

Mean Difference of Age at Menarche and Body Mass Index among Government and Private High-School Students of Mekelle City, Northern Ethiopia

Hadush Gebremariam^{1*}, Alem Gebremariam¹, Genet Tesfay², Omer Said Adem³ and Huruy Assefa³

¹Department of Public Health, College of Medicine and Health Science, Adigrat University, Adigrat, Ethiopia

²Department of Law, College of Social Science and Humanity, Adigrat University, Adigrat, Ethiopia

³Department of Public Health, College of Health Science Mekelle University, Mekelle, Ethiopia

Abstract

Background: The mean age at menarche varies from one setting to another. Individual differences in timing of menarche are associated with age differences in the onset of sexual activity and first pregnancy. The study was conducted to determine the mean difference of age at menarche and body mass index (BMI) among government and private high-school students of Mekelle city.

Method: A cross sectional study design was conducted in selected 6 governmental and private schools of Mekelle city. A total of 290 study subjects were interviewed. Systematic random sampling method was used to select study subjects. An independent sample t-test was done for two independent groups to compare age at menarche among governmental and private school girls in relation to various variables. One-way ANOVA and Pearson's correlation analysis was conducted on the combined analysis for the relationship between age at menarche and independent variables.

Result: The mean age at menarche was 14.24 year \pm 1.42 SD. The mean age at menarche was one year younger for private school girls compared with government school girls ($t=6.2$, $P<0.001$). Time spending sitting in a day ($r= -0.25$, $p<0.001$) duration of sleeping ($r= -0.13$, $p=0.03$), living in their own house ($t= -2.42$, $P<0.05$) were negatively correlated with age at menarche. There was significant difference of age at menarche among the participants maternal education ($F=6.0$, $P<0.001$), Father's education ($F=8.45$, $P<0.001$), and father's job ($F=9.55$, $P<0.001$). The mean BMI of the participants was 20.22 ± 2.66 SD. More than quarters of the participants were underweight (26.3%).

Conclusion: The mean age of menarche found in this study was higher than the report from other African countries. The mean age at menarche was statically different among the government and private school girls. Time spending sitting, duration of sleeping, living in their own house were negatively correlated with age at menarche.

Keywords: Age at menarche; Height; Weight; Body mass index; Mekelle City

Background

Menarche is the onset of menstruation and is one of the milestones in women's lives. Although it is a late marker of puberty, it is a well validated indicator and an easily remembered event when compared to other events in the process of female sexual maturity [1]. The age of sexual debut and the age at marriage are related to age at menarche [2]. The level of development of a society is inversely related to the age of first menstruation which is higher in underdeveloped regions. An example is illustrated by girls from the very poor Bundi region of New Guinea whose average age of first menstruation is 18.8 years, comparable to Europeans of one century ago [3].

Nutritional status has an important role in attainment of menarche, as nutritional status improves, age at menarche is lowered. Different literature stated that as the BMI of the girls increased, the age at their menarche will be lower [4-8]. This trend was statistically significant (Chi-square for trend $p \leq 0.00$). There was also a statistically significant difference between the mean BMI of those girls who had attained menarche (mean BMI 17.83) [9,10] and those who had not attained menarche (mean BMI 14.83), $p \leq 0.001$ (9, 10). Similarly, mean age at menarche in underweight, normal, overweight and obese girls was 12.72 ± 1.18 , 12.67 ± 1.37 , 12.43 ± 1.55 , 11.97 ± 1.68 , respectively [11]. More than 60% of the adolescents who got adequate sleep during the night had an earlier mean age at menarche [5].

The median age at menarche in Dutch, Turkish and Moroccan girls was 13.05, 12.50 and 12.60 years, respectively [4,6,8]. The estimated mean and median age at menarche was 12.72 years (SD = 1.05) and 12.67 years, respectively [12,13]. A study in North West Ethiopia, the median age at menarche was found to 14.8 years. The age at menarche by recall method was 15.8 ± 1.0 years with a range of 11.5 to 18.5 years [1]. Another study in south Ethiopia in Sawla town, the mean age of menarche was 13.9 ± 1.2 years (95% CI, 13.8 - 14.0 years) [5].

