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

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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 ±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=8.0, 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 ≤ 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 ≤ 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 12.66 years, respectively [5,6,8]. 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...
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 weighting 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 bi-
variate analysis was done to compare the characteristics of high-
school female students in governmental and private schools with
respectively p-values for chi-square. An independent sample t-test was
used 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 years ± 1.42 SD. According
the WHO classification of adolescents, most of the respondents were in
the range of middle age adolescents (87.2%). Predominantly, the study
subjects were Tigrigna (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 (X2=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 ± 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(±0.2SD) and 20.06(±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 ± 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 difference 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<0.001). 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
difference of age at 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
(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].

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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,
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 monarchial 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 our 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

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

<table>
<thead>
<tr>
<th>Variable</th>
<th>Level</th>
<th>Percentage</th>
<th>Mean ± SD</th>
<th>T-test</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>School</td>
<td>Government</td>
<td>156(53.8%)</td>
<td>14.71 ± 1.36</td>
<td>6.19</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>Private</td>
<td>134(46.2%)</td>
<td>13.72 ± 1.31</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meat eating habit</td>
<td>Yes</td>
<td>170(58.6%)</td>
<td>14.31 ± 1.40</td>
<td>0.86</td>
<td>0.39</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>120(41.4%)</td>
<td>14.16 ± 1.46</td>
<td></td>
<td></td>
</tr>
<tr>
<td>vegetable eating habit</td>
<td>Yes</td>
<td>123(42.4%)</td>
<td>13.98 ± 1.49</td>
<td>-2.57</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>167(57.6%)</td>
<td>14.43 ± 1.34</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eat snacks</td>
<td>Yes</td>
<td>273(94.1%)</td>
<td>14.26 ± 1.43</td>
<td>0.70</td>
<td>0.48</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>17(5.9%)</td>
<td>14.00 ± 1.31</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age in year</td>
<td>14-Oct</td>
<td>35(12.0%)</td>
<td>13.71 ± 1.29</td>
<td>2.37</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td>15-19</td>
<td>243(82.8%)</td>
<td>14.32 ± 1.43</td>
<td></td>
<td></td>
</tr>
<tr>
<td>House Ownership status</td>
<td>Owned</td>
<td>202(69.7%)</td>
<td>14.12 ± 1.37</td>
<td>-2.42</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td>Rented</td>
<td>76(30.3%)</td>
<td>14.58 ± 1.50</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**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.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Level</th>
<th>Percentage</th>
<th>Mean ± SD</th>
<th>F test</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fathers education</td>
<td>No formal education</td>
<td>67(23.2%)</td>
<td>14.70 ± 1.57</td>
<td>8.45</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>Elementary (1-8 grade)</td>
<td>48(16.5%)</td>
<td>14.81 ± 1.29</td>
<td>6.0</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>9-10 grade</td>
<td>36(12.4%)</td>
<td>14.28 ± 1.08</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>11-12 grade</td>
<td>32(11.1%)</td>
<td>14.13 ± 1.28</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>College and University</td>
<td>95(32.8%)</td>
<td>13.86 ± 1.32</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mothers education</td>
<td>No formal education</td>
<td>75(25.9%)</td>
<td>14.89 ± 1.61</td>
<td>6.00</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>1-4 grade</td>
<td>18(6.6%)</td>
<td>14.83 ± 1.29</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5-8 grade</td>
<td>46(15.9%)</td>
<td>14.63 ± 1.10</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>9-10 grade</td>
<td>43(14.8%)</td>
<td>13.74 ± 0.98</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>11-12 grade</td>
<td>31(10.7%)</td>
<td>13.84 ± 1.39</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>College and University</td>
<td>65(22.4%)</td>
<td>13.82 ± 1.43</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Father’s job</td>
<td>Employee</td>
<td>97(33.5%)</td>
<td>13.89 ± 1.21</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Business man</td>
<td>131(45.2%)</td>
<td>14.24 ± 1.47</td>
<td>9.55</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>Farmer</td>
<td>50(17.3%)</td>
<td>14.24 ± 1.42</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

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