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Original research article

To find out the association between Age at Menarche (AaM) and BMI in adolescent girls from different aaganwadi centers of Indore

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Abstract

Introduction: Menarche, a first menstrual bleeding, is a significant event in the reproductive life of a female in the adolescent age group. The acceleration of Age at Menarche (AaM) is associated with many medical and social problems in later life. Many factors including as BMI, nutritional condition, body composition, physical activity, living environment, and psychological stress influence the age at menarche. Hence, in our study we are interested in finding out whether there exist an association between Age at Menarche (AaM) and BMI.

Objective:

i) To find out the association between Age at Menarche (AaM) and BMI.

ii) To find out the mean Age at Menarche in Adolescent girls with Low BMI, Normal BMI and High BMI.

Methods: The data were collected from 45 adolescent girls aged 14-19 years from different Aaganwadi centers of Indore. Height and weight were measured and used to calculate BMI; detailed menstrual history including Age at Menarche (AaM) was taken. Adolescent girls were grouped into three categories i.e. Early menarche (<12yrs), Middle menarche (12-14yrs) and Late menarche (>14yrs). All the data were collected & tabulated and analyzed statistically using SPSS (Statistical Package for Social Sciences) software version 20.0.

Results: The inverse relation was observed between Age at Menarche (AaM) and BMI. Further analysis showed that 64.3% girls with high BMI had early menarche & 50% of girls with low BMI had late-menarche.

The mean age at Menarche was lowest (12.07) for girls with high BMI when compared with girls who had low & normal BMI with mean age at Menarche 14.9 and 13.05 respectively.

Conclusion: Negative correlation between Age at Menarche and BMI was observed. Rapid or early maturation seems to have long-term consequences with high BMI and should therefore be considered a risk indicator for the development of obesity in later life.

Keywords: Menarche, Age at Menarche (AaM), BMI (Body Mass Index)

Introduction

Age at Menarche (AaM) is the term used to describe the age at which menstruation first occurs. Although it occurs after the peak height velocity and breast growth, the menarche is regarded as a reference point for the onset of puberty in girls since it is an obvious, representative phenomena [1]. Normal age of puberty for girls is 12-14 years, girls attaining puberty in age less than 8 years of age are said to have precocious puberty and those who attained puberty in greater than 17 years of age have pathologically delayed puberty [2].

A sensitive indicator of the physical, biological, and psychological environments, age at Menarche has attracted a lot of interest in recent years. Early menarche in girls is associated with an increased risk of breast and endometrial cancer, psychosocial issues, and cardiovascular disorders [3]. Numerous researches on age at Menarche have found that menarche differs among different ethnic groups. However, the majority of the data point to a global decline in the mean age at Menarche [4].

Certain factors including as BMI, nutritional status, body composition, physical activity, living situations and psychological stress, have a stronger correlation with age at Menarche [3]. Even if the link between overweight and early menarche is debatable, it may be true [5]. According to Lee *et al.* [6], the rising trend in obesity in the USA may be a factor in the girls having early menarche. Few studies have shown that a higher body mass index (BMI) throughout childhood can lead to the onset of puberty occurring earlier [7, 8], while other researches indicates that early menarche is the real cause of increased BMI in adulthood [9,

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[10]. The Frisch-Revelle hypothesis simply claims that the most plausible explanation for early Age at Menarche (AaM) is the rise in BMI during childhood and adolescence [11]. A significant risk of being overweight as an adult is linked to early puberty weight gain. Leaner women report later age at Menarche, while fatter women consistently report earlier age at Menarche (for their birth cohort) [12]. Increased adult body mass index (BMI) has been linked to early menarche age, along with other early biological maturity indicators [13]. Many longitudinal studies conducted between 1972 and 2003 indicated a negative correlation between age at menarche and adult weight-for-height [14-23], measured by BMI in all but one research [14], although one longitudinal study found no correlation between age at menarche and adult BMI [24].
Therefore, the purpose of this study was to determine whether there is a link between BMI and age at menarche (AaM).

Material and Methods: This was a cross-sectional study conducted in the department of Physiology, M.G.M medical college on adolescent girls aged 14-19 years from different aaganwadi centers of Indore after obtaining institutional ethical committee clearance. After taking informed written consent and taking into account the inclusion and exclusion criteria's, 45 adolescent girls with regular menstrual cycle were enrolled for the study. The inclusion criteria were adolescent females from different aaganwadi centers of Indore, who were willing to participate and were not using any medications (including hormonal preparation).
Exclusion criteria were girls with chronic medical or psychiatric illness, precocious puberty (menarche before 8 years), pathologically delayed menarche (menarche after 17 years), pregnancy and lactation.
Detailed personal and menstrual history including menarche history was taken using predesigned, pretested, structured and self-administered questionnaire which was filled by adolescent girls of different aaganwadi centers. The girls were given a brief 15-minute explanation of the terms used in the questionnaire. The questionnaire was designed to obtain the information about menarche age, response at the time of menarche and about menstrual problems. The anthropometric parameters were measured using standard methods. Weight was measured from electronic weighing machine in kilograms (with light clothing and no shoes) and height (with bare-foot) from wall mounted stadiometer in centimeters. Body mass index was then calculated by the formula BMI = weight (kg)/square of height (m^2). Subjects were categorized into 3 groups on the basis of BMI:
1) Low BMI/underweight (BMI < 18.5).
2) Normal BMI (BMI= 18.5-22.9).
3) High BMI (>22.9) [25].

