

Original Article

Study of Age of Appearance and Development of Secondary Sexual Characteristics amongst Adolescents of the Bikaner Region, Rajasthan

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ABSTRACT

Estimation of the age of living persons is required in many civil and criminal cases and in questionable cases. Registration of birth certificate is the most reliable document as an evidence of real age, but for many reasons, births are not registered in many cases in India, especially in the rural areas. This requires various radiological investigations to be carried out to estimate the age. In rural settings, these facilities are not available and, if available, are limited to the use for patients who are in more need of such medical facilities. Thus, physical examination involving secondary sexual characteristics promises to be an easy and cost-effective means for the same purpose. The objectives of this study were: (1) to find out the age of appearance of various secondary sexual characteristics in adolescent males and females; (2) to note the ages of development of various stages of such characteristics; and (3) to find the maximum age after which a specific characteristic is universally present. The study involved the examination of adolescents of both the sexes, aged between 12 and 20 years, coming to the Out patient department (OPD) of the Forensic Medicine Department of the PBM Hospital and from the population residing around the campus. A total of 165 subjects (109 males and 56 females) were examined to study the appearance and development of various secondary sexual characteristics. Breast development started before the age of 12 years and most girls aged between 12 and 13 years exhibited stage A development. All girls aged above 17 years showed stage D development. Pubic hairs were in stage A in 90% of the girls aged between 12 and 13 years and 100% girls beyond 17 years exhibited stage D development. Axillary hairs were present in 100% subjects aged above 16 years. In males, pubic hairs appeared later than in females, but were present in all cases above 14 years and were in stage D in boys aged above 17 years. Axillary hairs appeared between 14 and 15 years of age in all the cases. Adam's apple became prominent between 14 and 16 years of age in all the cases and facial hairs appeared between 15 and 16 years of age. Secondary sexual characteristics could be utilised as a definite procedure for age estimation within a narrow age range in maximum number of cases, thus saving time, energy and resources. Remaining doubtful cases could be solved with more sophisticated methods, like radiological examination and dental analysis, requiring special diagnostic tools and specialised personnel. Though some regional variations were seen in secondary sexual characteristics, as were seen in other methods too, these could be easily worked out by undertaking regional research and setting the standards.

Keywords: Secondary sexual characteristics, Age estimation, Non-invasive methods, External physical examination, Breast development, Pubic hair

INTRODUCTION

Knowledge of the age of a person is important, as it is an important criterion for identification. Not only identification, it is also required for legal reasons ranging from various civil issues like validity of consent, employment, attainment

of majority, marriage and sports to criminal cases like establishing criminal responsibility, kidnapping, rape, etc. In countries like India, where most of the population resides in villages, maximum number of births takes place in the rural areas and most of these are not registered.^[1-2] In such cases, a definite proof of age is not available.

Estimation of age of such individuals may deem necessary in demanding situations, either related to civil or criminal matters, to be done by the medical practitioners who are experts in this field. Many methods are used for age estimation, but the most important and relevant are: (1) eruption of teeth (both primary and secondary), (2) ossification of bones and (3) secondary sex characteristics.^[3] Extensive research is done on the dental data, as it is one of the oldest methods for age estimation, and also on the appearance and fusion of various ossification centres of the bones. However, geographical-area-specific literature and studies pertaining to external physical examination, specially related to appearance and development of secondary sexual characteristics, are relatively scarce. With changing times, changes in the age of appearance and development of secondary sexual characteristics have been observed.^[4] In developing countries like India, where resources are limited and most of the population resides in villages with further limited facilities, such non-invasive methods of age estimation are of great significance. Therefore, this study was undertaken to gather scientific data of appearance of secondary sexual characteristics in the subjects aged 12-20 years. This is the age group when the secondary sexual characteristics develop, and mostly all the characters develop by the age of 20 years, even in cases of delayed puberty, and also determination of various specific ages is important in this age group from a legal point of view. Thus, anatomical and legal issues were considered for selecting this age range.

