ORIGINAL ARTICLE

The relationship between menarche age and anthropometric indices of girls in Sabzevar, Iran

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Abstract

Objective: To determine the relationship between anthropometric indices and the age of menarche in female students of Sabzevar, Iran.

Methods: The cross-sectional study was conducted in Sabzevar, Iran, from April to September 2010, and involved girls of 11-18 years of age. The required sample size for analysing the relationship between menarche age and Body Mass Index was estimated to be 110 by correlation coefficient and Cox survival regression model and by using the NCSS_PASS software. The study had 130 students who were selected by multi-stage probability sampling. Relevant data were collected through a questionnaire as well as by measuring the anthropometric indices such as height, weight etc. Analysis of data was done by independent t-test, Pearson's correlation coefficient, Chi-square, Kaplan-Meier and Cox survival regression model using SPSS 15.

Results: The mean menarche age was 12.5±1.4 years. Mean body mass index, weight and height of the menstruated girls were higher and significant than the corresponding figures of the non-menstruated girls. The correlation coefficient showed a significantly negative relation between body mass index and menarche age (r=-0.221, p=0.025(, but correlation between menarche age and height or weight was not significant. Menarche occurrence rate was significantly higher in overweight girls than girls with normal weight. Menarche occurrence rate in girls with low weight was lower than those of normal weight.

Conclusion: The menarche age and body mass index are significantly related; the higher body mass index, the lower was the menarche age, resulting in a higher menarche occurrence rate.

Keywords: Menarche age, Body mass index, Anthropometric indices, Iran. (JPMA 63: 81; 2013)

Introduction

Puberty is a natural growth issue, common to both man and woman. The onset of sexual puberty in girls is associated with secondary sexual changes, i.e. development of the nipple and, later, the growth of pubic and armpit hair; also the beginning of menarche is an indication of the maturity of internal genital organs, or the end of puberty.[1] Although heredity is still the main determining factor in puberty, it seems that other factors are also involved in the onset of puberty, such as geographical location, nutrition, health and well-being as well as socio-economic factors.[2]

The menarche age is often investigated for various reasons. Previous studies show that low menarche age is associated with the incidence of diseases such as the risk of breast and endometrium cancers.[3] There have been studies also on the role of height, weight and body structure on the menarche age. However, there is disagreement on the role of these factors.[4,5] Some researchers consider a bit of body fat be necessary in female adolescents and a minimum weight requirement for starting the menstruation.[6] On the other hand, studies show that childhood malnutrition can delay the onset of menstruation, but does not prevent its occurrence. Better nutrition and improved socio-economic status are among the factors leading to the lower age of menstruation, as witnessed in the present century.[7]

The menarche and puberty age are lower in Iran.[8] Since overweight and increased body mass index (BMI) have been among the major changes in girls, it is most likely that these factors affect the menarche age. However, there is no absolute agreement in this regard. The relationship between anthropometric indices and menarche age has not so far been investigated in Sabzevar, preferences which is a north-eastern city of Iran and has a dry and warm climate that is different from other cities in Iran. It has its own set of cultural, ethnic, nutritional and lifestyle preferences that differs from other parts of the country. The present study tried to explore the menarche age and its relationship with BMI, weight and height to recommend a well-managed puberty education

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programme for girls in Sabzevar. We can develop health and reproductive plans, and provide the target population with appropriate nutritional and behavioural patterns.

Subjects and Methods

The cross-sectional study was conducted on secondary and high school girls of 11-18 years from April to September 2010. The sample size for analysing the relationship between menarche age and BMI with confidence interval of 95% and power 80% and with a significance level of 0.05 in Pearson's correlation coefficient was estimated to be 110 subjects.[9] In the Cox survival regression model, it was estimated to be 55.[10] The calculation of the sample size was done using NCSS_PASS software. The study comprised 130 students who were selected from different schools in the municipal districts of Sabzevar, by multi-stage probability sampling. Because of different socio-economic circumstances of the city zones, we divided it into four zones and randomly choose 2-4 secondary and high school girls to complete the study sample.

Girls having diseases such as hormone-related disorders, diabetes, skeletal, neurologic and muscular disorders, and chronic diseases such as asthma, were excluded. All the participants were asked to furnish informed written consent to participate in the study, and the procedure was approved by the Research Ethics Committee of the Sabzevar University of Medical Sciences, Iran.

