Abstract. – OBJECTIVE: The age at menarche varies over time in line with the development level of society. The aim of the present study was to assess and compare secular trends of the age of menarche in Ankara, Turkey.

PATIENTS AND METHODS: One thousand thirty-five patients who presented for regular gynecological control were examined retrospectively between 2011 and 2015. The patients were asked when they had experienced their first period. The data were evaluated in 10-year periods (<1964, 1965-1974, 1975-1984, and 1985-2000). The mean age at menarche presents trends that have changed over the years.

RESULTS: The mean age at menarche decreased from 13.29 years in <1964 to 13.24 years in 1965-1974, 13.20 years in 1975-1984, and 13.10 years in 1985-2000. When the <1964 and 1985-2000 groups were compared, there was a two-fold increase in young age (≤ 11 years) at menarche.

CONCLUSIONS: There is a continuing secular trend (a two-fold increase) in earlier age at menarche (i.e., ≤ 11 years). The effects of global warming and rising socioeconomic levels in Turkey may be implicated in the increase in earlier age at menarche.

Key Words: Menarcheal age, Global warming, Socioeconomic development, Environmental factors

Introduction

The declining age of menarche is a global trend observed worldwide. Menarche marks a significant milestone in a girl's life, signifying the onset of puberty and the beginning of reproductive capability. In recent years, the decreasing age of menarche has become a topic of concern among healthcare professionals and researchers. Several environmental and socioeconomic factors have been identified as important contributors to this phenomenon.

Environmental factors are recognized as influential determinants of menarche. Nutritional deficiencies, such as low energy intake, protein inadequacy, and low-fat consumption, have been associated with delayed menarche. Obesity, on the other hand, is a significant environmental factor linked to the early onset of menarche. Additionally, environmental pollutants, such as pesticides, phthalates, heavy metals, and endocrine-disrupting chemicals, have been shown to affect menarcheal timing.

Socioeconomic factors also play a crucial role in influencing the age of menarche. It has been observed that girls from lower socioeconomic backgrounds experience menarche at an earlier age. Similarly, education level and income level are socioeconomic factors that impact the timing of menarche. Girls with higher levels of education tend to experience menarche at a later age. Likewise, there is a tendency for early menarche among girls from low-income families. In Turkey, a study conducted in 2005 reported the average age of menarche among women aged 15-49 as 13.3 ± 1.3 years.

The aim of the present study was to examine potential changes in the age of menarche in Turkey among patients now aged 15-30, 31-40, 41-50, and 50+ years. This study will investigate the underlying environmental and socioeconomic factors contributing to the declining age of menarche in Turkey. The findings of this study will contribute significantly to the development of health policies and the promotion of adolescent health.

Patients and Methods

The records of 1,035 women aged 13-70 who presented to the Department of Obstetrics and Gynecology, between January 2011 and December 2015 for any gynecological reason were examined. The patients were divided into the following four age groups: 15-30 years (group 1,
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On presenting to the hospital, the women were questioned about their age at menarche. Required information was provided. After obtaining the approval of the local Ethics Committee, the patients’ records were examined (age, menarche age).

**Statistical Analysis**

Kruskal-Wallis tests were used to compare the subgroups. SPSS Version 15.0 (SPSS Inc., Chicago, IL, USA) was used for statistical analysis. \( p < 0.05 \) was taken as a significant difference. Power analysis was performed according to the menarche age and age between the groups (SPH analytics 2021, Alpharetta, GA, USA) and it was found to be 70%, so it was decided that the sample size was sufficient.

**Results**

The mean age of the patients in group 1 (n = 178), group 2 (n = 372), group 3 (n = 339), and group 4 (n = 146) was 23.8 ± 4.6 years, 35.9 ± 2.8 years, 44.9 ± 2.7 years, and 57.4 ± 5.0 years, respectively. The average age at menarche of all the age groups was 13.21 ± 1.2 years. In groups 1-4, the mean age at menarche was 13.10 ± 1.28, 13.20 ± 1.29, 13.24 ± 1.27, and 13.29 ± 1.22 years, respectively, with no statistically significant difference (Table I, Figure 1).

When the patient groups were divided according to their age at menstruation (Figure 2), menstruation occurred most commonly at age 13 years, with a ratio of 34.3%, 39.5%, 36.9%, and 34.9% in groups 1-4, respectively.

