%, Z = 1.96 (confidence level at 95%), and the absolute precision or margin of error d=0.05. The 50% proportion (P=0.5) was taken for the sake of having a larger sample size. Sampling procedure: A two-stage sampling was used. In the first stage, one administrative district was selected randomly. In the second stage, four high schools, two from government and two from non-governmental schools, were selected randomly from the selected district. The two study government schools were Tikur Anbessa and Atse Naod High schools. The two non-governmental schools were Lycée Guebre Mariam (an international school) and the Nativity Girls School (a missionary school). The study sites also presented a comparative advantage in that each group of schools represented children from low and high socioeconomic groups.

Operational definition: The age at menarche was determined by questioning the age of the girl at having her first menstruation.

Data collection: Data was collected using a self-administered pre-tested questionnaire during school hours. Grades 9 to 11 students who already had menarche were included in the study using quota sampling on convenience till the sample size is reached. Of the total sampled 422 adolescents, 400 (95%) had their menarche and were eligible for analysis.

Data compilation and analysis: The collected data was coded, cleaned, and analyzed using SPSS version 21 statistical software. Descriptive statistics were used to present the results. Tables and different graphs were used to assist data presentation. The chi-square test of independence was done between the independent (socio-demographic variables) and dependent variables (age of menarche). The tested independent variables were the type of school, place of residence, religion, paternal and maternal educational levels, maternal and paternal occupation, and family size. The dependent variable was the age of menarche.

A stepwise analysis was conducted to explore the presence and strength of the association between the independent variables and age at menarche. Regression analysis was implemented between selected independent variables and age at menarche as a dichotomous variable ($\leq$13 and >13 years). Earlier age at menarche was taken as age at menarche of below the identified mean age at menarche in the present study. Initially, bivariate regression analysis was conducted for each independent variable with a chi-square value of <0.2 on cross-tabulation for the test of independence. Multiple regression analysis was then employed for those with a significant association (P<0.05) on bivariate analysis to control for confounding effects among the variables. Odds ratios (ORs) with their 95% confidence intervals were computed to identify the presence and strength of association and P-values<0.05 were taken as statistically significant.

Ethical considerations: Ethical approval was obtained from the Institutional Review Board of the College of Medicine and Health Sciences of the AAU. Permission to conduct the study was also obtained from the principals of participating schools. Participation in the assessment was completely voluntary with ascent and written informed consent was acquired from every participant and their parents before participation. No names were recorded to keep the identity of respondents anonymous.

RESULTS

Data for the present study was collected from 400 eligible schoolgirl study participants. The current age of the study participants ranged from 14 to 18 years, while the mean age was 15.98 (±1.14) years.

Sociodemographic variables
As shown in table-1 below, 230 (57.5%) of the participants were from private schools.

The majority of the study participants were from Addis Ababa and Orthodox in religion with proportions of 367 (91.8%) and 303 (75.8%), respectively. About two-thirds, 276 (69%) were grade 9 students. The paternal and maternal education level was higher education (above high school) for 184 (46%) and 148 (37%) of the participants, respectively.

Table 1: Socio-demographic characteristics of adolescents at selected high schools in Addis Ababa, Ethiopia, January - May 2017GC.

Characteristics	Frequency n (%)
Current age in years (n=400)	
14 years	35 (8.8)
15 years	115 (28.7)
16 years	117 (29.3)
17 years	89 (22.3)
18 years	44 (11.0)
Type of school (n=400)	
Private	230 (57.5)
Government	170 (42.5)
Residence (n=400)	
Addis Ababa	367 (91.8)
Outside Addis Ababa	33 (8.2)
Education level (Grade) (n=400)	
9	276 (69)
10	3 (0.8)
11	121 (30.2)
Religion (n=400)	
Catholic	12 (3.0)
Muslim	40 (10.0)
Orthodox	303 (75.8)
Protestant	41 (10.2)
Others	4 (1.0)
Paternal Education (n=389)	
Elementary or less	98 (24.5)
High school complete	107 (26.7)
Higher education	184 (46.0)
Unknown	11 (2.8)
Maternal Education (n=384)	
Elementary or less	118 (29.5)
High school complete	118 (29.5)
Higher education	148 (37.0)
Unknown	16 (4.0)
Family size (n=400)	
1-3	46 (11.5)
4-6	288 (72.0)
>6	66 (16.5)

