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Menarche Age and Its Association to Body Mass Index and Socioeconomic Status Among School Girls in Sanandaj in North-West of Iran

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Abstract

Objectives: The age of menarche can be different among girls based on region, ethnic, and some individual factors such as body mass index (BMI). Little is known about the menarche age in Kurdish girls. This study was conducted to determine the menarche age and its association to BMI and socioeconomic status among Kurdish schoolgirls.
Methods: This was a cross-sectional study conducted on 400 schoolgirls from different secondary and high schools in Sanandaj, northwest of Iran. Multi stage sampling was used to select the study samples. Data were collected using a checklist, which included demographic information and other variables under investigation. SPSS version 20 was used for data analysis. Independent sample *t*-test, one-way ANOVA, and logistic regression were used for data analysis. The significance level of the tests was considered to be 0.05.
Results: The mean and standard deviation (SD) of menarche age was 12.87 $\pm$ 1.17 years. About 60.3% of girls had normal BMI and 31%, 6.8%, and 2% of them were underweight, overweight, and obese, respectively. There was a significant relationship between higher BMI (P = 0.02) and menarche age. Based on multivariate analysis, the chance of early menarche in children with higher BMI ($\geq$ 25) was significantly 3.57 times higher than others (P = 0.004). There was no significant relationship between socioeconomic status, physical activity, and birth season, attitude towards menarche, nutritional status, and number of brothers with age of menarche.
Conclusions: The results showed a significant relationship between menarche age and BMI. The age of menarche in our region was also different compared to other regions of the globe. The findings of the present study can be used by health policy makers for planning and conducting the interventional programs related to menarche in girls.

Keywords: Menarche, School, Body Mass Index

1. Background

Maturation is a process that leads to physical and sexual evolution, and secondary sexual characteristics lead to changes in body composition along with growth and psychological puberty (1). The menarche is an important indicator of the onset of puberty and can be affected by environmental and socioeconomic conditions in each community (2). The age at menarche reflects various aspects of the health among the population, including the growth and nutritional status among different cultures and societies (3, 4). Based on existing evidence, the menarche age has declined in the last century throughout the developed and developing countries, resulting in early sexual activity, which can lead to sexual risky behaviors in girls (5, 6).

Several studies have shown the association of menarche age with different variables consisting of psychological factors, genetics, socioeconomic status, physical activity, presence of chronic diseases, diet, maternal and child factors such as weight, height, BMI, low birth weight, lack of breastfeeding, single child, birth order, family size, birth season, preeclampsia, mother smoking, childhood residency (urban or rural), parents occupation and education, and race or ethnicity (7-12).

The consequences of early menarche include overweight, nutrition disorders, diabetes, breast and ovarian cancer, cardiovascular diseases, depression, and educational drop (13-15).

The role of height, weight, and body structure on the menarche age has been reported in some previous studies;

however, there is an uncertainty about their roles (16, 17). According to the previous studies, which have been conducted in different ethnicities and societies, the menarche age has been found to be different (18, 19). Since knowing information about menarche age is essential for health policymakers, especially in the provision of health services and menstrual health education to school girls, and also there is no data or comprehensive study on menarche age and its related factors among Iranian Kurdish girls, this study was conducted to determine the menarche age and its related factors among girl schools of Sanandaj.

2. Methods

This was a cross-sectional study. A total number of 400 schoolgirls, aged 12 - 18 years, from different secondary and high schools in Sanandaj (the center of Kurdistan province in northwest of Iran), were recruited. The sampling method for the selection of the study subjects was multi-stage sampling. In general, schools in Sanandaj are under supervision of two educational district offices each of which has approximately 30 girl schools, 15 secondary girl schools, and 15 high girl schools. First, we randomly selected 10 girl schools, 5 secondary girl schools, and 5 high girl schools from each educational district, and then in each selected school, 20 students were selected by systematic sampling method. Study data were registered in a checklist including menarche age, number of sisters and brothers, family income, source of the first information about menarche, attitude towards the menarche, physical activity, nutrition status, mother and father education, mother and father social class, BMI, and socio-economic status. Physical activity, BMI, and nutrition status were measured using national non-communicable guideline (20).

Since the previous studies have examined the relationship between the socioeconomic status (SES) and the age at the menarche, in this study, we tried to determine this factor for everyone using the combination of three components, including parent education level (FE and ME for fathers and mothers education, respectively), social class (FSC and MSC for fathers and mothers social class, respectively), and family income (FI). The formula for calculating SES is as follows (21):

SES = 0.3 (FE + ME + FSC + MSC + FI)

Parent's education levels were categorized and valued as 0 = illiterate, 1 = elementary school, 2 = secondary school, and 3 = higher education. Social class was categorized and given values as 0 = jobless, 1 = unskilled and semi-skilled manual, and 2 = skilled and professional. Family Income per month was categorized and valued as 0 = fewer than \$250, 1 = \$250 - \$500, and 2 = higher than \$500.

