ORIGINAL ARTICLE

A Prospective Cross-Sectional Study to Assess the Association of Age of Menarche with Body Mass Index in Adolescent Girls of Urban and Rural Schools of Vijayapura, North Karnataka

Aruna M. Biradar[1], Rajasri G. Yaliwal[1], Shreedevi S. Kori[1], Laxmi S. Sangolli[1], Shobha S. Shirgur[1], Sangamesh S. Mathapati[1]*

[1]*Department of Obstetrics and Gynaecology, Shri. B.M. Patil Medical College Hospital and Research Centre, BLDE (Deemed to be University), Vijayapura-586103(Karnataka) India*

Abstract:

Background: Overweight and increased Body Mass Index (BMI) have been among the major changes in girls and is one of the likely factors affecting the menarche age. *Aim and Objectives:* To determine correlation of age at menarche with BMI in adolescent girls of urban and rural schools of Vijayapura, North Karnataka. *Material and Methods:* A prospective cross-sectional study was conducted by Department of Obstetrics and Gynaecology, Shri. B. M. Patil Medical College Hospital and Research Centre, BLDE (Deemed to be University), between 1st July 2019 to 29th February 2020. Girls below the age of 19 years who had attained menarche were included. Height and weight were measured, and BMI was calculated. Statistical analysis was carried out in SPSS software, version 23.0 and Microsoft 2010. Correlation between age at menarche and BMI was assessed in adolescent girls of urban and rural schools of Vijayapura. *Results:* The mean age at menarche among adolescent girls of urban and rural schools was about 13.6 ± 1.2 years. Among all participants, 60.2% were from urban area and 39.8% were from rural area. The mean age of the menarche was 13.8 ± 1.2 in rural population and 13.5 ± 1.3 in urban population (p value <0.001). Among all study participants, 48.3% had normal BMI; however, 29.8%, 15.4%, 5.8% and 0.7% were underweight, severe underweight, overweight, and obese respectively. Majority of girls had normal BMI in both urban (49.2%) and rural settings (47.0%). *Conclusion:* A statistically significant association ($p< 0.05$) was noticed between onset of menarche and area of residence. There was an inverse correlation between BMI and age at menarche, although this was not statistically significant.

Keywords: Menarche, Body Mass Index, Adolescent Girls, Urban, Rural

Introduction:

One of the most important part of a girl's life is the period of transition from puberty to adolescent, and the marker of this period is the attainment of menarche that is the beginning of the menstrual cycle. It usually occurs between the age group of 10-16 years with a wide variation [1]. The average age of menarche in India is 14.3 years whereas; in other developing countries like Nepal it is 16.2 years; 15.8 years in Bangladesh and 12.8 years in Sri Lanka. In the industrialized or developed countries like Great Britain the age of menarche is 13.3 years, in France 13.05 years and in the United States it is 12.8 years. The normal ovulatory menstrual cycle ranges from 21-35 days and usually lasts from 3 to 5 days, with a range of 2-7 days [1]. Usually, for the first few years of attainment of menarche, the cycles will be irregular and longer in duration [1]. As we know, the puberty is the result of activation of the

complex neuroendocrine regulatory mechanisms which in turn results in a pulsatile release of GnRH secretion [2]. But, still the exact mechanism is not completely known. It has been observed that is a relatively slow or modest increase in the average age of menarche [3-4].

Along with the attainment of menarche, there are marked physical changes such as, the development of breast; pubic hair and height spurt [5-6]. Menarche is associated with literacy, industriali- zation leading to lifestyle changes and also the environmental changes [7]. The average age of menarche is decreasing at a rate of three months every 10 years and is seen in both developed and developing countries, which in turn is attributed to improvement in the socioeconomic status, improved accessibility to health care with an associated increase in intake of energy rich food [8]. Age of menarche has been reported to be associated with growth status as reflected by height, weight and Body Mass Index (BMI) [9]. Some epidemiological studies indicate that the adolescent girls who have reached menarche earlier, gain more weight and height and so have higher BMIs than girls of the same age who have not started menstruating [10]. Consequently, adolescent girls may have a BMI in the range of overweight because of early onset of puberty rather than the accumulation of excess fat [11]. Age at menarche may also represent an important clinical and public health indicator of susceptibility to obesity in adulthood with its attendant morbidity [12].

Overweight and increased BMI have been among the major changes in girls and is one of the likely factors affecting the menarche age [13]. Early menarche is related to increased risk of diseases such as breast cancer, obesity and endometrial cancer[14-16]. The decline in the age of attainment of menarche or attainment of early menarche is known to be prone to risk factors like obesity, metabolic syndrome, cardiovascular disease and breast cancer [17-18]. Early menarche leads to premature closure of the epiphyseal plates and thus leads to shorter final height than other women [19] but have higher risk of cancers related to hormonal changes like breast and endometrial cancer [20-21]. Other factors which influence the age of menarche are economic and social status; public health; location and geographical location; nutrition; exposure to light; mental status; chronic diseases and environmental stimuli [22-24].