MATERIAL AND METHODS

The study was carried out in the Department of Forensic Medicine and Toxicology, SP Medical College and Hospital, Bikaner, Rajasthan. The subjects were randomly selected from various schools, neighbourhoods of various faculty members and staff and from cases attending the OPD of the Department of Forensic Medicine, PBM Hospital, Bikaner, Rajasthan. A total of 165 subjects aged between 12 and 20 years were physically examined to study the appearance and development of secondary sexual characteristics. Out of these, 109 were males and 56 were females. Examination of female subjects was done by a female doctor in the presence of another female, preferably the family member of the subject.

Informed written consent for the same was obtained from the male and female subjects, if major, or from their legal guardians, where required. The age of the subjects was confirmed from their birth certificates, other documents mentioning their actual age or date of birth or, in cases of doubt, by interrogating them under the promise of confidentiality.

Physical examination of the subjects was done to note secondary sexual characteristics. Following points were noted for female subjects:

1. Stage of development of the breast.
2. Appearance and stage of development of pubic hair.
3. Appearance of axillary hair.

Male subjects were examined to note the following:

1. Appearance and development of pubic hair.
2. Appearance of axillary hair.
3. Prominence of pomum Adami.
4. Appearance of facial hair.

Stages of development of various secondary sexual characteristics were classified as per the criteria given in the Modi's Medical Jurisprudence and Toxicology.^[5] These stages were comparable with the Tanner's classification stages 1-5 of breast and pubic hair development,^[6] where 1 stands for absence of feature, which we have noted otherwise. Subjects were classified in 1-year age groups, e.g. 12-13 years, 13-14 years and so on.

OBSERVATIONS AND RESULTS

Findings in Females

Examination of females for breast development revealed that all (100%) the girls aged between 12 and 14 years had stage A of breast development (Table 1). In all, 97% of the girls beyond 17 years of age were found to have stage D breast development and only 1 girl (3%) in the 18-19 years group had breast development at stage A. Most variable breast development was found in the 15-16 years age group, where the stage of development varied from B to D.

Pubic hair showed a specific pattern of appearance and development. In total, 87.5% girls in the age group of 12-13 years showed the presence of pubic hair, and all of them were at stage A (Table 2). Only 1 girl (12.5%) in this group had no pubic hair. No girl beyond 13 years of age had absence of pubic hair and no girl beyond 14 years had stage A hair. Between 14-17 years of age, pubic hairs were seen in various stages of development from B to D, but all the subjects beyond 17 years of age showed stage D hair.

None of the girls below the age of 14 years had axillary hair (Table 3). Axillary hairs start appearing between the ages of 14 and 15 years. Beyond 15 years of age, all the participants showed presence of axillary hair.

Findings in Males

A total of 83.33% of the subjects between 12 and 13 years of age showed absence of pubic hair, while in the remaining cases (16.67%) they were at stage A (Table 4). All the boys beyond 14 years of age had pubic hair, though in various stages of development. Between the ages of 13 and 17 years, gradual maturation of pubic hair

Table 1: Breast development

S.No.	Age group	Stage of breast development			
		A	B	C	D
1.	12-13	8	0	0	0
2.	13-14	2	0	0	0
3.	14-15	0	2	0	0
4.	15-16	0	2	1	1
5.	16-17	0	0	2	4
6.	17-18	0	0	0	19
7.	18-19	1	0	0	9
8.	19-20	0	0	0	5
	Total	11	4	3	38

Table 2: Development of pubic hair (female)

S.No.	Age group	Stage of pubic hair development				
		Absent	A	B	C	D
1.	12-13	1	7	0	0	0
2.	13-14	0	2	0	0	0
3.	14-15	0	0	2	0	0
4.	15-16	0	0	2	1	1
5.	16-17	0	0	0	2	4
6.	17-18	0	0	0	0	19
7.	18-19	0	0	0	0	10
8.	19-20	0	0	0	0	5
	Total	1	9	4	3	39

