Factors associated with early age at menarche among female secondary school students in Asmara: a cross-sectional study

Idris M. Idris, MSca,*, Samuel J. Woldayb, Feven Habteselassieb, Luwam Ghebremichaelb, Makda Andemariamb, Rahwa Azmerab, Frezghi H. Ghebrewoldi2

Objective: Several factors appeared to influence the onset of menarche. The current study was aimed to determine the mean age of menarche and the factors influencing its onset among female high school students in Asmara.

Methods: A cross-sectional study was conducted from January to February 2017 among secondary school female students of Asmara city. A 2 stage stratified sampling design was adopted to select the number of schools and students for the study. A structured and pretested questionnaire was used to collect the data through interview. Data analysis was done using SPSS version 22. Descriptive results were summarized using frequencies and percentages in tables and graphs. Moreover, bivariate and multivariate logistic regression analysis was done to find out the association of earlier onset of menarche and the predictor variables.

Results: A total of 300 female students participated in the study. The mean age of the participants was 16.1 years (SD = 1.3) with majority of them (57.3%) between the ages of 16 and 18 years. The mean age at menarche was 13.8 years (SD = 1.2). About 39% of the participants have the onset of their menarche earlier (before 14 y). An earlier onset of menarche was observed among younger age (above 16) respondents (adjusted odds ratio [AOR] [95% confidence interval (CI)]: 1.8 (0.96, 4.88), P-value: 0.02), having higher body mass index [AOR (95% CI): 3.8 (1.92, 7.85), P-value: 0.001] and from richer family. Lack of engaging in any kind of physical activity [AOR (95% CI): 2.56 (1.13, 5.27), P-value: 0.012] and more sleeping hours [AOR (95% CI): 2.2 (0.36, 4.18), P-value: 0.04] were also factors influencing earlier onset of menarche.

Conclusion: The mean age at menarche was relatively low. Factors related to higher body mass index, physical inactivity, more sleeping hours, good socioeconomic status, and younger age were associated with earlier onset of menarche. Initiatives on awareness creation are required to increase lifestyle modifications at individual level.

Keywords: School, Girls, Menarche, Factors, Asmara

Background

Menarche (the first menstrual bleeding) is an important milestone in the development of a female adolescent with a distinct benchmark for sexual maturation[1]. Evidence suggests that there was a secular decline in the average age at menarche in developed countries since 19th century[2]. Menarche occurs earlier than it once did in many parts of the world especially in Europe and North America. Age at menarche appears to have declining in recent decades in western industrialized countries at the rate of ~4 months per decade[3]. Several plausible factors influence the age of menarche, one of which is the increasing rates of childhood obesity which has been postulated to be the prime factor[4]. With the advancement of technology there is an increased risk of sedentary lifestyle affecting every section of the society including children. As a result of which there are certain changes in response to attainment of their growth markers, the very important of which is attainment of puberty. This important developmental milestone in female has been found to vary greatly across countries. The onset of menarche was shown to appear earlier in developed countries. The mean age at menarche among US girls was 12.34 years[5], and India (12.6 y)[6]. Compared with similar studies carried out in the developed countries, age at menarche was found to be delayed in the poorer countries[7,8]. Studying the age at menarche is quite interesting due to the huge public health implications associated with the changes in the mean age at menarche. Early age at menarche has been linked to several health effects during childhood such as eating disorders[9] depression[10], type 2 diabetes[11,11] metabolic syndrome[12], breast cancer[13,14], cardiovascular diseases, and overall mortality[11,15]. Several factors including genetics, environmental conditions, body stature, family size, body mass index (BMI), and socioeconomic status have been found to significantly influence the onset age of menarche[16,17].

The data on mean age at menarche in industrialized countries are abundant so does in our neighborhood countries like Ethiopia, whereas such data in Eritrea is scarce and the age at menarche among contemporary girls remain practically unknown. Hence, the current
study was aimed to determine the mean age of menarche and the factors influencing its onset among female high school students in Asmara.

