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## **ASSESSMENT OF PUBERTAL DEVELOPMENT IN PUNJABI BANIA GIRLS**

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### **ABSTRACT**

Adolescence is a period of biological, psychological and physiological changes. There is a great variation in the onset of puberty and rate of subsequent sexual maturation. 200 Punjabi bania girls from middle socioeconomic status at the onset of menarche have been examined cross sectionally by employing Marshall & Tanner ratings to ascertain the developmental status of secondary sex characters and median age at the onset of menarche. The results on statistical analysis of the data show median age at breast bud stage (B2) was 11.6 years, pubic hair stage (PH2) was 12.03 years while axillary hair stage (AH2) was 12.07 years and median menarcheal age was 12.3 years. Girls of the present study started pubertal development and menarche much earlier than those of earlier studies. Differences might be attributed to better nutrition and better hygienic practices in bania girls.

**Keywords:** *Puberty, Menarche, Girls, Secondary Sex Characters*

### **INTRODUCTION**

Puberty is a significant event of human growth and maturation associated with marked physiological and psychological changes. Physiological changes include maturation of gonads and development of secondary sex characters such as the development of breast, pubic hair, axillary hair and onset of menarche (Hosny *et al.*, 2005). Menarche is considered a distinct benchmark of sexual maturation with sudden and dramatic onset unlike other pubertal changes that are gradual and continuous (Thomas *et al.*, 1995).

The mean age at attainment of different puberty signs is effected by various factors like environment, nutrition, socioeconomic conditions. He found that children from higher socioeconomic classes and with good nutrition attain puberty earlier than those from lower socioeconomic classes and those who are malnourished (Tanner, 1962).

The age at menarche is clinically valuable, since it forms a basis for diagnosing delayed puberty and pathological and hormonal disturbances. The age at menarche is reportedly 12.8 years in Punjabi bania girls (Talwar & Kaur, 1999),  $13.25 \pm 0.08$  years in Burma and  $13.21 \pm 0.11$  years in Assam in girls from privileged section of society (Foll, 1961),  $13.21 \pm 1.33$  years in urban areas of Markazi province of Iran (Bayat *et al.*, 2012), 11.8 years in Sri Lankan girls (Godawatta and Wikramanayake, 1988), 12.72 years in Canadian girls (Al-Sahab *et al.*, 2010), 12.47 years in Egyptian girls (Hosny *et al.*, 2005) 13.6 years in US girls (Chumlea *et al.*, 2003), 13.4 years in Turkish girls (Semiz *et al.*, 2008).

Pubertal growth is also affected by calorie intake. The development of breast was found to first appear at the age of 8.25 years. It was followed by pubic and axillary hair development. The mean age at menarche was found to be 12 years for upper socioeconomic status (USES) and 12.8 years for lower socioeconomic status (LSSES). The onset of menarche, breast and pubic hair were significantly delayed in LSSES by 0.8 years. They also reported that menarche was found to correlate better with breast development than pubic or axillary hair. According to them, girls on adequate calories intake showed early onset of breast, pubic and axillary hair development and of menarche. Girls on inadequate calories showed approximately one year late onset of breast and pubic hair development. However, intermittent developmental stages of pubic and axillary hair showed no consistency with intake of calories (Qamra *et al.*, 1991).

India has population groups having diverse life styles. Excellent opportunities for growth studies exist in India as different population groups have contrasting nutrition, socio economic status and a host of other conditions which influence growth and development of children. It is required to have appropriate

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geographically relevant standards for practitioners to make proper clinical judgment. Punjab has approximately an area of 50,362 square kilometres which forms about 1.54% of the country's total geographical area.

As per census report of Govt. of India (2011), Punjab has a population of 27,743,338. Out of this population, females represent 13,103,873 and 14,639,465 are males. In this female population, girls in age group of 10-14 years form 1,137,872. Population studies on the normal characteristics of pubertal development are scarce for Punjabi girls, especially bania girls. The aim of the present study was to determine the mean age, median age and normal range of attainment of various pubertal development stages in normal healthy bania girls. Study will help the concerned department of the government to decide the appropriate age of children at which the topics like sex education, contraception, sanitary practices etc. should be incorporated.