Table 3: Development of axillary hair (female)

S.No.	Age group	Development of axillary hair	
		Absent	Present
1.	12-13	8	0
2.	13-14	2	0
3.	14-15	1	1
4.	15-16	0	4
5.	16-17	0	6
6.	17-18	0	19
7.	18-19	0	10
8.	19-20	0	5
	Total	11	45

Table 4: Development of pubic hair (male)

S.No.	Age group	Stage of pubic hair development				
		Absent	A	B	C	D
1.	12-13	10	2	0	0	0
2.	13-14	4	4	1	0	0
3.	14-15	0	2	3	2	0
4.	15-16	0	0	2	6	2
5.	16-17	0	0	0	3	14
6.	17-18	0	0	0	0	25
7.	18-19	0	0	0	0	19
8.	19-20	0	0	0	0	10
	Total	14	8	6	11	70

was observed, with maximum number of subjects showing higher stage of development with increasing age. All the subjects beyond 17 years of age showed fully mature stage D pubic hair.

None of the males aged below 14 years showed the presence of axillary hair, whereas all the subjects beyond 15 years of age had axillary hair (Table 5).

No boy below 14 years of age had prominent pomum Adami (Table 6). Pomum Adami seems to become prominent between 14 and 16 years of age, in which age group subjects with and without prominent pomum Adami were seen. All the subjects beyond 16 years of age had prominent pomum Adami.

Facial hairs were not present in any of the subjects aged below 15 years, and all the subjects aged above 17 years showed the presence of facial hair (Table 7).

DISCUSSION

We compared our results with a large-scale nationwide study conducted by the ICMR^[7] and a study conducted at Chandigarh by Singh *et al.*^[8] In our study, we found

Table 5: Development of axillary hair (male)

S.No.	Age group	Development of axillary hair	
		Absent	Present
1.	12-13	12	0
2.	13-14	9	0
3.	14-15	4	3
4.	15-16	0	10
5.	16-17	0	17
6.	17-18	0	25
7.	18-19	0	19
8.	19-20	0	10
	Total	25	84

Table 6: Development of pomum Adami

S.No.	Age group	Appearance of pomum Adami	
		Not prominent	Prominent
1.	12-13	12	-
2.	13-14	9	-
3.	14-15	4	3
4.	15-16	4	6
5.	16-17	0	17
6.	17-18	0	25
7.	18-19	0	19
8.	19-20	0	10
	Total	29	80

Table 7: Development of facial hair (male)

S.No.	Age group	Development of axillary hair	
		Absent	Present
1.	12-13	12	0
2.	13-14	9	0
3.	14-15	7	0
4.	15-16	9	1
5.	16-17	0	17
6.	17-18	0	25
7.	18-19	0	19
8.	19-20	0	10
	Total	37	72

that all the girls aged 12-14 years had stage A breast development. Our findings were in agreement with the ICMR study, which found stage 2 development (BD2) up to the ages of 12.3 years, but differed slightly from Singh *et al.*, who found it at 11 years of age. The mean age of development up to stage 5 (BD5) (stage D in our study) in the ICMR study was 14.8 years, this difference might be due to the age group (10-16 years) selected in the ICMR study. In the Singh *et al.* study, only 37% girls aged 16 years had stage 5 development. This is well in accordance with our study, where we found 33.33% stage

D development between 16 and 17 years and 100% stage D development after the age of 17 years.

In case of pubic hair, findings in our study were in consensus with the other two, i.e. pubic hairs start appearing before the age of 12 years, which, in our study, were present in 87.5% subjects in 12-13 years age group, though all were at stage A. In the study carried out in Punjab, 100% subjects aged above 16 years had stage 5 pubic hair, which was similar to our study, wherein 95% subjects aged above 16 years and 100% above 17 years had stage D pubic hair.

