Pattern of Sexual Development and Anthropometry in Adolescent Males

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ABSTRACT

Background: The significance of staging the sexual development becomes apparent on observing a group of adolescents of similar age but with great variability in size, shape and level of pubertal maturation. Objectives: To study the pattern of sexual maturation and anthropometry in adolescent males. Methods: The cross-sectional study was done in school having a total of 2347 male adolescents, out of which 390 students cooperated in the study. Probability proportionate to size sampling was used. Sexual Maturity Rating (SMR) was done by showing pictorial representation to the adolescents. The data obtained were tested statistically by percentages and Chi-square Test using SPSS version 10.0 for windows. Results: SMR-1 ranged from age 10 – 13 yrs, SMR-2 ranged from 10-16yrs, SMR-3 started from age 11yrs and ended gradually at 18yrs. Similarly SMR-4 started from 13 yrs and SMR-5 at 14 yrs. The mean weight and height increased from lower age groups to higher age groups within the same stage of sexual development. Within the same age group the mean weight as well as height also increased according to the current stage of sexual development. Conclusion: There is great variability in the timings of onset of puberty and the progression of the sexual maturity among the adolescents. The anthropometry indices for somatic growth in adolescent are influenced by both the chronological age and the sexual maturity of the adolescents. Thus calculating the anthropometric indices in adolescent according to the age alone will not be of much use as the somatic growth also depends on the sexual maturity of the adolescents.

Keywords: Sexual development, anthropometry, adolescents.

Introduction

Over the past 100-150 years, there have been changes in the physical aspect of adolescence. The age of onset of sexual maturation has been decreasing, growth and physical development are proceeding at an accelerating pace, and there has been a trend towards greater ultimate adult size. Many aspects of this acceleration remain obscure, although such factors as better nutrition and improved social and economic conditions are probably relevant. These findings are mainly based on studies on girls and data on sexual and physical maturation of boys during puberty is limited. Some scholars have reported no remarkable earlier maturation of boys in contrast to other researchers who reported a positive secular change. The age of onset and the rate of pubertal development show a wide variation. With the pubertal spurt, boys tend to become more muscular and girls show fat deposition in characteristic female distribution. The significance of staging the sexual development becomes apparent on observing a group of adolescents of similar age but with their great variability in size and level of pubertal maturation. Yet most are likely to be within the normal distribution range of pubertal events of ±2 SD from the mean as this encompasses the very broad span of ±2.5 years.

The objective of the present study was to present recent data regarding the pattern of sexual
maturation and to analyze effect of pubertal phases on physical growth parameters in adolescent boys.

Material and Methods

The cross-sectional study was undertaken in the schools located within the registered rural and urban field practice areas of the Department of Community Medicine, JNMC, Aligarh, Uttar Pradesh, India. The total population of male adolescents (10 – 19 yrs) in all the schools was 2347, out of which a sample of 410 students (205 from the rural schools and 205 from the urban schools) were selected using Probability Proportionate to Size sampling (P.P.S.). Only 390 students cooperated in the study. The non cooperation might be due to the reluctance in disclosing any information due to shyness in discussing sexual stages. The sample size was calculated using the formula –

\[
\text{Sample} = \frac{(1.96)^2 \times P \times Q}{L^2}, \text{ where Prevalence (P) = 20\%, Q = (1-P), Absolute Precision (L) = 4\%}.
\]

The study was started after its approval by institutional board of studies. Verbal consent of the Principals of the schools selected for the study was received, prior to starting the study. The parents of the students were informed about this study in the parent teacher meeting and their affirmation was taken by the Principal of the school.

The study tools consisted of a self-developed, pre-tested, semi-structured questionnaire dealing with the child’s socio- demographic background, anthropometry for assessing physical growth and sexual development was assessed by Sexual Maturity Rating. The study units were selected randomly and proportionately from 5th to 12th class in each school. Age was recorded from the school records as on their last birthday. Weight (Kgs) and Height (cms) was taken according to standard protocol. SMR (Sexual Maturity Rating) was done as described by Tanner JM 1962\textsuperscript{10}. Individuals were shown a pictorial representation of pubic hairs and genital stages of SMR and were asked the question – “In which stage of Maturity do you fall in?” The adolescents were required to point out from the picture and the stage was recorded.

Sexual Maturity Staging – Pubic Hairs

SMR 1 Preadolescent: no pubic hairs present; a fine vellus hair covers the genital area.

SMR 2 A sparse distribution of long, slightly pigmented hairs appears at the base of penis.

SMR 3 The pubic hair pigmentation increases; the hairs begin to curl and spread laterally in a scanty distribution.

SMR 4 The pubic hairs continue to curl and become coarse in texture. An adult type of distribution is attained, but the number of hairs remains fewer.

SMR 5 Mature: the pubic hair attains an adult distribution with spread to the surface of the medial thigh. Pubic hair will grow along linea alba in 80% of males.

Sexual Maturity Staging – Genitalia

SMR 1 Preadolescent: testes, scrotum, and penis identical to early childhood.

SMR 2 The testes and scrotum enlarges, developing a reddish hue and altering its skin texture. The penis enlarges slightly.

