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A Cross-Sectional Study of Bio-Social factors affecting the age of menarche among the Adolescent girls of Gwalior, Madhya Pradesh, India.

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ABSTRACT

Background:
The age at which first menstrual bleeding occurs in females, i.e. menarche is viewed as an excellent physiological marker of adolescent maturation. The aim of this study is to determine the mean age at menarche among girl students and to assess the influence of some Bio-Social parameters affecting it.

Methods:
A cross-sectional study was conducted among 192 adolescent girls in the age group of 9 to 16 years, randomly selected from 2urban & 2peri urban rural government girls' schools of Gwalior.

Results:
Mean age at menarche was found to be 12.94(±1.04). The most frequent age of menarche was among 13 years 85(44.3%) had its onset. The lowest age was 9 years and the highest was 16 years. The majority of girls who attained late menarche belonged to social class IV. Girls from high income earning families, high BMI experienced menarche earlier than those who were born to or lived with lower income earners or low BMI. It was also found to be significantly associated with exercise and living status. When correlated between the age of menarche and BMI, it was found a significant positive correlation meaning High BMI increases the age of menarche.

Conclusion:
There seems to be the definite association of various factors which modify the age at menarche like socio-economic status, body mass index, place of residence, and physical activities. Low socioeconomic status has an impact on the age of attainment of menarche, BMI and physical activities also have much effect on age of attainment of menarche.

Key Words: Menarche age, Adolescent girls, Body mass index, Socio-economic status, Urban-peri urban.

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INTRODUCTION

Menstruation is considered a sign of sexual health during the adolescence and fertility age of women. Historically, it has been celebrated as the gift of puberty in many human societies. Puberty is the result of hormonal changes in the hypothalamus-pituitary-gonad axis. This hormone decreases and remains minimal up to adolescence when the occurrence of first menstruation marks its rapid increase (Grumbach, 2002)[1]

Menarche is an important milestone in the development of female adolescents unlike other pubertal changes that are gradual & continuous, menarche is a distinct event with a sudden and dramatic onset. It is considered a distinct benchmark for sexual maturation. It is also considered an indicator of the quality of life of a population since a number of biological & socio-economic factors influence it. (Prado et al 1995)[2]. The age at menarche (first menstruation) is clinically valuable since it forms a basis for diagnosing delayed puberty and pathologic and hormonal disorders. The age of first menstruation is different among various ethnicities. In the United States, the average age at menarche has shifted from 12.75 to 12.54 years over a period of 25 years. The age at menarche is reportedly 12.9 years in Europe, 12.5-12.9 in different regions of India, and 13.3 years in Africa (Anderson et al., 2003; Bektas, 2008; Ogata, 1979; Wyshak & Frisch) [3,4,5,6].

It appears that the level of development of a society is inversely related to the age of first menstruation which is higher in underdeveloped regions. An example is illustrated by girls from the very poor Bundi region of New Guinea whose average age of first menstruation is 18.8 years, comparable to Europeans of one century ago (Cagas & Riley, 1970)[7]. Variations in the timing of puberty (onset/timing of menarche) are marked between well and underprivileged populations with a marked delay in menarche reported in underprivileged girls (Thomas F et al 2001)[8]. These data highlight the role of socioeconomic and nutritional conditions in the timing of puberty. A worldwide phenomenon of the secular trend of advancing age at menarche is reported by Low et al (1982)[9]. General improvements in Nutrition and health have been suggested to explain the downward trend Wyshak G (1982)[10], Chowdhury S (2000)[11]. Association between nutritional status & onset of menarche has been well documental Chowdhury S (2000)[11], Osteria TS (1983)[12]. In general, an adolescent who are taller and heavier with a greater body fat mass tend to reach menarche at a younger age. Chowdhury S [11], Osteria TS[12]. Frisch and Revelle (1970[13] suggested that age at menarche might be related to attainment of appropriate weight for reproduction rather than appropriate skeletal status. Researchers have reported genetic factors as the most influential factor on the time of first menses (Chumlea et al., 2003)[14].

Other factors include area of residence (Uche-Nwachi et al., 2007)[15] nutritional pattern, body mass index, size of a newborn at birth (Tanner & Davies, 1985)[16], mental, economic, and social factors. Some studies have been conducted in India about the age of first menstruation; however, considering the fact that this variable changes with changes in society and also the fact that age at menarche is an indicator of growth in the health of people in a society. The aim & objective of the present work was to find the age of menarche in school girls and evaluate the factors influencing the age of menarche in Gwalior North Central Area of Madhya Pradesh India.