There is variability in the mean onset of menarche in different studies. Therefore, the purpose of this study is to assess mean age at menarche, and compare the difference among government and private high-school female students. The result of this study can be used as

***Corresponding Author:** Hadush Gebremariam, Department of Public Health, College of Medicine and Health Science, Adigrat University, Adigrat, Ethiopia, Tel: 251-914709829; E-mail: hadushgn@yahoo.com

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a baseline information for further studies in this area and provide important information for program managers and other concerned bodies to enable them provide proper health services to these segments of the population and the community at large.

Methods

During February 2013, an institution based cross sectional study was conducted in Mekelle town, Northern Ethiopia. Samples of 290 high-school female students aged 12-19 years were included in the study. There were eighteen governmental and five private High-schools (secondary and preparatory school) in Mekelle City. Of the total female students of the town; 5258 student were enrolled in the governmental schools, and 5238 students were enrolled in the private schools. The schools were stratified in two strata; governmental and none governmental schools. Using a lottery method three schools from each stratum was selected. That is a total of six schools were selected. From the selected schools, by using a lottery method one section per grade was selected. Totally 22 sections, nine to twelfth grade, were included in the study. To take the exact sample size per class in one section on average, there were 26 female students. Using systematic random sampling every 2nd student was considered to take thirteen students per section. Finally a total of 290 samples were included in the interview.

Data were collected using structured self-administered questionnaire. The questionnaire was first developed in English and translated to Tigrigna (local language) and back translated to English by language experts to check its consistency. Anthropometric data were collected by trained data collectors who were grade twelve completed. Data collection tool is fixed weighing and height measuring tool which were calibrated every five adolescents and taken three times and consider the average measurement. The height was taken by considering to the nearest of 0.1 cm, during measurement foot and head wear removed, head in correct plain, subject in erect position, knees bent or feet not on ground, and board firmly against head. Weight measured with nearest of 100 gms and was calibrated to zero, wearing heavy clothes was avoided.

Data quality was insured by training the data collectors and supervisors as well as providing day to day supervision during the whole period of data collection. Pre-test was conducted. Based on the pretest, questions were revised, edited, and those found to be unclear or confusing were modified. Every day, all collected data was checked for their completeness, clarity and consistency by supervisors and principal investigator.

Data entry was done using package SPSS for window version 16. Anthropometric data were entered and analyzed using WHO Anthro-plus software. Descriptive statistics were made and results were presented in texts, tables and graphs using summary measures such as percentages, median, mean and standard deviation. A bivariate analysis was done to compare the characteristics of high-school female students in governmental and private schools with respective p-values for chi-square. An independent sample t-test was done for two independent groups to compare age at menarche among governmental and private school girls in relation to various variables. One-way ANOVA was used to compare menarche age with variables having more than two categories. Pearson's correlation analysis was conducted on the combined analysis for the relationship between age at menarche and independent variables. Statistical significance was defined as p-value <0.05.

Ethical Approval was obtained from Mekelle University College

of Health Science Ethical Review Committee with reference number ERC0162/2013. Support letter was also obtained from Mekelle University department of Public Health to Mekelle zonal education bureau and the zonal education bureau wrote to each high school. Oral informed consent was obtained from the study participants. Confidentiality of the participants' information was kept throughout the study.

Result

Socio - demographic characteristics

A total of 290 female students were participated in the study. The mean age of the study participants was 16.3 year \pm 1.42 SD. According to the WHO classification of adolescents, most of the respondents were in the range of middle age adolescents (87.2%). Predominantly, the study subjects were Tigrians (97.9%) and Orthodox Christian (93.1%). More than half (53.8%) of the study subjects were from government schools. Whereas the rest, 134(46.2%) were from private schools. There was a statistically significant difference on the house ownership status of the governmental and private school girls ($X^2=7.6$, p-value <0.006). There was significance difference on the educational status and occupational status of the parents among the governmental and private school girls (Table 1).

Body mass index of respondents

The mean body mass index of the participants was 20.22 \pm 2.66 SD with 95%CI of 19.91 to 20.53 (Table 2). Seven out of ten (71.2%) girls were in the normal range of BMI. The rest were under weight, overweight and obese 26.3%, 2.2%, and 0.4%, respectively (Figure 1).

The mean BMI of government and private school girls was 20.35(\pm 0.2SD) and 20.06(\pm 2.8SD), respectively. There was no statistically difference in the mean of BMI (t=0.92, p=0.36) among the private and government school girls.