**Methods**

**Study design**

A cross-sectional quantitative study was conducted from January to February 2017 among secondary school female students of Asmara city. The study was conducted in 5 secondary schools: Halay, Semaetat, Sembel, Barka, and Diaa secondary schools located in different locations of the capital city Asmara. Asmara is the capital city of the State of Eritrea.

**Study population, sampling frame, and subject recruitment**

The targeted population was secondary school female students. A 2 stage stratified sampling design was adopted: at the first stage schools were selected using probability proportional to size method, size being the number of students in the schools. List of high schools by their number of female students (Supplementary Digital Content, http://links.lww.com/GRH/A0), obtained from central region ministry of education was used as a sampling frame to randomly select the high schools for the study. Of the total 14 high schools in Asmara, 5 schools were randomly selected taking in to account the geographical location and size of the students. At the second stage, using probability proportional to size method sample was allocated to each grade (9th–11th) of every school. After explaining the objectives of the study, screening of the students was done using a written paper, asking whether or not they have attained menarche. After having the number of students who have attained menarche of each grade, the allocated samples were then selected using lottery method (Table 1).

**Sample size justification**

Using the Cochrane formula and the assumptions: confidence level of 95% (z-score 1.96), estimated value of the proportion of the variable of interest (taken as 50%) and margin of error of 5%. The minimum size required was 196 students; however, to accommodate a nonresponse rate of 5% and strongest statistical power and effect size (design effect and population correction factor), the samples were projected to 300 students.

**Outcome and predicting variables**

Mean age of menarche was the outcome variable. Taking the average or mean age of menarche as a cut-point, students who had the onset of menarche below the average age were considered to have had earlier onset of menarche. The independent or predicting variables include: demographic characteristics (age, parents educational, and employment status), socioeconomic status, sleeping hours, physical activity or body exercise, and BMI.

**Data collection tools and methods**

A structured and pretested questionnaire was used to collect the data through face to face interview to determine the mean age of menarche and the associated factors affecting its onset. The questionnaire was developed by conducting an extensive review of the existing literature and it was reviewed by different experts on the field and one statistician for its content and face validity as well as to revise its relevance and quality. Reliability of the questionnaire was calculated using the Cronbach α reliability and the internal consistency among the questionnaire items was found to be r = 0.6. Before conducting the main study, the questionnaire was pretested in 30 students of St. Mary School (one of the nonselected high schools in Asmara) for its sensitivity, comprehensibility, and appropriateness. During piloting the questionnaire for its clarity and consistency, students were directed to self-administer the questionnaire after explaining the objectives of the study and clarifying the questions. Self-administering method was preferred in order to respect the sensitivity and privacy of the subject, that is the students can freely answer the questions without being shy. The questions were found to be clear and consistent; however, self-administering the questionnaire was found to have scoring error. Hence, the research team considered the interview method as a procedure for data collection during the main study.

**Ethical considerations**

The ethical clearance for conducting the study was granted by the “Ethical and Scientific Clearance Committee” of the School of Nursing, Asmara College of Health Sciences. Permission of the study was obtained from school authorities of the respective schools used for the study. Informed consents (written) was obtained from the parents and assents from the participants. Confidentiality was maintained and topmost priority was given to the rights and concerns of the students. Purpose of the study was made known to the participants and also made aware that partaking in the study was strictly voluntary.

**Data entry and analysis**

After data collection was completed, the questionnaires were checked for their completeness and consistency; and the variables (responses) of interest were coded and entered in to SPSS (statistics package for social sciences, Version 22). Cleaning of the entered data was done to look over the accuracy, consistency and avoidance of missed values during entry. Data was described using tables and graphs. Continuous variables such as age were