METHODOLOGY

Place of study: Department of Community Medicine, GR Medical College, Gwalior, MP, India.

Study design: This is a cross-sectional observational study conducted in four schools of Urban & peri urban areas of Gwalior city, MP, India.

Study period: Study was conducted during the period of Oct 2021 to Nov 2021.

Sample: The study group included 200 school girls of age 09 to 18 years randomly and out of which eight was not completed questionnaire so finally study sample was 192 adolescent girls in the age group of 9-18 years.

Sampling technique: The schools were selected by purposive sampling. After taking permission from the principal of the school; teachers and girl students were explained about the importance of the study. Written informed consent explaining the nature and confidentiality of the study to be read and signed by their parents was given.

Inclusion criteria: Only those girls whose parents gave consent were included in this study.

Exclusion Criteria: Girls suffering from chronic illness or who were on prolonged medication were excluded.

Tools and techniques of data collection: A self-formulated questionnaire was administered to those students who gave consent for the study. girls were examined thoroughly to rule out any systemic diseases, their weight, height, exact date of attainment of menarche, was recorded the girls were interviewed privately and other aspects like socioeconomic status, parents' income and other details was collected in a pre-designed Performa which was taken home and filled with parental assistance. The girls were grouped in different socio-economic status category according to their parents' income and described by Agarwal AK (2008)[17] Social classification based on per capita income unbiased for urban as well as rural areas. The body mass index was calculated using the equation BMI= Weight (kg)/Height (m^2).

Statistical analysis: Statistical analysis was done using MS Excel spreadsheet. Analysis of variance (ANOVA) and 't' test was applied to see the significance of anthropometric measures and other socio-demographical variables on menarcheal age. Statistical significance was assessed at $P < 0.05$ (95% confidence interval). Pearson's correlation was used to see the correlation between anthropometric measurements.

RESULTS

Table I shows the frequency distribution of girls by starting their Ist menstruation. The most frequent age of menarche is 13 years when 85 cases (44.3%) had their onset. The lowest age of menarche was found to be 9 years & the highest age was 16 years, only one case had its onset at 9 years and age advances number of cases increases and it gets maximum at 13 years and thereafter the onset gets decreases and at 16 years only 2 cases and from 16 years onward no case of onset was found. The mean age of the girls was 12.94(95%; CI 12.79, 13.09) ± 1.04 with Median (12.8) (Fig1).

Table1. Distribution of students according to their age of menarche (n=192)

Age of menarche (yrs.)	No. of girls (%)	Mean Age [SD) and Median age of Menarche (Yrs.)
9-10	01 (1%)	12.94 [± 1.04] (95%CI 12.79, 13.09) [12.8 Yrs.]
10-11	04(2%)	
11-12	13(7%)	
12-13	44(23%)	
13-14	85(44%)	
14-15	41(21%)	
15-16	02(1%)	
≥16	02(1%)	