SMR 3 The testes and scrotum continues to grow. The length of penis increases.

SMR 4 The testes and scrotum continues to grow; the scrotal skin darkens. The penis grows in width, and the glans penis develops.

SMR 5 Mature: adult size and shape of testes, scrotum, and penis.

Statistical Analysis

Data collected were entered and analyzed by SPSS\textsuperscript{11} for Windows version 10. Data was tested statistically by percentages, means and ANOVA where applicable. Linear correlations were used to define the relation between different parameters.

Results

Socio-demographic Characteristics

The age of the study population ranged from 10-19 years. Most of the study population was Hindu by religion, belonging to lower and middle socioeconomic status, living in unitary families with more than 5 total family members.

Majority of the population (42.3 %) belonged to 10-13 years age group (early adolescents)
followed by 35.6% in 14 to 15 years age group (mid adolescents) and only 22.1% were in the 16 to 19 years age group (late adolescents) Table-1. It also depicts that in both urban and rural areas there were lesser number of students in the age group 16-19 yrs (23% and 21% respectively). In rural area the majority of the population (59%) belonged to 10-13 yrs age group as compared to (26.5%) of urban area.

Table-1. Distribution of Adolescent Boys According to their age Groups

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Place</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Urban No. (%)</td>
<td>Rural No. (%)</td>
</tr>
<tr>
<td>10 - 13 yrs (Early adolescents)</td>
<td>53 (26.5)</td>
<td>112 (59)</td>
</tr>
<tr>
<td>14 - 15 yrs (Mid adolescents)</td>
<td>101 (50.5)</td>
<td>38 (20)</td>
</tr>
<tr>
<td>16 - 19 yrs (Late adolescents)</td>
<td>46 (23)</td>
<td>40 (21)</td>
</tr>
<tr>
<td>Total</td>
<td>200 (100)</td>
<td>190 (100)</td>
</tr>
</tbody>
</table>

Pattern of Sexual development (SMR Staging)

Table 2, shows the range in years of SMR stages i.e. no student was seen in SMR-1 stage at 15 yrs of age, SMR-2 stage was attained by 14.3% students at 10 yrs of age and it ended at 16 yrs of age. SMR-3 stage was attained at 11 yrs of age by 5% of the students only whereas majority (46.3%) attained it at 15 yrs of age and it ended gradually at 18 yrs of age. Similar trend was seen with SMR-4 stage, which was attained by 4.9% of 13 yrs old students of our study population, with a maximum of 47.1% at age 16 yrs tapering gradually to end at 19 yrs. Lastly SMR-5 stage was attained at age 14 yrs by only 4.2% of the students, its prevalence increased gradually with age so that by age 19 yrs the prevalence was 100%.

Influence of sexual development (SMR stages) on mean weight of adolescent boys

Figure 1 shows the mean weight in relation to the sexual development (SMR) stages of the study population. Increment in mean weight is apparent from lower age group to higher age groups among adolescents with the same stage of sexual development. It is evident from the observation that in SMR-3 the mean weight increased from 38.0 kgs, to 47.2 kgs respectively.

While within the same age group the increment in mean weight is apparent according to the advancement of sexual development (SMR stages). This is evident from the observation that in age group of 14-15 yrs the mean weights are 37.0 kgs, 44.5 kgs, 45.8 kgs and 47.8 kgs in SMR-1, SMR-2, SMR-3 and SMR-4 respectively.

Table-2 : Pattern of Sexual Development (Sexual Maturity Rating) in adolescent boys

<table>
<thead>
<tr>
<th>Age (yrs)</th>
<th>SMR-1 (%)</th>
<th>SMR-2 (%)</th>
<th>SMR-3 (%)</th>
<th>SMR-4 (%)</th>
<th>SMR-5 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>85.7</td>
<td>14.3</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>11</td>
<td>70</td>
<td>25</td>
<td>5</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>12</td>
<td>55</td>
<td>35</td>
<td>10</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>13</td>
<td>25.9</td>
<td>45.7</td>
<td>23.5</td>
<td>4.9</td>
<td>—</td>
</tr>
<tr>
<td>14</td>
<td>5.6</td>
<td>38</td>
<td>29.6</td>
<td>22.5</td>
<td>4.2</td>
</tr>
<tr>
<td>15</td>
<td>—</td>
<td>11.9</td>
<td>46.3</td>
<td>20.9</td>
<td>20.9</td>
</tr>
<tr>
<td>16</td>
<td>—</td>
<td>—</td>
<td>13.7</td>
<td>47.1</td>
<td>39.2</td>
</tr>
<tr>
<td>17</td>
<td>—</td>
<td>—</td>
<td>5.3</td>
<td>15.8</td>
<td>78.9</td>
</tr>
<tr>
<td>18</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>8.3</td>
<td>91.7</td>
</tr>
<tr>
<td>19</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>100</td>
</tr>
</tbody>
</table>

Influence of sexual development (SMR stages) on mean height of adolescent boys

Figure 2 shows the mean height in relation to the sexual development (SMR) stages among study population. Increment in mean height is apparent from lower age group to higher age groups among adolescents with the same stage of sexual development. This is evident from the observation that in SMR-4 the mean height was 153.6 cms.
161.6 cms and 164.8 cms for the age groups 10-13 yrs, 14-15 yrs and 16-19 yrs respectively.