Age at menarche

The mean and median ages at menarche in the present study were 13.75 (±1.30) and 13 (IQR 2) years, respectively. Demonstrated below in Figure 1 is the age at menarche of the study participants. The age at menarche ranged from 10 to 16 years. Nearly all, 392 (98%) had their menarche by 15 years.
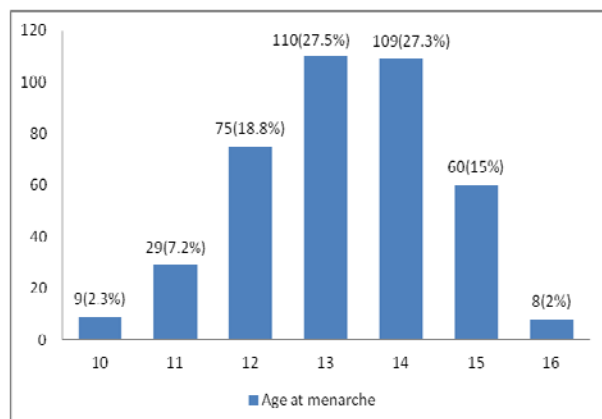
Figure 1: Age at menarche of schoolgirls at selected high schools in Addis Ababa, Ethiopia, January - May 2017GC. (n=400)

Regression analysis was implemented between selected independent variables and age at menarche as a dichotomous variable (≤13 and >13 years). Earlier age at menarche was taken as age at menarche of below the identified mean age at menarche in the present study.

A stepwise analysis was conducted to explore the presence and strength of the association between the independent variables and age at menarche. Initially, bivariate regression analysis was conducted for each independent variable with a chi-square value of <0.2 on cross-tabulation for the test of independence. Bivariate regression analysis implemented using age at menarche as a dichotomous variable above and below the mean age at menarche (≤13 years and >13 years) revealed associations between earlier age at menarche (≤13 years) and selected independent variables. On multivariate analysis, however, only type of school and religion remained to be significantly associated (P<0.05) with earlier age at menarche (≤13 years).

Table 2 shows the results of the logistic regression model of selected socio-demographic variables vs. earlier age at menarche for adolescents.

The mean age at menarche was 0.96 years younger for private school girls (12.82 years) compared to government school girls (13.78 years). The private school girls had about 4 times higher odds of having menarche at an earlier age (AOR 4.12; 95% CI 2.44-6.95).

The study subjects who were Catholic in religion had a mean age of 12.6 years, which is 1.15 years earlier than the overall mean age at menarche (13.75 years). The Catholics had about 10 times higher odds of having menarche at an earlier age compared to protestants (AOR 9.5; 95% CI 1.04-86.76).

As shown in the table, study participants whose paternal and maternal education levels were elementary and high school had a significant association with earlier age at menarche in the bivariate analysis (P<0.05), while the association was lost in multiple regression models.

Menstrual cycle pattern

Table 3 below demonstrates the menstrual cycle pattern of the study participants. Of the total study population, 77 (19.3%) adolescents had a menstrual cycle length shorter than 21 days. More than half, 211 (52.8%) had a cycle length between 21 and 28 days. In 23 of them (5.8%), the menstrual cycle interval was longer than 35 days. The majority, 282 (70.5%), had a menstrual duration of flow of 3-5 days, while only 4 (1.0%) had a duration of fewer than 3 days. The menstrual cycles were described as regular by half and 203 (50.7%) of the participants. Nearly half of the participants, 199 (49.7%), used 3-4 sanitary pads per day during menstruation. Only 22 (5.5%) used > 4 pads per day.