## Aims

The aim of the present study was to determine the mean age, median age and the normal range for attainment of pubertal characteristics in a sample of healthy bania girls of Punjab and also to find out the age of onset of menarche.

Sexual maturity stages at different ages can also provide normal standards for this population, as no uniform data can be applied for the whole population of a country.

## MATERIALS AND METHODS

The study was conducted on 200 Punjabi bania girls. The study was approved by Institutional Ethics Committee. A written, informed consent was obtained from all the participants. Each girl was given a printed preliminary consent proforma to take home and she was asked to get the form filled in by parents or guardians and to sign it and get it signed by parents or guardians. From the date of birth and date of examination of the girls, decimal age of each individual was calculated up to three decimal places according to the decimal age calendar (Tanner, 1978).

Based on the decimal age of the girls they were put into one year age groups. All girls for example, from the age group of 11.500 years to 12.499 years were put into the group of 12 years old and so on. In the present study 200 girls were examined whose age ranged from 10.500 to 14.499 years. These girl students were put into 4 groups of yearly intervals as shown in table 1.

**Table 1: Year Age Groups Distribution of Bania Girls who had Experienced Menarche**

| Sr. no.      | Yearly Interval Age Groups | Number of Girls in Each Age Group | Mean Age (Years) | Median Age (Years) |
|--------------|----------------------------|-----------------------------------|------------------|--------------------|
| 1            | 11 (10.500-11.499)         | 8                                 | 11.18            | 11.12              |
| 2            | 12 (11.500-12.499)         | 110                               | 12.01            | 12.07              |
| 3            | 13 (12.500-13.499)         | 74                                | 12.87            | 12.80              |
| 4            | 14 (13.500-14.499)         | 8                                 | 13.80            | 13.50              |
| <b>Total</b> |                            | 200                               | 12.36            | 12.30              |

**Sexual Maturity:** The evaluation of sexual maturity staging has been obtained by self examination. Privacy, confidentiality were maintained at the time of examination. Sexual maturity staging has been applied by using the abbreviations B1, B2 etc. for breast development PH1, PH2 for pubic hair development and AH1, AH2 etc. for axillary hair development. The various sexual maturation characteristics were rated as follows (Marshall & Tanner, 1969):

### A. Development of Breast:

Stage 1: Pre adolescence; elevation of papilla only (B1)

Stage 2: Breast bud stage; elevation of breast and papilla as a small mound (B2)

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Stage 3: Further enlargement of breast and areola with no separation of their contours (B3)

Stage 4: Projection of areola and papilla to form a secondary mound above the level of breast (B4)

Stage 5: Mature stage; projection of papilla only due to recession of areola to the general contour of the breast (B5)

### **B. Axillary Hair Development:**

Stage 1: Pre-adolescent, Absence of hair in the axilla (AH1)

Stage 2: Slight growth of long hair in the arm pit (AH2)

Stage 3: Medium growth of hair pigmentation of hair seen (AH3)

Stage 4: Adult quantity and form of hair in the axilla (AH4)

### **C. Development of Pubic Hair:**

Stage 1: Pre-adolescent; no pubic hair (PH1)

Stage 2: Sparse growth of long, slightly pigmented, downy hair, appearing along the labia (PH2)

Stage 3: Considerably darker, coarser and more curled (PH3)

Stage 4: Hair is adult in type in a very small area (PH4)

Stage 5: Distributed as an inverse triangle of the classically feminine pattern (PH5)

### **Statistical Analysis**

For statistical analysis of the data SPSS version 16.0, Illinois, Chicago was used. Statistical significance was determined at  $P < 0.05$ . The percentages of girls who had attained various stages of the different sexual characteristics were calculated at each age. Pearson's chi square test was applied to find out correlation.

## **RESULTS AND DISCUSSION**

### **Results**

In our study, maximum frequency for menarcheal age was seen for the age group 12 years and here the number stood at 110 i.e. 55 %. Minimum frequency i.e. just 8 (4%) subjects for menarcheal age was seen for the age group of 11 and 14 years. A small number of girls 74 (37%) started menstruation at the age of 13 years as shown in table 1.