The data were analyzed using SPSS version 20. Mean and standard deviation of quantitative variables were calculated. The normality of the data was investigated using the Kolmogorov-Smirnov test. The association between quantitative variables and age of menarche was examined by independent sample *t*-test, one-way ANOVA and its corresponding post-hock, Tukey' test. To control the potential confounders, logistic regression was used to assess the association between age at menarche and studied independent variables. In fact, to assess the association between menarche age and independent variables, the age at menarche was first dichotomized below 11 and above 11 years, and then logistic regression modeling was conducted. The significance level of the tests was considered to be 0.05.

For ethical considerations, parents were provided with the written informed consent for their child's participation. In addition, the study was ethically reviewed by the Ethics Committee of Kurdistan University of Medical Sciences and was approved: code IR.MUK.1391.516.

3. Results

Overall, 367 (91.8%) of the 400 studied schoolgirls experienced menarche. The mean and standard deviation of menarche age was 12.87 $\pm$ 1.17 years. The mean and standard deviation of weight and height were 47.73 $\pm$ 10.3 kg and 154.28 $\pm$ 10.5 cm, respectively. Among the participants, 60.3% of girls had normal BMI and 31%, 6.8%, and 2% were underweight, overweight, and obese, respectively. In the majority of study subjects, 283 (70.8%), menarche had occurred in warm seasons of year, namely 102 (25.5%) and 181 (45.3%) in spring and summer, respectively. Other variables, which were investigated in the study, are summarized in Table 1.

Mean and SD of BMI in study subjects was 20.0 $\pm$ 3.6. Based on post-hoc analysis in ANOVA (Tukey-test), menarche age in overweight and obese (BMI $\geq$ 25) girls was significantly different compared to underweight girls (BMI $<$ 19), therefore, overweight and obese girls had reached the menarche earlier (P = 0.02). There was also a significant relationship between the numbers of sisters with menarche age; thus, with increasing the number of sisters, the menarche age increased (P = 0.007). No significant relationship was observed between socioeconomic status, physical activity, birth season, attitude towards menarche, nutritional status, and number of brothers with age of menarche (Table 2).

Table 3 shows the results of logistic regression modeling of association between menarche age and independent variables. Based on multivariate analysis, the chance of early menarche in children with higher BMI ($\geq$ 25) was

Table 1. Demographic Characteristics of Studied Participants

Variable	No. (%) (n = 400)	Variable	No. (%) (n = 400)
Menarche age		**Attitude towards the menarche**	
9	3 (0.8)	Positive	332 (83)
10	7 (1.8)	Negative	68 (17)
11	35 (8.8)	**Physical activity**	
12	115 (28.8)	Active	337 (84.3)
13	132 (33.0)	Passive	63 (15.7)
14	65 (16.3)	**Nutrition status**	
15	9 (2.3)	Undesirable	65 (16.3)
16	1 (0.3)	Fairly desirable	332 (83)
Number of sisters		Desirable	3 (0.8)
0	138 (34.5)	**Mother education**	
1	144 (36)	Illiterate	56 (14)
2	66 (16.5)	Elementary school	165 (41.3)
3 and above	52 (13)	Secondary school	119 (29.8)
Number of brothers		Higher education	60 (15)
0	145 (36.3)	**Father education**	
1	160 (40)	Illiterate	46 (11.5)
2	65 (16.3)	Elementary school	113 (28.3)
3 and above	30 (7.5)	Secondary school	157 (39.3)
Family income, $		Higher education	84 (21)
< 250	210 (52.4)	**Mother social class**	
250 - 500	139 (34.8)	Jobless	5 (1.3)
> 500	51 (12.8)	Unskilled and semi-skilled manual	349 (87.3)
Birth season		Skilled and professional	46 (11.5)
Spring	102 (25.5)	**Father social class**	
Summer	181 (45.3)	Jobless	36 (9)
Autumn	67 (16.8)	Unskilled and semi-skilled manual	266 (66.5)
Winter	50 (12.5)	Skilled and professional	98 (24.5)
Source of the first information		**BMI**	
Friends	81 (20.3)	< 19	124 (31)
Family	219 (54.8)	19 - 25	241 (60.3)
Internet	4 (1)	> 25	35 (8.7)
School	96 (24)		
SES			
Low class	62 (15.5)		
Middle class	266 (66.5)		
High class	72 (18)		

Abbreviation: SES, socio-economic status.

significantly 3.57 times higher than others (P = 0.004). In addition, the chance of early menarche age in individuals with middle class SES was significantly higher than that of lower class SES (Adjusted OR = 3.13; 95%CI, 1.04 - 9.43).

