A Comparative Analysis of Chronological Age with Dental Age and Skeletal Age
in 6 Years to 18 Years Age Group Individuals Coming for Age Estimation in the
Department of Forensic and State Medicine, Medical College, Kolkata

■ ORIGINAL ARTICLE

A Comparative Analysis of Chronological age with Dental age and Skeletal age in 6 years to 18 years age group individuals coming for age Estimation in the Department of Forensic and State Medicine, Medical College, Kolkata

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ABSTRACT

INTRODUCTION:

Age estimation is an essential assignment in clinical forensic medicine. In forensic medicine department of Medical College, Kolkata, dental age is assessed by noting eruption/emergence of respective tooth and skeletal age is estimated by observing appearance and fusion of secondary ossification centres on the skiagram, in reference to Galstaun's chart. Both are age-old and have significant observer variations. This study is done to ascertain applicability of these methods to contemporary population.

OBJECTIVES: To determine correlation between dental, skeletal and chronological age of the study population.

MATERIALS AND METHODS: A cross-sectional and observational study was performed on 52 Bengali subjects of 6-18 years age (36 male and 16 female) excluding subjects with obvious skeletal or developmental abnormalities and without valid documentation of age. Pearson's coefficient was applied to measure the correlation, as mentioned.

RESULTS: Chronological age was found to be positively correlated with dental and skeletal age and found to be statistically significant (p<0.01). The correlation between dental and skeletal age was also found to be statistically significant (p<0.01).

CONCLUSION: The routine methods used for age estimation is simple, cost effective, easy to perform with minimum training and is still applicable to the contemporary population.

.KEYWORDS | Age estimation; Chronological age; Correlation; Dental age; Skeletal age

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INTRODUCTION

Age estimation is an important assignment in forensic medicine and is carried out for different purposes, civil and criminal. Dental maturity is considered as one of the most reliable methods for estimation of age There are various methods available for estimation of age from teeth e.g., visual, chemical, radiological and histological.[1]

The skeletal maturity of the individual is known as bone age. Bone age is an indicator of physiological development and is distinct from the chronological age. The appearance and union of the different secondary centres of ossification follows a fairly definite pattern and time schedule from birth to maturity.[2] A Radiological study of these skeletal maturational processes provides a valuable criterion of the level of osseous maturation up to a certain age. The relation between dental, skeletal and chronological age are of great interest in indicating an advancement or delay compared to standard growth. Hereditary, environmental, nutritional, sexual, metabolic, social, emotional and cultural factors affect growth and development greatly.[3,4] Throughout the scientific literature, available all over the world, there are several studies which focused in relationship between the dental age, skeletal maturity and chronological age among different populations and different age groups sometimes stratified with other variables. To our knowledge no such study is available in local population. Therefore, in this present study we want to determine and compare dental age and skeletal age with chronological age of the study sample and to determine correlation between dental age, skeletal age and chronological age in the same context. We think the results will be of great help in the field of clinical forensic medicine.

OBJECTIVES

GENERAL OBJECTIVE: To determine the reproducibility of routine methods of age estimation used in the Department of FSM of Medical College, Kolkata.

SPECIFIC OBJECTIVES:

- To determine chronological age from valid documents of birth.

- To estimate dental age from observation of eruption/emergence of respective tooth.

- To estimate skeletal age from observation of appearance and fusion of ossification centres around pre-specified joints in digital skiagram with respect to Galstaun's chart

- To calculate, statistically, the correlation between chronological age, dental age and skeletal age.

MATERIAL & METHODS

STUDY DESIGN: A cross-sectional and observational study.

STUDY POPULATION: Individuals from Kolkata metropolis and its suburban towns, belonging to 6-18 years of age group and coming for estimation of age in the Department of Forensic and State Medicine of Medical College, Kolkata.

PLACE OF STUDY: Department of FSM, Medical College, Kolkata.

PERIOD OF STUDY: 1.09.2021 to 31.01.2022

SAMPLE SIZE: 52 (n =52) individuals of both genders. Male= 36, Female=16.

SAMPLING TECHNIQUE: Census method (Complete Enumeration Survey Method)

SAMPLING CRITERIA

1. INCLUSION CRITERIA: All Male and Female subjects 6-18 years of age who attended department of FSM of Medical College, Kolkata for estimation of age, during the period of study.

2. EXCLUSION CRITERIA

- Individuals not having valid documentation (Discharge certificate following delivery/birth from government or private health institutions & Certificate of Registration of birth showing evidence of institutional delivery) of Chronological age,

- Individuals with obvious skeletal deformity.

- Individuals suffering from obvious disorders of growth and development.

