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AGE AT MENARCHE, MENSTRUAL PATTERNS, BODY SIZE AND NUTRITIONAL STATUS OF SEMI-RURAL ADOLESCENT GIRLS OF YAMUNANAGAR, HARYANA

Shruti Chopra and Krishan Sharma

The present study analyzes age at menarche, menstrual characteristics, body traits and nutritional status on the basis of a cross-sectional data on120 semi-rural adolescent girls aged 13 to 18 year from Yamunanagar, Haryana. On the basis of retrospective method, mean age at menarche was 13.4 years with a standard deviation of 0.99 years. The menstrual flow period continued on an average for 4.43±1.4 days and mean interval between cycles was 27.88± 1.21days. F-ratios based on one-way ANOVA were significant for height, weight and age at menarche showing significant age differences among groups and not for menstrual flow days and mean interval between menstrual periods. Nutritional status was tested on the basis of body mass index (BMI) contrasted with CDC growth data percentiles and subjects were grouped into various BMI categories. One-way ANOVA analysis revealed that girls having BMI higher than 50th percentile of the CDC 2000 growth norms had lower age at menarche than those having BMI less than 50th percentile. The post-hoc Scheffe's test to study multiple comparisons showed significant results for BMI only and insignificant for age at menarche. Family income was not significantly correlated with body height, weight and age at menarche in this sample.

Keywords: Menarche, Height, Weight, BMI, Menstrual characteristics, Adolescence.

Introduction

"No longer children, not yet adults-adolescents are at a stage of rapid development when they acquire new capacities and are faced with many new situations. As adolescents face the challenges of the second decade of life, a little help can go a long way in channelling their energy towards positive and productive paths. Neglect of adolescents can lead to problems, both immediately and in the years ahead. One of the most important commitments a country can make for future economic, social and political progress and stability is to address the health and development needs of its adolescents" (WHO 2001: 212-213).

The 'Adolescence' is considered by many as the intermediary stage of growth between childhood and adulthood representing a period of time during which a person is subjected to an array of biological transformations and runs into a number of emotional tribulations. The ages, which are termed to be part of adolescence extends from the preteens to nineteen years. According to the World Health Organization (WHO 1999), adolescence encompasses the epoch of life between 10 and 20 years of age. The notion of 'adolescence' as a defined and discrete life phase is a relatively new concept. It is related to earlier sexual maturity, delayed

Address for communication: **Shruti Chopra and Krishan Sharma,** Department of Anthropology, Panjab University, Chandigarh

marriage, changing constructions of gender, and a need for greater preparation for the social and economic complexities of adulthood in the contemporary world (UNFPA 1998). Age at menarche is an important indicator of physiological development in female and, consequently, it has been extensively studied in many populations as well as many ethnic groups (Eveleth and Tanner 1976). Average age at menarche finds application in a variety of contexts. It is an excellent overall comparative indicator of population health, timing of maturation and nutritional status (Tanner and Eveleth 1975). Age at menarche has been extensively studied by various researchers in India and abroad. Menarche is known to be influenced by a variety of environmental factors Eveleth and Tanner (1976), Danker and Hopfe (1986), Ulijaszek, Evans and Miller (1991). Malina (1974) reported that adolescence begins with acceleration in rate of growth prior to the attainment of sexual maturity, and then merges into a decelerative phase, terminating with the cessation of statural growth. The age at menarche has been a useful device an index of maturation of a girl and her physiological development. It was reported by several authors that menarche is delayed in populations with low nutritional intake, in rural areas ad in populations with low economic status (Eveleth and Tanner, 1976; Susanne, 1980). Menarche has been studied extensively in relation to environment (Artaria and Henneberg 2000; and Balquis and Madhavilatha 2003), nutrition (Bojlen and Bentzon 1971; Chowdhury *et al.* 2000), and high altitude (Malik and Hauspie 1986 and Sharma 1990).

