

# A STUDY OF THE DEVELOPMENT OF SECONDARY SEX CHARACTERS IN URBAN GIRLS

By

SAROJ SINGH, N. KAPOOR, B. SARKAR AND D. N. PANDEY

## SUMMARY

A cross-sectional study was conducted on 500 girls aged 9-18 years in an urban school. Development of secondary sex characters, the most remarkable feature of adolescent growth, was studied employing Marshall & Tanner Puberty staging. Initial breast development ( $B_2$ ) occurred at the median age of 11.04 years followed by changes in the pubic hair ( $PH_4$ ) at 11.37 years. Axillary hair were observed at the median age of 11.45 years followed by further development of pubic hair and breast, menarche being attained at 13.4 years. Complete sexual maturity of breast ( $B_5$ ) and pubic hair ( $PH_5$ ) occurred at the ages of 16.87 and 16.84 respectively. The attainment of full maturity took a longer time as compared to Western standards inspite of early setting of the puberty in this region.

### Introduction

Adolescence is the period which takes a girl to womanhood. In this period, there is a growth spurt known as 'adolescent spurt'. Every muscular and skeletal dimension of the body seems to take part in the adolescent spurt, the reproductive organs in particular. The growth of the reproductive organs is expressed externally as the appearance of secondary sex characters like development of breast, appearance of pubic hair, axillary hair, and the onset of menstruation.

The study of secondary sex characters could be longitudinal or cross sectional both have their own merits and give different informations. Cross sectional studies being cheaper and quicker, can cover a large age span. The median age

of the appearance of any character can be estimated accurately using cross-sectional studies. We have conducted a cross-sectional one to study the appearance of secondary sex characters in Indian Urban Girls.

### Material and Methods

A cross-sectional study of 500 urban girls aged 9-18 years was done to assess the development of secondary sex characters. All the girls were selected from one school situated in the centre of Agra city. Nearly all the students studying here were of the upper middle class. They were divided into 10 groups according to age in years so that the 1st group included all the cases between 9 and 10 years and were denoted by 9+ and so on.

All the girls thus selected were subjected to the examination for the presence of secondary sex characters including—

Breast development  
 Pubic hair  
 Axillary hair, and  
 Menarche  
 The breast and pubic hair staging used were those described by Tanner (1962)

Stage 1 — Pre adolescent.  
 (B<sub>1</sub>)

Stage 2 — Breast bud stage—slight elevation of breast and papilla.  
 (B<sub>2</sub>)

Stage 3 — Further enlargement and elevation of breast and areola with no separation of their contours.  
 (B<sub>3</sub>)

Stage 4 — Projection of areola and papilla to form a secondary mound above the level of the breast.  
 (B<sub>4</sub>)

Stage 5 — Mature stage—projection of papilla, only due to recession of the areola.  
 (B<sub>5</sub>)

Pubic hair stages ..

Stage 1 — Pre-adolescent, no pubic hair.  
 (PH<sub>1</sub>)

Stage 2 — Sparse slightly pigmented hair along the labia.  
 (PH<sub>2</sub>)

Stage 3 — Considerably darker, coarser, and more curled, the hair spreads sparsely over the junction of the pubis.  
 (PH<sub>3</sub>)

Stage 4 — Hair now resemble the adult type but the area covered is still considerably smaller. Not spread to the medial surface of the thigh.  
 (PH<sub>4</sub>)

Stage 5 — Adult in quantity and type with distribution of the horizontal pattern spread to the medial surface of thigh.  
 (PH<sub>5</sub>)

Axillary hair was divided into two stages, present or absent while menarche was recorded as attained or not.

