Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.elsevier.com/locate/jobcr

Original Article

Reliability of India-specific regression formula for age estimation of population in and around Bahadurgarh, Haryana (India)

Ankita Tandon [a,*], *Vartika Agarwal* [b], *Varun Arora* [c]

[a] *Department of Oral Pathology & Microbiology, PDM Dental College and Research Institute, Bahadurgarh, Haryana, India*

[b] *Department of Public Health Dentistry, ITS Dental College Hospital & Research Institute, Greater Noida, Uttar Pradesh, India*

[c] *Research Consultant at APS and Visiting Faculty (Epidemiology and Biostatistics), Lucknow University, Lucknow, Uttar Pradesh, India*

ARTICLE INFO

Article history:
Received 25 March 2015
Accepted 20 June 2015
Available online 29 July 2015

Keywords:
Age estimation
Demirjian's method
Forensic dentistry
India-specific

ABSTRACT

Objectives: The study was conducted to check the reliability of India-specific regression formula for age estimation of population in and around Bahadurgarh, Haryana (India).

Materials and methods: The study was conducted using digital orthopantomograms (OPGs) of 464 subjects (253 males and 211 females). Chronologic age (CA) was derived from that mentioned on the OPG. Each tooth in the left mandibular segment was scored using Demirjian's scoring and age was calculated using the regression formulas derived by Acharya. The difference of the chronologic and estimated age was used to check the reliability of India-specific regression formula.

Results: The mean estimated age was found to be significantly higher as compared to CA for overall as well as both the genders independently ($p < 0.001$). Difference (in $\pm$) between estimated and CA ranged from 0 to 4.2 years. Mean difference in age was 0.85 ± 0.73 years for males and 0.87 ± 0.76 years for females.

Conclusion: The published India-specific regression formula does not have reliability in the population of Bahadurgarh, Haryana and hence cannot be universally applied.

1. Introduction

Estimation of age is very significant in aspect of accordance with laws.[1] The age estimation process has to be highly accurate in predicting the individual's age and should be easy to use. In the current scenario, most of the age estimation modalities are invasive, require lengthy processing times, use expensive instruments and services of an experienced pathologist to deduce the age of the person.[2,3] Various methods of age estimation have been suggested in the literature which includes Gustafson's method, measurement of dentin translucency, counting annular cemental rings, calculating pulp-to-tooth ratio, using amino acid racemization, measuring ^{14}C levels, etc.[4]

* *Corresponding author.*
E-mail addresses: tandon_ankita7@rediffmail.com, drankitatandon7@gmail.com (A. Tandon).

http://dx.doi.org/10.1016/j.jobcr.2015.06.013

But the biggest pitfall had been the lack of usability of these methods in-vivo.[2,3] Radiographic approach, therefore, renders an insight into the developmental stages of the teeth, which provides a baseline data for age estimation.[3]

Hence, Demirjian et al.[5] classified the development of teeth into 8 stages and derived an age estimation formula. The original method used only seven left mandibular teeth and assigned a gender-specific maturity score to each tooth. The scores were then summed up and compared with the charts to arrive at the age.[5] This method has undergone a number of modifications, since then due to its lack of reliability in several subsequent studies.[6]

In order to overrule the differences in age detection, Acharya[6] carried out a regression analysis and derived a formula incorporating third molars as well into the age estimation process in an Indian population. The aim of this study is to evaluate the reliability of the India-specific regression formula for age estimation of population in and around Bahadurgarh, Haryana (India).

2. Materials and methods

The study was carried on orthopantomograms (OPGs) retrieved from the Department of Oral Medicine and Radiology with the permission of the institutional ethical committee. The OPGs belonged to the age group of 7–21 years (males = 253 and females = 211, total = 464). OPGs with the full complement of teeth in the left mandibular segment were included in the study. Subjects with prior history of malnutrition and growth disorders as mentioned in the history proforma of the software were excluded. Also, OPGs with distortion of image, lack of contrast, dental crowding, and pathologies were not included in the study.