Relevant data were collected through a questionnaire that comprised demographic information. Besides, height and weight were measured and BMI was calculated. The menarche age was ascertained and recorded by self or parental report. For measuring the weight with an accuracy of 0.1kg, minimum clothes and no shoes were requested. A portable scale (made in Germany by SOEHNLE) was calibrated daily with a standard scale, and used for measuring weight. The participants' height was measured by a plastic measuring tape attached to a smooth wall. The participants were required to put their legs straight together, keep their arms to their sides, and keep knees, shoulders and the back of the head all in the same direction. The ruler was kept touching their head on the top, and the measurement was recorded with an accuracy of 0.5 cm. Also, BMI was calculated by dividing the weight (kg) by squared height (m^2).

Data analysis was done by independent t-test, Pearson's correlation coefficient, Chi-square, Kaplan-Meier and the Cox survival regression model. In the Cox regression model, the covariate effects were expressed as hazard ratios (HR) and 95% confidence intervals (CI). Menarche event was considered in the Cox survival regression model and the cumulative survival curve was displayed. In this study, BMI was classified into 3 categories: BMI <18 (low weight); 18≤BMI<24.9 (normal weight) and BMI≥25 (overweight). Normal BMI was considered as reference for comparison of menarche rates in Cox regression model. SPSS 15 was used for statistical purposes and results were considered to be significant with P ≤0.05.

Results

The mean age of the 130 participants was 15.32±2.5 years. Their mean weight, height and BMI were also calculated (Table-1). It was observed that 25 (19.2%) were non-menstruating, and while 105 (80.8%) had experienced their menarche. The mean menarche age was 12.5±1.4 years. It was inferred from the data that the most common menarche age range was 11 to 13 years (n=63; 59.96%). Anthropometric indices and their relationship with the menarche age showed that the mean height, weight and BMI of the menstruating girls were all significantly higher than those of the non-menstruated ones.

The correlation coefficient analysis showed no significant relationship between the menarche age and height or weight (r=0.145, p=0.142 and r=-0.118, p= <0.231 respectively). However, a significant relationship was observed between menarche age and BMI (r=-0.221, p=0.025). Besides, 77 (59.4%) girls with low weight (BMI<18), 114 (88%) girls with normal weight (18<BMI<24.9), and 121 (93.3%) overweight girls (BMI>25) had experienced menarche. The difference between these 3 BMI categories was significant (P<0.001). The relationship between BMI and the menarche age was significant in the Cox regression model (P<0.010). The results of the Cox model showed that the menarche occurrence rate in overweight girls (BMI>25) was significantly higher than girls with normal weight (HR=2.042). The menarche occurrence rate in low-weight

Table-1: Mean weight, height and BMI in menstruated and non-menstruated girls.

Index	Total of sample*	Menstruating Girls	Non-Menstruating Girls	P-value**
Weight (kg)	49.14±11.3	51.43±10.73	40.54±9.6	0.001
Height (cm)	154.33±11.3	156.06± 11.35	148.21±8.36	0.002
BMI (kg/m2)	20.68±4.2	21.27± 4.15	18.43 ±3.63	0.002

*Mean ± Standard Deviation. **Comparison between menstruating and non-menstruating girls.

Table-2: Relationship between different BMI categories and menarche age in Cox regression model and Kaplan-Miere method.

	Cox Regression Model			Kaplan-Meier
BMI	**HR**	**95% CI for HR**		**Median's menarche age**
Less than 18	0.778	0.464	1.307	13.312
18-24.9	reference			12.712
25 and more	2.042	1.102	3.782	11.896

HR BMI≥25/18 ≤ BMI < 24.9 = 2.623. 95% CI: 1.285, 5.353.

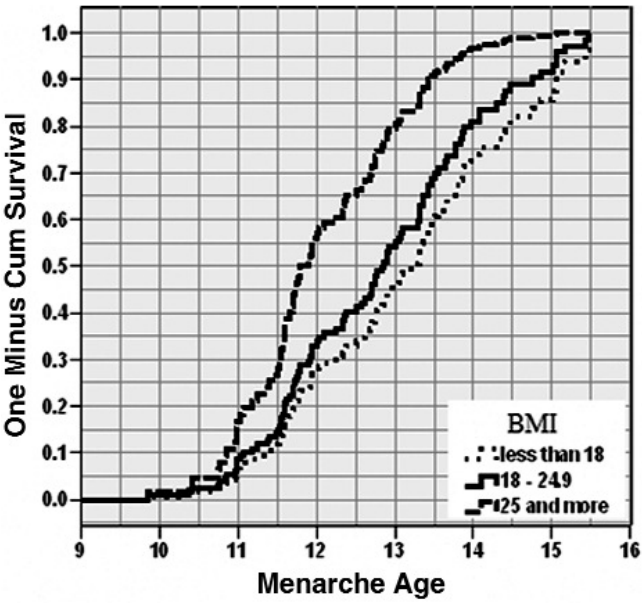

Figure: One minus survival curve in Cox model for three categories of BMI and menarche age.

girls was lower than girls with normal weight (HR=0.778) (Table 2). Also, the cumulative survival curve reflected the difference of the menarche age in different categories of BMI (Figure). The median of the menarche age was 12.712 through the Kaplan-Meier method.