Age at menarche

Most of the respondents, 278 (96.7%), had seen their first menstrual period (menarche) during the interview. The mean age of their menarche was 14.24 year \pm 1.42 SD with 95%CI of 14.08 to 14.41. The minimum and maximum age at menarche was 11 and 18 years, respectively (Figure 2).

There was a significant difference in the mean age of menarche between government and private school girls. The mean age at menarche was 1 years younger for private school girls compared with government school girls (t=6.2, P<0.001). Respondents who have habit of vegetable eating have lower age at menarche (t= -2.57, P<0.01). Similarly, there is significant difference among age group of the participants (t =-2.57, P<0.05) and house ownership status (t=-2.42, P<0.05) (Table 3). Based on one-way ANOVA test, there was statistical difference in the mean age of menarche among the levels of parents' education, and father's job status (Table 4).

Time spending sitting in a day (r = -0.25, p <0.001) and duration of sleeping (r= -0.13, p=0.03) were negatively correlated with age at menarche. But, the anthropometric measurements were not significantly correlated with age at menarche (Table 5).

Discussion

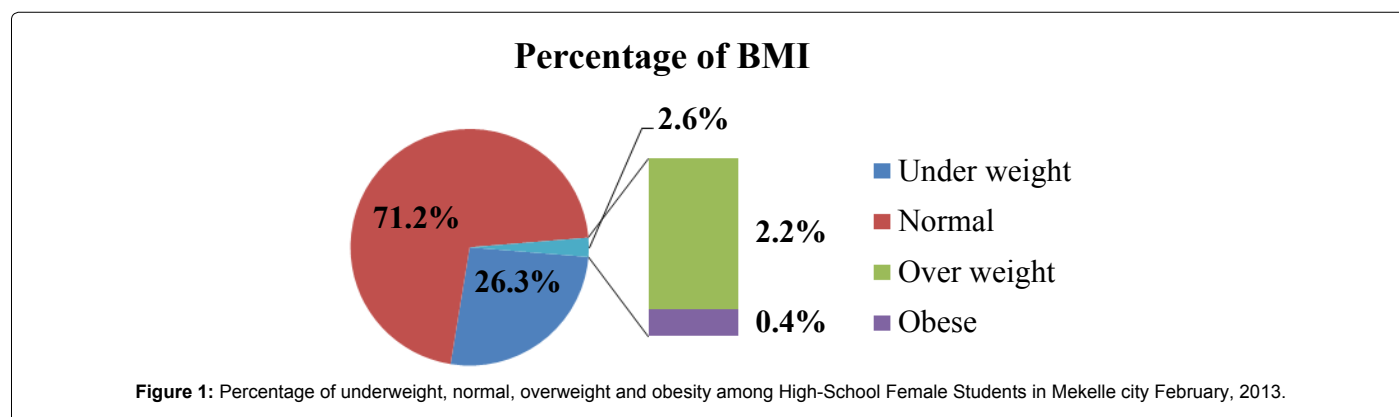
This study indicated that, the mean age of menarche was 14.24 years with 95%CI of 14.08 to 14.41. This is not in agreement with the study done in North Gonder 15.8 [1], and South Ethiopia, Sawla town

Variable N=290	Level	Government School n=156(53.8%)	Private school n=134(46.2%)	X ² (df)	P value
Age in year	14-Oct	14(37.8%)	23(62.2%)	3.6(1)	0.056
	15-19	142(56.1%)	111(43.9%)		
house Ownership status	Owned	102(48.6%)	108(51.4%)	7.6(1)	0.006
	Rented	54(67.5%)	26(32.5%)		
Education Fathers	No formal education	51(72.9%)	19(27.1%)	69.9(4)	0
	Elementary (1-8 grade)	44(88.0%)	6(12.0%)		
	9-10 grade	23(62.2%)	14(37.8%)		
	11-12 grade	12(36.4%)	21(63.6%)		
	College and university	26(26.0%)	74(74.0%)		
Mothers education	No formal education	55(69.6%)	24(30.4%)	64.1(5)	0
	1-4 grade	13(68.4%)	6(31.6%)		
	5-8 grade	42(89.4%)	5(10.6%)		
	9-10 grade	17(37.8%)	28(62.2%)		
	11-12 grade	7(21.2%)	26(78.8%)		
Father's job	Employee	46(46.0%)	54(54.0%)	31.75(2)	0
	Business man	63(46.0%)	74(54.0%)		
	Farmer	47(88.7%)	6(11.3%)		
Mother's job	Employee	36(52.2%)	33(47.8%)	24.1(2)	0
	Merchant	28(33.3%)	56(66.7%)		
	Housewife	92(67.2%)	45(32.8%)		

Table 1: Socio Demographic Factors associated with schooling (Government and private) among High-School Female Students in Mekelle city February, 2013.