Adolescent girls were also divided into 3 groups on the basis of their age at Menarche:
1) Early menarche group (menarche age < 12 years).
2) Middle menarche group (menarche age 12-14 years).
3) Late menarche group (menarche age >14 years) [2].

Statistical analysis: The statistical analysis was performed using the Statistical Package for Social Sciences version 20.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to find out the frequencies and percentages. Comparison of mean age at menarche between Low, Normal & High BMI groups was carried out by using one way ANOVA. The prevalence of Low, Normal and High BMI in each menarche groups was compared by means of Pearson Chi- square test. The statistical tests were conducted at a 95% confidence interval (CI) and p-value< 0.05 was taken as statistically significant.

Results
We included 45 adolescent girls of age group 14-19 years. Early menarche was reported by 11 subjects (24.4%), Middle menarche by 27 subjects (60%), and Late menarche by 7 subjects (15.6%).
Table 1 depicts how the study participants were distributed into 3 menarche groups based on their BMI.
Approximately 31.1% of our total study population included High BMI or overweight individuals. In the Early menarche group, there was a statistically significant difference between the proportion of participants with a BMI >22.9 and those with a BMI< 18.5 (64.3% versus 0%). In the late menarche, the number of subjects with high BMI was less (7.1%) than those with low BMI (50%) (Table 1). The majority of the participants with early menarche were overweight and had high BMIs, whereas those with late menarche had lower BMIs, according to the findings.

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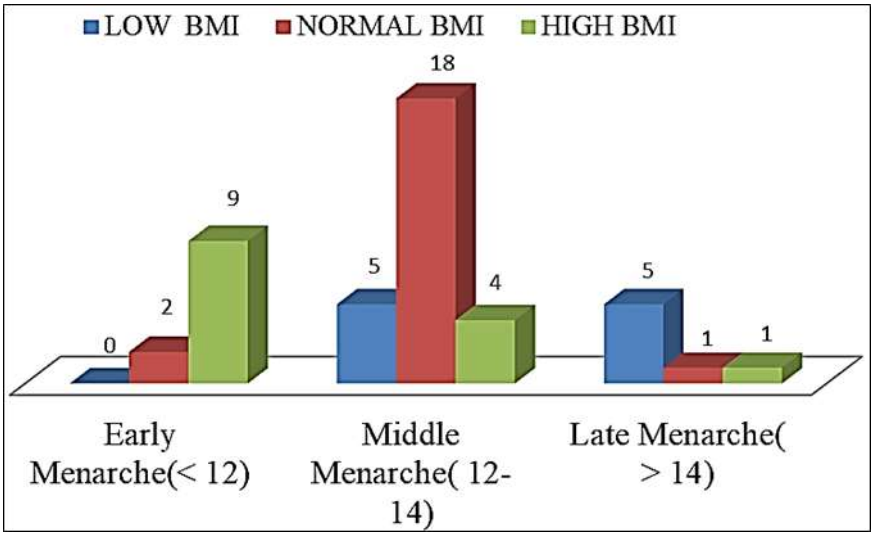
Table 1: Age at menarche and its relationship to body mass index among adolescent girls

Age at Menarche (AaM)	BMI						Total	
	Low (< 18.5)		Normal (18.5-22.9)		High (> 22.9)			
	No.	%	No.	%	No.	%	No.	%
Early Menarche (<12)	0	0.0%	2	9.5%	9	64.3%	11	24.4%
Middle Menarche (12-14)	5	50.0%	18	85.7%	4	28.6%	27	60.0%
Late Menarche (>14)	5	50.0%	1	4.8%	1	7.1%	7	15.6%
Total	10	22.2%	21	46.7%	14	31.1%	45	100.0%

Pearson Chi-Square=28.071, df=4, p value= <0.0001, Highly Significant

1. Bar diagram depicts-BMI wise distribution of adolescent girls in Early Menarche, Middle Menarche and Late Menarche categories



The mean Age at Menarche for High BMI, Low BMI, Normal BMI was 12.07, 14.90, 13.05 respectively. The comparison of the mean Age at Menarche between High BMI, Low BMI, Normal BMI groups indicating a statistically significant difference in the mean Age at menarche between the 3 groups of BMI as determined by one way ANOVA (P value <0.001) (Table 2).