Peri-menstrual symptoms

Table 4 below demonstrates the perimenstrual symptoms reported by the study participants. Abdominal cramps and backaches were the shared reported symptoms experienced by 303 (75.8%) and 188 (47%) of the participants, respectively. A quarter of them, 102 (25, 5%), reported having been absent from school due to perimenstrual symptoms. The use of medication for the symptoms was practiced by 98 (24.5%) of the participant girls.

Table 2: Regression analysis of selected socio-demographic variables vs earlier age at menarche of Adolescents at selected high schools in Addis Ababa, Ethiopia, January - May 2017GC

| Characteristics | Mean age at menarche | OR for earlier age at menarche (≤13 years) | | | | |
		COR** P-value	95% CI	AOR*** P-value	95% CI
Type of school (n=400)					
Private	12.83	0.000	3.88 (2.55-5.90)	0.000	4.12 (2.44-6.95)*
Government	13.78		1		1
Religion (n=400)					
Catholic	12.67	0.031	10.48 (1.24-88.75)	0.046	9.50 (1.04-86.76)
Muslim	13.48	0.908	1.05 (0.44-2.52)	0.097	2.24 (0.86-5.79)
Orthodox	13.21	0.610	1.19 (0.62-2.28)	0.545	1.24 (0.62-2.50)
Others	13.37	0.963	0.95 (0.12-7.42)	0.779	0.73 (0.08-6.42)
Protestant	13.00		1		1
Paternal Education (n=389)					
Unknown	13.64	0.499	1.53 (0.45-5.19)	0.818	0.86 (0.23-3.15)
Elementary or less	13.48	0.002	2.24 (1.36-3.70)	0.836	0.93 (0.44-1.94)
High school complete	13.36	0.028	1.80 (1.11-2.92)	0`.341	0.74 (0.40-1.39)
Higher education	13.00		1		1
Maternal Education (n=384)					
Unknown	13.25	0.429	1.52 (0.54-4.33)	0.53	9.70 (0.24-2.11)
Elementary or less	13.53	0.000	2.49 (1.51-4.09)	0.97	8.99 (0.46-2.11)
High school complete	13.28	0.047	1.65 (1.01-2.72)	0.88	1.05 (0.56-1.97)
Higher education	12.96		1		1

Table 3: Menstrual cycle pattern of adolescents at selected high schools in Addis Ababa, Ethiopia, January - May 2017 GC (n=400)

Age (years)	Frequency	Percent	Cumulative Percent
Length of Menstrual cycle (days)			
< 21	77	19.3	19.3
21-28	211	52.8	72.0
29-35	89	22.3	94.3
>35	23	5.8	100.0
Duration of flow (days)			
< 3	4	1.0	1.0
3 – 5	282	70.5	71.5
6-8	114	28.5	100
Regularity of menstrual cycle			
Regular	203	50.7	50.7
Not regular	197	49.3	100.0
Number of sanitary pads used per day			
1-2	179	44.8	44.8
3-4	199	49.7	94.6
>4	22	5.5	100

Table 4: Peri-menstrual symptoms and related effects of adolescents at selected high schools in Addis Ababa, Ethiopia, January - May 2017GC. (n=400)

Age (years)	Frequency	Percent
Type of peri-menstrual symptom reported		
Abdominal cramp	303	75.8
Backache	188	47.0
Headache	64	16.0
Nausea	44	11.0
Vomiting	22	5.5
Diarrhea	2	0.5
Others	17	4.3
Absence from school due to symptoms		
Yes	102	25.5
No	298	74.5
Use of medications for symptoms		
Yes	98	24.5
No	302	75.5

Source of information about menstruation
Only 7 (1.8%) of the study participants had no information about menstruation before menarche. The most important source of information for the adolescents was mothers, reported by 270 (65.7%) of the participants. Sisters, friends, and teachers were other sources of information for 67 (16.8%), 56 (14%), and 44 (11%) of the participant's students, respectively. Other sources like books and magazines were reported as sources of information by 24 (6%) participants.

