

## Original Research Article

# Study of sexual maturity rating among female adolescents who have attained menarche

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### ABSTRACT

**Background:** Adolescence is an important stage in the growth and development of girls. There has been a change in sectorial trend in the onset of puberty menarche. Thus, this study is designed to study the change in sectorial trend. In this background the study has been framed with these objectives, to correlate the attainment of menarche among the subjects in relation to their mothers and to study the sexual maturity rating among the study subjects.

**Methods:** This is a cross sectional observation study involving 70 female adolescent girls. Data was collected from study subjects admitted in the department of Pediatrics, KIMS Hospital and those visiting KIMS OPD during September 2018 to February 2019. Study Subjects were examined by the female investigator and data on anthropometry, Tanner SMR staging, and other examination findings were collected using a pretested standardized questionnaire, after taking the consent. Subjects were divided based on the age into six groups.

**Results:** The mean age of attainment of menarche is 12.36 years and mean age at menarche in mothers was 14.18 years. In this study the earliest age of attainment of menarche is 10 years. In our study most of the subjects attained menarche between 12-13 years, which is earlier than the age of attainment of menarche in the mothers which was 14-15 years. All the subjects who attained menarche were in SMR Breast stages 3, 4 and 5 and pubic hair stages 2, 3, 4 and 5.

**Conclusions:** There is a positive correlation between the ages of attainment of menarche in the mothers and the subjects in this study it is found that there is a positive correlation between age, weight, height and SMR Stages.

**Keywords:** Adolescence, Menarche, Sexual maturity rating

### INTRODUCTION

Puberty refers collectively to the morphological, physiological and psychological changes occurring in the growing boys and girls as the gonads change from infantile to adult state. Puberty is a period of profound physical and behavioral changes extending from the preteen age to the end of 2<sup>nd</sup> decade during which the immature child becomes an adult. Puberty is the state of becoming functionally capable of procreation.<sup>1</sup>

The origin of the word Adolescence is from Greek Latin word, 'Adolescere' which means to grow or to grow to maturity.<sup>2</sup> Adolescence is a process- a series of varied, rapid and extensive changes as well as period of life.<sup>3</sup> Today approximately 1/5<sup>th</sup> of world's population is constituted by adolescents (10-19 years) out of which more than 4/5<sup>th</sup> residing in developing countries.<sup>4</sup> Adolescents represents 22.8% of population of India.<sup>5</sup>

Knowledge of the age of menarche of our population is important for the study of adolescent sterility interval. It

is also essential factor in any study on growth of adolescents. A correct appraisal of the age at menarche of our girls is a pressing need, without which no social law, especially those related to marriage can be made. A shift in the age of menarche signifies a concurrent change in the factors associated with it.<sup>6</sup>

Adolescents include children from age 10 to 19 years, during which they undergo various changes in the sexual development both physical and hormonal.<sup>7</sup> Adolescence can be divided into early adolescence 10-13 years, Middle adolescence 14-16 years, late Adolescence 17-19 years.

Early Adolescence corresponds to SMR stages 1 and 2, beginning of rapid growth. Middle adolescence corresponds to SMR stages 3 and 5, attainment of peak height, menarche/spermarche, late adolescence corresponds to SMR stage 5, slower growth.<sup>8</sup>

The development of secondary sex characteristics in girls is a significant event signalling the onset of physiological and psychological changes of profound importance to individual, family and society. In girls this includes breast development, pubic hair development, attainment of menstrual period.

- Thelarche: Development of breasts- 1<sup>st</sup> sign of onset of puberty.
- Pubarche: Development of axillary and pubic hair- 2<sup>nd</sup> sign of puberty.
- Menarche: First menstrual period.
- Tanners staging: This staging of pubertal changes in girls includes breast development and pubic hair development.

**Table 1: Tanner’s staging.**

	Breast	Pubic hair
Stage 1	Preadolescent	Preadolescent
Stage 2	Breast and papilla elevated. As small mound, areola diameter increases	Sparse lightly pigmented Straight, medial border of labia
Stage 3	Breast and areola enlarge, No contour separation	Darker beginning to curl increased amount
Stage 4	Areola and papilla form secondary mound.	Coarse, curly abundant but amount less than in adult
Stage 5	Mature, nipple projects. Areola part of breast contour.	Adult feminine triangle, spread to medial side of thighs

**Timing of puberty**

Various factors influencing the timing of puberty include genetic, geographic location, general health and nutrition, psychological factors, exposure of light.

Earlier the onset of puberty in family earlier the onset in the child. There is a good correlation between the times of menarche of mothers and daughters and between the sisters. Early onset of puberty is seen in people living closer to the equator, lower altitudes, urban areas and in obese children, children with more percentage of body fat, when compared to those living in northern latitudes, at higher elevations above sea level, in rural areas and normal weight.