Table 2: Mean Age at menarche and its comparison with different body mass index among adolescent girls

BMI	Age at Menarche Mean ± SD	95% Confidence Interval		F value	P value
		Lower Bound	Upper Bound		
Low	14.90±1.52	13.81	15.99	11.674	.000*
Normal	13.05±1.07	12.56	13.54		
High	12.07±1.77	11.05	13.10		
Total	13.16±1.73	12.64	13.68		

One-way ANOVA applied. P value <0.001 is statistically significant

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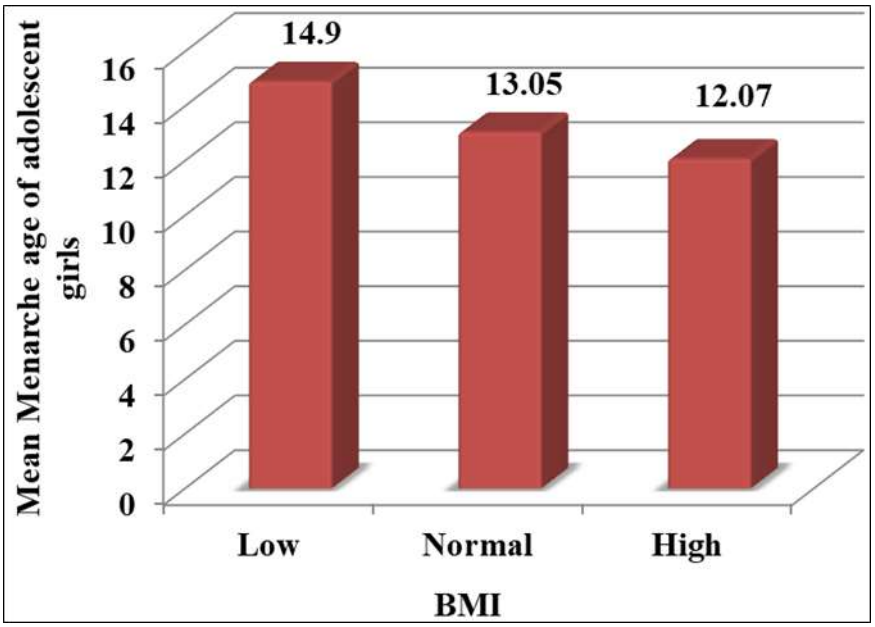
2. Bar diagram depicts- Mean age at Menarche in Low, Normal, High BMI groups of adolescent girls



Discussion

Finding the link between age at Menarche and BMI was one of the primary objectives of this study. In this study, we found a negative relationship between BMI and age at Menarche, which is consistent with previous other studies [7-10]. Our results support the findings of earlier researches, which found a negative relationship between age at Menarche and BMI in later life [14-16, 18-23]. Other researches reveal that greater BMI is actually a result of early menarche, contrary to certain authors' claims that a higher weight gain in children is associated to an earlier onset of puberty [7, 8].

The present study also demonstrates that girls with late menarche had a much lower BMI than girls with early menarche. Data from developing and underdeveloped nations shows that their populations have later menarche than those in developed and wealthy nations, which supports our findings [4].

The findings of other researchers are also consistent with the outcomes of this study. Numerous scholars have noted the connection between the rate of maturation and relative body mass and it has been proven that girls who reach puberty earlier than their counterparts who reach puberty at an average or later age tend to weigh more and be fatter both in childhood and in adulthood [26, 27, 28, 29, 30, 31].

Less physical exercise is another element causing an increase in BMI. In youngsters who participate in athletics, it has been found that intense training reduces body fat and body mass index, delaying the onset of puberty [32]. In addition to affecting the age of puberty, greater body mass index values in childhood-which are mostly the product of a particular lifestyle-also causing higher body mass index values to remain into adulthood. Therefore, the link between age at Menarche and BMI also exist beyond puberty; even in middle and old age, early puberty is linked to greater BMI [33].

Other studies have been published which showed the connection between rising BMI and age at menarche. Findings from the study of Elkhair *et al*. [34] and Dosoky & Amoudi [35] are also consistent with the present study. But according to data compiled by Shaik *et al*. [36], there is no correlation between higher BMI and earlier menarche; but here the authors themselves speculated that this result may be because of limited sample size.

Study limitation: This study documents negative correlation between BMI and age at menarche, due to the study limitations we were not able to identify that either increased BMI of the study subjects was a cause of early menarche, or early menarche was a cause raised BMI. Moreover, we were not able to control other confounding variables such as diet analysis, physical activity and genetics, another major limitation of our study is small sample size. Therefore, further retrospective, prospective, and follow up studies should be carried out with bigger sample size for exploration of this fact, and its underlying patho-physiological mechanisms.

Conclusion

Since there is a negative relationship between BMI and Age at Menarche, we can infer that rising BMI may be a significant contributor to the overall decline in age at Menarche. Therefore, it is advised to raise awareness regarding overweight and its long-term implications on general health and reproductive health of females.

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