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The effect of Exercise on the Age at Menarche in Girls at Guidance Schools of Shiraz, Iran

Raha Afshariani,[1] Leila Malekmakan,[2,*] Maryam Yazdankhah,[1] Arghavan Daneshian,[2] and Mehrab Sayadi[3]

[1]Department of Public Health, School of Health, Shiraz University of Medical Sciences, Shiraz, IR Iran
[2]Shiraz Nephro-Urology Research Center, Shiraz University of Medical Sciences, Shiraz, IR Iran
[3]Student Research Committee, Shiraz University of Medical Sciences, Shiraz, IR Iran

*Corresponding author: Leila Malekmakan, Shiraz Nephro-Urology Research Center, Shiraz University of Medical Sciences, Shiraz, IR Iran. Tel: +98-7136281563, Fax: +98-7136281563, E-mail: malekl@sums.ac.ir

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Abstract

Background: Menarche is a woman's first menstruation and is determined by multiple factors.
Objectives: The aim of this study was to evaluate the effect of exercise on the age of menarche in girls at guidance schools of Shiraz, Iran.
Patients and Methods: This cross-sectional study attempted to evaluate the effect of regular exercise on the age of menarche in relation to demographic data in 483 randomly selected girls from guidance school in Shiraz, Iran, using statistical analysis including independent t-test, variance analysis and linear regression tests.
Results: Participants were divided in two groups including 181 and 302 athletic and non-athletic girls, respectively. A statistically significant difference was found in the mean age at menarche between athletic 12.4 ± 0.9 SD and non-athletic girls 12.1 ± 1.0 SD years (P = 0.003). Linear regression indicated that mother's age (P = 0.049) and exercise (P = 0.001) both have significant association with age at menarche.
Conclusions: The age at menarche for the athletic group was significantly delayed. Exercise and mother's age were significantly associated with age at menarche, whereas no significant association was observed between age at menarche and weight, BMI, father's age, and mother's and father's educational levels.

Keywords: Exercise, Age, Shiraz, Menarche, Iran

1. Background

Menarche is a woman's first menstruation, an event that indicates sexual maturation and the beginning of reproductive life. Age at menarche is determined by multiple factors such as nutritional status, ethnic or racial background, birth weight, exercise, stress and mother's age at menarche etc. (1-3). It has been well documented that the age of puberty (as defined by the age of menarche) has declined significantly since the 19th and early 20th centuries (4-6), probably due to improved nutrition and overall public health.

Women have become increasingly physically active over the past several decades. While exercise provides substantial health benefits, rigorous physical activity is also associated with a unique set of risks for the female athlete (7). The female reproductive system is highly sensitive to physiological stress, and reproductive abnormalities. These include delayed menarche, primary amenorrhea (absence of menstruation by the age of sixteen), secondary amenorrhea (absence of menses for three or more months in women who have reached menarche), and oligomenorrhoea (menstrual cycle duration > 36 days) occurring in 6% - 79% of women engaged in athletic activity (8, 9).

Female athletes who begin training at a young age often have delayed menarche. The time at which athletic training was initiated has been implicated as a factor in delayed menarche because intense training before puberty may alter hypothalamic-pituitary function. Body composition has also been used to explain the delayed menstruation and menstrual cycle irregularities among elite athletes (9). On the other hand, more recent studies have suggested that delayed menarche may be due to genetic factors (6, 10).

2. Objectives

The aim of this study was to evaluate the effect of exercise on the age of menarche in girls at guidance schools of Shiraz, Iran.

3. Patients and Methods

This is a cross-sectional study designed to evaluate the effect of exercise on the age at menarche in girls in guidance schools of Shiraz, Iran. The education system in Shiraz is

comprised of four regions; hence a total of 483 girls were selected randomly from 4 guidance schools, one from each region.

All subjects completed a questionnaire including demographic data such as age, height, weight, body mass index (BMI); calculated as the body mass in kilograms divided by the square of the body height in meters, age, level of parent's education, and the age at menarche. Regarding those who exercised, the duration and the age at which they began exercise were also included. Regular exercise in this study was defined as 3 days per week for at least 6 months.

Exclusion criteria were refusal to complete the questionnaire, having no menarche, and giving incomplete or inappropriate answers.