Frisch argued that a critical body weight (47.8 kgs) must be reached by a girl to achieve menarche greater the percentage of fat in the body earlier the onset of menarche.

**Dietary influence**

Harvard longitudinal studies of childhood health and development related dietary intake to Menarche and found that Girls had earlier menarche if they were taller and consumed more animal protein and less veg protein as early as 3-5 years of age. Girls had earlier peak growth if they had a history of higher dietary fat intake at 1-2 years of age and higher animal protein intake at 6-8 years. Girls had higher peak velocity if they consumed more calories and animal protein 2 years before peak growth. Moderate obesity up to 30% above normal weight for age is associated with earlier menarche.

Leptin a peptide secreted in adipose tissue acts on CNS neurons and regulate eating behavior and energy balance. Leptin administration accelerates the onset of puberty. Leptin levels increase at puberty in boy’s low leptin levels seen in patients with anorexia and athletes so delayed puberty. Leptin levels gradually increase until puberty this shows that a threshold level of leptin is necessary for puberty to begin. Higher the leptin levels earlier is the age of menarche, so it shows that a relationship exists between CNS and body fat in the process of puberty with leptin serving as the messenger. In girls the leptin-body composition correlation is quite different. Body fat, both relative and absolute, continues to rise as do the circulating levels of leptin.<sup>9-11</sup>

**Influence of activity on puberty**

Strenuous physical activity in girls especially but not necessarily when associated with low body weight can delay or arrest puberty. On the contrary inactive, bedridden children with mental retardation reach menarche at an earlier age and at a lower proportion of body fat value than do similarly retarded children who are more active.

**METHODS**

This is a cross sectional observation study involving 70 female adolescent girls. Data was collected from study subjects admitted in the department of Pediatrics, KIMS Hospital and those visiting KIMS OPD during December

2018 to February 2019. Study Subjects were examined by the female investigator and data on anthropometry, Tanner SMR staging, and other examination findings were collected using a pretested standardized questionnaire, after taking the consent. Subjects were divided based on the age into six groups.

**Statistical methods**

Descriptive and inferential statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean±SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5% level of significance. The following assumptions on data is made,

Assumptions were dependent variables should be normally distributed, samples drawn from the population should be random and cases of the samples should be independent. Analysis of variance (ANOVA) has been used to find the significance of study parameters between three or more groups of patients, Chi-square/ Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups, Non-parametric setting for qualitative data analysis. Fisher exact test used when cell samples are very small.

Pearson correlation between study variables is performed to find the degree of relationship, Pearson correlation coefficient ranging between -1 to 1, -1 being the perfect negative correlation, 0 is the no correlation and 1 means perfect Positive correlation.

**Significant figures**

- +Suggestive significance (P value: 0.05<P<0.10)
- Moderately significant ( P value: 0.01<P≤0.05)
- \*\* Strongly significant (P value: P≤0.01)

**Statistical software**

The Statistical software namely SPSS 18.0, and R environment ver.3.2.2 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc.

**RESULTS**

Table 2 shows that 28.6% of individuals are between 15-15.11 years, 21.4% of study subjects are between 13-13.11 years, 17.1% of individuals between 14-14.11 years, least number of subjects were found between 10-10.11 years of age constituting only 4.3% of study population, which indirectly reflects that the proportion of female population attaining menarche in this age group is less as compared to other age groups.

Table 3 shows that out of 70 study subjects, majority (34.3%) of them attained menarche at 13 years , 25.7% of

them attained menarche at 12 years of age, 17.1% of them attained menarche at 11 years, 14.3% of them attained menarche at 14 years and 7.1% of them at 10 years, and the least being 1.4% at 15 years of age.

Table 4 shows that out of 70 subjects 24.2% were in SMR breast stage 3, 44.2% in stage 4, 31.4% in stage 5. Among the subjects who attained menarche at 10 years majority of them were in stage 3, while those who attained menarche at 14 years and 15 years majority of them were in stage 5. Among 24 study subjects who attained menarche at 13 years majority of them, i.e. 9 of them were in stage 4. This table shows that majority of study subjects were in stage 4 SMR breast.