Material and Methods:
Study Design:
A prospective cross-sectional study

Study Place:
At schools by Department of Obstetrics and Gynaecology, Shri. B. M. Patil Medical College Hospital and Research Centre, BLDE (Deemed to be University), Vijayapura, Karnataka, India.

Study Duration:
From 1st July 2019 to 29th February 2020

Study Population:
Girls below the age of 19 years who have attained menarche

Ethical Clearance:
Ethical Clearance was obtained from Institutional Ethics Committee, BLDE(DU)/IEC/365-/209-20. A cross-sectional study was conducted among the school girls aged below 19 years and who had attained menarche. After obtaining permission from the school principal with a prior verbal consent from the students and their parents to

them, and the data about height, weight and the age of menarche was recorded for each student. In the present study we measured the height in cm. A measuring chart pasted on to the plain wall was used for this purpose. The students were told to remove the shoes and were asked to stand straight with legs together against the wall with the shoulders, back, head and legs in the same line with the arms to the sides, by keeping a ruler on the head on top. The weight in kilograms was measured using an electronic weighing machine. BMI was calculated with the formula: weight divided by height squared: BMI = mass (kg) / [height (m^2)]. Age of menarche in years was noted by asking the participants when they matured [25]. At the end of collection of data, an awareness programme regarding the menstrual hygiene was conducted for the students.

Study population description:

A total of 10 schools were randomly included for this study with the permission of the Block Education Officer (BEO) Vijayapura. Students who fulfilled the inclusion criteria were included and the rest were excluded. As girls from nearby villages also attended the schools, so they were considered as rural population.

After calculating the BMI, the participants were categorised into - Severe underweight $\leq$ 15; underweight $\leq$ 18.5; normal -18.5-24.9; overweight- 25.0-29.9; Obese $\geq$ 30.

Statistical Analysis:

Analysis was carried out in SPSS software v.23.0 and Microsoft 2010. The data were summarized descriptively. For continuous variables, the summary statistics of Mean ± Standard Deviation (SD) were used. For categorised data, the number and percentage were used in the data summaries and diagrammatic presentation. Chi-square (χ2) test was used for association between two categorical variables. If the p-value was < 0.05, then the results were considered to be statistically significant otherwise it was considered as not statistically significant.

Results:

A total of 1500 girls were included in the study, of which 484 girls were not sure of their age of menarche; so, they were excluded from the study group. The age group of the girls included in the study was below19 years of which the maximum number of girls were in the group of 17-17.9 (31.6%) (Table 1). The average age at menarche in our study was 13.6 ± 1.2 (Table 2). Among all participants, 4.6% had attained menarche before the age of 12 years and those who attained after 16 years were 5.3%. Majority of the study population (90.1%) had attained menarche between 12-16 years (Table 1). Among 1016 girls in the study, 612 (60.2%) were from urban population and 404 (39.8%) were from rural population (Table 2). Among all study participants, 48.3% had normal BMI. However, 29.8%, 15.4%, 5.8% and 0.7% were underweight, severe underweight, over-weight, and obese, respectively (Table 3). In our study, majority of girls had normal BMI in both urban (49.2%) and rural setting (47.0%). Table 6 represents the BMI distribution according to area of residence. No statistically significant association (p = 0.165) was noticed between BMI and area of residence. In present study, we determined the correlation of age of menarche with BMI and hip to waist ratio in adolescent girls of urban and rural schools. The mean age of the menarche was 13.8 ± 1.2 in rural population and 13.5 ± 1.3 in urban

population. (Table 4) There was a significant association (p<0.001) between the onset of menarche and area of residence, indicating that area of residence is dependent on the onset of menarche. However, there was no significant association (p = 0.119) between BMI of study participants and age of menarche (Table 4). A negative correlation was noticed between age of menarche and BMI (Table 4).

Table 1: Age Distribution of the Study Participants		
Variable	**Number of participants (n=1016)**	**Percentage**
Age (Years)		
12.0-12.9	11	1.1
13.0-13.9	52	5.1
14.0-14.9	141	13.9
15.0-15.9	182	17.9
16.0-16.9	138	13.6
17.0-17.9	321	31.6
18.0-18.9	156	15.4
19.0-19.9	12	1.2
Age of Menarche		
7.0-7.9	1	0.1
8.0-8.9	0	0
9.0-9.9	0	0
10.0-10.9	5	0.5
11.0-11.9	41	4
12.0-12.9	143	14.1
13.0-13.9	255	25.1
14.0-14.9	321	31.6
15.0-15.9	196	19.3
16.0-16.9	51	5.0
17.0-17.9	1	0.1
18.0-18.9	2	0.2

Table 2: Descriptive of the Study Participants

Parameters	Frequency	Percentage
Residential Area		
Urban	612	60.2
Rural	404	39.8
BMI Grading		
Severe Underweight (15<BMI<16)	156	15.4
Underweight (16≤BMI<18.5)	303	29.8
Normal (18.5≤BMI<25)	491	48.3
Overweight (25≤BMI<30)	59	5.8
Obese (30≤BMI)	7	0.7
Age of Menarche (Mean±SD)	13.6±1.2	