Menarche is also related with ecological and socio-economic factors (Mierzejewek, 1970), urban and rural conditions (Malina *et al.* 1977; Shukla *et al.* 1994 and Marridan *et al.*, 2000), seasonal variation (Bojlen and Bentzon 1971; Valenzula *et al.* 1991). Socio-economic status and nutrition seems to be dominant factors influencing the age of menarche (Bojlen and Bentzon 1968). The girls belonging to the low socio-economic strata generally attain age at menarche significantly later than those of higher strata (Eveleth and Tanner, 1990) also the relationship between Age at menarche and Socio-economic status have been investigated in India (ICMR: 1972). Several others workers who have made valuable contribution to understand age at menarche in different regions of India are Basu and Gupta (1979), Roberts *et al.*, (1977). Sharma (1990) studied age at menarche in North-west Indian females. Other studies are done on Assamese girls (Srivastava and Goswami, 1968), Andhra Pradesh girls (Bilquis and Madhavilatha, 2003), North-west Indian girls (Sharma, 1990), Maharastrian girls (Bhattacharya al., 1991), Uttar Pradesh girls (Singh and Shukla, 1992), Jammu girls (Gupta and Jaiswal, 1992), West Bengal girls (Sen, 1994), Karnatka girls (Reddy and Gangadhar , 2004). The study was conducted with the following major aims and objectives: (1) To find mean age at menarche; (2) To study age changes in body height and weight after attaining menarche status through various adolescent age groups; (3) to study association of BMI with age at menarche; 4) to study association of nutritional status with age at menarche.

Materials and Methods

The present study was carried out in Bilaspur Subdivision on two Developmental Blocks: Bilaspur and Chhachhrauli of the Yamunanagar District, Haryana. The latitude and longitude of Yamunanagar is 30° 6' 0" N / 77° 17' 0" E. Bilaspur town, named after the writer of the Epic *Mahabharata - Maharishi Ved Vyas*, is a historical place. It is believed that there was an Ashram of Ved Vyas on the bank of a pond situated here. There is a statue of *Uma Mahadev* made in 9th-10th century, and statue of *Ganesha* made in 11th-12th century. It is a Sub Divisional Headquarter. As of 2001 India census, Bilaspur had a population of 9620. Males constitute 53% of the population and females 47%. Bilaspur has an average literacy rate of 65%, higher than the national average of 59.5%; with male literacy of 69% and female literacy of 61%. 14% of the population is under 6 years of age. The main tehsil of Chhachhrauli is situated in north east and 11 km from Jagadhri. In the past, it was the capital of Kalsia state. It was created by Raja Gurbaksh Singh in 1763. Today *'Ravi Mahal'*, *Ghantaghar*, *Janak Niwas* and the fort are some monumental places. There is also a *Sainik Parivar Bhawan* and *Bal-kunj* social welfare institution at Chhachhrauli.

The data was collected on cross-sectional sample of 120 adolescent girls ranging in age from 13 to 18 years. None of the respondents was illiterate since most of them were school going girls. Apart from the school girls, few data was also collected from the girls in their households in Chhachhrauli. Height and weight measurement were taken methods given by (1981). Menstruation data was collected using interview schedule. Age at menarche was recorded using 'Method of Recall or retrospective method' Furthermore the data was subjected to statistical analysis to test level of significance using statistical package SPSS 20. One way Anova was applied for different age groups with different variables. Furthermore, post hoc Scheffe's test was applied in order to find relation of selected BMI Categories based on CDC growth norms (Kuczmarski et al. 2002) with BMI of adolescent girls and age at menarche respectively.

Results

In the present study, only menstruating girls were taken in consideration. Age was converted to decimal age. Table 1 shows mean and standard deviation of various parameters i.e. height, weight, BMI, age at menarche, days of interval of menstrual flow per cycle and interval of menstrual cycle. It is observed that the mean height shows a varied trend as it is highest among the girls at the age group of 14 years i.e. 156.42cm and lowest among the age group of 13 years i.e. 149.12 cm. Except the height gain in girls of 15 years of age the mean height shows increasing trend. In case of weight, the girls in the age group of 16 years shown maximum mean weight and BMI also observed to be highest in age group 18 years i.e. 18.7965 kg/m^2 while is minimum in age group 13 years i.e.17.2627 kg/m^2

Increase in mean age at menarche was observed from age group 13 to 18 years. The duration of menstrual cycle showed almost a decreasing trend. Mean age of menarche of the total sample was 13.40 year, mean duration of menstrual flow was 4.43 days, and mean interval between menstrual cycles was 27.88 days. One-way ANOVA which tests the level of significance between various age groups was significant for height, weight, and age at menarche. On the other hand, there was no significant age difference for menstrual cycle duration of menstrual flow and interval of menstrual cycle among the adolescent girls in the age group ranging from 13-18 years. Thus, the parameters of height, weight and age at menarche demonstrated a significant age differences.