- Individuals suffering from documented malnutrition.

STUDY TOOLS

- Metallic Probe

- Standard charts of dentition.[5]

- Digital Skiagrams showing antero-

posterior view of wrist joint, antero-posterior and lateral view of elbow joint of non-dominant side and antero-posterior view of pelvis

- View box
- Galstaun's chart.
- Technical feature of X-ray machine-generator of 80KW (kilowatt) power, collimator with focal spot size of 0.6mm, anode heat capacity of 300 KHY (Kilo Heat Unit where 1 Joule= 1.4 HU), ceiling suspended tube with movement in all direction, x-ray table having a weight bearing capacity of 200 kg, digital detector with a spatial resolution of 2.5 lines pair/millimetre, high speed processor of 32 bit and an image storage disc of 70 gigabyte.

STUDY TECHNIQUE

- ***Consent:*** Before commencement of examination, the procedure is explained thoroughly in their own vernacular to the subjects including their legal guardian/ parent (as most of the subjects were less than 18 years). Thereafter written and witnessed informed consent was obtained from their legal guardian/ parent along with the ascent of the subjects. The documentations regarding consent were preserved properly.
- Chronological age, as on the day of examination, was calculated from the certified date of birth i.e., from the valid certificate of registration of birth/discharge certificate of following delivery.[6]
- For dental examination, the subject was made to sit on a stool under proper illumination and exposure. Then, eruption/emergence of respective tooth (Temporary and Permanent) is observed with a probe as per conventional method.[1,7]
- Digital Skiagrams of specific parts [Wrist of non-dominant side (AP view), Elbow joint of non-dominant side (AP and Lateral view) and Pelvis (AP view)] was

taken as per standard specifications and skeletal age was estimated by observing the status of appearances and fusions of secondary ossification centres with reference to the Galstaun's chart.[8]

- To minimize observer bias, dental and radiological observation of each case was recorded separately and independently by investigators according to predetermined standardized criteria.
- Observations were tabulated with the help of Microsoft Excel and statistical analysis were performed with the help of SPSS software.
- The central tendency of the data was measured in the form of mean, median, mode and range. The dispersion was calculated by standard deviation. To determine the correlation between the chronological, dental and skeletal age, Pearson's correlation coefficient was calculated.

RESULTS

Of the samples collected, 69.2% were male and 30.8% were female (Table No 1).

Table 1: Gender wise distribution of samples.

Gender	n	Percentage (%)
Male	36	69.2
Female	16	30.8

The sample had most subjects (16/30.72%) in the age group of 10 to 12 years, followed by (12/23.10%) in the age group of 8 to 10 years (Table no 2).

Table 2: Age wise distribution of sample

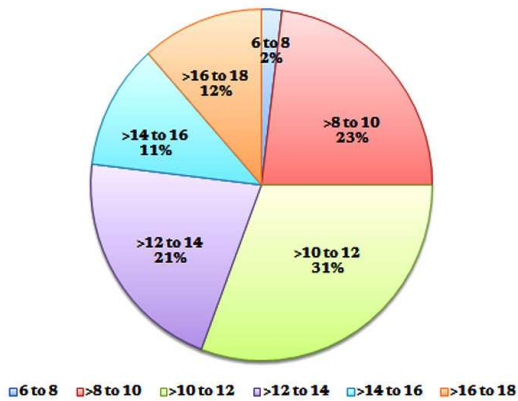| Age group	n	Percentage (%)
6 to 8	1	1.92
>8 to 10	12	23.10
>10 to 12	16	30.72
>12 to 14	11	21.16
>14 to 16	6	11.55
>16 to 18	6	11.55

Fig.1: Age wise distribution of sample.

The mean chronological, dental and skeletal age of female subjects were 11.31, 11.66, 11.47 years respectively, whereas that for male subjects were 12.47, 12.97, 13.09 years respectively (Table No.3).

Table 3: Gender wise mean age Mean age of study parameters.

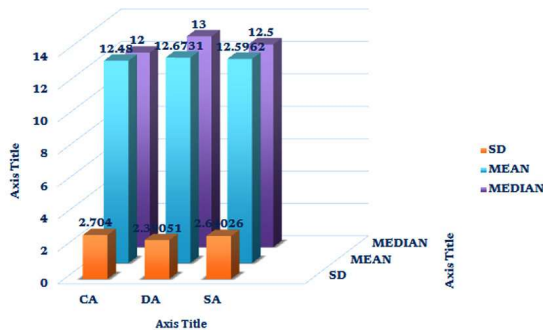| Gender	Chronological age	Dental Age	Skeletal Age
Male	12.47	12.97	13.09
Female	11.31	11.66	11.47

Fig. 2: Chart showing central tendency of the study sample.