Figure 1 Distribution of girls by menarche age

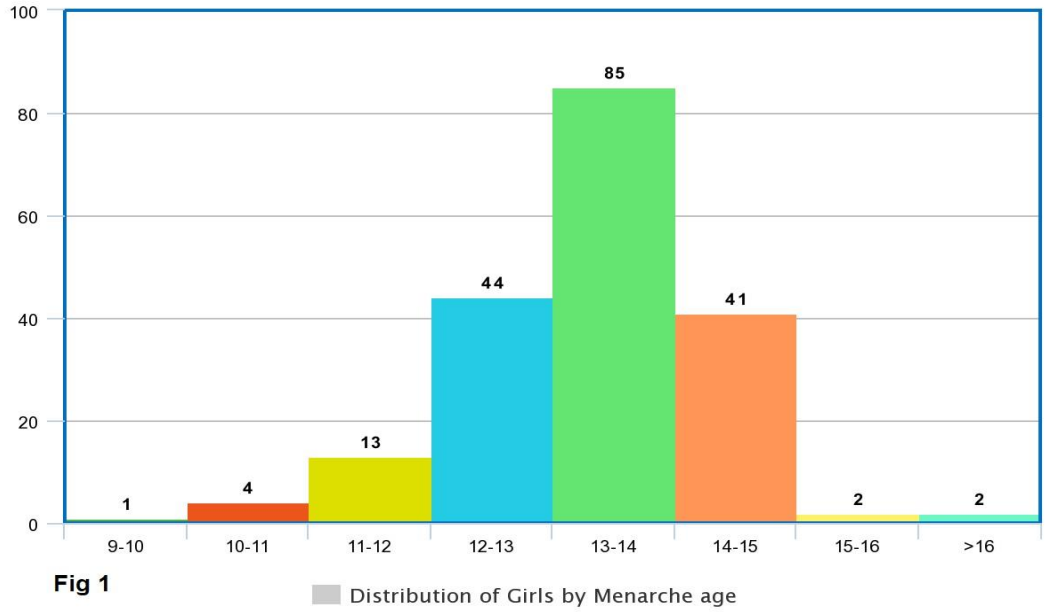

Fig 1

Table2 shows the mean age at menarche and some modifying Bio social factors. Socio-economic status is assessed according to Agarwal AK social classification based on per capita income applied equally both for urban as well asperi urban areas. To know the relationship between socio-economic status and age at menarche the study group was categorized according to various socio-economic status and correlated with the corresponding mean age of menarche. As shown in table 2 Mean age of menarche was lowest (12.33 ±0.97) among the upper class while the highest 13.74(±1.16) among lower class. Similarly in the present study cases are divided into four groups according to their body mass index. It shows earlier mean age at menarche in obese (12.62±0.9) and later in underweight i.e. (13.3(±0.75) and in normal is (12.97(±1.01)). It was observed that in the girls of an urban area the mean age at menarche is (12.82 ±1.11)) as compared to peri-urban area where it was (13.221.08). The majority of girls 130(72.9%) were belonged to vegetarian and had higher mean age (13.1±1.04) in comparison to non-vegetarian (12.75±1.22) and this difference was found significant statistically ($p<0.05$). Sports/exercise and TV seeing also influence the age of menarche, in our study, those girls who had more than 7 hours sports / exercise were started late menstruation had mean age (13.22±1.22) in comparison to less than 7-hour sports / physical exercise (12.74±1.14). The majority of girls 110 (57.5%) were seeing TV more than 10 hours a week and had lower age of menarche *12.87*(±1.26). Therefore, socio-economic status, body mass index, area of residence, and sedentary activities i.e., more TV seeing and less sports/ exercise significantly ($P<0.05$) influence the mean age at menarche. Co-relation between Social status, BMI, area of residence and physical activities (i.e., sports, exercise), and age of monarchy attainment was also statistically significant and the value of R^2 had a negative correlation, which means that high BMI scores, high social status go with lower age of menarche attainment (and vice versa), while High physical activities and peri urban areas significantly extend the age of menarche as shown inTable2.

Table2. Association and Correlation of variables with mean age of menarche

Variables		No. of Girls (%)	Average age of menarche ±SD	Correlation r^2
Socio Economic Status [Per capita income]	High>18000	42 (23.0)	12.33 (±0.97)	-0.76 [Strong Negative correlation]
	Upper middle12001-18000	61(31.8)	12.88(±1.11)	
	Lower middle6001-12000	51(26.5)	13.27(±1.06)	
	Lower lower<=6000	38 (19.8)	13.74(±1.16)	
	Analysis of Variance (ANOVA) p value=0.001**			
Body Mass Index [BMI]	Obese (≥30)	26(13.5)	12.62(±0.9)	-0.55 [Moderate Negative Correlation]
	Overweight (25-30)	34(17.7)	12.78(±0.8)	
	Normal (18.5-24.9)	111(57.8)	12.97(±1.01)	
	Underweight (<18.5)	21(10.9)	13.3(±0.75)	
	Analysis of Variance (ANOVA) p value =0.058*			
Type of diet	vegetarian	130(72.9)	13.1(±1.04)	0.12 [Not significant correlation
	non-veg	44(22.9)	12.75(±1.22)	
	Veg + egg	18(4.1)	12.85(±1.11)	
	Analysis of Variance (ANOVA) p value =0.156			
exercise(hrs./ wk.)	≤7	87(45.3)	12.74(±1.14)	0.59 [Moderate positive correlation]
	>7	105(54.7)	13.22(±1.22)	
	t test p value = 0.03*			
TV seeing (hrs/wk)	≤10	82(42.7)	13.2(±1.19)	0.32 [Weak Correlation]
	>10	110(57.3)	12.87(±1.26)	
	t test p value = 0.06			
Residence	Urban	131	12.82 (±1.11)	0.61 [Moderate Positive correlation]
	Rural	61	13.22(1.08)	
	t test p value = 0.02*			