The number and percentage of girls who had attained various stages of sexual characteristics at different ages are given in tables 2 to 4. The secondary sex characteristics examination reveals that majority of the girls were at AH2 (116; 58%) with a median age of 12.5 years, B4 (98; 49%) with a median age of 12.4 years and PH3 (97; 48%) with a median age of 12.34 years. The first sign of puberty was the onset of breast development in 6% girls at median age of 11.6 years, second to appear was the pubic hair (PH2) at median age of 12.03 years and axillary hair AH2 stage was attained at median age of 12.5 years. However, 2 girls have attained AH4 stage at the median age of 11.9 years who must be considered as early maturers.

### **Interrelationships between Events**

Table 5 shows the number of girls in each stage of axillary hair when they were first seen in each successive PH stage. The table read as follows

The appearance of PH2 was observed in 36 girls, the appearance of PH3 in 97 girls, of PH4 in 66 girls, and of PH5 in 1 girl. Of the 36 girls seen reaching PH2, 29 girls were in AH1 (absence of axillary hair), 7 girls were in AH2 & no girl was seen in AH3, AH4 stage of axillary hair. Thus, we see that pubic hair starts growing earlier than the axillary hair.

Table 6 & 7 are similarly constructed. Table 6 shows the interrelationship between breast and pubic hair. This table shows that when 36 girls were in PH2 stage, 11 girls were in B2 stage, 22 girls were in B3 stage, 3 girls were in B4 stage. Thus, breast development is in earlier age as compared to the growth of pubic hair.

Table 7 shows that the breast development is much earlier to the growth of axillary hair. When 8 girls were in B2 stage, 31 girls were in B3 stage, 31 girls were in B4 stage, 11 girls were in B5 stage axillary hair were found to be missing i.e. 81 girls were in AH1 stage. All these sexual maturity characteristics are interrelated with each other as indicated by p-value which was found to be  $.000 < 0.05$ .

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**Table 2: Number & % Age of Girls along with Mean & Median Age at Different Stages of Pubic Hair Development**

| Pubic Hair Stages | No. of Cases | Mean Age Years | Std. Deviation | Std. Error   | 95% Confidence Interval for Mean |               | Minimum     | Maximum     | Median      |
|-------------------|--------------|----------------|----------------|--------------|----------------------------------|---------------|-------------|-------------|-------------|
|                   |              |                |                |              | Lower Bound                      | Upper Bound   |             |             |             |
| PH2               | 36 (18%)     | 11.999         | .4775          | .0796        | 11.837                           | 12.160        | 11.0        | 13.1        | 12.03       |
| PH3               | 97 (48%)     | 12.397         | .6140          | .0623        | 12.274                           | 12.521        | 11.1        | 14.6        | 12.34       |
| PH4               | 66 (33%)     | 12.498         | .5827          | .0717        | 12.355                           | 12.641        | 11.3        | 14.2        | 12.4        |
| PH5               | 1 (0.5%)     | 14.300         |                |              |                                  |               | 14.3        | 14.3        | 14.3        |
| <b>Total</b>      | <b>200</b>   | <b>12.368</b>  | <b>.6183</b>   | <b>.0437</b> | <b>12.282</b>                    | <b>12.454</b> | <b>11.0</b> | <b>14.6</b> | <b>12.3</b> |

**Table 3: Number and Percentage of Girls along with Mean & Median Age at Different Stages of Axillary Hair Development**

| Axillary Hair Stages | No. of Cases | Mean Age      | Std. Deviation | Std. Error   | 95% Confidence Interval for Mean |               | Minimum     | Maximum     | Median      |
|----------------------|--------------|---------------|----------------|--------------|----------------------------------|---------------|-------------|-------------|-------------|
|                      |              |               |                |              | Lower Bound                      | Upper Bound   |             |             |             |
| AH1                  | 81(40.5%)    | 12.125        | .5352          | .0595        | 12.007                           | 12.244        | 11.0        | 13.5        | 12.07       |
| AH2                  | 116(58%)     | 12.546        | .6116          | .0568        | 12.433                           | 12.658        | 11.1        | 14.6        | 12.5        |
| AH3                  | 1 (0.5%)     | 12.400        |                |              |                                  |               | 12.4        | 12.4        | 12.4        |
| AH4                  | 2 (1%)       | 11.900        | 1.1314         | .8000        | 1.735                            | 22.065        | 11.1        | 12.7        | 11.9        |
| <b>Total</b>         | <b>200</b>   | <b>12.368</b> | <b>.6183</b>   | <b>.0437</b> | <b>12.282</b>                    | <b>12.454</b> | <b>11.0</b> | <b>14.6</b> | <b>12.3</b> |