**Table 2: Age distribution of patients studied.**

Age in years	Mean age	No. of patients	%
10-10.11	10.05	3	4.3
11-11.11	11.07	11	15.7
12-12.11	12.06	9	12.9
13-13.11	13.07	15	21.4
14-14.11	14.04	12	17.1
15-15.11	15.03	20	28.6
Total	13.23	70	100.0

**Table 3: Menarche subject distribution of subjects studied.**

Menarche subject	No. of patients	%
10	5	7.1
11	12	17.1
12	18	25.7
13	24	34.3
14	10	14.3
15	1	1.4
Total	70	100.0

**Table 4: Menarche subject distribution in relation to SMR breast of subjects studied.**

Menarche subject	SMR breast			Total
	Stage 3	Stage 4	Stage 5	
10	3 (17.6%)	1 (3.2%)	1 (4.5%)	5 (7.1%)
11	2 (11.8%)	7 (22.6%)	3 (13.6%)	12 (17.1%)
12	4 (23.5%)	10 (32.3%)	4 (18.2%)	18 (25.7%)
13	7 (41.2%)	9 (29%)	8 (36.4%)	24 (34.3%)
14	1 (5.9%)	4 (12.9%)	5 (22.7%)	10 (14.3%)
15	0 (0%)	0 (0%)	1 (4.5%)	1 (1.4%)
Total	17 (24.2%)	31 (44.2%)	22 (31.4%)	70 (100%)

Table 5 shows that out of 70 subjects' majority i.e. 38.5% (27) were in stage 3 SMR Pubic hair, 32.8% (23) were in Stage 4 SMR pubic hair and 15.7% were in stage 2 SMR pubic hair, 12.8% (9) were in stage 5, 38.5% were in in stage 3, 32.8% were in stage 4. None of the study subjects were in stage 1.

Table 6 shows that majority of subjects 28 (40%) who attained menarche belonged to upper middle class.

Among those who attained menarche at 13 years, majority of them belonged to upper middle class. Those who attained menarche at 14 years were equally distributed in various classes of socioeconomic status. In this it was observed that SES and age of attainment of menarche follows the usual observed pattern from upper middle, upper lower class and upper class.

**Table 5: Menarche subject distribution in relation to SMR pubic hair of subjects studied.**

Menarche subject	SMR public hair					Total
	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	
10	0 (0%)	3 (27.3%)	1 (3.7%)	0 (0%)	1 (11.1%)	5 (7.1%)
11	0 (0%)	5 (45.5%)	3 (11.1%)	4 (17.4%)	0 (0%)	12 (17.1%)
12	0 (0%)	2 (18.2%)	7 (25.9%)	8 (34.8%)	1 (11.1%)	18 (25.7%)
13	0 (0%)	1 (9.1%)	12 (44.4%)	6 (26.1%)	5 (55.6%)	24 (34.3%)
14	0 (0%)	0 (0%)	4 (14.8%)	4 (17.4%)	2 (22.2%)	10 (14.3%)
15	0 (0%)	0 (0%)	0 (0%)	1 (4.3%)	0 (0%)	1 (1.4%)
Total	0 (0%)	11 (15.7%)	27 (38.5%)	23 (32.8%)	9 (12.8%)	70 (100%)

**Table 6: Menarche subject distribution in relation to socioeconomic status of subjects studied.**

Menarche subject	Socio economic status					Total
	Lower class	Lower middle class	Upper class	Upper lower class	Upper middle class	
10	0 (0%)	1 (20%)	1 (10%)	2 (9.1%)	1 (3.6%)	5 (7.1%)
11	0 (0%)	2 (40%)	1 (10%)	3 (13.6%)	6 (21.4%)	12 (17.1%)
12	1 (20%)	0 (0%)	4 (40%)	7 (31.8%)	6 (21.4%)	18 (25.7%)
13	2 (40%)	1 (20%)	2 (20%)	7 (31.8%)	12 (42.9%)	24 (34.3%)
14	1 (20%)	1 (20%)	2 (20%)	3 (13.6%)	3 (10.7%)	10 (14.3%)
15	1 (20%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (1.4%)
Total	5 (100%)	5 (100%)	10 (100%)	22 (100%)	28 (100%)	70 (100%)

**Table 7: Distribution of menarche of mother in relation to menarche of the subject.**

Menarche mother	Menarche subject						Total
	10	11	12	13	14	15	
12	1 (20%)	3 (25%)	2 (11.1%)	1 (4.2%)	0 (0%)	0 (0%)	7 (10%)
13	1 (20%)	3 (25%)	4 (22.2%)	4 (16.7%)	0 (0%)	0 (0%)	12 (17.1%)
14	3 (60%)	3 (25%)	8 (44.4%)	9 (37.5%)	1 (10%)	0 (0%)	24 (34.3%)
15	0 (0%)	3 (25%)	4 (22.2%)	5 (20.8%)	5 (50%)	0 (0%)	17 (24.3%)
16	0 (0%)	0 (0%)	0 (0%)	5 (20.8%)	3 (30%)	0 (0%)	8 (11.4%)
17	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (10%)	1 (100%)	2 (2.9%)
Total	5 (100%)	12 (100%)	18 (100%)	24 (100%)	10 (100%)	1 (100%)	70 (100%)