TABLE 1: MEAN, STANDARD DEVIATION AND F-RATIOS OF DIFFERENT AGE GROUPS

Age in years N=120

Variables	*13 (20)*	*14 (20)*	*15 (20)*	*16 (20)*	*17 (20)*	*18 (20)*	*Total (120)*	*p-value*
Decimal Age								0.00**
Mean	13.369	14.311	15.225	16.434	17.308	18.425	15.85	
S.D.	.2794	.3045	.3089	.3198	.2786	.3149	1.76	
Height*								0.00**
Mean	148.82	155.18	155.44	156.32	155.8	154.74	154.39	
S.D.	4.675	3.388	4.563	5.965	4.91	6.084	5.53	
Weight*								0.03**
Mean	37.65	44.66	43.2000	45.29	43.47	43.84	43.02	
S.D.	6.243	7.611	6.99	4.204	5.571	5.312	6.47	
BMI*								0.31
Mean	16.95	18.76	17.88	18.53	17.90	18.28	18.05	
S.D.	2.25	2.74	2.54	1.51	2.27	1.91	2.26	
Age at menarche*								0.00**
Mean	12.50	13.10	13.30	13.25	13.80	14.45	13.4	
S.D.	.688	.72	.923	.85	.695	.887	0.99	
Duration of MF*								0.86
Mean	4.3	4.85	4.3	4.6	4.2	4.3	4.38	
S.D.	1.08	1.53	1.26	1.50	1.54	1.49	1.35	
Interval*								0.25
Mean	26.32	26.4	28.00	28.15	28.25	28.25	27.8	
S.D.	6.32	6.32	1.45	1.18	.91	.91	1.20	

*height in cm, weight in kg, BMI in kg/m^2, age at menarche in years, duration of menstrual flow and interval of menstrual cycle in days; ***The mean difference is significant at the 0.05 level.

Table 2 shows the mean, standard deviation and F-ratio for height, weight and BMI with respect to age at menarche. The results show differences for body height

in various age groups with respect to age at menarche, while for body weight there were significant differences, and for BMI too F-ratio reached near the critical level. Mean height, weight and BMI was highest among girls who had late age at menarche i.e. 16 years, 156.8±0.28 cm and 49±1.41 kg and 19.93±0.64 kg/m^2 respectively.

TABLE 2: MEAN, STANDARD DEVIATION AND F-VALUE OF HEIGHT, WEIGHT AND BMI W.R.T AGE AT MENARCHE OF ADOLESCENT GIRLS

Variables	*Age at Menarche*	*N*	*Mean*	*Std. Deviation*	*F*	*p-value*
Height	11.00	2	148.75	4.59	1.317	.262
	12.00	21	152.51	6.50		
	13.00	38	153.98	5.80		
	14.00	45	155.55	5.29		
	15.00	11	154.52	6.05		
	16.00	2	156.80	.28		
	Total	119	154.32	5.77		
Weight	11.00	2	37.80	11.03	2.775	.021*
	12.00	21	41.75	6.35		
	13.00	38	40.42	6.79		
	14.00	45	45.09	6.50		
	15.00	11	42.50	6.32		
	16.00	2	49.00	1.41		
	Total	119	42.71	6.83		
BMI	11.00	2	16.95	3.93	2.232	.05*
	12.00	21	17.85	1.66		
	13.00	38	17.01	2.53		
	14.00	45	18.63	2.48		
	15.00	11	17.80	2.52		
	16.00	2	19.93	.647		
	Total	119	17.89	2.45		

Table 3 depicts Pearson correlation among height, weight, BMI, age at menarche and family income of adolescent girls. It was concluded from the table that height and weight were positively correlated to each other and age at menarche, while weight showed positive correlation with BMI. On the other hand, none of the variables showed significant correlation with family income.