**Table 4: Number and % Age of Girls along with Mean & Median Age at Different Stages of Breast Development**

| Breast Development Stages | No. of Cases | Mean Age      | Std. Deviation | Std. Error   | 95% Confidence Interval for Mean |               | Minimum     | Maximum     | Median Age  |
|---------------------------|--------------|---------------|----------------|--------------|----------------------------------|---------------|-------------|-------------|-------------|
|                           |              |               |                |              | Lower Bound                      | Upper Bound   |             |             |             |
| B2                        | 12(6%)       | 11.616        | .2606          | .0752        | 11.450                           | 11.781        | 11.1        | 12.3        | 11.6        |
| B3                        | 61(30.5%)    | 12.215        | .5024          | .0643        | 12.086                           | 12.344        | 11.0        | 13.2        | 12.18       |
| B4                        | 98(49%)      | 12.494        | .5957          | .0602        | 12.375                           | 12.614        | 11.1        | 14.2        | 12.4        |
| B5                        | 29(14.5%)    | 12.576        | .7256          | .1347        | 12.300                           | 12.852        | 11.6        | 14.6        | 12.45       |
| <b>Total</b>              | <b>200</b>   | <b>12.368</b> | <b>.6183</b>   | <b>.0437</b> | <b>12.282</b>                    | <b>12.454</b> | <b>11.0</b> | <b>14.6</b> | <b>12.3</b> |

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**Table 5: Interrelationship among Pubic and Axillary Hair Development Stages**

| Pubic Hair | Axillary Hair |     |     |     | Total | P Value |
|------------|---------------|-----|-----|-----|-------|---------|
|            | AH1           | AH2 | AH3 | AH4 |       |         |
| PH2        | 29            | 7   | 0   | 0   | 36    | .000    |
| PH3        | 29            | 66  | 0   | 2   | 97    |         |
| PH4        | 23            | 42  | 1   | 0   | 66    |         |
| PH5        | 0             | 1   | 0   | 0   | 1     |         |
| Total      | 81            | 116 | 1   | 2   | 200   |         |

**Table 6: Interrelationship among Breast Development & Pubic Hair**

| Pubic Hair | Breast Development |    |    |    | Total | P Value |
|------------|--------------------|----|----|----|-------|---------|
|            | B2                 | B3 | B4 | B5 |       |         |
| PH2        | 11                 | 22 | 3  | 0  | 36    | .000    |
| PH3        | 1                  | 36 | 55 | 5  | 97    |         |
| PH4        | 0                  | 3  | 40 | 23 | 66    |         |
| PH5        | 0                  | 0  | 0  | 1  | 1     |         |
| Total      | 12                 | 61 | 98 | 29 | 200   |         |

**Table 7: Interrelationship of Breast Development with Axillary Hair**

| Breast Development |    |    |    |    |       | P Value |
|--------------------|----|----|----|----|-------|---------|
| Axillary Hair      | B2 | B3 | B4 | B5 | Total |         |
| AH1                | 8  | 31 | 31 | 11 | 81    | .000    |
| AH2                | 4  | 29 | 66 | 17 | 116   |         |
| AH3                | 0  | 0  | 0  | 1  | 1     |         |
| AH4                | 0  | 1  | 1  | 0  | 2     |         |
| Total              | 12 | 61 | 98 | 29 | 200   |         |

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### **Discussion**

#### *Age at Menarche*

The present study showed that the median age at menarche for Punjabi bania girls was 12.3 years. This is in close agreement with median menarcheal age of  $12.9 \pm 0.72$  years as reported by earlier study conducted on bania girls from Mandi Gobindgarh (Talwar and Kaur, 1999). Thus, in bania girls of Punjab, median age at menarche has been shifted down from 12.9 to 12.3 years in the past fifteen years from 1999 to 2016. Comparing our findings to those of similar study indicates that the average age at menarche has decreased by 0.5 years in Punjabi bania girls over the last 15 years. Lower age at menarche is an indicator of improved nutritional status, as this population based study on bania girls also demonstrates a secular trend.

