

## Age at Menarche and its Relationship to Anthropometric Indices in Adolescent Girls

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### Abstract

#### Background

Menarche is a substantial and important period in the health of adolescent girls', and has a significant impact on their health in the upcoming years. Accordingly, in this study, we aimed to not only determine the average age of menarche among high school girls in Qom city, but also to examine the effect of some factors on onset age of menarche.

#### Materials and Methods

In this cross-sectional study, a researcher-made questionnaire was presented to 400 girl students from six high schools in Qom city-Iran, including questions about individual characteristics, onset age of menarche in the participant and her mother, and some other indicators related to menarche. Data were analysis using SPSS version 16.0 software.

#### Results

From 400 distributed questionnaires 370 (92.5%) were filled correctly and completely. The findings of this study showed that the average age of menarche in girls has been  $12.3 \pm 1$  year and 90% of the subjects had experienced menarche before the age of thirteen. Among the effective factors, a significant relationship was observed between daughters' onset age of menarche and their mothers' age ( $P < 0.01$ ). Weight, Body mass index (BMI), and waist circumference (WC) was inversely and significantly associated age of menarche among the test subjects ( $P < 0.01$ ).

#### Conclusion

Based on the findings of this study, there was a high relationship between the onset age of menarche among the mothers and the daughters' menarche age. Also, our results confirm that higher BMI, weight, and WC were negatively correlated to the age at onset of menarche.

**Key Words:** Adolescent Girls, Body mass index, Menarche, Waist circumference.

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## 1- INTRODUCTION

Menarche is an important period in girls' puberty and has a significant impact on their physical and sexual health (1). According to previous studies, the onset age of menarche can be affected due to factors such as depression and eating disorders (2), diabetes (3), metabolic syndrome (4), and cancer (5). Various factors like hormonal factors (6) influence the onset age of menarche, but the onset timing of menarche has been more dependent on the interaction between genetic and environmental factors while lifestyle is also influential (4). Among the environmental factors, nutritional status was a significant factor (7). Results of a study showed that food insecurity has caused a one-year delay in the onset of menarche among Ethiopian girls (7).

According to various studies, the age of menarche has gradually decreased since the nineteenth century; the reason to this reduction is known to be nutritional status, public health, and community health improvements (1, 8, 9). For example, in a study done on 529 girls in the city of Medina, Ghana, Aryeetey et al. found that the average onset age of menarche in those girls was  $12.74 \pm 1/2$  years and body mass index and household's socio-economic status were the most significant factors affecting it. It was mentioned that menarche age in Iran is lower than other countries (10). Previous studies showed that in different parts of Iran, mean age of menarche vary from 11.86 to 12.91 (10-15). Furthermore, menarche age had decreased in this age group compared to their mothers (9). However, some other research was reported the stop of the decline of the age of menarche (16). Although a lot of studies have been conducted in western countries in terms of the onset age of menarche and its consequences on health, few studies have been published on this issue in the region of West Asia and the Middle East. Adali

and Koç estimated the average onset age of menarche among girls in Turkey to be about 13.3 years (1). Al-awadhi et al. reported average age of the menarche in girls in Kuwait as 12.41 years (2). It should be noted that according to a study in Turkey and based on previous literature, during each decade, the average age of menarche decreased on an average of 1.44 months (1). Therefore, prospective studies should focus on issues like changes in the onset age of menarche and factors affecting it to precisely control the case. Recently, the researcher's focus is on the relation between age at menarche and some health and anthropometric indices. Harris found that one-year delay in the onset of menarche was associated with 0.5 kg/m<sup>2</sup> decrease in their body mass index in next year's; he conclude that age at menarche as a health and clinical indicator- could predict the susceptibility of woman to overweight and obesity (17).

Since awareness of the age at menarche can notify governmental institutions of the proper time to provide the necessary training on sexual behavior and it can play a significant role in appropriate planning for sexual health in young women (16), one of the research priorities would be assessment and determination of the age at menarche and factors affecting it. Therefore, in this study, we aimed to estimate the average onset age of the menarche and factors affecting it among adolescent girls living in Qom- Iran.