DISCUSSION

This study found that the majority of study participants experienced menarche between ages 13 and 15, with a mean recall age at menarche of 13.26 ±1.319 years. The mean age at menarche in the present study was earlier than previous reports from Ethiopia and some other developing countries (19-21), but later than that in developed countries like USA, Italy, and Canada (5, 17, 18, 22, 23)

Prior studies done in Ethiopia revealed age at menarche of 13.9 ± 1.2 years at Sawla town (3), 14.8 (13.9 -15.3) years at Dabat and Koladiba (12), 14 years in Tigray (24) and 13.72 ± 1.31 years in Addis Ababa (25) which were all above the present finding. This possibly is due to the fact that the current study was conducted in a capital city where social welfare is higher than in other parts of the country. And the second reason may be linked to the time effect: these studies were done nearly a decade ago between 2007 and 2013. This may also reflect a declining trend of age at menarche in Ethiopia as well, which may be a proxy indicator of the ongoing improvement in the socioeconomic status of the population in the country.

The age at menarche in our study, however, was higher than some in African countries, 12.5 years in South Africa (26), and 12.49 years in Egypt (27), 13.66, and Northern Ghana (28). The mean AAM was also higher than reports from developed countries, 12.54 years in the United States (29), 12.7 years in the UK (30), and 12.72 (±1.05) years in Canada (23). The higher AAM in the present study may be related to socioeconomic differences between the countries

Factors influencing age at menarche
The study showed that there were statistically significant differences in menarcheal ages based on the category/class of school they attend (aOR 4.12, 95%CI 2.44-6.). Seventy percent of students attending private schools had a menarche age of lower than 13 years compared to 37% of those from public schools. The difference here and compared to other countries may be explained by the economic disparity between the two natures of schools. (25)

The effect of socioeconomic circumstances on the age of menarche has been shown in several studies with girls in more deprived situations experiencing later menarche as they are unable to obtain the appropriate nutrition for proper growth and development (5, 28, 31). The proportion of students based on religion whose age at menarche was less than 13 years was Catholic (91.1%), Orthodox (54.4%), Muslim (52.5%), and Protestant (51.2%). The differences in menarche age based on religion were statistically significant (aOR 9.50, 95% CI 1.04-86.76). This may reflect the disparities in the standard of life among different religious followers.

Menstrual pattern

Menstruation may be associated with various kinds of symptoms occurring before and during menses. In this study, the most common symptoms experienced by the students were dysmenorhea (abdominal cramps) 75.8 %, backache 47.0 %, and headache 16%. This finding is comparable to studies done in Ethiopia (3), India (32) and Malasya (33). Dysmenorrhea was a major cause of school absenteeism 25.5%). The school absenteeism due to dysmenorhea in this study was higher than in Indian study (34), comparable to a Saudi Arabian study (35), but less than reports from Ethiopia (12)), Malaysia 33 and USA (36) It is important that school girls are given adequate counselling and offered proper guidance on dysmenorhea and other perimenstrual symptoms..

Menstrual cycle abnormalities (irregular and longer cycles) are more common among younger girls in the first few years after menarche. 12 = (10) In this study abnormal menstrual cycle lengths occurred in 25.1 % of our respondents, which is in the range of 13.2 % to 37.2 % noted in some studies. (33, 37)

Conclusion and implications

The mean age at menarche of the respondents in this study was 13.26 ±1.319 years. This age at menarche was earlier than prior reports from Ethiopia. Socioeconomic status was identified as a factor significantly associated with the age at menarche. Dysmenorrhea was the commonest perimenstrual symptom.

Sociodemographic attributes may be a marker for the age of menarche and symptoms. Prospective studies are needed to better understand the influence of biological markers and the age at which young girls begin their menstrual cycle and the symptoms they experience.

Limitation of the study

The study population is not representative of the population of the country. Thus outcomes of the study may not be generalizable to the general population.

Availability of Data

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

Conflict of Interest

All authors declare that they have no competing interests.

Contribution of Authorship

EK designed and implemented the study. This included seeking IRB approval, collecting data, and cleaning data. EK reviewed the reference articles and wrote the initial manuscript. EM contributed to data analysis, constructed summary tables, and wrote the final manuscript. MS contributed to initial manuscript writing and data analysis.

