Stature estimation from facial measurements in medical students of Tehran university of Medical Sciences: an Iranian population

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Objectives Stature (S) estimation is one of the most important methods for identification of individual in forensic medicine. Different kinds of methods are available for estimation of S from different parts of the body.

Methods The present study aimed to estimate S from three facial measurements including facial breadth (FB), total face height (TFH) and upper facial height (UFH) of 200 healthy students (100 males and 100 females) aged 20–25 years, studying at Tehran University of Medical Sciences. The correlation between stature and facial anthropometric measurements was investigated and equations for stature prediction were demonstrated by using linear regression analysis.

Results The mean stature, FB, TFH and UFH in males were higher than females. As well, there were significant correlations between stature and FB, TFH and UFH in all subjects, males and females. Additionally, we could formulate the stature from FB, TFH and UFH by using linear regression equation.

Conclusion According to the results, the formulas were calculated for predicting stature from facial measurements. So in forensic and archeology investigations, if the available remains are skulls, to predict the stature we can use the obtained formulas from Iranian population.

Keywords stature, facial measurements, anthropometry, regression

Introduction

Anthropometric studies are essential in forensic medicine and archeology for identifying a true race from the local mingling of races.[1] Stature is one of the most frequently used biological profiles for identification of an individual.[2,3] One of the main goals of forensic medicine is to identify an unknown or tentative person, particularly when just some parts of deceased body remain.[4] The stature is the height of a person in standing position, which is varied in different ethnic groups and populations.[5] This variation in stature measurement of different populations is related to the several factors such as genetic, nutritional status and environmental factors.[6] The relationship of measurements between the different body segments and the stature were analyzed in different countries and equations for stature estimation were determined.[7–9] Stature and sex can be predicted from different body measurements by using statistical models.[10] The improvement of models to predict sex and stature from anthropometric data in different ethnic groups are necessary, because there is a great need for population-specific studies on stature estimations.[11] Several studies have been performed on the estimation of stature from different body parts such as hand length,[12] foot length[13] and metacarpal length.[6]

The craniofacial anthropometry is a branch of anthropometry which deals with head and face measurements.[14] Craniofacial morphology has great importance in maxillofacial surgery, plastic surgery, orthodontics and forensic medicine.[15] Craniofacial measurements are varied from one person to another due to several influencing factors such as age, sex, ethnicity, nutrition, genetic, environmental conditions and soft-tissue matrices.[16] Sometimes from an unknown fragmentary deceased just the skull is available. In this situation, cephalo-facial dimensions are very useful for accurate identification.[17] Different facial measurements were used for stature estimation as a decisive factor for identifying an individual such as total and upper facial height, height of lower face, minimum frontal, bigonial, biocular and interocular breadth.[18]

This study aimed to evaluate the correlation between three facial measurements including facial breadth (FB), total facial height (TFH) and upper facial height (UFH) and stature in medical students of Tehran University of Medical Sciences.

Materials and Methods

Subjects

This study was designed to evaluate among the students of Tehran University of Medical Sciences in Iran. A total number of 200 students were randomly selected from the volunteers of Iranian students (100 females and 100 males) in the age range of 20–15 years old with normal craniofacial configuration, without any deformity of the vertebral column and no history of facial plastic surgery. Each subject was examined for stature, FB, TFH and UFH. Afterward, the association between stature and mentioned parameters was determined by statistical analysis.

Stature

Stature was measured by a standard anthropometer in centimeters. The student was asked to stand barefoot on the flat surface base in an erect position with the head oriented in the Frankfurt Plane. Then, the measurement was taken in centimeters as the vertical distance between the vertex to the flat surface.[19]

Facial measurements

Facial measurements were taken by using sliding venire calipers.

Facial breadth
Measured as a distance between two zygions (Zy).

Total facial height
Measured as a distance between nasion (N) and menton (Me) in centimeters.

Upper facial height
Measured as a distance between N and subnasale (Sn) in centimeters (20).

Definition
Zy: Most lateral point of zygomatic arches.
N: Midline depression locating below the level of the eyebrows.
Sn: Point of the nasal septum and the upper lip Junction.
Me: Inferior point on the symphysis (the lowest portion of chin).

Statistical analysis

The data analysis was performed using SPSS 22.0 for Windows. The differences between two sexes were tested by using independent *t*-test. The association between stature and facial measurements was determined by using Pearson correlation analysis. Linear regression analysis was used to determine equations for stature estimation from facial measurements. $P < 0.05$ was considered significant.

Results

According to Table 1, there were significant differences in stature ($P = 0.0001$) and facial anthropometric measurements including FB ($P = 0.02$), TFH ($P = 0.0001$) and UFH ($P = 0.0001$) of sex groups.

The correlation confections between stature and facial anthropometric measure were evaluated in Table 2. There were signification correlation confections between S and FB ($r = 0.002$ and $P = 0.001$), TFH ($r = 0.02$ and $P = 0.0001$) and UFH ($r = 0.01$ and $P = 0.0001$). The male and females were analyzed separately. As shown in Table 2, the significant correlation were recorded for male subjects between S and FB ($r = 0.001$ and $P = 0.0001$), TFH ($r = 0.01$ and $P = 0.0001$) and UFH ($r = 0.01$ and $P = 0.0001$). As well, these values were lower for female subjects as defined between S and FB ($r = 0.0001$ and $P = 0.003$), TFH ($r = 0.001$ and $P = 0.002$) and UFH ($r = 0.01$ and $P = 0.01$).

Based on Table 3, the linear regression was performed to find reliable formulas between *S* and FB, TFH and UFH. Additionally, the relation between *S* and FB, TFH and UFH were formulated for male and female subjects, separately.

