

Association of age at menarche with body mass index and waist–hip ratio

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Abstract

Background: Menarche is the first onset of menstruation. Current trend shows decrease in age of menarche. There is strong evidence that the increasing rate of obesity can be attributed to decreasing menarche age.

Objective: To analyze the relation between age at menarche and anthropometric parameters such as body mass index (BMI) and waist–hip ratio.

Materials and Methods: This cross-sectional study was conducted on 170 adolescent girls aged between 18 and 25 years. The participants were given a questionnaire that included data on birth date, age of menarche, parent's education, ethnic background, and food habits. Height and weight were measured, and BMI and waist–hip ratio was calculated. The participants were divided into three different categories based on BMI values. Statistical analysis was carried out in SPSS software, version 16.0. The data were analyzed using descriptive statistics and one-way ANOVA. Pearson's correlation coefficient was used for correlation studies.

Result: Majority of the participants showed a normal BMI, and no significant correlation could be drawn between age at menarche and BMI ($p > 0.05$). There was no significant relation between waist–hip ratio and menarche too.

Conclusion: Relation between BMI and age at menarche was not significant in this study. The abovementioned findings suggest that there are other factors also that contribute to early puberty. Data were also required for amount of energy intake at the time of puberty, especially those foods that contain hormones such as estrogen and antiestrogens. Other important factors such as ethnic and cultural background, socioeconomic status, supportive family, and lifestyle factors also play a very important role in determining the age of menarche.

KEY WORDS: Menarche, BMI, waist–hip ratio

Introduction

Menarche is the term coined to denote the onset of menstruation in girls.^[1] It is considered physiologically as the initial marker for the onset of puberty. It also denotes the start of fertile period in girls.^[2,3] Girls become reproductive after the

attainment of menarche. There is a corresponding physical change marked by the development of breast and pubic hair and height spurt.^[4,5] The age of menarche varies between 9 and 13 years.^[6]

In the early nineteenth century, the age of menarche was closely associated with climatic changes and conservative family background. In this era, menarche shares a link to the literacy rate, rapid industrialization that brought significant lifestyle changes, and environmental modifications.^[7] The age of menarche is decreasing at a rate of 3 months every 10 years.^[8]

Current trend shows reducing age of menarche in both developed and developing countries. This can be attributed to improved socioeconomic status, increased access to health care, and excess intake of energy-rich food. The first study was done by Adadevoh et al.^[9] in 1989 among adolescent girls of Kamasi. The study was done in multiple centers

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throughout the world. Various studies have supported the link between early onset of menarche and increased body mass index (BMI), diabetes mellitus, cerebrovascular diseases, and metabolic syndrome,^[10–13] but, till now, study done from India are few. This study is designed to provide further insight into the association between menarche and BMI.

Materials and Methods

The study was done on adolescent girls aged between 18 and 25 years. The participants were given consent form and list of questionnaires with clear instructions to be filled within a specified time to prevent interpersonal discussion bias. The questionnaire included data on birth date, age, parent's education, ethnic background, and food habits. The parameters were measured on girls only after they returned the completed questionnaire. Exclusion criteria were: girls with menarche age of more than 16 years as it can be owing to certain pathological condition and girls on hormone pills or on medicines owing to some other clinical condition.

The exact age of first menstruation was obtained by prompt recall from the girls, which were confirmed by telephonic conversation with parents. Majority of the participants were able to provide only the month and year of menstruation as they were unable to recall the exact date. So, the 15th day of the month recalled was used for analysis. Menstrual period of 2–6/21–35 days with loss of 20–60 mL blood was considered as normal.^[14]

Weight was measured to the nearest 0.1 kg using a digital weighing scale. Standing height was measured to the nearest 0.1 cm using a stadiometer. Waist circumference was measured at the end of normal expiration, to the nearest 0.1 cm, by using a measuring tape at the narrowest point between the lower borders of the rib cage and the iliac crest. BMI, defined as the ratio of weight in kilograms to height squared in meters, was calculated.^[15]

Informed consent was obtained from the participants. Ethical approval for the study was obtained from the institute's ethical committee.

Statistical Analysis

Statistical analysis was carried out in SPSS software, version 16.0. The data were analyzed using descriptive statistics and one-way ANOVA. Pearson's correlation coefficient was used for correlation studies. Student's *t*-test was used to compare the variables. The difference was considered significant if the *p* value was <0.05 and highly significant if the *p* value was <0.001. The data were analyzed, and valid conclusions were drawn.