The sample size projection was based on the study of Kumar and Gopal[3] who had reported the estimated age error within ±1 year range in 44% of their samples. Considering this to be the targeted precision of ±1 year in our study, we calculated the sample size using the following formula:

$$n = z^2 \frac{p(1-p)}{d^2},$$

where 'p' is the proposed prevalence (44% or 0.44), z is a constant having a value of 1.96 at 95% confidence and 80% power, and d is the proposed absolute error (5% or 0.05).

Putting these values in above equation, we get

$$n = 1.96^2 \frac{0.44(1-0.44)}{0.05^2} = 378.68 = 379$$

Thus the calculated sample size for the proposed precision level was 379. After adding for a contingency at 25% the projected sample size was 474. A total of 474 OPGs were collected, however, for 10 OPGs, the data were inappropriate and hence they were excluded from assessment. Finally, the sample size was 464, which is sufficient enough to explain the targeted precision.

The radiographs were divided into the following groups:

Group A: 7–10 years
Group B: 11–15 years
Group C: 16–18 years
Group D: 19–21 years

The images obtained from digital OPG machine (Panoramic X-Ray Imaging System, Pax 400 C, Vatech Co. Ltd, Korea) were converted to JPEG format. The digital images were then analyzed with Adobe Photoshop 7.0. During the analysis, 'Magnify' and 'Ruler' tools were used.

The teeth in the left mandibular segment were scored based on the Demirjian's modified criteria, which included ten stages of tooth development[7] since at present no India-specific maturity scores have been proposed.[3] The scores were summed up and age was estimated using the gender-specific regression formula proposed by Acharya.[6]

$$\text{Males}: \quad \text{Age} = 27.4351 - (0.0097 \times S^2) + (0.000089 \times S^3)$$

$$\text{Females}: \quad \text{Age} = 23.7288 - (0.0088 \times S^2) + (0.000085 \times S^3)$$

The calculated values were designated as the dental age (DA) and these were compared with the chronological ages (CA), which were obtained from the date of birth as recorded on the digital OPG. To rule out the intra-observer difference, 100 randomly selected radiographs were re-evaluated. The inter-observer agreeability was arrived by scoring 100 randomly selected radiographs between two observers, and the results obtained were compared. The statistical analysis was carried out using Statistical Package for Social Sciences, version 15.0. Data were represented as mean ± SD as number and percentages. Chi-square test, Student 't'-test, and paired 't'-test were used for comparison purposes. The confidence level of the study was kept at 95%, hence a "p" value less than 0.05 indicated a significant association.

3. Results

A total of 464 subjects were enrolled in the study. Majority of them were males (n = 253; 54.5%). Age of subjects ranged from 7 to 21 years with a mean age of 15.34 ± 3.92 years. Maximum number of subjects in both the genders was aged 11–15 years. Mean age of boys was 15.28 ± 3.98 and that of girls was 15.41 ± 3.86 years. Statistically, there was no significant difference in mean age of subjects between two genders (p = 0.737) (Table 1).

On comparing the CA with estimated age using India-specific regression formula, mean estimated age was found to be significantly higher as compared to CA for overall as well as both the genders independently ($p < 0.001$) (Table 2).

On comparing the difference between CA and estimated age in different chronologic age groups, the pattern of difference remained same with estimated age being higher as compared to CA and difference between estimated age and CA was significant statistically too ($p < 0.05$) for all the chronologic age groups except age group 16–18 years (p = 0.061).

On evaluating this relationship for the two genders separately, males showed a similar trend with mean estimated age being higher as compared to CA for all the chronologic age groups and the difference being significant statistically too for all chronologic age groups ($p < 0.05$) except age group 7–10 years (p = 0.121) and 16–18 years (p = 0.236). Among females too, the