Axillary hairs in our study were not observed before the age of 14 years in any subject, while 100% subjects showed the presence after 15 years of age. It is said that axillary hairs appear after pubic hair (ICMR^[7]). The ICMR and Singh *et al.* studies were in partial consensus with ours as in these studies, the axillary hairs were seen to appear even before 12 years of age, but in all the three studies, 100% subjects were observed to have axillary hair beyond the age of 15-16 years.

Pubic hairs appear earlier than axillary hair and this finding was in agreement to the standard literature. Pubic hair appeared later in boys compared with girls, as only 16.67% boys in the age group of 12-13 years showed the presence of pubic hair, while in girls, 87.5% subjects showed the presence of pubic hair in the same age group. All the subjects above 14 years of age showed pubic hair in various stages of development, which was in agreement to that of the ICMR study, and 100% boys beyond the age of 17 years had stage D pubic hair.

Axillary hairs in boys were seen to appear between the ages of 14 and 15 years, with no subject showing their presence before the age of 14 years. These findings were in unison with those seen in the ICMR study.

Pomum Adami, in our study, was seen to become prominent above 14 years of age in 42.86% and above 15 years in 60% of the boys. All the subjects beyond 16 years had a prominent Adam's apple. These findings were in agreement with those in the literature^[9].

Facial hair among the boys was seen to start developing between 15 and 16 years of age, with none of them

showing them before 15 years of age and 100% subjects showing their presence after 16 years of age. This finding was in agreement to that of the ICMR study, which showed earlier appearance of facial hair only among boys from Chandigarh.

CONCLUSION AND RECOMMENDATIONS

Identifying various secondary sexual characteristics can definitely be helpful as non-invasive, no cost method for age estimation. Though slight regional variations are seen, these can be worked out by carrying out more and more regional studies and strengthening the literature.

Development of breast in majority of the cases started before the age of 12 years, and up to 13 years of age, maximum girls had stage A or BD2 development. Between the ages of 16 and 17 years, just one-third of the girls had stage D development, which was present in 100% cases after the age of 17 years.

Pubic hairs appeared before axillary hairs, prior to 12 years of age, and between the ages of 12 and 13 years, almost 90% girls had stage A development. Stage D development was seen in 95% subjects above the age of 16 years and 100% in girls aged above 17 years.

Axillary hair appeared a little later than pubic hair and were seen in only 50% girls aged above 13 years, but were present in 100% cases aged above 16 years.

Among the boys in our study, appearance of pubic hair was the earliest change, which appeared in stage A in 16.67% cases aged above 12 years and in 100% cases aged above 14 years in various stages. All the boys above 17 years had adult-type pubic hair.

Axillary hair and prominent pomum Adami both made their appearance only after the age of 14 years and were present in 100% subjects aged beyond 15 and 16 years.

Facial hairs were seen to appear only after the age of 15 years and were present in 100% of the subjects beyond 16 years of age.

All these studies suggest that there is a very narrow range of appearance and development through various stages of maturation of these secondary sexual characters. Slight variations in the particular ages are seen in different

regions. Large studies like that conducted by the ICMR show a little wider range, while regional studies like ours and that conducted at Chandigarh show a very narrow range. This signifies the importance of work on these external characters in various regions and of setting local guidelines.

External physical examination is a very cost-effective method of age estimation, especially in countries like India, where resources are limited and almost 70% of the population reside in rural areas with no definite birth records.^[1-2,10] Utilising already scarce resources for age estimation in most of the civil and criminal cases is a costly affair in the developing countries. Thus, external examination to assess the development of secondary sexual characteristics and, thus, age estimation can be an easy-to-perform, handy and cost-effective tool in the rural settings, at least to screen out large number of cases in which definite diagnosis can be made by this method alone. In the remaining doubtful cases, utilisation of more sophisticated tools for age estimation can be made to save time, energy and, at the top, resources.

Therefore, we recommend the following:

1. More studies should be carried out by the researchers in various states of India to find out regional standards.
2. Studies should include as many number of subjects as possible, to increase accuracy of the findings.
3. Further classification of stages of development of axillary hair should be attempted so that more precise age estimation can be done.

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