ACKNOWLEDGMENT

REFERENCES

1. Ersoy B, Balkan C, Gunay T, Egemen A. The factors affecting the relation between the menarcheal age of mother and daughter. Child: care, health and development. 2005 May 1; 31(3):303–8.
2. Cole TJ: The secular trend in human physical growth: a biological view. Economics and Human Biology 2003, 1:161-68.
3. Ayele E, Berhan Y. Age at menarche among in-school adolescents in Sawla Town, South Ethiopia. Ethiop J Health Sci. 2013;23(3):189-200.
4. Amir DJ, M. R.Bribiescas, R. G. A Longitudinal Assessment of Associations between Adolescent Environment, Adversity Perception, and Economic Status on Fertility and Age of Menarche. PLoS One. 2016;11(6).
5. Chumlea WC, Schubert CM, Roche AF, Kulin HE, Lee PA, Himes JH, et al. Age at menarche and racial comparisons in US girls. Pediatrics. 2003 Jan 1; 111(1):110–13. PMID: 12509562
6. Swenson I, Havens B. Menarche and menstruation: a review of the literature. J Community Health Nurs. 1987;4(4):199–210.
7. Thomas F, Renard F, Benefice E, de Meeüs T, Guegan JF. International variability of ages at menarche and menopause: patterns and main determinants. Hum Biol.2001;73(2):271–90.

8. P K. Pubertal development in girls: secular trends. Current Opinion in Obstetrics & Gynecology. 2006; 18 (5):487-491.

9. Wyshak G, Frisch RE. Evidence for a secular trend in age of menarche. N Engl J Med. 1982; 306:1033–5.

10. Bagga A, Kulkarni S. Age at menarche and secular trend in Maharashtrian (Indian) girls. Acta Biologica Szeged. 2000;44(1-4):53–7.

11. Ambade R, Sagdeo M. Age at menarche and the menstrual pattern of secondary school adolescents in central India. Int J Res Med Sci 2017; 5:3610-4.

12. Zegeye DT, Megabiaw B, Mulu A. Age at menarche and the menstrual pattern of secondary school adolescents in northwest Ethiopia. BMC women's health. 2009; 9(1):29.

13. Apter D, Viinikka L, Vihko R: Hormonal pattern of adolescent menstrual cycles. J Clin Endocrinol Metab 1978, 47(5):944–954.

14. Chan SS, Yiu KW, Yuen PM, Sahota DS, Chung TK: Menstrual problems and health-seeking behaviour in Hong Kong Chinese girls. Hong Kong Med J 2009, 15(1):18–23.

15. Treloar AE, Boynton RE, Behn BG, Brown BW: Variation of the human menstrual cycle through reproductive life. Int J Fertil 1967, 12(1 Pt 2):77–126.

16. Vollman RF: The menstrual cycle. Major Probl Obstet Gynecol 1977, 7:1–193.

17. Rigon F, Bianchin L, Bernasconi S, Bona G, Bozzola M, Buzi F, Cicognani A, De Sanctis C, De Sanctis V, Radetti G, Tatò L, Tonini G, Perissinotto E: Update on age at menarche in Italy: toward the leveling off of the secular trend. J Adolesc Health 2010, 46(3):238–244.

18. Rigon F, De Sanctis V, Bernasconi S, Bianchin L, Bona G, Bozzola M, et al. Menstrual pattern and menstrual disorders among adolescents: an update of the Italian data. Ital J Pediatr. 2012; 38-38.

19. Ameade EPK, Garti HA (2016) Age at Menarche and Factors that Influence It: A Study among Female University Students in Tamale, Northern Ghana. PLoS ONE 11(5): e0155310. doi:10.1371/journal.pone.0155310,

20. Tunau KA, Adamu AN, Hassan MA, Ahmed Y, Ekele BA. Age at menarche among school girls in Sokoto, Northern Nigeria. Annals of African medicine. 2012; 11(2):103–7. doi: 10.4103/1596-3519. 93533 PMID: 22406670.