TABLE I  
 Number and Percentage of Girls in Various Groups According to Stage of Breast Development

Age in years	Total cases/B <sub>1</sub>	Stages			
		B <sub>2</sub>	B <sub>3</sub>	B <sub>4</sub>	B <sub>5</sub>
9	26	6 (23.77)	1 (3.84)	—	—
10	32	8 (25.00)	2 (6.25)	—	—
11	53	28 (52.83)	12 (22.64)	4 (7.54)	—
12	65	49 (75.38)	29 (44.61)	12 (18.46)	1 (1.53)
13	74	70 (94.59)	57 (77.02)	33 (44.59)	8 (10.81)
14	68	67 (98.50)	62 (91.17)	44 (64.70)	17 (25.00)
15	58	58 (100)	54 (93.10)	41 (70.68)	18 (31.03)
16	69	69 (100)	68 (98.55)	58 (84.05)	25 (36.37)
17	37	37 (100)	37 (100)	34 (91.89)	14 (37.83)
18	18	18 (100)	18 (100)	17 (94.44)	8 (44.44)
Median age in years		11.04	12.13	13.68	16.87
S.E.		0.09	0.05	0.17	0.19

*Statistical Analysis*

Table I shows the number and percentage of girls in various age groups with different stages of breast development. Number of girls in stage 5 were also added to the number of girls in stage 4, 3 and 2 as it is a cross sectional study and a girl who has attained stage 5 development has already crossed the previous stages. Similarly, candidates in stage 4 were included in stage 3 and 2. Stage I is the pre-adolescent stage and is thus the same as the total number of cases in that age group so the median age of this stage is not calculated. The median age of development of the various stages was calculated by probit analysis (Finney 1962). The same principles have been used for the other characters.

*Observations*

The appearance of breast bud was the first sexual characteristic to appear (Table I) in this series. The median age for B<sub>2</sub> was 11.04 years while the breast development was completed at the median age of 16.87 years. Thus it took 5.83 years to complete the breast development. B<sub>3</sub> and B<sub>4</sub> occurred at 12.13 years and 13.68 years respectively. Next to the breast bud was the appearance of pubic hair at the median age of 11.37 years (Table II) stages 3, 4 and 5 were seen at the median ages of 12.34 years 13.59 years and 16.84 years respectively. It took 5.47 years for the completion of pubic hair development.

TABLE II  
Number and Percentage of Girls in Various Groups According to Stage of Pubic Hair Development

Age in years	Total cases/ PH <sub>1</sub>	PH <sub>2</sub>	PH <sub>3</sub>	PH <sub>4</sub>	PH <sub>5</sub>
9	26	4 (15.38)	1 (3.84)	—	—
10	32	5 (15.60)	1 (3.12)	—	—
11	53	25 (47.17)	8 (15.09)	3 (5.66)	—
12	65	46 (70.76)	24 (36.93)	9 (13.84)	—
13	74	70 (94.59)	55 (74.32)	27 (36.48)	4 (5.40)
14	68	68 (100)	64 (94.11)	42 (61.76)	14 (20.58)
15	58	57 (98.27)	53 (91.37)	44 (75.86)	19 (32.75)
16	69	69 (100)	67 (97.10)	58 (94.05)	28 (40.59)
17	37	37 (100)	37 (100)	35 (94.59)	18 (48.64)
18	18	18 (100)	18 (100)	17 (94.44)	10 (55.55)
Median age in years		11.37	12.34	13.59	16.84
S.E.		0.04	0.07	0.12	0.16

Table III similarly shows the development of axillary hair and menarche. In our study axillary hair appeared at the age of 11.45 years while the median age for menarche to occur was 13.4 years.

TABLE III  
Number and Percentage of Girls in Various Groups According to Presence of Axillary Hair and Menarche

Age in years	Total cases	Presence of axillary hair	Menarche
9	26	3 (11.53)	—
10	32	10 (31.12)	1 (3.12)
11	53	20 (37.73)	6 (11.32)
12	65	36 (55.36)	6 (9.23)
13	74	56 (75.67)	26 (35.13)
14	68	57 (83.82)	44 (64.70)
15	58	55 (94.82)	50 (86.20)
16	69	67 (97.10)	66 (95.68)
17	37	37 (100)	36 (97.29)
18	18	18 (100)	18 (100)

The sequence of the development of various characters is shown in Fig. 1, we see that B<sub>2</sub> is the first to appear being followed by PH<sub>2</sub>, then AH at 11.45 years and menarche at 13.4 years. The completion of breast development being the last, occurring at the age of 16.87 years. Table IV shows the intervals between various stages.