Discussion

Most of the menstruating girls in the study were in the age range of 11-13 years (n=63; 59.9%). The mean menarche age was 12.5±1.4 years, which was lower in comparison with countries like Bangladesh (15.8), Congo (13.83), Ghana (13.98), Tanzania (15.21) and Senegal (16.1), but similar to countries like the US (12.8), Greece (12) and Italy (12.2).[11]

Although the timing of puberty changes is gene-specific individuals, other factors such as geographical location, general health status, nutrition and socio-economic status, affect the onset of menstruation and its progression. Since the data collection procedures of different studies vary and these affect their results, interpretation and comparison of their results, therefore, require some caution. This was the first study of menarche age in Sabzevar in the north-east of Iran. The results when compared with other Iranian studies indicated that the menarche age among Sabzevar girls was similar to those in the northern and central parts of Iran,[4,5] but different from other parts of the country.[1] However, they showed a decreasing trend in the menarche age throughout the last 20 years, as in some Asian countries.[5,8,12]

There are various studies showing the decreasing trend of the menarche age in the last 100 years. One such study showed that the mean menarche age in American girls had decreased from 12.75 to 12.54 over 20 years.[13] Another study showed that the mean menarche age had decreased within the past 40 years, attributing the reduction to girls' increasing obesity.[14] Other researchers also attributed this to other factors, including social, economic, health and nutritional improvement.[7]

One of the major concerns of high disagreement is the effect of body weight and structure on such reproductive characteristics as menarche age.[15] In the present study, the mean weight of the menstruated girls in Sabzevar was 51.43±10.73kg, which was higher than what has been reported from other Iranian areas.[16] It seems that the intake of fast food and high-fat foods is the cause of overweight in these girls. A study believed that in order to start menstruation, girls need to achieve a minimum weight of 47.8 kg; and, more importantly, their body fat should amount to 23.7%.[6] Therefore, puberty starts earlier in medium-obese girls than in girls with normal weight. In contrast, girls with malnutrition and food insecurity will experience a delay in menstruation.[17] In the present study, the menstruating girls had higher weight than the non-menstruating ones. This too is in line with some earlier studies too.[18]

The mean height of the menstruating participants in the study was 156.06±11.35cm, which is close to figures obtained in studies of other Iranian regions.[16] The height of the menstruating girls was significantly taller than the non-menstruating ones. This finding is in line with earlier studies.[16] Other studies showed that taller girls (148.60cm) experience menstruation earlier than the shorter ones (135cm) in California.[14] A study on Korean girls born between 1920 and 1986 indicated that the menarche age had lowered from 16.8 to 12.7 within a 67-year period. Simultaneously, their height had increased from 149.23 to 161.75cm. This trend has been attributed to the changes in the physical growth of girls in that study.[19]

In the current study, it was observed that the girls' BMI in

Sabzevar was higher than the corresponding figures in other Iranian regions and the menstruated girls' BMI was significantly higher than that of the non-menstruated girls. This is also congruent with other studies.[16,19,20] In the present study, according to Cox regression model, it was observed that with the increasing of BMI, the menarche occurrence rate also increased. This indicated that their physical condition was appropriate for the first menstruation. The Kaplan-Meier curve showed that there were significant differences among BMI categories. The median of menarche age was 12.7 years, and had significant difference in BMI categories. Our data showed that the relation between BMI and menarche probability was equal in 3 BMI categories until the age of 11, but after that, the difference was obvious.

As is the case in other countries,[21] factors such as social and cultural factors, attitude, family environment, nutritional habits and beliefs are also important in determining the timing of menstruation in Sabzevar girls.

Conclusion

The menarche age is experiencing a decreasing trend in Iran, too. Health managers in Iran, and similar countries, should emphasise on educational plans and encourage the adolescents to change their lifestyle and select suitable nutritional and behavioural patterns, so that complications resulting from the lowered menarche age could be prevented.

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