3.1. Statistical Analysis

The statistical analysis of the data was performed using independent t-test and linear regression and Statistical Package for Social Sciences version 16 (SPSS Inc, Chicago, IL, USA) to examine the relationship between exercise and age at menarche. The results related to the continuous variables were presented as mean ± standard deviation (SD) and those related to the quantitative or categorical data were shown as percentage or frequency. Also, we examined the assumptions of regression; normal distribution of variables, the linearity between the independent and dependent variables, reliable measuring of variables and the comparable variance of errors across all levels of the IV. P-value less than 0.05 were considered statistically significant.

4. Results

The study analyzed the data from questionnaires completed by 483 female students at four guidance schools from October 2014 to May 2014. The mean age of the girls at the start of study was 13.8 ± 0.8 SD years, and their mean age at their menarche was 12.2 ± 1.0 SD years. A total of 188 (37.5%) girls were in athletic and 302 (62.5%) were in non-athletic groups. In the athletic group, the mean duration of regular exercises was 47.2 ± 22.4 SD months and the mean age at the start of regular exercises was 9.7 ± 2.0 SD years, and the corresponding difference in mean age between the two groups in the beginning of the study was not statistically significant (P = 0.06).

As shown in Table 1, the mean age of menarche was significantly different between the two groups (P = 0.03); which was 12.4 ± 0.9 SD years in the athletic and 12.1 ± 1.0 SD years in the non-athletic girls. There was no significant difference between the two groups regarding BMI (P = 0.19), mother's (P = 0.06) and father's age (P = 0.53). However with respect to mother and father's education, a significant difference was seen between the athletic and non-athletic groups (P < 0.001). In this context, 35.2% and 16.6% of fathers in the athletic and non-athletic groups had university education, respectively.

Univariate linear regression analysis showed significant association between mother's age (P = 0.04, Cl = 0.00 - 0.02) and age at menarche. However, no significant association was found between father's age and age at menarche (P = 0.21). As shown in Table 2 there was no significant association between BMI and the age at menarche (P = 0.87, Cl = -0.02 - 0.02).

The analysis of variance and t-test were used for categorical variables including athletic and father and mother's education (Table 3). As indicated, age at menarche was significantly (P = 0.003) different between the athletic and non-athletic groups. According to the fathers' education, age at menarche was significantly (P = 0.042) higher in girls whose fathers had educations under diploma in comparison to those with higher educations.

Finally, as shown in Table 4, the variables with P < 0.05 were enrolled in multiple linear regression (F = 4.6, P = 0.001, R^2 = 19%). It is indicated that mother's age (P = 0.049) and exercise (P = 0.001) were significantly associated with age at menarche while no significant association (P = 0.20) was seen between father's education and age at menarche (Table 3).

Table 1. Demographic Data in 483 Girls at Guidance Schools[a]

Variable	Athletic Group (n = 181)	Non-Athletic Group (n = 302)	Total (n = 483)	P Value
Age at study	13.7 (0.8)	13.9 (0.8)	13.8 (0.8)	0.06
Age of menarche	12.4 (0.9)	12.1 (1.0)	12.1 (1.0)	0.003
BMI	20.8 (10.1)	19.9 (4.1)	20.3 (6.9)	0.19
Mother's age	38.9 (5.4)	37.9 (5.5)	38.4 (5.3)	0.06
Father's age	44.5 (5.7)	44.1 (5.9)	44.3 (5.8)	0.53
Father's education				< 0.001
Under diploma	40 (22.0)	125 (41.2)	164 (33.9)	
Diploma	77 (42.8)	127 (42.2)	205 (42.5)	
University graduated	64 (35.2)	50 (16.6)	114 (23.6)	
Mother's education				< 0.001
Under diploma	35 (19.2)	96 (31.8)	131 (27.1)	
Diploma	68 (37.4)	125 (41.3)	192 (39.8)	
University graduated	78 (43.4)	81 (26.9)	160 (33.1)	

[a]Data are presented as mean (SD) or No. (%).