The results of analysis of BMI with respect to selected percentile categories of BMI as per CDC 2000 growth norms. (Kuczmarski *et al.* 2002) and menarcheal data with respect to selected BMI categories given in Table 4. Girls with BMI more than 50th percentile had mean menarcheal age 12.88 ± 0.781 year, while girls

having less than 5th percentile had higher mean age at menarche. One-way ANOVA p-value was significant for BMI and not significant for age at menarche

TABLE 3: PEARSON CORRELATION BETWEEN DIFFERENT VARIABLES

Variables		*height*	*Weight*	*Age at menarche*	*Family Income*	*BMI*
Height	Pearson Correlation	1	.527**	.199*	.122	.078
	Sig. (2-tailed)		.000	.030	.183	.395
	N		120	119	120	120
Weight	Pearson Correlation		1	.224*	.029	.886**
	Sig. (2-tailed)			.014	.752	.000
	N			119	120	120
Age at menarche	Pearson Correlation			1	.065	.166
	Sig. (2-tailed)				.485	.071
	N				119	119
Family Income	Pearson Correlation				1	-.026
	Sig. (2-tailed)					.779
	N					120
BMI	Pearson Correlation					1
	Sig. (2-tailed)					
	N					

**Correlation is significant at the 0.01 level (2-tailed).
• Correlation is significant at the 0.05 level (2-tailed).

TABLE 4: BMI AND AGE AT MENARCHE IN RELATION TO NUTRITIONAL STATUS BASED ON 2000 CDC GROWTH CHARTS

Selected percentile for BMI		*N*	*%*	*Mean*	*Std. Deviation*	*F*	*Sig.*
BMI	more than 50th percentile	17	15	21.76	1.727	103.97	.000
	between 25th and 50th percentile	24	22	19.42	1.150		
	between 5th and 25th percentile	43	39	17.57	.971		
	less than 5th percentile	36	24	15.95	1.17		
	Total	120	100	18.05	2.27		
Age at menarche	more than 50th percentile	17	15	12.88	.781	2.076	.107
	between 25th and 50th percentile	24	22	13.58	1.14		
	between 5th and 25th percentile	43	39	13.40	.955		
	less than 5th percentile	36	24	13.60	.971		
	Total	120	100	13.40	.991		

TABLE 5: SCHEFFE'S TEST FOR MULTIPLE COMPARISON BETWEEN CDC GROWTH CATEGORIES AND BMI AS DEPENDENT VARIABLE

Dependent Variable	*(I)Selected percentile for BMI*	*(J) Selected percentile for BMI*	*Mean Difference (I-J)*	*Std. Error*	*Sig.*	*95% Confidence Interval*	
						Lower Bound	*Upper Bound*
BMI	more than 50th percentile	between 25th and 50th percentile	2.34*	.38	.000*	1.2652	3.4182
		between 5th and 25th percentile	4.18*	.34	.000*	3.2151	5.1609
		less than 5th percentile	5.80*	.35	.000*	4.8071	6.8058
	between 25th and 50th percentile	more than 50th percentile	-2.34*	.38	.000*	-3.4182	-1.2652
		between 5th and 25th percentile	1.84*	.31	.000*	.9810	2.7115
		less than 5th percentile	3.46*	.32	.000*	2.5698	4.3596
	between 5th and 25th percentile	more than 50th percentile	-4.18*	.34	.000*	-5.1609	-3.2151
		between 25th and 50th percentile	-1.84*	.31	.000*	-2.7115	-.9810
		less than 5th percentile	1.61*	.27	.000*	.8513	2.3856
	less than 5th percentile	more than 50th percentile	-5.80*	.35	.000*	-6.8058	-4.8071
		between 25th and 50th percentile	-3.46*	.32	.000*	-4.3596	-2.5698
		between 5th and 25th percentile	-1.61*	.27	.000*	-2.3856	-.8513

*. The mean difference is significant at the 0.05 level.

The data was subjected to Scheffe's test for multiple comparisons between Selected percentile for BMI and BMI (Table 5) and between Selected percentile for BMI and age at menarche (Table 6). It was observed that there were no significant differences observed in age at menarche of adolescent girls. Selected percentile for BMI show highly significant differences in terms of BMI; as all value shows significance level of 0.00 which is below the tested p-level i.e. <0.05. However,

these categories are not significantly different from one another in case of age at menarche.