Variable N=290	Minimum	Maximum	Mean	Std. Deviation
Height in centimeter	142	177	155	.05571
Weigh in kilogram	31.00	78.00	49.19	6.62802
BMI of students	10.5	34.2	20.22	2.6593

Table 2: Height, weight and BMI and the range, mean and standard deviation of respondents among High-School Female students in Mekelle city February, 2013.



(13.9) [5]. This could be due to the difference in the study participants and the study area. The study in Gonder was community based and relatively rural compared to Mekelle city. Similarly, the study in Sawla town was among primary and secondary school girls which are lower in age than these study participants. In the United States, the average age at menarche has shifted from 12.75 to 12.54 years over a period of 25 years. The age at menarche is reportedly 12.9 years in Europe, 12.5-12.9 in different regions of India, and 13.3 years in Africa. It appears that the level of development of a society is inversely related to the age of first menstruation which is higher in underdeveloped regions [14].

The mean age of menarche was statistically different among the government and private school Students. This could be due to the difference in economic status of their family. There was also a significant difference among parents educational and occupational status among

the private and government school students. This shows that most of the families having good economic status prefer sending their child to the private schools. The other factor that affected age at menarche was an intake of vegetables. Girls who had habit of eating vegetable had lower age at menarche.

The study indicated that as the duration of night sleeping increased the onset of the menarche will become earlier. A study in South Ethiopia among in school adolescents also indicated that those adolescents getting adequate sleep during the night had an earlier mean age at menarche [5].

In this study, BMI was not correlated to the age of menarche. Similarly, a study in Northern Uganda indicated that BMI and waist circumference was not correlated with menarche [15]. In the contrary,

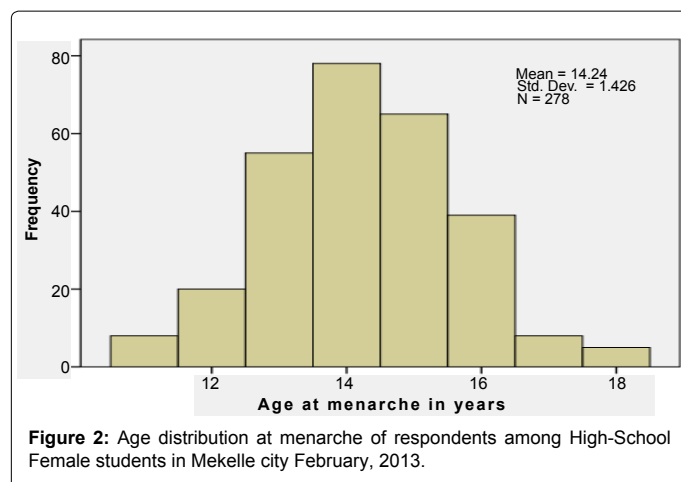


Figure 2: Age distribution at menarche of respondents among High-School Female students in Mekelle city February, 2013.

Variable	Level	Percentage	Mean ± SD	T-test	P-value
School	Government	156(53.8%)	14.71 ± 1.36	6.19	0
	Private	134(46.2%)	13.72 ± 1.31		
Meat eating habit	Yes	170(58.6%)	14.31 ± 1.40	0.86	0.39
	No	120(41.4%)	14.16 ± 1.46		
vegetable eating habit	Yes	123(42.4%)	13.98 ± 1.49	-2.57	0.01
	No	167(57.6%)	14.43 ± 1.34		
Eat snacks	Yes	273(94.1%)	14.26 ± 1.43	0.7	0.48
	No	17(5.9%)	14.00 ± 1.31		
Age in year	14-Oct	35(12.0%)	13.71 ± 1.29	-2.37	0.02
	15-19	243(88.0%)	14.32 ± 1.43		
House Ownership status	Owned	202(69.7%)	14.12 ± 1.37	-2.42	0.01
	Rented	76(30.3%)	14.58 ± 1.50		

Table 3: Mean age at menarche difference among High-School Female Students in Mekelle city February, 2013.