4. Discussion

A total number of 400 schoolgirls from the city of Sanandaj were recruited into the study in order to determine menarche age and related factors. Results showed that mean age of menarche incidence was 12.87 ± 1.17 years. There are similarities and differences in our results compared to national and global studies. In a cohort study in Tehran, 2014, the mean age of menarche occurrence was 13.06 ± 1.24 years (22), which is higher than the average menarche age incidence in the current study. In two other studies conducted in Shiraz and Kerman (southern Iran), the mean ages of the menarche occurrence were 12.91 and 12.98 years, respectively (23, 24). In comparison with studies conducted in developed countries, our results are consistent with studies in Canada and United Kingdom in 2010. In the Canadian study that assessed 1403 girls, the

Table 2. Association Between Some Studied Variable and Age at Menarche

Variable	Mean (SD)	P Value
SES		0.2[a]
Low class	12.63 (1.13)	
Middle class	12.86 (1.19)	
High class	12.67 (1.07)	
Physical activity		0.43[b]
Active	12.68 (1.22)	
Passive	12.81 (1.16)	
BMI		0.02[a]
< 19	12.86 (1.11)	
19 - 25	12.82 (1.19)	
> 25	12.23 (1.17)	
Birth season		0.08[a]
Spring	12.85 (1.15)	
Summer	12.65 (1.17)	
Autumn	12.85 (1.18)	
Winter	13.11 (1.11)	
Attitude towards the menarche		0.4[b]
Positive	12.77 (1.17)	
Negative	12.88 (1.12)	
Number of sisters		0.007[a]
0	12.73 (1.19)	
1	12.68 (1.13)	
2	12.74 (1.07)	
3 and above	13.31 (1.23)	
Number of brothers		0.55[a]
0	12.83 (1.15)	
1	12.79 (1.19)	
2	12.82 (1.13)	
3 and above	12.50 (1.17)	
Nutrition status		0.7[a]
Undesirable	12.86 (1.11)	
Fairly desirable	12.78 (1.18)	
Desirable	12.33 (.58)	

Abbreviation: SES, socio-economic status.
[a] Results of One way ANOVA.
[b] Results of Independent sample T-test.

mean age of menarche was 12.72 ± 1.05 years (5), and in the other study in the UK, the mean age of menarche was 12.70 ± 1.5 years (9). In a study conducted in Turkey as one of the neighboring countries of Iran that is geographically located in the northwest of Kurdistan province, the menarche age was 13.30 years (25), which is higher than the result of the present study. In another study in Kuwait, it was 12.4, which was slightly lower than the mean age of menarche in the girls in our area (26). In a study of Saudi Arabia in 2014, the mean age of the menarche was 11.5 + 1.48 (19), which was reported lower than the result of the current study. It seems that the existing differences between the present study and other mentioned studies could be somewhat due to geographical variation, racial diversity, and nutrition as well as weather conditions of different studied areas.

Based on the results of the present study, the most important variable related to the menarche age was BMI. Although, in this study as well as others, the relationship between BMI and menarche age have been significant, BMI is changing over time, particularly during puberty. The results showed that in girls with higher BMI, the menarche age was lower. This finding is supported by many studies in some regions of the world, including Kirchengast in 2007 in Austria (27), Lee in South Korea in 2013 (28), Goon in Nigeria in 2010 (6), and Wang in China in 2016 (29).

The relationship between BMI and menarche age is controversial, thus, underweight girls with lower levels of fat have a delayed menarche. On the other hand, excessive obesity has a negative effect on the mechanism of the hormone axis of the hypothalamus-pituitary with increasing body fat and decreasing the secretion of sex hormones, even leptin delays the onset of menarche (30).

Although we found statistical significance between BMI and menarche age in the study, the percent of obese girls with BMI > 30 was only 2%. In fact, most girls were categorized in normal BMI and overweight, respectively. It seems that endo-biological process of relationship between the occurrence of menarche and high BMI (average obesity) is partly unknown; however, some reasons have been stated in previous studies. One reason may be that the girls who arrive early at menarche have had a high BMI and positive energy balance for a long period of time (23). The other reason can be derived from this fact that fat-derived leptin protein secretion in obese girls is one of the causes of hypothalamus stimulation to increase the secretion of the GnRH hormone that activates the pituitary-ovarian axis and initiates puberty phenomenon (31). Some studies have pointed to the activity of sex hormones caused by pituitary and hypothalamic hormones at puberty as the cause of weight changes in girls (24, 32).

