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Research Article

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Sexual Maturation Pattern in Adolescent School Girls of Rural India: A Cross Sectional Study from Nagpur

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Abstract

Background: Puberty is transformation of the child into an adult. It includes all the events of somatic and mental maturation. Secondary sex characters were also a part of this period. The objective was to assess the pattern of sexual maturation of adolescent school girls in rural India.

Methods: This was a community based cross sectional study conducted among school children of Sevanand High school, Mahadula, Nagpur. 322 girls in the age group of 10-18 years were assessed for sexual maturation. The pubertal evaluation was made with reference to Tanner stages and grading was done as per Tanner's scale. For statistical analysis, median and standard error along with 95% confidence interval (CI) were calculated using Epi Info statistical package programme version 6.0 updated 2009. Statistical significance was assessed at a type I error rate of 0.05.

Results: We found that pubertal changes appeared earlier in girls. The first to appear was breast development at a median age of 10.40 years. The last to appear was pubic hair development (PH5) at median age 16.87 years, the total time taken for complete sexual maturation being 6.38 years. Median age of menarche was found to be13.18 years.

Conclusion: The pattern of sexual maturation in rural adolescent school children revealed that though puberty set in earlier in girls, but took longer time for complete maturation.

Keywords: Sexual maturity, Secondary sexual characteristics, Tanner's stages, Rural.

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Background

Puberty is transformation of the child into an adult. It includes all the events of somatic and mental maturation. Reproductive capacity is acquired in this period [1]. The time and speed of pubertal development in majority of the children shows wide fluctuation. Nevertheless the sequence of pubertal maturation remains more or less consistent among most children.

Most of the research studies done in the past have largely concentrated on the consequences of pubertal timing. It is worth noting that a faster speed of maturation would also present special problems and challenges to children for adjusting to new biological and social milestones [2].

Puberty is considered as the most obvious and real change of all of the developmental changes occurring during adolescence. It is considered to define the onset of adolescence though it is only one component of adolescent development [3].

All children neither experience puberty at the same time, nor do they complete it at the same time. Biologic maturity may not always correspond with the chronological age of the child [4].

In girls, menarche is generally considered as an indicator of sexual maturation [5]. The major noticeable events in one's life such as the beginning of pubertal development, the menarche and the showing down of the body's development growth could be in a typical manner which may differ from one individual to another [6].

Current international studies suggest earlier puberty in boys than previous studies, following recent trend in girls [7-9]. The existing research work done on adolescent growth has not touched the important innovative aspect such as the development of secondary sex characters. Even research studies related to basic information on secondary sex characters are rare or non-existent in many countries. With this background, the present study has been conducted to assess the pattern of sexual maturation of adolescent school girls in rural Nagpur.

Material and Methods

Study design and the participants

School children selected from Sevanand High school, Mahadula, Nagpur. The school is situated 16 km away from Indira Gandhi Government Medical College, Nagpur. There are six census towns in Nagpur district, of which Mahadula has maximum population of schedule caste and schedule tribe as per 2001 census. Out of three schools situated in Mahadula, Sevanand High school, was selected randomly for the present study.

Study Period

Present study was done in 2005 – 2006 (2years).

Response Rate

Out of 739 students studying in 5th to 10th standard at Sevanand High school, 322 students were girls and all of them participated in the study, giving a overall response rate of 100%.

Data collection

Out of 735 students of Mahadula, Sevanand High School, 413 were boys and 322 were girls. Detailed information regarding socio-demographic characteristics such as age, sex, education, socio-economic status was recorded as per the predesigned pretested proforma. Adequate privacy was ensured during gonadal examination and sexual maturity assessment was done in a separate room. Examination of girls was done in presence of a lady teacher.

Inclusion criteria

Those students temporarily absent in the classes were included at subsequent visits since the school was taken up for a period enabling inclusion of all students in the age group 10-18 years.

Exclusion criteria

Four students who were absent for long periods were excluded.

Outcome variable

Breast development, pubic hair development and axillary hair development were considered as outcome variable.

Explanatory variables

The demographic and other factors were considered as explanatory variable.

Ethical committee approval

The study was approved by the Institutional Ethics Committee. Before conducting study, written informed consent from the parents of the study subjects was obtained.

Data management and statistical analysis

Sexual maturity assessment was done as per Tanner's scale [10]. Sexual maturity rating (SMR) stages, as described by Tanner and Marshall, provide a more accurate assessment of the developmental stage of the adolescent. These SMR stages provide a classification to monitor the normal events of puberty from pre-pubertal (SMR1) to adult (SMR5) stage. The rating for girls is based on breast (B1 to B5) and pubic hair (PH1 to PH5) development. Axillary hair development (AH1 to AH3) is also rated in girls.

Statistical analysis was done by calculating percentages, median and standard error along with 95% confidence interval (CI). Epi Info statistical package programme version 6.0 updated 2009 was used to analyze the data. P value less than 0.05 was considered as statistically significant.