Table 3: BMI Distribution by Place of Residence

BMI Grading	Urban		Rural		*P*
	N	%	N	%	
Severe Underweight (15<BMI<16)	96	15.7	60	14.9	
Underweight (16≤BMI<18.5)	172	28.1	131	32.4	
Normal (18.5≤BMI<25)	301	49.2	190	47.0	0.165
Overweight (25≤BMI<30)	36	5.9	23	5.7	
Obese (30≤BMI)	7	1.1	0	0.0	
Total	612	100.0	404	100.0	
Age of Menarche (Mean±SD)	13.8 ± 1.2		13.5 ± 1.3		<0.001

Table 4: BMI by Age of Menarche

BMI	Age of Menarche	P
	Mean ± SD	
Underweight	13.7 ± 1.3	
Normal	13.6 ± 1.3	
Overweight	13.4 ± 1.3	0.119
Obese	13.9 ± 1.6	
Total	13.6 ± 1.3	

Discussion:

In the present study, we investigated the correlation of age of menarche with BMI in adolescent girls of urban and rural schools in northern Karnataka. The age group of the girls who attained menarche below 19 years were included in the study, of which the maximum number of girls were in the group of 17-17.9 (31.6%).The average age of menarche in our study was 13.6 ± 1.2. In our study, the average age of menarche in urban area girls was 13.5 ± 1.3 years and rural area girls was 13.8 ± 1.2 years. In a study conducted at Mangalore, Karnataka, the mean age of the menarche was 12.34 ± 1.35 years which is lower than the result of the current study [27]. In a cross-sectional study, conducted in south Indian population showed that onset of age at menarche was about 13 ± 1.1 years, which is slightly lower than our study findings [1]. Another study conducted in northern India showed an average age of menarche was 12-13.4 years [25]. In a cohort study conducted in Tehran in 2014, the average age at menarche was 13.06 ± 1.24 years which is similar to the results of the current study [27]. This is similar to the global figure of 14 years

[28]. In another study of Saudi Arabia in 2014, the mean age of the menarche was 11.5 ± 1.48 which is lower than our study findings [29]. The concern about the age at menarche in different societies is its decreasing trend as a risk factor for breast cancer and cardiovascular disease [29-30].

Among 1016 girls in the study, 612 (60.2%) were from urban population and 404 (39.8%) were from rural population. Among all study participants, 48.3% had normal BMI; however, 29.8%, 15.4%, 5.8% and 0.7% were underweight, severe underweight, overweight, and obese, respectively. A study conducted in Tehran reported that among the participants, 77.7% had normal BMI; however, 4.3%, 10.4%, and 7.7% were underweight, over-weight, and obese, respectively which is in consistent to our study findings [27]. In the present study, a majority of girls had normal BMI in both urban (49.2%) and rural setting (47.0%). In contrast to our findings, a study conducted in Indonesia identified the differences in overweight and obesity risk factors in rural and urban areas [34]. Those living in urban areas had a higher

percentage of overweight and obesity than rural area. No statistically significant association (p = 0.165) was noticed in our study between BMI and area of residence. This may be due to the fact that the schools visited in the urban area were Government aided schools which catered to girls from low socio-economic status.

In present study, we aimed to assess the association of age of menarche with BMI in adolescent girls of urban and rural schools. The mean age of the menarche was 13.8 ± 1.2 in rural population and 13.5 ± 1.3 in urban population. There was a significant association (p<0.01) between the onset of menarche and the area of residence, indicating that change in area of residence is dependent on the onset of menarche. Similar to our study findings a study done at Uttar Pradesh, India observed that mean age at menarche was significantly higher among rural population (12.51 ± 1.55) than urban population (12.37 ± 1.46) [35]. A multicentric study conducted suggested that the menarcheal age was significantly associated (p<0.01) with the area of residence, geographic region, linguistic groups, educational attainment, wealth status, caste and religious affiliations among Indian women [36]. However, there was no significant association (p = 0.119) between BMI of study participants and age of menarche. In a cross-sectional study conducted on 170 adolescent girls aged between 18 and 25 years in Kerala, India it was observed that there was no significant correlation between age at menarche, BMI, and waist–hip ratio [28]. A negative correlation was noticed between age of menarche and BMI. (r = - 0.034), showing that increase in BMI was inversely correlated to onset of menarche. In a descriptive cross-sectional study that was conducted in Nigeria among female adolescent girls in three secondary schools showed that age at menarche and BMI were inversely correlated to each other [37]. No significant differences in the age at menarche and BMI were observed in the present study. There was an inverse correlation between BMI and age at menarche, although this was not statistically significant.

Conclusion:

The mean age at menarche among adolescent girls of urban and rural schools was 13.6 ± 1.2 years. A majority of the study population (90.1%) had attained menarche between 12-16 years. Majority of girls had normal BMI in both urban and rural setting. No statistically significant association was found between BMI and area of residence.

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Author for Correspondence:
Dr. Aruna M. Biradar, Department of Obstetrics and Gynaecology, Shri. B.M. Patil Medical College Hospital and Research Centre, BLDE (Deemed to be) University, Vijayapura- 586103, Karnataka Email: aruna.biradar@bldedu.ac.in Cell:8197191472