Based on our findings, another significant factor related to the early menarche age was a higher socioeconomic status of the study participants. This result is in line with the results of the studies conducted by Braithwaite in 2009 and Elshiekh in 2011 (33, 34).

Although there was no relationship between the num-

Table 3. Logistic Regression for Association of Age of Menarche and Studied Variables

Variable	Unadjusted		Adjusted	
	OR (95% CI)	P Value	OR (95% CI)	P Value
BMI ≥ 25	3.16 (1.38 - 7.27)	0.007	3.57 (1.51 - 8.41)	0.004
Number of sisters				
0	-	-	-	-
1	1.99 (0.55 - 7.18)	0.3	2.75 (0.723 - 10.46)	0.1
2	2.63 (0.749 - 9.27)	0.1	3.88 (1.047 - 14.43)	0.04
≥ 3	1.94 (0.476 - 7.89)	0.3	2.49 (0.585 - 10.63)	0.2
SES				
Low class	-	-	-	-
Middle class	2.37 (0.822 - 6.85)	0.1	3.13 (1.04 - 9.43)	0.04
High class	1.29 (0.514 - 3.25)	0.6	1.43 (0.557 - 3.67)	0.4
Birth season				
Spring	-	-	-	-
Summer	1.53 (0.468 - 5.02)	0.5	1.5 (0.422 - 5.09)	0.5
Autumn	1.59 (0.522 - 4.85)	0.4	1.64 (0.518 - 5.17)	0.4
Winter	1.34 (0.37 - 4.86)	0.6	1.23 (0.327 - 4.64)	0.7

Abbreviations: CI, confidence interval; OR, odds ratio.

ber of brothers in each girl with menarche age, and this finding is consistent with the study of Matchock et al. in 2016 (35), the number of sisters was an important factor associated with menarche age, therefore, girls who had more sisters had later menarche. This result is similar to the result of the Matchock study in 2006 in the United States indicating that an increase in the number of sisters, especially older sisters, has delayed menarche age. Evidence from animal studies has confirmed this finding (35).

In this study, there was no significant relationship between socioeconomic status and menarche age, which is consistent with the Sylvia Kirchengast's study in Austria in 2007 (27). However, this result was not similar to the results of the ADANU study in Ghana in 2006 (36) and Jansen study in Colombia in 2015 (37).

In this study, there was no significant relationship between physical activities and menarche age. However, there has been a significant relationship in some previous studies in Iran and other regions in the world. In the study of Afshariani in Shiraz, Iran, in 2016, a significant relationship was reported between high physical activity and later menarche age (38). Furthermore, the study of Agita in 2014 revealed the same association (39). Some studies have reported higher age menarche in athletic girls (38). In the present study, 85% of the girls were physically active, which justifies a relatively higher mean age of menarche in this study rather than other studies in regions with similar climate (40).

We did not find a significant relationship between the nutrition status and menarche age, whereas in several studies this association has been reported (41, 42). Inconsistency between our finding and other studies can be resulted from various nutritional measurement tools and also individual biological differences. Our study showed that the nutrition status of 99% of studied girls was not favorable. This result is expected to be due to the deprivation and lack of development of the Kurdistan province. In a previous study conducted in our region, the high proportion of malnutrition in primary school students has been confirmed (43). In addition, it can also justify the lack of relation between socioeconomic status and menarche age in our study.

The main limitation of the present study was the lack of information related to mothers' menarcheal age due to the low level of mothers' education that led to impossibility of assessing the potential effect of mothers' menarcheal age on menarche age in the girls.

The menarche age (12.87 ± 1.17 years) obtained in this study was higher than studies conducted in tropical countries. However, the unexpected finding in this study was a lower age at menarche in Sanandaj schoolgirls compared to regions with warmer climates in Iran. Based on the results, higher BMI was the main factor related to the menarche age, while no significant relationship was found be-

tween age of menarche and socioeconomic status.

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Footnotes

Authors' Contribution: Abdorrahim Afkhamzadeh and Azadeh Habibi and Obeidollah Faraji undertook data collection, conducted the data analysis and drafted the manuscript. Abdorrahim Afkhamzadeh, Khaled Rahmani and Obeidollah Faraji designed and developed the study, and revised the manuscript. All authors critically reviewed the manuscript and approved the final version submitted for publication.

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