**Significant Statistically **Highly Significant Statistically*

DISCUSSION

Numerous factors act in combination, including genetic influences, socio-economic conditions, general health and well-being, nutritional status, and some types of exercise, to determine the age of menarche. Therefore, the finding may be attributed due to differences in socioeconomic status environment condition, body mass index, and participants' sports/exercise activities. In the present study, findings are consistent between 9 to 16 years in which maximum incidence is seen between 13 years when 85(44.3%) girls had its menarche. Menarche age is the most widely used indicator of sexual maturation and is influenced by many factors such as genetic and environmental conditions, family size, body mass index, SES, and level of education (Thomas et al[8], Chumela et al[14]), The mean menarche age in the present study is 12.94(95%CI; 12.79; 13.09) ± 1.04) and Median [12.8). The age at menarche in our study was lower compared to underdeveloped countries (mostly in Africa) such as Algeria (14.3 years), Haiti (13.98 years), Bangladesh (15.8%), Ghana (13.83 years), Tanzania (14 years), Congo (15.21 years), Nigeria (15.37 years), Yemen (14.4 years), and Senegal (16.1 years). On the other hand, the average age at menarche was higher compared to more developed countries such as Greece (12 years), the United States (12.8 years), and Italy (12.2 years) (Thomas et al., 2001) and essentially similar to other studies of Omidvar, S et.al[1]., Cakir M et al.[19], and Singh A et. al[20].

In our study, the relationship between social class and age of menarche was significant P<0.005 (HS). As the socio-economic status increases, the age of menarche decreases. Out of the 5 girls who attained menarche at 10 or below, belonged to the Upper Social Class (I). On the contrary, a girl who attained late menarche i.e at 16 yrs belonged to a lower social class (IV). These results correlate well with the study done by Deardorff J et al (2015)[21] and the study were carried out in Lucknow by Tabassum Khatoon et al in Lucknow (2011)[22]. Nutritional status has an important role in the attainment of menarche, as nutritional status improves, the age at menarche is lowered. It was seen that as the BMI increased, the number of girls attaining menarche also increased. This trend was statistically significant (p<0.05). In our study majority of girls who attained menarche by 13 years had normal BMI, underweight is usually associated with a delay in the age of menarche. There was a strong inverse relationship between BMI and age at menarche.

The study showed that the average age at menarche differed among the urban area and this data is in parallel to the study conducted in Spain that show that the age of first menstruation is lower in large cities compared to small cities (Cabanes et al., 2009)[23] and the one in Iran that confirms that the age at menarche in urban areas is lower than the rural (Delavar & Hajian-Tilaki, 2008)[24] , while it was contrasted with the other studies of Iran[25], Bangladesh[26] and in Lucknow of India[22] where the figure of urban and rural areas are practically identical and therefore the place of residence does not seem to affect the age at menarche.

With regard to physical activity, however, research indicates that activity per se has little influence on leptin levels (Zimmet et al.,1996)[27], thus the later menarche among athletes is mainly due to the reduction in adiposity. The reduction in adiposity through participating in physical activity results in a suppression of reproduction. In our study on average, girls who are competing in sports activities / exercise more undergo extend of menarche, than girls who become less or not competitive in sports / physical activities, which makes the statistically significant correlation between physical activity and age at menarche practically meaningful and similar to study of E Peja et al (2016)[2] and Biro et al[29] Similar leisure activity like seeing more TV influence the menarche age. In our study, those girls seeing TV more than 10 hours a week had more age of menarche but this difference was not significant and had a weak positive correlation. Specific to a leisure activity, the finding of this study is consistent with other studies Ayele E, et al (2013)30, Freedman DS, et al (2003)31 and Ketheleen M et al (2003)32.

CONCLUSION

The pattern of age at menarche and the pattern of distribution of body mass index is shifting down, consistent with developed countries during the last decades. Thus, the trend of lowering the age at menarche is well marked as we moved from lower and middle to higher socioeconomic stratum. Body mass index is also said to affect the age of menarche. In cases of better nutrition and more weight (Obese) the mean age at menarche is earlier as compared to cases of under nutrition and less weight. The mean age at menarche in urban areas was not practically identical with in rural areas, therefore place of residence also seem to affect the mean age at menarche. Despite these interesting findings, a major limitation of this study may affect its broad applicability. It was undertaken among female adolescent students of the urban and peri-urban school campus for development Studies due to limited resources. The results of this study can therefore not be generalized for all females. However, since all respondents in this study had already experienced menarche, the recall technique was the only feasible method. In the present study, there seems to be a definite association between Bio-Social factors and mean age at menarche. This study has observed a sharp decline in the menarche age of women in India. This decline is directly associated with puberty ahead of schedule in a large section of female children experiencing early maturity and growing up earlier than scheduled and its effects on reproductive health and well-being of women have become a matter of concern. Therefore, we recommend further qualitative research (e.g., interviews, focus group discussions, or use

of other participatory methods) to include those perspectives about the trend of menarche.

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