Discussion

In the forensic field, stature is an important and reliable factor for personal identification in addition to age, sex, and ethnical origin and is a factor that helps forensic scientist to narrow the medicolegal investigations. According to literature, formulation of stature by using long bones of limbs is one of the most accurate factors.[21,22] However, when the long bones are not available and remains of skull, head or face are found in the forensic investigations, it becomes hard for forensic specialist to identify the cases. So characteristics of other bones or body parts such as skull or head and neck have been performed to predict stature.[18] In different studies, it has been demonstrated that regression analysis is the most reliable and easy method for predicting the stature.[23,24] In this study, we focused to formulate the stature from face measurements by using regression analysis in an Iranian population, rarely studied.

At first, we compared the measurements based on sex groups. Our results showed that the facial measurements were higher than females. Different studies confirmed our results. Din et al.[25] showed that the nasofacial values in females were lower than males. In a study by Omotoso et al.,[26] they demonstrated that the mean nasofacial measurements were different based on the gender. Their results are comparable to the present study.

Studied on stature prediction based on cephalo-facial anthropometric characteristic are so limited. We could estimate correlation confections between stature and facial measurement for total studies sample and separately for male and female subjects. The strongest one was between TFH and stature. In a study on Koli male subjects by Krishan,[27] the high correlation between cephalo-facial dimensions and stature was reported for North India population. Their findings were related to the Koli population as an endogamous group with high homogeneity.[27] As well, in a study on Japanese cadavers, Chiba and Terazawa[28] reported a correlation between cephalo-facial values and stature with correlation coefficients range of 0.32–0.53. After excluding over 70 year subjects, they reported higher correlation coefficients between stature and these measurements.[28]

Additionally, our results confirmed that the male subjects had stronger correlation coefficient compared to the female subjects. Chiba and Terazawa[28] recorded that female subjects had shown smaller correlation coefficient than males. Chiba and Terazawa[28] also emphasized that the morphological structure of the head, especially the antero-posterior diameter, changed in relation to the age of the individual. Kalia et al.[29] tried to estimate stature by using

Table 1. Comparing facial anthropometric measurements based on sex groups *n* medical students of Tehran University of Medical Sciences

| | Total | | | | Sex | | | | | | | | *P*-value |
| | | | | | Male | | | | Female | | | | |
	M	SD	Min	Max	*M*	SD	Min	Max	*M*	SD	Min	Max	
FB (cm)	11	0.11	8	13	11.2	0.1	10	13	12	0.2	8	112	0.02
TFH (cm)	11	0.12	8	13	11.1	0.1	9	13	10	0.1	8	11	0.0001
UFH (cm)	7.05	0.2	5	8	7.1	0.2	6	8	6	0.2	5	8	0.0001
S (cm)	171	9.3	153	190	178.2	6.1	163	194	164	5.02	153	175	0.0001

M, mean; SD, standard deviation; min, minimum; max, maximum; FB, facial breadth; TFH, total facial height; UFH, upper facial height; *S*, stature.

Table 2. The correlation between stature and facial anthropometric measurements

		FB (cm)	TFH (cm)	UFH (cm)
S_T (cm)	r	0.002	0.02	0.01
	P-value	0.001	0.0001	0.0001
S_m (cm)	r	0.001	0.01	0.01
	P-value	0.0001	0.0001	0.0001
S_f (cm)	r	0.0001	0.001	0.01
	P-value	0.003	0.002	0.01

r, correlation coefficients; FB, facial breadth; TFH, total facial height; UFH, upper facial height; S, stature; m, males; f, females.

Table 3. Formulation of stature by using facial measurements in total, males and females

Formulas	R^2	SEM	P-value
$S_T = 3.014FB + 136$	0.051	6	0.0001
$S_T = 6TFH + 98$	0.062	6	0.0001
$S_T = 8UFH + 115$	0.041	7	0.0001
$S_m = FB + 160$	0.043	6	0.0001
$S_m = 3TFH + 137$	0.061	6.5	0.0001
$S_m = 8UFH + 115$	0.066	6	0.0001
$S_f = FB + 149$	0.044	4	0.0001
$S_f = TFH + 148$	0.037	4	0.0001
$S_f = 2UFH + 140$	0.055	4.2	0.0001

SEM, standard error of the estimate; FB, facial breadth, TFH, total facial height; UFH, upper facial height; S, stature; m, males; f, females

odontometry and skull anthropometry. Correlation coefficients were between 0.56 and 0.38 and were close to those of Chiba and Terazawa, but only when combined data were used. When male and female individuals were evaluated separately, a significant decrease was observed in the correlation coefficients. For male subjects, they changed between 0.20 and 0.13, which is similar to the results of this study. However, Sarangi et al.[30] investigated the correlations between stature and maximum transverse length circumference of the skull and recorded that the correlation coefficients of stature for those variables were insignificant for a suitable estimation of stature.

In our study, the range of SEE was 6–7 for all subjects, 6–6.5 for male and 4–4.5 for females according to the findings obtained from linear regression equations. R-square obtained from regression equation for facial measurements was less than 0.1. In the prediction of S from facial measurements in northwest Indians, Sahni et al.[18] demonstrated that the range of SEE obtained from multiple regression was 3.569–3.610 in males and 2.880–2.914 in females. Agnihotri et al.[31] used cephalo-facial dimensions to estimate stature by regression analysis in Indo-Mauritian population. Their results showed that r of all cephalo-facial measurements were less than 0.5. All these findings confirm that the correlation confections are not high for facial measurement to predict stature and the findings are directly related to the homogeneity of populations studied.

Conclusion

According to the findings of the present study, the formulas were calculated from facial measurements for predicting stature in an Iranian population. As well, the correlation confections calculated for males were better than females. Forensic scientists and anthropologists can use from these findings to identify cases which just their remains are head, face or skull in Iranian population. ■

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