## 2- MATERIALS AND METHODS

### 2-1. Study design and population

This cross sectional study was carried out in Qom a religious city near to the capital city of Iran that has a rapidly growing population from November 2016 through January 2017.

### 2-2. Methods

A study was performed in six out of the 30 public and private high schools for girls in

Qom, Iran. The schools were selected by means of simple randomization with the use of ballot from a list of schools provided by the Iranian Ministry of Education. In each selected schoolgirls, girls aged between 12- 16 years were invited to participate in study. The selected girls for the participation were started menstruations (18). The participants were given questionnaire and a consent form to take home and complete if their parents consented to their participation. According to previous study (19), and 95% confidence level (CI), and 90% test power, the sample size by following formula was calculated at least 238 students, that finally 370 students were participated in this study.

$$C(r) = \frac{1}{2} \log_e \frac{1+r}{1-r} \quad N = \left( \frac{z_\alpha + z_\beta}{C(r)} \right)^2 + 3$$

Where:  $1-\alpha=0.95$ ,  $1-\beta=0.90$ , and  $r=0.001$ .

### 2-3. Measuring tools: validity and reliability

We used a researcher-made questionnaire (27 questions) to collect self-reported data on demographic data, and menarche age. In order to verify the face and the content validity, the questionnaire were reviewed by a panel of experts of faculty members of Qom University of Medical Sciences; then, we modify the questionnaire according of their comments. Before the final version, internal consistency (reliability) of questionnaire was assessed by Cronbach's alpha coefficient using a sample consisted of 20 randomly selected students. Cronbach's alpha for student's responses to the questionnaire was 0.76, respectively.

The age of menarche was determined by a retrospective method (18). We asked girls to mention the date of their first menstruation with the one month or a quarter of the year accuracy (20). Weight

was measured to the nearest 0.1 kg on a Seca electronic scale, with no shoes and with light-weight clothing. Height was determined to the nearest 0.1 cm by using a stadiometer, and Waist circumference was measured to the nearest 0.1 cm with a meter of fabric (21). Body mass index (BMI) was calculated as weight (kg) divided by height (m<sup>2</sup>) (22). Then according to CDC charts for age and gender, BMI percentiles specific was used to categorize girls as either underweight (less than 5<sup>th</sup> percentiles), normal weight (between 5<sup>th</sup> to 85<sup>th</sup> percentile), overweight (between 85<sup>th</sup> to 95<sup>th</sup> percentile), or obese (more than 95<sup>th</sup> percentile) (12, 23). Anthropometric indices of all participants were measured by a single technician.

### 2-4. Ethical consideration

Before the study, we briefly explained the aim of study to students. With full informed consent, 400 students have been entered to study. Students were allowed to be excluded from the study, if they did not like to continue their participation.

### 2-5. Data Analyses

Data analysis was performed using Statistical Package for Social Sciences (SPSS) version 16 (SPSS Inc, Chicago, USA). The results are expressed as mean  $\pm$  standard deviation. The data were analyzed using the descriptive statistic including the percent and frequency. Also, Pearson correlation coefficient was used for correlation between anthropometric indices and menarche pattern.  $P < 0.05$  was considered statistically significant in all statistical tests.

## 3- RESULTS

From 400 distributed questionnaires 370 (92.5%) were filled correctly and completely. The majority of participants (84%) were born in Qom. The demographic and anthropometric characteristics of the girls included in this study were mentioned in **Table.1**. Mother's

education levels in more than half of participants was less than diploma ( $n=188$ , 54%), and only 12 % of mother's ( $n=42$ ) has academic education. **Table.2** shows the menarche age and menstrual pattern of participants. There was no significant difference in the mean age at menarche between the students who was born in Qom ( $12.2 \pm 0.9$  years) or other city ( $12.5 \pm 1$  years) of Iran ( $P < 0.05$ ). In terms of onset age of menarche, the findings are mentioned according to the participants' age in **Figure.1**. As shown in **Figure.1**, the prevalence of early menarche (less than 11 years of age) (2), was 19.8% ( $n=72$ ). More than 90 percent of subjects had first menstruation before 13 years old.