| Table 1 |
| --- |
| Illustration of the sampling procedure. |
| **High Schools** | **A Total of 14 High Schools in Asmara City** |
| **Selected school Location** | **Halay South East** | **Semaetat South East** | **Sembel South West** | **Barka North East** | **Diaa North West** |
| **Grade** | 9th | 10th | 11th | 9th | 10th | 11th | 9th | 10th | 11th | 9th | 10th | 11th |
| **Female students** | 428 | 444 | 379 | 402 | 297 | 233 | 297 | 265 | 171 | 370 | 399 | 304 | 76 |
| **Attained menarche** | 293 | 441 | 377 | 378 | 287 | 230 | 271 | 261 | 170 | 350 | 386 | 300 | 69 |
| **Allocated sample** | 31 | 32 | 27 | 30 | 23 | 19 | 22 | 21 | 14 | 23 | 24 | 20 | 5 |
| **Total selected** | 90 | 72 | 67 | 64 | 51 | 44 | 47 | 42 | 30 | 50 | 55 | 48 | 14 |
summarized using mean ± SD. The mean age at menarche (the dependent variable) was computed. After the average age of menarche was known, those participants who have had the onset of menarche before the average age were considered to have attained menarche at earlier age. Crude odds ratio (95% CI) of the age at menarche by various socio-demographic variables were computed at bivariate level. Using logistic regression, variables that were found significant at the bivariate level were further used for multivariate analysis to find out the association of age at menarche and various categories of the predictor variables after controlling the confounding effect. Adjusted odds ratio (95% CI) was presented and P-values <0.05 were considered as statistically significant during the analysis.

Results

Demographic characteristics

All the selected students (300) participated in this study. There was no absenteeism of the selected students during the time of interview and all the students were voluntary. Majority of the students were from Halay (30%) and the least were from Diaa (4.7%) secondary schools, respectively. The mean age of the students were from Halay (30%) and the least were from Diaa (4.7%) secondary schools, respectively. The mean age of the participants was 16.1 years (SD = 1.3) with majority of them (57.3%) between the ages of 16 and 18 years. About two-third (64.7%) of the participants live with both of their parents and almost nine-tenth (88%) of them are permanent Asmara residents (Table 2).

Mean age at menarche

The overall mean age at menarche was found to be 13.8 years (SD = 1.2). The minimum and maximum ages at the onset of menarche were 10 and 18 years, respectively. Majority of the participants (34.3%) have had started their menstruation at the age of 14 years (Fig. 1).

On the basis of the average onset of menarche, participants who have had their onset of menarche before the mean age were considered to have attained their menarche earlier. Majority of the participants (61%) have started their menstruation 14 years and above, whereas the remaining 39% have their onset before 14 years (Fig. 2).

Menarche was more likely to start before 14 years of age among girls aged 14–15 years (52.1%) compared with other age groups. About 44% of daughters of fathers with secondary or higher level of education reported that their Menarche came before 14 years of age compared with 23.5% of daughters of fathers with no education. Similarly, the likelihood for menarche to come earlier was higher among daughters of mothers with secondary or higher level of education compared with girls of mothers with no education (44.2% vs. 20.6%, respectively). The proportion of girls who’s Menarche started below 14 years of age increased with an increasing wealth quintile from 33.3% among those in the lowest wealth quintile to 51.7% among those belonging to the highest wealth quintile. Menarche was found to start earlier among girls who were not involved in any kind of sport activity (39.7%) compared with those who were involved in any kind of sport activities (36.6%). Nearly half of the girls who usually travelled to school using bus or family car reported their Menarche to come earlier. The proportion of girls whose Menarche started earlier was higher among those whose BMI was 18.5 and above (45.7%) compared with those whose BMI was below 18.5 (33.9%). The remaining variables are elaborated in Table 3.