The ratio of first age at menarche of 11 years and younger increased two-fold in group 1 (15-30 years) compared to group 4 (50 years and older) (7.9% vs. 3.4%). Compared to the total population, the ratio of first age at menarche of 11 years was 7.9% in the 15-30-year-old group. The ratio was 6.2% in group 2 and 4.4% in group 3 (Table II).

**Discussion**

Previous studies\(^{14-16}\) of the age at menarche in European countries reported that menarcheal age was lower in Mediterranean countries, including France, than in Western European countries and that genetic, ethnic, and geographical influences explained this difference. The age at menarche of wealthy Chinese, Japanese, and Indian girls was similar to that reported in Mediterranean countries, with menarche occurring at 12.4, 12.6, and 12.1 years, respectively\(^{14-16}\). The age at menarche in South America (Chile, 12.5 years; Venezuela, 12.6 years) was also shown\(^{14-16}\) to be similar to that in Mediterranean countries, whereas it was higher in African countries.

<table>
<thead>
<tr>
<th>Group (Age)</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-30</td>
<td>178</td>
<td>13.10</td>
<td>1.289</td>
</tr>
<tr>
<td>31-40</td>
<td>372</td>
<td>13.20</td>
<td>1.299</td>
</tr>
<tr>
<td>41-50</td>
<td>339</td>
<td>13.24</td>
<td>1.273</td>
</tr>
<tr>
<td>≥ 50</td>
<td>146</td>
<td>13.29</td>
<td>1.227</td>
</tr>
</tbody>
</table>

**Table I.** The mean age of the patients in groups.

![Figure 1. Distribution of menarche age according to years.](image)
Pubertal onset in girls has been observed to occur at earlier ages in the United States and other developed countries. A meta-analysis investing the onset of breast development revealed a global trend, indicating a decrease of 0.24 years per decade over the past 36 years. However, it is important to note that each country and society is different, and there are multiple factors that influence the age of menarche. Socioeconomic factors are just one aspect and should be considered in conjunction with other factors. It is crucial to remember that the age of menarche is determined by a variety of factors, including genetic factors, nutrition, health, lifestyle, and environmental influences.

In studies conducted in Turkey, the menarcheal age between 1967 and 2004 varied between 12.4 and 15.9 years, regardless of differences in socioeconomic levels. Based on these averages, the age of menarche seems to show a declining trend in Turkey in the last 30 years. In the present study, the mean age at menarche was 13.21 ± 1.2 years.

In the current study, the patients were grouped according to specific age ranges. Based on this grouping, the age at menarche has fallen in recent decades. One factor potentially explaining this decline may be global warming. Compared with temperatures in the 1970s, temperatures in Turkey are following an increasing trend. World-

### Table II. Distribution of menarche age according to groups and age.

<table>
<thead>
<tr>
<th>Menarche</th>
<th>15-30 years</th>
<th>31-40 years</th>
<th>41-50 years</th>
<th>&gt; 50 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 years n: 2</td>
<td>0</td>
<td>1 (0.3)</td>
<td>1 (0.3)</td>
<td>0</td>
</tr>
<tr>
<td>11 years n: 55</td>
<td>14 (7.9)</td>
<td>22 (5.9)</td>
<td>24 (4.1)</td>
<td>5 (3.4)</td>
</tr>
<tr>
<td>12 years n: 249</td>
<td>47 (26.4)</td>
<td>84 (22.6)</td>
<td>83 (24.5)</td>
<td>35 (24.0)</td>
</tr>
<tr>
<td>13 years n: 384</td>
<td>61 (34.3)</td>
<td>147 (39.5)</td>
<td>125 (36.9)</td>
<td>51 (34.9)</td>
</tr>
<tr>
<td>14 years n: 198</td>
<td>31 (17.4)</td>
<td>62 (16.7)</td>
<td>64 (18.9)</td>
<td>31 (21.2)</td>
</tr>
<tr>
<td>15 years n: 90</td>
<td>14 (7.9)</td>
<td>31 (8.3)</td>
<td>28 (8.3)</td>
<td>17 (11.6)</td>
</tr>
<tr>
<td>16 years n: 53</td>
<td>10 (5.6)</td>
<td>18 (4.8)</td>
<td>20 (5.9)</td>
<td>5 (3.4)</td>
</tr>
<tr>
<td>17 years n: 14</td>
<td>1 (0.6)</td>
<td>7 (1.9)</td>
<td>4 (1.2)</td>
<td>2 (1.4)</td>
</tr>
<tr>
<td>Means of menarche age</td>
<td>13.1</td>
<td>13.2</td>
<td>13.6</td>
<td>13.3</td>
</tr>
</tbody>
</table>

*Kruskal-Wallis tests were used to compare the subgroups.*
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wide, compared to the menarcheal age in Turkey, the age at menarche was reported\textsuperscript{23} to be higher in regions close to the poles and younger in regions close to the equator. Thus, the increase in temperature in Turkey in parallel to global warming may be contributing to an increase in the menarcheal age in Turkey.