Result

The questionnaire was distributed among 300 girls, of which only 200 returned the completed form. Thirty of them

were unsure about the onset of menarche; so, they were excluded from the study group. The age of the girls in the study group was between 18 and 25 years, with mean and standard deviation of 19.33 ± 1.196 .

Mean age at menarche was estimated at 12.34 ± 1.35 years. Among the participants, 77.64% had attained menarche before the age of 13. By the age of 15, all the participants had already had their first menstruation. The study supports the fact of declining trend in age of menarche in Asian countries.^[16] The yearly fluctuations in age at menarche were less in the study. Majority of the girls (77.6%) had a regular menstrual pattern.

Table 1 shows mean and standard deviation of various parameters (i.e., age, menarche, cycle length, weight, BMI, and waist-hip ratio). Table 2 shows the correlation of age at menarche with BMI, which was not significant.

Table 3 shows the different categories of BMI. Majority of the participants showed a normal BMI, and no significant correlation could be drawn between age at menarche and BMI (*p* > 0.05). There was no significant relation between waist-hip ratio and menarche too.

Discussion

The study found that the mean menarcheal age of female students was 12.34 ± 1.35 years. This study did not find any significant correlation between age at menarche, BMI, and waist-hip ratio.

The age at menarche is an important marker of sexual maturity in girls. In this study, the age at menarche was 12.34 ± 1.35 years. This finding supports the trend of decreasing age of menarche among girls.^[17] Majority of the studies have observed significant relationship between onset of menarche and nutritional status,^[18,19] but, our study did not find any statistical significance between onset of menarche and anthropometric parameters. This is supported by few of the research works that conclude that, other than BMI, there are other factors also which play a role in the first menstruation (i.e., heredity, genetic factors, geographical location, lifestyle factors, and sex hormone difference).^[20,21] Guillette *et al.*^[22] and few other research workers have proved that genetic factors such as early age of menarche among family members, especially mother also contributes to the first menstruation onset in girls.^[22] Few studies have also shown that stress among female subjects also plays a very important role in the early onset of menarche such as broken family, early death of one of the parents, and violence.^[23] Few researchers have shown that, for onset of menstruation, a minimum weight of 47.8 kg and body fat of 23.7% are required. So, obese girls tend to attain menarche early.^[24]

This study mainly focused on association between age at menarche and anthropometric parameters. As BMI and waist-hip ratio were the only parameters measured, the study would have been more conclusive if other indices of

Table 1: Mean and SD values of the parameters measured

	N	Minimum	Maximum	Mean	SD
Age	170	18	25	19.33	1.196
Menarche	170	9	15	12.34	1.359
Cycle length	170	18	150	34.05	13.910
Weight (kg)	170	35.00	88.50	53.3588	9.20545
BMI (kg/m ²)	170	14.85	33.59	21.5474	3.27745
Waist-hip ratio	170	0.000	1.429	0.75831	0.090429

Table 2: Correlations of the age at menarche and BMI

		Menarche	Cycle length	BMI	Waist-hip ratio
Age	<i>r</i>	0.091	-0.102	0.132	0.007
	<i>p</i>	0.240	0.184	0.085	0.927
Menarche	<i>r</i>		0.103	-0.090	-0.093
	<i>p</i>		0.182	0.245	0.227
Cycle length	<i>r</i>			-0.005	-0.090
	<i>p</i>			0.946	0.244
BMI (kg/m ²)	<i>r</i>				0.151
	<i>p</i>				0.049

Table 3: Frequency and percentage of different BMI groups

	Frequency	Percentage
Underweight	26	15.3
Normal	118	69.4
Overweight	24	14.1
Obese	2	1.2
Total	170	100.0

body fat measurement such as skinfold thickness and bioelectrical impedance were added to the study. The study did not focus on the importance of other factors such as weight at birth,^[25,26] socioeconomic conditions,^[27] dietary habits,^[28] and physical activity.^[29] More research work is required to support the abovementioned findings.

Relation between BMI and age at menarche was not significant in this study. The abovementioned findings suggest that there are other factors also which contribute to early puberty.

Conclusion

Relation between BMI and age at menarche was not significant in this study. The abovementioned findings suggest that there are other factors also which contribute to early puberty. Data were also required for the amount of energy intake at the time of puberty, especially those foods that contain hormones such as estrogen and antiestrogens. Other important factors such as ethnic and cultural background, socioeconomic status, supportive family, and lifestyle factors also play a very important role in determining the age of menarche.

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