Results

The number and percentage of girls who attained various stages of sexual characteristic at different ages is shown in tables 1 to 3. The results of probit analysis giving the median ages at which the different sexual characteristics appear are shown in table 4.

As shown in Table 1, out of the total 322 girls, 61 (18.9%) were in the B2 stage, 123 (38.2%) were in the B3 stage and 27 (8.4%) were in the B5 stage of breast development. 31 (9.6%) girls showed no breast development. Mean age of B2 stage was found to be 10.84 years and that for B5 stage 15.87 years. As

far as different age groups are concerned, in the age group of 10-11 years, maximum girls (50%) were in the B2 stage. Also, majority of the girls were in the B3 stage i.e. 45.3% in 11-12 years, 69.4% in 12-13 years, 47.2% in 13-14 years and 52.1% in 14-15 years of age group. Whereas maximum girls were in B4 stage i.e. 56.3% in 15-16 years and 45.5% in 16-17 years of age group. In 17-18 years, maximum (69.2%) we got B5 stage of breast development.

Table-1: Breast development in girls

Age (years)	N	Stages of breast development				
		B1 N (%)	B2 N (%)	B3 N (%)	B4 N (%)	B5 N (%)
10-11	50	24 (48.0)	25 (50.0)	1 (2.0)	-	-
11-12	53	6 (11.3)	23 (43.4)	24 (45.3)	-	-
12-13	49	1 (2.0)	10 (20.4)	34 (69.4)	4 (8.2)	-
13-14	55	-	3 (5.5)	26 (47.2)	24 (43.7)	2 (3.7)
14-15	48	-	-	25 (52.1)	22 (45.8)	1 (2.1)
15-16	32	-	-	8 (25.0)	18 (56.3)	6 (18.8)
16-17	22	-	-	3 (13.7)	10 (45.5)	9 (40.9)
17-18	13	-	-	2 (15.4)	2 (15.4)	9 (69.2)
Total	322	31(9.6)	61 (18.9)	123 (38.2)	80 (24.8)	27 (8.4)

Figures in parentheses indicate percentage.

As shown in Table 2, 84 (26.1%) were in the PH2 stage, 71 (22.4%) were in the PH4 stage and 59 (18.3%) were in the PH3 stage. Only 58 (18.0%) were in the PH1 stage i.e. no pubic hair development, while 15.2% girls were having adult pubic hair pattern. In different age groups, in the age group of 10-11 years, maximum girls (76%) were in the PH1 stage. Also, majority of the girls were in the PH2 stage i.e. 56.6% in 11-12 years and 49% in 12-13 years of age group. In PH3 stage, 29.1% were in 13-14 years of age group. Whereas maximum girls were in PH4 stage i.e. 54.2% in 14-15 years and 50% each in 15-16 and 16-17 years of age group. In 17-18 years, maximum (69.2%) were in PH5 stage of pubic hair development.

Table-2: Pubic hair development in girls

Age (years)	N	Stages of pubic hair development				
		PH1 N (%)	PH 2 N (%)	PH 3 N (%)	PH 4 N (%)	PH 5 N (%)
10-11	50	38 (76.0)	12 (24.0)	-	-	-
11-12	53	16 (30.2)	30 (56.6)	7 (13.2)	-	-
12-13	49	4 (8.2)	24 (49.0)	20 (40.8)	1 (2.0)	-
13-14	55	-	14 (25.5)	16 (29.1)	14 (25.5)	11 (20.0)
14-15	48	-	3 (6.25)	11 (22.9)	26 (54.2)	8 (16.7)
15-16	32	-	1 (3.1)	3 (9.4)	16 (50.0)	12 (37.5)
16-17	22	-	-	1 (4.6)	11 (50.0)	10 (45.5)
17-18	13	-	-	1(7.7)	3 (23.1)	9 (69.2)
Total	322	58 (18.0)	84 (26.1)	59 (18.3)	71(22.4)	50 (15.2)

Table 3 shows the axillary hair development in girls. It was found that 98 (30.4%) were in the AH2 stage and 94 (29.2%) were in the AH3 stage i.e. they had attained the adult type of axillary hair development. 130 (40.4%) girls were having no axillary hair development. Mean age for AH2 was found to be 13.5 years and that for AH3 was 14.6 years. Considering different age groups, majority of girls between 10-13 years age group were in AH1 stage of development. Whereas maximum girls in 13-15 years age group were in AH2 stage of development. Also, majority of girls were in AH3 stage i.e. 62.5% in 15-16 years; 68.2% in 16-17 years and 100 % in 17-18 years age group.

Table-3: Axillary hair development in girls

Age (years)	N	Stages of axillary hair development		
		AH1 N (%)	AH 2 N (%)	AH 3 N (%)
10-11	50	49 (98.0)	1 (2.0)	-
11-12	53	47 (88.7)	6 (11.3)	-
12-13	49	24 (49.0)	14 (28.6)	11 (22.4)
13-14	55	10 (18.2)	30 (54.5)	15 (27.3)
14-15	48	-	28 (58.3)	20 (41.7)
15-16	32	-	12 (37.5)	20 (62.5)
16-17	22	-	7 (31.2)	15 (68.2)
17-18	13	-	-	13 (100.0)
Total	322	130 (40.4)	98 (30.4)	94 (29.2)

Figures in parentheses indicate percentage.