TABLE 6: SCHEFFE'S TEST FOR MULTIPLE COMPARISONS BETWEEN SELECTED PERCENTILE FOR BMI AND BMI AS DEPENDENT VARIABLE

Dependent Variable	*(I) Selected percentile for BMI*	*(J) Selected percentile for BMI*	*Mean Difference (I-J)*	*Std. Error*	*Sig.*	*95% Confidence Interval*	
						Lower Bound	*Upper Bound*
Age At Menarche	more than 50th percentile	between 25th and 50th percentile	-.701	.31	.170	-1.58	.18
		between 5th and 25th percentile	-.513	.28	.345	-1.31	.28
		less than 5th percentile	-.645	.28	.176	-1.46	.17
	between 25th and 50th percentile	more than 50th percentile	.701	.31	.170	-.18	1.58
		between 5th and 25th percentile	.188	.25	.903	-.52	.89
		less than 5th percentile	.056	.26	.997	-.68	.79
	between 5th and 25th percentile	more than 50th percentile	.513	.28	.345	-.28	1.31
		between 25th and 50th percentile	-.188	.25	.903	-.89	.52
		less than 5th percentile	-.132	.22	.948	-.76	.49
	less than 5th percentile	more than 50th percentile	.645	.28	.176	-.17	1.46
		between 25th and 50th percentile	-.056	.26	.997	-.79	.68
		between 5th and 25th percentile	.132	.22	.948	-.49	.76

*. The mean difference is significant at the 0.05 level.

Discussion

The Guidelines for Adolescent Preventive Services (GAPS) recommends that nutrition screening be included as a routine part of annual health guidance (American

Medical Association 1992). Common indicators of nutritional risk that should be considered include overweight, underweight, hyperlipidemia, hypertension, iron deficiency (anaemia), food insecurity, eating disorders, substance use, and excessive intake of foods and beverages that have high fat or sugar contents (Stang and Story 2005). In the present study nutritional risk countered includes mostly adolescent girls lying between 5th and 25th percentile and less than 5th percentile of CDC 2000 BMI values (Kuczmarski *et al.* 2002).

Growth in height is rapid for few years prior to menarche, with onset of the growth spurt occurring between 10 - 14 years. Peak height velocity occurs about one to one and a half years before menarche. Additional height is gained after peak height velocity (10.8 - 22.3 cm) and after menarche (7.4 - 10.6 cm) (Kurz 1994). This additional height may be gained over a period of 4.7 years after menarche (Tanner, 1972). In the present study, it was found that height differences after menarche among different age groups was not statistically significant.

Urbanization, educational status of parents, socio economic status of family, living conditions, as well as family size do not exert a direct influence on the occurrence of the first menstruation (Danker-Hopfe 1986). These are 'secondary' factors more or less associated with those factors that presumably have a more direct influence, such as nutritional condition and health status of adolescent girls (Deb 2009).

Between 1972 and 2003, 10 longitudinal studies found a negative relation between age at menarche and adult weight-for-height (Biro et al. 2001; Okasha *et al.* 2001), assessed by BMI in all but one study (Miller et al. 1972), but only one longitudinal study showed no relation between age at menarche and adult BMI (*et al*. 1992). Age at menarche has been declining (Andersen *et al.* 2003) at the same time adult BMI has been increasing, although the rate of decline menarche age has slowed or stopped in some countries in recent times (Styne 2001). These studies too indicate association between increase in body weight and decline in age at menarche. In the present study, on the basis of correlation analysis, it was found that age at menarche had significant association with weight and height.

There are intra-population and inter-population differences in age at menarche among girls. Mean age at menarche observed in the present study is 13.4 years which is higher when comparable with the studies in U.S. (12.3 years for black girls and 12.6 years for white girls) (Freedman *et al.* 2002), and UK (12.5 years) (Joinson *et al.* 2011). Khatoon *et al.* (2011) observed early mean age at menarche among obese (11.97 years) than over-weight (12.43 yrs), underweight (12.72 years), and normal girls (12.67 yrs). The present study found that girls with BMI more than 50th percentile had earlier mean age at menarche than those having BMI less than 5th percentile of growth Chart provided by CDC 2000 (Kuczmarski *et al.* 2002). Some other studies have also shown that that body mass index significantly influence the mean age at menarche.

To conclude, BMI is a good indicator of nutrition among adolescents. Though socioeconomic status itself was not a significant determinant of age at menarche in the present study, but girls having BMI more than 50th percentile of the CDC 2000 growth data had early menarche than girls with BMI at lower percentiles. So, nutrition has some role to play in delaying age at menarche, though the timing of menarche is significantly genetically determined. Both height and body weight were significantly correlated with age at menarche. The girls with late menarche were relatively taller than girls who had early menarche.

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