Variable	Level	Percentage	Mean ± SD	F test	P value
Fathers education	No formal education	67(23.2%)	14.70 ± 1.57	8.45	0
	Elementary (1-8 grade)	48(16.5%)	14.81 ± 1.29		
	9-10 grade	36(12.4%)	14.28 ± 1.08		
	11-12 grade	32(11.1%)	14.13 ± 1.28		
	College and university	95(32.8%)	13.66 ± 1.32		
Mothers education	No formal education	75(25.9%)	14.69 ± 1.61	6	0
	1-4 grade	18(6.6%)	14.83 ± 1.29		
	5-8 grade	46(15.9%)	14.63 ± 1.10		
	9-10 grade	43(14.8%)	13.74 ± 0.98		
	11-12 grade	31(10.7%)	13.84 ± 1.39		
Father's job	College and university	65(22.4%)	13.82 ± 1.43	9.55	0
	Employee	97(33.5%)	13.89 ± 1.21		
	Business man	131(45.2%)	14.24 ± 1.47		
	Farmer	50(17.3%)	14.24 ± 1.42		

Table 4: One-way ANOVA test of some of the socio-demographic factors associated with age at menarche among High-School Female Students in Mekelle city February, 2013.

different studies indicated as the BMI increased, the number of girls attaining menarche also increased [4-8]. This could be explained by the nature of the study design that temporal relationship could not be established by conducting cross sectional study. The BMI the study subjects might not be the BMI during their menarche.

The mean BMI was 20.22. More than one quarter of the study

participants were under weight. Whereas the BMI obtained from the study in Nigeria was 22.1, with 5.0% under-weight [16]. This indicates that female students in our study are increasingly at risk of underweight 26.3% than female students in Nigeria which might delay their menarche. This indicates that high nutritional education and intervention is needed for school age female students in the study area. In the contrary, the magnitude of overweight and obesity was lower in this study (2.6%) compared to the finding in Nigeria (9.9%) [16].

The findings of this study should be viewed in light of the following limitations. The random and systematic measurement error in self-reported age at menarche, physical activities and dietary intake might attenuate the association observed in this study. Age at menarche assessment was made at the time of study hence, recall bias is inevitable. We did not also assess the effect of wide range of dietary factors on age at menarche; therefore, causal relationship cannot be inferred from this cross sectional study. Therefore, detail prospective study should be conducted to assess the cause effect relationship of the explanatory variables with age at menarche.

Conclusion

Compared to similar studies carried out in other African countries, and Europe and some Asian countries monarchical age was found to be delayed in the study area. This study showed that the mean age of menarche was statically different among the government and private school girls. Time spending sitting, duration of sleeping, living in their own house were negatively correlated with age at menarche. There was significant difference of age at menarche among the participants maternal education ($F=6.0, P<0.001$), father's education ($F=8.45, P<0.001$), and father's job status ($F=9.55, P<0.001$). There was statistically significant socio-economic difference among the private and government school female students. There was no statistically difference in the mean of BMI ($t=0.92, p=0.36$) among the private and government school girls. Compared to other studies the mean body mass index of the participants was low. This indicates that female students in the study are increasingly at risk of underweight which might delay their menarche. Therefore, nutritional education and intervention is needed for school age female students in the study area.

Competing Interests

The authors declare that they have no competing interests.

Authors' Contributions

Hadush Gebremariam carried out the conception and designing the study, performed statistical analysis and wrote the manuscript. Alem Gebremariam performed statistical analysis, critically evaluated

Variables	Pearson correlation (r)	P-value
Daily Walking	-0.15	0.008
Physical Exercise	0.039	0.52
Time spends sitting in a day	-0.25	0.000
Duration of sleeping	-0.13	0.03
Waist circumference	0.07	0.23
BMI	-0.05	0.33
Waist to hip ratio	-0.003	0.96
Height	0.09	0.11
Weight	0.035	0.55
Hip circumference	-0.01	0.85

Table 5: The Pearson correlation test between age at menarche and other quantitative variables among High-School Female Students in Mekelle city February, 2013.

and made progressive suggestions throughout the study. Genet Tesfay critically evaluated and made progressive suggestions throughout the study. Umer Said and Huruy Assefa critically commented the draft paper, revised the manuscript and approved the manuscript. All authors read and approved the final manuscript.

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