The results according to BMI category of students and the mean age at menarche that were mentioned in **Table.3**, showed a reduction in age at menarche with the increasing of BMI of students. There was a significant relationship between the three anthropometric indices and the onset of menarche ( $P < 0.05$ ), and results was mentioned in **Table.4**, so that, increase if weight and BMI, and central obesity was significantly correlated with age at menarche. Also, body weight ( $P < 0.01$ ,  $r = 0.238$ ) and high BMI ( $P < 0.01$ ,  $r = 0.338$ ) in subjects were associated with weight gain during puberty. 119 participants

(32.2%) believed that consumption of certain foods has been effective in relieving menstrual pain in them. On the other hand, 247 girls (66.8%) believed that food consumption has no effect on menstrual pain. In evaluating the relationship between onset age of menarche among adolescents and onset age of menarche in their mothers, the results showed that there was a positive correlation between these two variables ( $P < 0.01$ ,  $r = 0.206$ ). Moreover, the onset age of menarche had a significant, negative correlation with the severity of the pain during menstruation ( $P < 0.01$ ,  $r = -0.156$ ). Of course, the severity of the pain had a significant, positive correlation with the menstrual duration ( $P = 0.018$ ,  $r = 0.126$ ).

In 81 percent of participants, duration of flow was less than 8 days. In 69 subjects (20%) the interval between the two periods were less than 25 days while this time span was 25-35 days among 228 subjects (66%), and the periodical interval among 48 (14%) of the participants of the study was more than 35 days. In respect to the starting season of menarche, 156 girls (42.2%) has announced summer as the starting season of menarche while fall, spring, and winter were next in rank with 73 subjects (19.7%), 57 subjects (15.4%), and 54 subjects (14.6%), respectively.

**Table-1:** Personal data of girl's students participating in this study ( $n=370$ )

Variables	Minimum	Maximum	Mean $\pm$ SD
Age (years)	12	16	$13.7 \pm 0.8$
Weight (Kg)	34	85	$53.2 \pm 10$
Height (Cm)	124	180	$159.5 \pm 7.1$
BMI (Kg/m <sup>2</sup> )	13.5	36.4	$20.9 \pm 3.8$
Waist circumference (Cm)	34	96	$69.5 \pm 9.5$

SD: standard deviation.

**Table-2:** Menarche age and menstrual characteristics of participants ( $n=370$ )

Variables	Minimum	Maximum	Mean $\pm$ SD
The age of menarche (years)	9	15	$12.3 \pm 1$
Mean duration of flow (days)	2	16	$6.8 \pm 1.7$
The age of mother's menarche (years)	8	17	$13.2 \pm 1.8$
The pain of menarche (mm)	0	10	$4.5 \pm 3$

SD: standard deviation.

**Table-3:** The mean age of menarche in different BMI category (n=343)

BMI	Number	%	Mean age at menarche
Underweight (less than 5 <sup>th</sup> percentile)	12	4	12.35 ± 0.94
Normal weight (between 5 <sup>th</sup> to 85 <sup>th</sup> percentile)	245	71	12.1 ± 1.2
Overweight (between 85 <sup>th</sup> to 95 <sup>th</sup> percentile)	60	17	11.7 ± 1.1
Obese (more than 95 <sup>th</sup> percentile)	26	8	11.9 ± 0.94

**Table-4:** The correlation between age at menarche and some anthropometric indices

Variables		Weight (Kg)	Body mass Index (Kg/m <sup>2</sup> )	Waist circumference (cm)
Age at menarche	r	-0.232	-0.248	-0.144
	P-value	<0.01	<0.01	0.007

r: Pearson correlation coefficient.

#### 4- DISCUSSION

According to the findings of this study, the onset age of menarche in adolescent girls of Qom city was about 12.3 years old and there was a significant, positive correlation between onset age of menarche among mothers and daughters. Menarche is a key indicator of sexual maturity in females; therefore determination of the onset age of menarche and its effective factors has an important role in sexual health of adolescent girls (9). Several studies indicate a decline trend in the age of menarche over the last century while subsequent studies report stability and lack of reduction since 1970s and afterwards (24, 25). Age of menarche is associated with a variety of factors ranging from level of health and well-being to onset age of menarche in the first-degree relatives of persons (1).