| Background Characteristics | Frequency (n) | Percentage (%) |
|----------------------------|--------------|----------------|
| Age in years (mean ± SD: 16.1 ± 1.3) | | |
| 14–15 | 96 | 32 |
| 16–17 | 172 | 57.3 |
| 18–21 | 32 | 10.7 |
| Grade | | |
| 9th | 86 | 28.7 |
| 10th | 108 | 36 |
| 11th | 106 | 35.3 |
| School | | |
| Barka | 67 | 22.3 |
| Diaa | 14 | 4.7 |
| Halay | 90 | 30 |
| Semaetat | 72 | 24 |
| Sembel | 57 | 19 |
| With whom do you live | | |
| With both parents | 194 | 64.7 |
| With mother alone | 62 | 20.7 |
| With father alone | 9 | 3 |
| With other relatives | 35 | 11.6 |
| Mother’s level of education | | |
| No formal education | 4 | 11.3 |
| Primary/Intermediate | 110 | 36.7 |
| Secondary | 137 | 45.7 |
| College and above | 19 | 6.3 |
| Father’s level of education | | |
| No formal education | 17 | 5.7 |
| Primary/Intermediate | 63 | 21 |
| Secondary | 161 | 53.7 |
| College and above | 59 | 19.6 |
| Religion | | |
| Christian | 268 | 89.4 |
| Muslim | 32 | 10.6 |
| Diet consumption | | |
| Mixed diet consumers | 292 | 97.3 |
| Strict vegetarians | 3 | 1 |
| Strict nonvegetarians | 5 | 1.7 |
| Residence in Asmara | | |
| Residents | 264 | 88 |
| Migrants | 36 | 12 |

Figure 1. Distribution of respondents by their age at menarche, Asmara, 2017 (n = 300).
Predicting factors of age at onset of menarche

The bivariate analysis indicated that age under 16 years, daughters of educated fathers, BMI \( \geq 18.5 \text{ kg/m}^2 \), more sleeping hours (10–15), Physical inactivity, being permanent Asmara residents and those from richer family were found to have significant association with early onset of menarche. Whereas the remaining variables: education of mothers, parents’ employment status, and means of transportation was not found to have significant impact on the early onset of menarche.

The significant factors at the bivariate level were further analyzed at the multivariate level to adjust their confounding effect. Those participants aged younger than 16 years were 1.8 times more likely to have had menarche started earlier compared with their counter parts. However, factors that were significant at the bivariate level (being Asmara residents and daughters whose menarche started earlier increased with an increasing wealth quintiles and the difference was statistically significant).

Discussion

Mean age at menarche

The present study revealed that the mean age at menarche among secondary school girls was 13.8 years. While the results are comparable to that of Ghana (13.66 y)\(^8\), the mean age at menarche was found to occur earlier compared with study conducted in Ethiopia (14.24 y)\(^9\). On the other hand, compared with studies in the United States (12.65 y)\(^5\), India (12.6 y)\(^6\), the mean menarche age in our study was occurred slightly delayed. This difference shows that the mean age at menarche might be influenced by different factors including the developmental status of a country or a city, geographical location, living style of the society, and other related factors as discussed below.

Determinant factors of age at menarche

Studies indicated that the age at menarche is continuously in decreasing trend since decades. Several demographic and socio-economic factors were shown to influence the earlier onset of menarche in studies conducted elsewhere\[^{6,7}\], consistently, a significant association between earlier age at menarche and younger age of the participants was reported in our study in which menarche was more likely to start earlier among girls aged 14–15 years. Our study also indicated that the proportion of girls whose menarche started earlier increased with an increasing wealth quintiles and the difference was statistically significant.

Table 3

Distribution of respondents by age at onset of menarche, according to background characteristics (\(n=300\)).