Bania girls were found to achieve menarche at a median age of 12.3 years which is much earlier age than other Indian girl's i.e. 13.57 years for Jabalpur girls (Kaul *et al.*, 1983), 13.4 years for Poona girls (Ghosh *et al.*, 1972) and 12.58 years for Greek girls (Dacou-Voutetakis *et al.*, 1983).

#### *Secondary Sex Characteristics*

In the present study, Breast development (B2) was the first sexual characteristic to be appeared followed by pubic hair (PH2) and then axillary hair (AH2) whereas another study on Delhi girls showed that pubic hair was the earliest sign followed by breast and axillary hair development (Bhargava *et al.*, 1983). In the present study, none of the girls were found to be at PH1 and B1 stage.

However, 40.5% were in AH1 stage i.e. absence of axillary hair, at the onset of menarche. Only 1 girl was seen in PH5 stage of pubic hair, 1 girl in AH3 and 2 girls were found to be in AH4 stage of axillary hair. Complete sexual maturity of pubic hair was attained at the median age of 14.3 years whereas complete maturity of breast development was attained much earlier at a median age of 12.45 years as shown in tables 2 and 4.

In the present study, pubertal stages were attained at a median age of 11.6 years for B2, 12.03 years for B5; 12.03 years for PH2, 14.3 years for PH5 when compared with other Indian girls (Jabalpur girls) i.e. 10.99 years for B2, 17.37 years for B5; 11.48 years for PH2, 16.77 years for PH5 (Kaul *et al.*, 1983) and 10.60 years for B2, 14.17 years for B5, 10.47 years for PH2; 14.31 years for PH5 in Greek girls (Dacou-Voutetakis *et al.*, 1983).

Thus, It is concluded from the above findings that while onset of most of the pubertal stages are being delayed in bania girls but complete maturity is being attained at a much earlier age than Indian (Jabalpur) and Greek girls. Differences between present study and other studies can be attributed to genetic, geographical and racial differences.

#### *Comparison between Mean Ages of Bania Girls with Other Populations*

When mean ages of attainment of secondary sex characters in bania girls are compared with British girls (Marshall & Tanner, 1969), onset of pubic hair and breast development was found to be delayed by 0.2 years and 0.5 years in bania girls.

The mean age at B2 was  $11.15 \pm 1.1$  years; for PH2 was an  $11.69 \pm 1.21$  years in US girls (Kaplowitz and Oberfield, 1999) which is in close agreement with present data.

Secondary sex characteristics in menstruating Poona girls were studied. Breast bud (B2) appeared at an average age of 12.2 years, pubic hair with an average age of 12.4 years and age of onset of menarche is 13.2 whereas in the present study, breast bud and pubic hair appeared at an average age of 11.6 and 11.9 years in menstruating bania girls. Thus, puberty sets earlier in bania girls than other Indian (Poona) girls (Ghosh *et al.*, 1973).

Singh and Sodhi, (2012) suggested a non-invasive method of age estimation from the development stage of any of the secondary sex characteristics as this study is helpful for the forensic practitioner in medico legal cases like rape, molestation, abortion, under age marriage.

Mean age of attainment of B2 is 11.1 years, PH2 is 11.7 years and 13.47 years for menarche in British girls (Marshall and Tanner, 1969), 10.8 years for B2, 11.6 years for PH2 in North American girls (Reynolds and Wines, 1948), 9.93 years for B2, 11.63 years for PH2 in Chinese girls (Lee *et al.*, 1963), 10.15 years for B2, 10.48 years for PH2, 14.54 years for menarche in Iranian girls (Rabbani *et al.*, 2008)



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whereas in the present study mean age for B2 is 11.6 years, PH2 is 11.9 years and 12.3 years for menarche.

Thus, bania girls were found to be little bit late in attaining certain stages of sexual maturity although menarche is attained at a much earlier age when compared with British girls, North American, Chinese and Iranian girls.

### **Conclusion**

The current study provides an up-to-date reference of normal sexual maturation of bania population. This population based study on bania girls demonstrates a trend over time of decreasing age at menarche from 12.8 to 12.3 in the past fifteen years when compared with earlier study on bania girls. This might be attributed to better nutritional status and better hygienic practices in bania girls as these factors lead to lower age of menarche.

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