Table 7 shows that majority of mothers attained menarche between age 14 and 15 while majority of children attained menarche at an earlier age that is between 12 and 13 years which shows earlier age of attainment of menarche in the present generation. Out of 70 subjects who attained menarche 35 (50%) subjects attained menarche before 12 years of age while in

mothers only 7 (10%) attained menarche before 12 years. In this study the mean age of menarche in mothers is 14.18 years and the mean age of menarche in the subjects is 12.36 years.

Table 8 shows that there exists a positive correlation between ages of the subjects and their weight, height, and

SMR stages. Age is positively significantly correlated with SMR breast and SMR pubic hair, though significant, correlation is moderate,  $r=0.373$ ;  $P<0.001^{**}$  for SMR breast and  $r=0.548$ ,  $P<0.001^{**}$  for SMR pubic hair.

Actual height is moderately significantly correlated with SMR breast and SMR Pubic Hair. Actual weight is moderately significantly correlated with SMR breast and SMR pubic hair.

**Table 8: Pearson correlation.**

		Age	Actual height	Actual weight	SMR breast	SMR pubic hair
Age	Pearson correlation	-	0.447	0.248	0.373	0.548
	Sig. (2-tailed)	-	<0.001**	0.039*	0.001**	<0.001**
Actual height	Pearson correlation	0.447	-	0.229	0.123	0.243
	Sig. (2-tailed)	<0.001**	-	0.012*	0.312	0.042*
Actual weight	Pearson correlation	0.248	0.299	-	0.324	0.347
	Sig. (2-tailed)	0.039*	0.012*	-	0.006**	0.003**
SMR breast	Pearson correlation	0.373	0.123	0.324	-	0.784
	Sig. (2-tailed)	0.001**	0.312	0.006**	-	<0.001**
SMR pubic hair	Pearson correlation	0.548	0.243	0.347	0.784	-
	Sig. (2-tailed)	<0.001**	0.042*	0.003**	<0.001**	-

**Table 9: Comparative mean age (years) of attainment of menarche.**

Author	Marshal and Tanner <sup>13</sup>	Kaul et al <sup>14</sup>	Tripathi et al <sup>15</sup>	Qamra <sup>16</sup>	Lata R Kollur et al <sup>17</sup>	Present study
Year	1969	1970-71	1979-80	1984	2007-09	2018-19
Place	UK	Jabalpur	Varanasi	Chandigarh	Karad	Bangalore
SES status	Lower	Mixed population	Upper	lower	Lower	Mixed population
Mean age of menarche	13.47	13.57	12	12.8	13.4	12.36

**DISCUSSION**

This study done in KIMS Hospital; Bangalore included 70 female adolescents between the age of 10-16 years. Subjects were divided into various groups for convenience of statistical analysis as shown in Table 1. The mean age of subjects in various age groups is 10.05, 11.07, 12.06, 13.07, 14.04, 15.03 years.

The mean height of subjects in various age groups is 143, 149, 151, 154, 156, 155 centimeters respectively. There is an increase in the mean height of subjects between ages of 10-11 years probably as the sample size is less. The mean weight of subjects in various age groups is 33.33, 39.36, 45.11, 39.27, 44.42, 42.55.

In this study, the earliest age of attainment of menarche is 10 years. It is found that most of the subjects attained menarche between the age of 12-13 years, which is earlier than the age of attainment of menarche in the mothers, which was 14-15 years. The mean age for menarche was 12.6 year according to study done by DK Agarwal and KN Agarwal in 1992.<sup>12</sup> All the subjects who attained menarche were in SMR Breast stages 3,4 and 5, none were in stages 1 and 2, and pubic hair stages 2, 3, 4 and 5, none were in stage 1.

In this study the age of attainment of menarche is earlier when compared to other studies except with study done in Delhi and among upper class in Chandigarh.

This could be because the present study is done in mixed population unlike the other which was done in upper class subjects.

In this study the mean age of menarche in mothers is 14.18 years, and the mean age of menarche in the subjects is 12.36 years. There is a positive correlation between the ages of attainment of menarche in the mothers and the subjects.

**CONCLUSION**

All the subjects who attained menarche were in SMR Breast stages 3, 4 and 5 and none were in stage 1 and 2 and pubic hair stages 2, 3, 4 and 5 and none were in stage 1. In this study it is found that there is a positive correlation between age, weight, height and SMR stages.

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