While within the same age group the increment in mean height is apparent according to the advancement of sexual development (SMR stages). This is evident from the observation that in 10-13 yrs the mean heights were 139.3 cms, 146.0 cms, 152.5 cms and 153.6 cms in SMR-1, SMR-2, SMR-3 and SMR-4 respectively.

Table-3 shows the distribution of the study population according to the age of their Spermarche (1st ejaculation). The age range of Spermarche in the children was from 14yrs-17yrs. Also the onset of Spermarche in majority (44.4%) followed by (35%) of the children was at 15 yrs and 16 yrs of age respectively. There was no significant difference in the pattern of onset of Spermarche in the rural and urban children in this study.

Table-3. Age of 1st ejaculation in adolescent boys

<table>
<thead>
<tr>
<th>Age at 1st nocturnal emission</th>
<th>Place</th>
<th>Urban</th>
<th>%</th>
<th>Rural</th>
<th>%</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>14 yrs</td>
<td></td>
<td>11</td>
<td>52.3</td>
<td>10</td>
<td>47.7</td>
<td>21</td>
<td>100</td>
</tr>
<tr>
<td>15 yrs</td>
<td></td>
<td>33</td>
<td>63.4</td>
<td>19</td>
<td>36.6</td>
<td>52</td>
<td>100</td>
</tr>
<tr>
<td>16 yrs</td>
<td></td>
<td>24</td>
<td>58.5</td>
<td>17</td>
<td>41.5</td>
<td>41</td>
<td>100</td>
</tr>
<tr>
<td>17 yrs</td>
<td></td>
<td>1</td>
<td>33.3</td>
<td>2</td>
<td>66.7</td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>69</td>
<td>58.9</td>
<td>48</td>
<td>41.1</td>
<td>117</td>
<td>100</td>
</tr>
</tbody>
</table>

Discussion

In this study presence of lesser number of students in the age group 16-19 yrs was due to the non-inclusion of the only senior secondary school in the urban field practice area, because of lack of cooperation from the school authorities and in the rural area this was due to drop out rates among children that exist in the schools. Finding that both in rural and urban area the majority of the population belonged to early and mid teen age as compared to late adolescent which may be due to the high drop out rates in schools. Similar findings were also reported by various governmental agencies\(^2\) where the drop out rate for children in the primary level at grade V in U.P. India was given as high as 47.91%.

The importance of staging becomes evident on observing any group of adolescents of the same chronological age with their great variability in size, shape and level of pubertal maturation.\(^2\) The same is apparent in our study. Similar pattern of variation regarding the sexual development in the adolescents is also shown by other researchers\(^8,13\) and gave similar conclusion that there is great variability in the timings of onset of puberty and the progression of the sexual maturity among the adolescents. Similar results are reported in the study of other researchers\(^14\) where at 10 yrs of age 20.73 % were in SMR-2, and this stage ended by 17 yrs of age. A maximum of 39.14 % children were in stage-2 at 12 yrs of age. The SMR-3 stage was achieved by 6.22 % students at the age of 10 yrs. The maximum of 30.79 % of students in SMR-3 were of 14 yrs of age, and at 18 yrs of age only 2.35 % remained in SMR-3 as compared to our study where the maximum of 46.3 % students in stage-3 were at 15 yrs of age.

The difference in the observation of our study and\(^14\) study might be because our study relied on the comparison of the genitalia with the graphic representation of the SMR stage (Tanner J M) by the students themselves i.e. no direct observation was made by the doctor.

In this study, mean weight and height increased from lower age group to higher age group within the same stage of sexual development. This may be due to the effect of chronological age on somatic growth. On the other hand, within the same age group the mean weight as well as height also increased according to the current stage of sexual development. This increase in may be the effect of endocrine controlled somatic growth that occurs during adolescence. This shows that the anthropo-
metric indices for somatic growth in adolescence are influenced by both the chronological age and the sexual maturity of the adolescents. The results of our study are also in accordance to the results of the study of other scholars.15

Thus calculating the anthropometric indices in adolescence according to the age alone will not be of much use as the somatic growth also depends on the sexual maturity of the adolescents.

It was observed that at the age of 16 yrs 97.3% of the children had their first emission. Ejaculation occurred for the first time, usually during masturbation, and later spontaneously in sleep. The findings of this study are similar to the study done by other researchers16 on the variations and pattern of pubertal changes in boys reported the mean age of Spermarche as 14 yrs (S.D.:± 1.04 yr). Other scholars17,18 reported an earlier age (13 yrs) of Spermarche as compared to this study.

Conclusion

There is great variability in the timings of onset of puberty and the progression of the sexual maturity among the adolescent boys. The anthropometric indices for somatic growth in adolescence are influenced by both the chronological age and the sexual maturity of the adolescent boys. Thus calculating the anthropometric indices in adolescence according to the age alone will not be of much use as the somatic growth also depends on the sexual maturity of the adolescents.

References