Table-4: Median age for different stages of sexual maturation in girls

Sexual characteristic	Stage	Median age (yrs)	*SE	95% CI
Breast	B2	10.4	0.42	9.6-11.2
	B3	12.2	0.50	12.3-13.2
	B4	15.1	0.65	13.9-16.4
	B5	16.4	0.72	15.0-17.8
Pubic Hair	PH2	10.6	0.58	9.5-11.7
	PH3	13.0	0.57	11.8-14.2
	PH4	15.5	0.58	14.3-16.1
	PH5	16.8	0.42	16.0-17.7
Axillary Hair	AH2	13.9	0.96	12.0-15.8
	AH3	15.0	0.82	13.8-16.6
Menarche	M	13.2	0.23	12.7-13.6

*SE: standard error

Table 4 shows the median age for different stages of sexual maturation in girls. It was observed that the onset of breast development occurred at median age of 10.4 years and last stage of breast development i.e. B5 achieved at the median age of 16.4 years. It took on an average 6 years to complete the breast development. It was observed that the onset of pubic hair development occurred at median age 10.6 years and last

stage of pubic hair development i.e. B5 achieved at the median age of 16.8 years. It took on an average 6.09 years to complete the pubic hair development in girls. Onset of axillary hair occurred at median age of 13.9 years and 15 years was the median age of achievement of adult type of axillary hair development. It took on an average 1.09 years to complete the axillary hair development in girls. Median age for menarche was observed to be 13.2 years.

Discussion

In the present study, we evaluated the sexual maturation pattern in adolescent school girls of rural India. It was observed that puberty set in earlier in girls and took longer time for complete maturation. These findings highlight the need to consider multiple sources of individual variability in pubertal development and suggest different pubertal challenges for girls. Consequences of earlier biological maturation on adolescent health behaviors and outcomes should also be monitored [2, 11]. Gupta N. et al, [12] in their longitudinal study in Indian children found that pubic hair was the first sexual characteristic to appear in majority of the girls, while it was breast development in our study. Median age at menarche in our study was 13.18 years, which is similar to that reported by ICMR study, [13] in which it was found to be 12.96 years, while Kaul et al [14] reported to be 13.57 years. Mean age at menarche was reported to be 12.41 years by Semiz et al [8] in Turkish girls and 12.6 years by Agarwal DK et al [15] in Indian girls.

Kaul et al [14] in their cross-sectional study of 4982 girls from 9 to 20 years of age found appearance of pubic hairs observed at median age of 11.48 years and for P5 median age was 16.77 years. The mean age for the appearance of axillary hair was found to be 11.53 years. They also found that median age for B2 was10.99 years and for B5 it was 17.37 years. For B2-B5 maturation, it required 6.38 years. Whereas pubic hair development required 5.29 years to develop from PH2-PH5 and for AH2, median age was found to be 14.30 years.

ICMR [13] reported for local girls (Nagpur) that mean age for the appearance of pubic hair was 11.96 years. Prabhakar A et al [16] reported that mean age at appearance of axillary hair in higher socio-economic and lower socioeconomic was 12.99 years and 14.62 years respectively.

Conclusion

The pattern of sexual maturation in rural adolescent school children revealed that though puberty set in earlier in girls, but took longer time for complete maturation.

Limitations and future scope of the study

It appears from this study that puberty set in earlier but took longer time for complete maturation in girls. But this being a cross-sectional study, this statement may have to be taken with caution. Hence it is recommended that longitudinal studies in this aspect should be undertaken to estimate the actual period of development of various sexual characters in Indian children. Additional studies are required to further evaluate these findings and to explore the public health implications. A complex model of maturation and environmental-social interaction is constructed and currently supported by research, but it is clear that a great deal of further research work is necessary to fully understand this process [17]. The results of our study present the epidemiology of sexual maturation of adolescent school children in a single school at Nagpur. Hence the findings cannot be generalized to the whole population. Similarly ethnic differences in the pubertal development cannot be commented upon. Moreover, correlation of pubertal development with nutritional status or other factors (eg socio-economic status) was not assessed in our study since we assumed such factors to be similar in our study group, for example, 98% students belonged to middle socio-economic stratum.

Competing interests

Authors do not have any competing interests.

Authors' contribution

Akre VC, Sukhsohale DN, Kubde SS, designed the study, performed the experiment, interpreted the data, drafted the manuscript, and revised it. Akre VC, Sukhsohale DN, Kubde SS, Chaudhary M S, Khamgaonkar B M took part in data analysis, interpreted the data, and revised the manuscript. Final manuscript was approved by all authors.

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