A decrease in the age of menarche in the last century in rich countries may be a reflection of changes in nutritional habits. For example, in a study conducted in 1975, Neyzi et al\textsuperscript{23} found that the age at menarche ranged between 12.4 ± 0.1 and 13.3 ± 0.1 years (mean of 12.8 ± 0.1) in four different socioeconomic levels and that there was a significant difference in the number of cases of menarche observed in 12- and 13-year-olds, depending on the socioeconomic group to which they belonged. In other words, the higher the socioeconomic level, the higher the incidence of menarche at an early age (12 and 13 years). In a study conducted 17 years later, Kolukisa et al\textsuperscript{24} determined that the age at menarche ranged between 12.49 ± 1.15 and 12.75 ± 1.15 years (mean of 12.62 ± 1.12) in subjects from four different socioeconomic levels. They concluded that the falling century-wide trend in menarcheal age had stabilized in the highest socioeconomic classes and that, although it had continued in other socioeconomic groups, the inter-group range had narrowed. According to OECD data\textsuperscript{26}, per capita income in Turkey, which was $4,000 in 1980, reached $20,000 in 2015. In the present study, the mean age at menarche was 13.10 ± 1.28 years in group 1 (1985-2000), 13.20 ± 1.29 years in group 2 (1975-1984), 13.24 ± 1.27 years in group 3 (1965-1974), and 13.29 ± 1.22 years in group 4 (before 1964). More importantly, as shown in Table II, the age at menarche of 11 years and younger increased two-fold. In addition, Esen et al\textsuperscript{27} reported that the mean age at menarche was 12.7 ± 1.3 years in 2015. This result demonstrated that decreasing in age at menarche continues.

Together with socioeconomic development, rapid developments in purchasing power and technology over the past 30 years may also have affected the age of menarche. Salti et al\textsuperscript{28} concluded that changes in melatonin levels were associated with the length of time spent looking at television and computers and that these changes may cause early onset of hormonal hypothalamus stimulation. After 1980, access to television increased across Turkey. As noted in the study by Salti et al\textsuperscript{28}, this may have played a role in the decline in menarcheal age detected in the present study.

**Limitations**

One limitation of the present study was that no information was available on the participants’ body mass index. Furthermore, the age ranges of the groups were wide, and it was not possible to ascertain the body mass index at the age of menarche of patients older than 40 or 50 years. However, Sobal et concluded that socioeconomic development affected the age at menarche independently of the weight in a developing country\textsuperscript{29}. The role of socioeconomic development in menarcheal age is explained not only by weight gain and obesity but also by improved nutrition in the form of protein, calcium, and animal-based products.

**Conclusions**

The novel aspects of the present study are that no previous studies have determined the age at menarche in Turkey according to specific age ranges or the age at menarche within these age groups. Early menarche may be attributed to global warming, socioeconomic development, technology-related lifestyle changes, and earlier exposure to sexual stimuli (this exposure occurs via television watching). The aforementioned factors appear to have affected menarcheal age in Turkey, with a declining trend detected in age at menarche.

**Conflict of Interest**

The authors declare that there are no conflicts of interest.

**Informed Consent**

Patients and/or their families signed informed consent forms.

**Authors’ Contributions**

MU, MO, and UF designed this study. MU, MO, and UF provided funding. MU revised the manuscript. MU and MO finished the manuscript and analyzed the data. MU, MO, UF collected the clinical data. MU and MO contributed to the literature search.

**Data Availability**

The raw data supporting the conclusions of this article will be made available by the authors.

**Ethics Approval**

Ethical approval (No.: 8000-08-13 date: 05.02.2013) for the study was obtained from the Scientific Research Ethics Committee of Etimesgut Military Hospital and the study was carried out in accordance with the principles of the Helsinki Declaration.
References