| Background Characteristics | \(< 14 \text{ y}; n (\%)\) | \(\geq 14 \text{ y}; n (\%)\) |
|---------------------------|--------------------------|--------------------------|
| Age in years              |                          |                          |
| 14–15                     | 50 (52.1)                | 46 (47.9)                |
| 16–17                     | 62 (36)                  | 110 (64)                 |
| 18–21                     | 5 (15.6)                 | 27 (84.4)                |
| Mother’s level of education |                         |                          |
| No formal education       | 7 (20.6)                 | 27 (79.4)                |
| Primary                   | 41 (37.3)                | 69 (62.7)                |
| Secondary/higher          | 69 (44.2)                | 87 (55.8)                |
| Father’s education level  |                          |                          |
| No formal education       | 4 (23.5)                 | 13 (76.5)                |
| Primary                   | 17 (27)                  | 46 (73)                  |
| Secondary/higher          | 96 (43.6)                | 124 (56.4)               |
| Residence in Asmara       |                          |                          |
| Residents                 | 106 (40.2)               | 158 (59.8)               |
| Migrants                  | 11 (30.6)                | 25 (69.4)                |
| Father’s employment status|                          |                          |
| Employed                  | 97 (39.3)                | 150 (60.7)               |
| Unemployed                 | 20 (37.7)                | 33 (62.3)                |
| Wealth index              |                          |                          |
| Very poor                 | 20 (33.3)                | 40 (66.7)                |
| Poor                      | 17 (28.8)                | 42 (71.2)                |
| Medium                    | 25 (41)                  | 36 (59)                  |
| Rich                      | 24 (40)                  | 36 (60)                  |
| Very rich                 | 31 (51.7)                | 29 (48.3)                |
| Are you involved in any kind of sport activity | | |
| Yes                       | 26 (36.6)                | 45 (63.4)                |
| No                        | 91 (39.7)                | 138 (60.3)               |
| Means of transportation to school |             |                          |
| Foot \(\geq 30\) min       | 34 (35.8)                | 61 (64.2)                |
| Foot \(< 30\) min          | 65 (38.7)                | 103 (61.3)               |
| Bus/family car             | 18 (48.6)                | 19 (51.4)                |
| Hours of usual sleep in 24 h |             |                          |
| \(< 10\) h                 | 61 (36.1)                | 108 (63.9)               |
| 10–15 h                   | 56 (42.7)                | 75 (57.3)                |
| BMI classification \(< 18.5\) | 58 (33.9) | 113 (66.1)               |
| 18.5 and above             | 59 (45.7)                | 70 (54.3)                |

BMI indicates body mass index.
The proportion of girls who have attained earlier age of menarche was higher among daughters of highly educated and employed parents, though the difference was not significant. Some studies depicted that variations in diet consumption was associated with earlier onset of menarche, for instance, higher proportion of the subjects taking mixed diet attained menarche earlier than those who were strictly vegetarians in a study conducted in India[6]. In this current study, almost all the respondents were mixed diet consumers, hence the diet consumption was not correlated to the onset of menarche since there was no much difference in the type of food consumed by all the participants. Moreover various studies have reported higher BMI and physical inactivity as predisposing factors affecting earlier onset of menarche[6,19]. In a similar way, in our study higher BMI and lack of engaging in any physical activities were found to have a significant correlation with earlier onset of menarche. Though the specific mechanism remains unclear, it is explained that increased fat deposition might facilitate menarche earlier due to its association with higher level of estrogen secretion. In addition, nearly half of the girls who usually travelled to school using bus or family car reported their menarche to come earlier, though the difference was insignificant. Moreover, the more number of hours the participants sleep in a day and night, the earlier was the onset of menarche, and the difference was found highly significant. Similar studies conducted elsewhere reported earlier onset of menarche among physically inactive and more sleeping girls[6,19]. Therefore, from these studies it is shown that lack of physical activity is noted to initiate the onset of menarche. This might be attributable to the fact that physical inactivity could facilitates the pulse of gonadotropin releasing hormone. The earlier onset of menarche was associated with factors related to sedentary lifestyles.


eight of the study

The study had several limitations. First, menarche data were obtained by asking respondents who have already attained menarche to recall their age at first menses retrospectively. This could have a recall bias, particularly for those with greater time elapsed between menarche and the interview date. However, the research team have had the assumption that girls consider menstruation as part of their personal developmental milestone, thus the probability to forget their menstruation seems narrow. Second, onset of menarche is determined by other factors (genetic, geographical, and medical problems) in which this study did not cover because of time and cost implications. Third, the data was collected using an interview method, which might cause interview bias since the issue of menstruation is personal and sensitive. To decrease such a bias, the research team have made their top best to make a friendly approach to build a rapport communication with the respondents before directly entering to the subject. Fourth, the study was conducted only in Asmara due to budget constraints. To make generalization feasible, inclusion of participants from the rural communities would have been better. To fill this gap, nationwide study is recommended.


eonclusion

The mean age at menarche was found to be 13.8 years. An earlier onset of menarche was observed among younger age respondents, having higher BMI and from richer family. Lack of engaging in any kind of physical activity and those who had more sleeping hours were also started menarche earlier. To ensure a healthy lifespan development, lifestyle modifications is necessary at the individual level. Further studies are recommended at national level.