21. Padez C. Age at menarche of schoolgirls in Maputo, Mozambique. Annals of human biology. 2003 Jan 1; 30 (4):487–95. PMID: 12881146

22. Carfagna M, Figurelli E, Matarese G, Matarese S. Menarcheal age of schoolgirls in the district of Naples, Italy, in 1969–70. Human Biology. 1972 Feb 1:117–25.

23. Al-Sahab B, Ardern CI, Hamadeh MJ, Tamim H. Age at menarche in Canada: results from the National Longitudinal Survey of Children & Youth. BMC Public Health. 2010 Nov 28; 10(1):736.

24. Bayray A. Assessment of Menstrual Perceptions and Preparation of Rural Adolescent Females, South Eastern Zone of Tigray, Ethiopia. Scholarly Journal of Medicine. 2011;1:12-21.

25. Abera Y. Menarche, Menstruation related Problems and Practices among Adolescent High School Girls in Addis Ababa. Medicine. 2003;Corpus ID: 78417016.

26. Laura L, Jones PLG, Shane A Norris, John M Pettifor, Noël Cameron Age at Menarche and the Evidence for a Positive Secular Trend in Urban South Africa. Am J Hum Biol. 2009; 21(1):130-2.

27. Hatem I. Abdelmoty MY, corresponding author Shimaa abdallah, Khaled Abdel-Malak, Nawara M. Hashish, Dalia Samir, Moutafa Abdelbar, Ahmed Naguib Hosni, Mohamed Abd-El Ghafar, Yasser Khamis, and Mostafa Seleem. Menstrual patterns and disorders among secondary school adolescents in Egypt. A cross-sectional survey. BMC women's health. 2015; 15: 70.

28. Evans Paul Kwame AG, Helene Akpene. Age at Menarche and Factors that Influence It: A Study among Female University Students in Tamale, Northern Ghana. PLoS ONE 2016; 11(5).

29. Demerath EW, Towne B, Chumlea WC, Sun SS, Czerwinski SA, Remsberg KE, et al. Recent decline in age at menarche: The Fels Longitudinal Study. American Journal of Human Biology. 2004; 16(4): 453-7.

30. Morris DH, Jones ME, Schoemaker MJ, Ashworth A, Swerdlow AJ. Determinants of age at menarche in the UK: analyses from the Breakthrough Generations Study. Br J Cancer. 2010; 103 (11): 1760-4.

31. KarapanouO PA. Determinants of menarche. Reprod Biol Endocrinol. 2010;30;8 (115):20920296.

32. Singh A, Kiran D, Singh H, Nel B, Singh P, Tiwari P: Prevalence and severity of dysmenorrhea: a problem related to menstruation, among first and second year female medical students. Indian J Physiol Pharmacol 2008, 52(4): 389–397.)

33. Lee LK CP, Le KK, Kaur J. Menstruation among adolescent girls in Malaysia: a cross sectional survey. Singapore Med J. 2006; 47(10):869-74.

34. Dharampal G. D., Sanjay V. W., Jayesh Y. D. Age at Menarche and Menstrual Cycle Pattern among School Adolescent Girls in Central India. Global Journal of Health Science Vol. 4, No. 1; January 2012. doi:10.5539/gjhs.v4n1p105 URL: http://dx.doi.org/10.5539/gjhs.v4n1p105).

35. Ibrahim N AM, Al-Shaibani A, AlAmri F, Alharbi H, Al-Jadani A, Alfaidi R. Dysmenorrhea among female medical students in king Abdulaziz University: prevalence, predictors and outcome. Pak J Med Sci. 2015; 31 (6): 1312-7.
36. Banikarim C, Chacko MR, Kelder SH: Prevalence and Impact of Dysmenorrhea on Hispanic Female Adolescents. Arch Pediatr Adolesc Med 2000, 154(12):1226-1229.
37. Houston AM AA, Huang Z, D'Angelo LJ. Knowledge, attitudes, and consequences of menstrual health in urban adolescent females. Pediatr Adolesc Gynecol. 2006;19(4):271-5.