FIGURE I  
SEQUENCE OF SEXUAL CHARACTERISTICS IN GIRLS

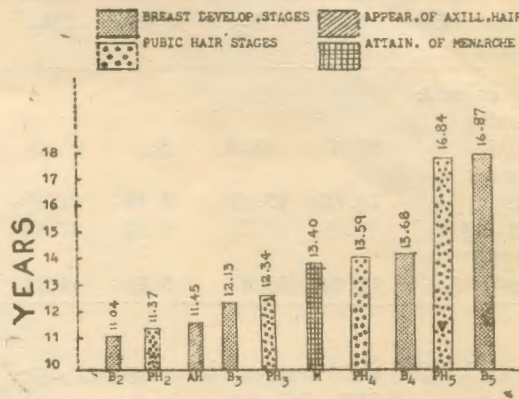


TABLE IV  
The Interval (in years) Between the Development of Various Stages

B <sub>2</sub> -B <sub>3</sub>	1.09
B <sub>3</sub> -B <sub>4</sub>	1.55
B <sub>4</sub> -B <sub>5</sub>	3.19
B <sub>2</sub> -B <sub>5</sub>	5.83
PH <sub>2</sub> -PH <sub>3</sub>	0.97
PH <sub>3</sub> -PH <sub>4</sub>	1.25
PH <sub>4</sub> -PH <sub>5</sub>	3.25
PH <sub>2</sub> -PH <sub>5</sub>	5.47
B <sub>2</sub> -M	2.36
B <sub>2</sub> -AH	0.41
B <sub>2</sub> -PH <sub>2</sub>	0.33

Table V shows the comparison of the results of various studies with our study. Nicholson and Hanley (1953) studied the secondary sex characters in America, Tanner in British girls. We can see that the Breast development starts at an earlier age in Indian girls in comparison to British girls, but it takes longer for them to complete the development. Similarly, for the pubic hair Indian girls take longer to complete the development of pubic hair in comparison to western girls. Menarche was recorded at 13.40 years in our study and AH at 11.45 years. In a study of ICMR in Madhya Pradesh the mean age for the pubic hair to appear

TABLE V  
 Comparison of the Results (In Years) of Various Studies With the Present Study

Name of Study	B <sub>2</sub>	B <sub>5</sub>	B <sub>2</sub> -B <sub>5</sub>	PH <sub>2</sub>	PH <sub>5</sub>	PH <sub>2</sub> -PH <sub>5</sub>	M	A.H.	B <sub>2</sub> -M
Nicholan & Havley (1953)	10.6	13.9	3.3	11.6	—	—	12.8	—	2.2
Tanner (1959)	11.15	15.33	4.18	11.69	14.41	2.72	13.47	—	2.32
Kaul (1971)	10.99	17.37	6.38	11.48	16.77	5.29	13.57	11.53	2.58
Present study	11.04	16.87	5.83	11.37	16.84	5.47	13.40	11.45	2.36

was 12.23 years but as the stage of appearance of PH was not studied it is not possible to compare with this study. The ICMR results for the appearance of axillary hair in Madhya Pradesh was 11.43 years similar to our study and the age for menarche was 12.96 years.

To conclude it appears from this study that although puberty seems to set in early in Indian urban girls the time taken to attain full maturation is longer in comparison to Western Girls. This being a cross-sectional study, this statement may be taken with caution and there is an urgent need for longitudinal study in Indian children.

#### References

1. Finey, D. J. Probit Analysis, London, Cambridge University Press, 1962.
2. Indian Council of Medical Research. Growth & Physical Development of Indian Infants and Children. Tech. Report Series 1972; No. 18.
3. Marshall, W. A. and Tanner, J. M.; Variations in pattern of pubertal changes in girls. Arch. Dis. Child 44: 291, 1969.
4. Nicholson, A. B. and Hanley, C.: (1953). Indices of Physiological maturity, derivation and interrelationship. Child Develop., 24, 3.
5. Tanner, J. M.: Growth at Adolescence 2nd Edition. Oxford and London, Blackwell Scientific Publications, 1962: p. 32.