Author contribution

All authors participated in all phases of the study including topic selection, design, data collection, data analysis and interpretation. I.M.I. and S.J.W. contributed in critical revision of the manuscript for publication.

Conflicts of interest disclosure

The authors declare that they have no financial conflict of interest with regard to the content of this report.

Acknowledgments

The authors are grateful to all the students who participated in the study and the teachers who helped us during data collection.

References

[1] He C, Zhang C, Hunter DJ, et al. Age at menarche and risk of type 2 diabetes: results from 2 large prospective cohort studies. Am J Epidemiol 2010;171:334–44.
[2] Adams Hillard PJ. Menstruation in adolescents, what’s normal, what’s not. Ann NY Acad Sci 2008;1135:29–35.
[3] Lehmann AC, Hermanussen M. The variation in age at menarche: an indicator of historic developmental tempo. Anthropol Anz 2010;68:85–99.
[4] Kaplowitz PB, Slora EJ, Wasserman RC, et al. Earlier onset of puberty in girls, relation to increased body mass index and race. Pediatrics 2001;108:347–53.
[5] Elizabeth N. Trends in the age of menarche. 2011.
[6] Rokad S, Mane AJ. A study of age at menarche, the secular trend and factors associated with it. J Biol Anthropol 2008;3:1–7.
[7] Hadish G, Alem G, Genet T, et al. Mean difference of age at menarche and body mass index among government and private high schools. J Nutr Food Sci 2015;53. doi: 10.4172/2155-9600.S3-004
[8] Adadevoh SW, Agble TK, Hobbs C, et al. Menarcheal age in Ghanaian school girls. Int J Gynecol Obstet 1989;30:63–8.
[9] Striegel-Moore RH, McMahon RP, Brog FM, et al. Exploring the relationship between timing of menarche and eating disorder symptoms in Black and White adolescent girls. Int J Eat Disord 2001;30:421–33.
[10] Kaltiala-Heino R, Kosunen E, Rimpela M. Pubertal timing, sexual behaviour and self-reported depression in middle adolescence. J Adolesc 2003;26:531.
[11] Lakshman R, Forouhi NG, Sharp SJ, et al. Early age at menarche associated with cardiovascular disease and mortality. J Clin Endocrinol Metab 2009;94:4953–60.
[12] Stokl D, Meisinger C, Peters A, et al. Age at menarche and its association with the metabolic syndrome and its components: results from the KORA F4 study. PLoS One 2011;6:e26076.
[13] Petridou E, Syrigou E, Toupadaki N, et al. Determinants of age at menarche as early life predictors of breast cancer risk. Int J Cancer 1996;68:193–8.
[14] Hadiisavvas A, Lozidou MA, Middleton N, et al. An investigation of breast cancer risk factors in Cyprus: a case control study. BMC Cancer 2010;10:447.
[15] Jacobsen BK, Oda K, Knutsen SF, et al. Age at menarche, total mortality and mortality from ischaemic heart disease and stroke: the Adventist Health Study, 1976–88. Int J Epidemiol 2009;38:245–52.
[16] Karapanou O, Papadimitriou A. Determinants of menarche. Reprod Biol Endocrinol 2010;8:20920296.
[17] Dambhare DG, Wagh SV, Dudhe JY. Age at menarche and menstrual cycle pattern among school adolescent girls in central India. Global J Health Sci 2012;4:421.
[18] Cochran WG. Sampling Techniques, 3rd ed. New York, NY: John Wiley and Sons Inc; 1977.
[19] Ajita A, Jwanjot JJ. Overweight and physical activity as a major of age at menarche in females. Am J Sport Sci Media 2014. [Epub ahead of print].