Overall mean chronological, dental and skeletal ages were 12.48, 12.6731 and 12.5962 years respectively. (Table No.4)

Table 4: Measures of Central Tendency of various study parameters.

Statistical Parameter(N=52)	Chronological Age (CA)	Dental Age (DA)	Skeletal Age (SA)
Mean	12.48	12.6731	12.5962
Median	12	13	12.50
Mode	11	15.50	10.50

Std. Deviation	2.704	2.39051	2.64026
Range	10	7	10
Minimum	8	8.50	7.50
Maximum	18	15.50	17.50

Standard deviation for chronological, dental and skeletal age were 2.704, 2.39051 and 2.64026 respectively. (Table No.4)

A correlation was found between chronological age and dental ages. (Table No.5)

$$r=0.897, p<0.01$$

A correlation was observed between Chronological and skeletal ages. (Table No.5)

$$r= 0.949, p<0.01$$

A correlation was also found between dental and skeletal ages (Table No.5)

$$r=0.884, \quad p<0.01$$

Table5: Overall relationship between Chronological, Dental and Skeletal age.

		Chronological age	Skeletal age	Dental age
Chronological age	Pearson Correlation	1	.949**	.897**
	Sig. (2-tailed)		.000	.000
	N	52	52	52
Skeletal age	Pearson Correlation	.949**	1	.884**
	Sig. (2-tailed)	.000		.000
	N	52	52	52
Dental age	Pearson Correlation	.897**	.884**	1
	Sig. (2-tailed)	.000	.000	
	N	52	52	52

Correlation is significant at the level of 0.01 (2- tailed)

DISCUSSION

In available literature, there are limited number of studies in India on estimation of age, both by application of comparison based radiological method and by observation of dental eruption; even fewer in West Bengal. As age estimation is a common routine assignment, as an aid to medicolegal cases, there is need to check applicability of the age old methods used in

present study setting.

Our study sample mostly comprise of the individuals, who sought age estimation for competitive age category sports. The sample showed preponderance of male subjects than that of female subjects (Table No. 1). This phenomenon can be attributed to the fact that females of local population are not usually encouraged to outdoor sports e.g., swimming, tennis etc. Thus, creating a gender-based discrepancy in the sample size.

It was observed that the mean chronological, dental and skeletal age for females were lower than that of male individuals (Table No. 3).

There was no significant difference between the overall mean, median and mode of chronological, dental and skeletal age (Table No. 4).

We observed highly significant positive correlation between chronological vs dental, chronological vs skeletal and dental vs skeletal ages (Table No. 5) But the highest correlation coefficient was between chronological and skeletal age i.e.; 0.949.

In the study of Palanisamy V et al[9] on 104 children of 9-14 years of age in Karnataka, they used hand-wrist radiographs and Fishman's skeletal maturation index for skeletal age and Demirjian's method for dental age estimation. They found that chronological age was positively correlated to dental age and skeletal age while being statistically significant (P < 0.01). The correlation between dental age and skeletal age was also statistically significant with P < 0.001 and correlation coefficient of 0.683 and 0.704 for males and females respectively. This outcome is consistent with the results of our study.

The study of Hasan BM et al[10] on 112 Sudanese patients of 7-16 years age using Cervical Vertebral Maturation stages for skeletal and Demirjian's method for dental age estimation, showed an overall highly significant correlation between chronological, dental and skeletal age (P<0.05). Our results are also similar to this.

The outcome of our study is also similar to studies done by Gupta M et al[11] and Chaudhury K et al.[12]

CONCLUSION

This cross-sectional observational study was conducted on 52 individuals from Kolkata metropolis and its suburban towns, belonging to 6-18 years of age group and coming for estimation of age in the Department of Forensic and State Medicine of Medical College, Kolkata. The objective was to determine the correlation between chronological, dental and skeletal age by using visual inspection method of dental eruption/emergence for dental age estimation and comparison-based method of observing appearance and fusion of pre-determined ossification centres as per Galstaun's chart for skeletal age estimation. The outcome was that there was highly significant positive correlation between chronological vs dental, chronological vs skeletal and dental vs skeletal ages.

Thus, it can be concluded that method used for estimation of age in this study is still valid and reliable, though being simple and an age-old method.

Limitation of the Study and Recommendation

Limitation

- Small sample size which increases the chances of random error.

- For the purpose of statistical analysis, mainly for calculation of Pearson's correlation coefficient, we took the median of the estimated age range for both skeletal and chronological age.

Recommendation: Another similar study with larger sample size for the same population will yield more reliable outcome.

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