In this study, a significant, positive relationship was found between the ages of menarche among girl's students with their mothers' menarche age. Such a result is consistent with the findings of Rigon et al. in Italy (26) and Adali and Koç (1); that based on these findings, onset age of menarche among a person's first-degree relatives like her mother or sister is considered to be one of the important and

influential factors in the occurrence of menarche. The findings of this study about the prevalence of early menarche (less than eleven years old) or delayed menarche (after age 13) (2) were similar to the findings of Areetey et al. (9). Onset age of menarche is effective on girls' health and disease (5). For example, in his study, Akter et al. showed that the early onset age of menarche (less than 12 years old) is associated with an increase the risk of getting metabolic syndrome when compared to delayed onset of menarche (over 13 years old) (4). However, other studies disagree with these findings (27).

The mean duration of flow in our study was higher than Zegeye et al. study in Ethiopia that found the mean duration of flow in Ethiopian girls  $4 \pm 1.3$  days (28). In our study, two girls (0.5 %) have the mean duration of flow over than ten days that could increase the mean of duration flow in our study. In this study, no difference was observed between the onset ages of menarche in girls according to their place of birth. Individual race has indeed been regarded as one of the most important and effective factors in the occurrence of menarche (1, 8, 29); however, the participants of this study – regardless of their birth place – has the same Iranian race, and thus the findings

are not contrary to the previous findings (30). Accordingly, it seems that the onset age of menarche is more affected by the environmental factors such as nutritional status and socio-economic condition (25, 31). However, the findings are not consistent with the study results of Cabane- et al., which indicates a further decline in onset age of menarche in rural communities compared to urban population (5). Moreover, a study by Rigon et al. showed that parents' birth place has a significant, independent relationship with the onset age of menarche among daughters (26). Therefore, it is suggested to consider parents' birth place as well as their inhabitancy period in further studies in order to assess the impact of birth place on the onset age of menarche among girls.

The results of this study found significant correlation between timing of menarche and anthropometric indices including weight, waist circumference, and body mass index. In this regard, some studies suggest that the weight gained due to improved nutritional status and increased energy intake together with physical inactivity may be effective on early onset of menarche among girls (4, 9, 20, 32).

Similar to our results, Wronka was reported a significant relationship between weight and BMI in girls with the onset of menarche; in a way that girls with higher BMI have an earlier menarche onset; he has described this effect independent of socioeconomic factors (20). A majority of previous research has been reporting similar findings (9, 25, 33, 34). Although, according to Bau's et al. finding, BMI was announced as the main effective factors on menarche age (24). Thus, further investigations should focus on a larger number of girls to offer a closer examination of the relationship between body mass index and menarche onset. Some evidence also indicates a higher relationship between weight and body

composition with puberty in boys than in girls (8). Also, the findings of this study represent a significant, positive relationship between BMI and waist circumference in adolescence; that is, increase in body mass among adolescents led to increased waist circumference which is in accordance with Biro et al.'s findings on girls and it is considered as a risk factor for increased abdominal obesity among girls after the age of 18 (35).

#### **4-1. Limitations of the study**

We have some limitation in this study. First, the findings of this study were based on self-report data. Age at menarche recalled retrospectively could be a source of error (5, 18). Although, this recall method may less valid, because it is fraud with poor memory (18); But, we enrolled daughters that recently has experienced menarche. Second, sample size is another limitation of this study. It is recommended to evaluate menarche onset in a prospective research by studying the same number of girls classified in two groups of fit and fat participants.

#### **5- CONCLUSION**

In conclusion, the mean age at menarche among participants was  $12.3 \pm 1.1$  years old. There was a significant relationship between mother's age at menarche and menarche age in girls. Also, we have found a significant negative relationship between anthropometric indices (such as weight, body mass index, and waist circumference) and age at menarche.

#### **6- CONFLICT OF INTEREST**

The authors declare that they have no competing interests.

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