Table 2. The Association Between Age at Menarche and Related Factors in One Variable Linear Regression Analysis

Variables	Univariate Linear Regression			
	Values[a]	β	CI	P Value
Mother's age	38.30 (5.46)	0.01	0.00 - 0.02	0.049
Father's age	44.26 (5.85)	0.008	-0.005 - 0.02	0.21
Body Mass index (BMI)	19.87 (2.99)	-0.002	-0.02 - 0.02	0.87

[a]Data are presented as mean (SD).

Table 3. The Comparison of Mean Age at Menarche Due to Different Categories of Exercise, Father and Mother's Education

Values	Values[a]	P Value
Athletic		0.003
Yes	12.38 (0.96)	
No	12.10 (1.03)	
Mother's education		0.13
Under diploma	12.34 (0.94)	
Diploma	12.14 (1.05)	
University graduated	12.14 (1.03)	
Father's education		0.042
Under diploma	12.40 (0.9)	
Diploma	12.15 (1.06)	
University graduated	12.12 (1.02)	

[a]Data are presented as mean (SD).

Table 4. Association Between Age at Menarche and Related Factors in Multiple Linear Regression Analysis

Values	B (Regression Coefficient)	Standard Error	Beta (standard Regression Coefficient)	t	P Value
Mother's age	0.004	0.008	0.021	0.461	0.049
Athletic					
No (baseline)	-	-	-	-	-
Yes	0.324	0.096	0.154	3.36	0.001
Father's education					
Under diploma (baseline)	-	-	-	-	-
Diploma	-0.281	0.114	-0.135	-2.46	0.067
University graduated	-0.356	0.120	-0.165	-2.95	0.085

5. Discussion

Our findings showed that the age at menarche for girls with regular exercise was significantly delayed compared with the age matched control. This is consistent with the results of other studies, where age at menarche of the female rhythmic gymnasts, artistic gymnasts and ballet dancers were reported to be significantly delayed compared with controls (11-14). It has been hypothesized that temporary interruption of puberty by exercise is often accompanied by stalled skeletal age maturation evidenced by slow growth and reduction in the level of sex steroids (15). Also, exercise can change hormonal concentration including insulin, cortisol, growth hormone and catecholamine, etc. (16).

Previous studies have also suggested that the age of the onset of pubertal development varies greatly, and is influenced by nutrition, heredity, state of health, percentage of body fat, and other factors (17). In our study no significant difference in BMI was observed between the athletic and non-athletic groups, which was contrary to the results of other studies where the athletic group was much thinner, had lower BMI and less body fat than the non-athletes of the same age (9, 13).

Multiple linear regression analysis showed a significant association between exercise and age at menarche, which was in agreement with that of other studies indicating delayed menarche among athletes (9, 15, 17, 18). The parents of our athletic group, who had delayed menarche compared with the control, exhibited a significantly lower education, however there was no significant relationship between parental education and age at menarche. This was consistent with the findings of another study (19), where parental education was unrelated to age at menarche. However, there was a significantly graded association between household income and age at menarche, while our study did not measure the household income.

According to Frisch et al. girls who began athletic training before menarche were more prone to delayed menarche and secondary amenorrhoea than those who began training after menarche (9). This was in line with our results where most girls in the athletic group who had delayed menarche, began regular exercises at an early age (9.7 ± 2.0 SD years) and before puberty. Also, age at menarche is determined by multiple factors such as mother's age at menarche (1-3). In other words, girls whose mothers had menarche earlier reached menarche at a younger age. In our study, girls who had menarche earlier had younger mothers and there was a significant correlation between age at menarche and mother's age.

In conclusion, according to our results the age of menarche in girls with regular exercise was significantly delayed compared with the age matched control. Exercise and mother's age both had significant association with age at menarche. There was no significant relationship between weight, BMI, father's age, mother's and father's education and age at menarche. Future research should include a detailed nutritional profile of these athletes.

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Footnotes

Authors' Contribution: Study concept and design: Raha Afshariani and Maryam Yazdankhah; analysis and interpretation of data: Raha Afshariani, Leila Malekmakan, Arghavan Daneshian; drafting of the manuscript: Arghavan Daneshian; critical revision of the manuscript for important intellectual content: Leila Malekmakan, Arghavan Daneshian, Raha Afshariani and Maryam Yazdankhah; statistical analysis: Leila Malekmakan, Raha Afshariani.

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