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Original Article

ESTIMATION OF STATURE FROM HEAD LENGTH & HEAD BREADTH IN CENTRAL INDIAN POPULATION: AN ANTHROPOMETRIC STUDY

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ABSTRACT

Background: Stature is an important parameter in medico-legal examination. It happens many a times when highly decomposed or mutilated bodies or sometime only facial remains of skull are brought for medico-legal examination and this is most common in our region where victims are attacked by wild animals in deep forests which makes difficult to identify deceased. In such medico legal examination stature estimation is important including age, sex, race, etc. Each race requires its own formula for stature estimation because racial and ethnic variations exist in population of different geographical regions. The climate and dietary habits of the people of different regions of India are variable. Hence opinions based on the result of studies done in one population cannot be entirely applicable to other population**.** Considering this scenario the aim of the present study is to estimate the stature from skull anthropometry in this region.

Aims: Present study was undertaken to determine stature from maxillo-facial anthropometry in central Indian region using head length and head breadth.

Methods: The study was conducted on 470 young and healthy subjects, 260 males and 210 females of 18 to 24 years. Two skull measurements namely head length and head breadth were taken by following standards anthropometric methods and technique.

Results: Regression equation for stature of males using head length is 122.32 + 2.63 × HL and using head breadth is 162.63 + 0.57 × HB. The regression equation for stature in females using head length and breadth are 133.76 + 1.49 × HL and 123.9 + 2.33 × HB respectively.

Conclusion: Regression equations are population specific and will not yield exact stature if applied to other population. Stature estimation can be possible with the help of these two parameters when only skull or remains of the skull are available for medico legal examination.

KEY WORDS: Stature, Anthropometry, Medico legal, Regression.

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INTRODUCTION

Stature is an important biological parameter in medico-legal forensic examination. It occurs many a times when highly decomposed or mutilated bodies or fragmentary remains of skull are brought for medico-legal examination. Sometime only skull is brought for examination and this is most common in our region where victims are attacked by wild animals in deep forests. In such situation it becomes difficult to identify deceased. Among the common questioner of medico legal examination e.g. age, sex, race, etc, estimation of stature becomes equally important in such cases. There is definitive biological correlation of stature with all the body parts such as extremities, head, trunk, vertebral column etc. There are variations in the length of limb bones relative to stature and according to race, sex, age, side of the body, climate, heredity and nutrition [1].

There are a few studies for stature estimation from skull alone. It is proved beyond doubt that each race requires its own formula for stature estimation. The climate and dietary habits of the people of different regions of India are variable. Racial and ethnic variations also exist in population of different geographical regions. Hence opinions based on the result of studies done in one population cannot be entirely applicable to other population [2]. Many studies have been conducted on stature from percutaneous measurements of various body part including arm, leg, feet, etc [3-6]. Considering this scenario there is a need of systematic study for stature estimation from fragmented and dismembered skull remains.

Therefore the present study was undertaken to determine stature from maxillo-facial anthropometry in central Indian region using head length and head breadth.

MATERIALS AND METHODS

This prospective study was carried out from December 2007 to September 2008, in the department of Anatomy, Government Medical College, Nagpur which is located in the central India, the Vidarbha region. In the present study 470 medical students were taken comprising of males 260 and females 210 within the age group of 18 to 24 years. This age group was selected because generally stature at 18 years accepted as an adult [7] and multiplication factor more or less remains constant in this group [8]. Healthy students without any obvious congenital or acquired deformity of spine, extremities and head were included in this study. This project was approved by Institutional Ethics Committee.

Anthropometric methodology:

1. **Stature:** The stature was measured in standing position to the vertex in Frankfurt plane by using anthropometric rod.
2. **Head Length (HL):** The distance between the glabella and farthest projecting point in the mid-sagittal plane, on back of the head (Occiput). The later is termed as the Opisthocranion. Glabella is the most forward projecting point in the midline of the forehead at the level of supraorbital ridges and above the nasofrontal suture.
3. **Head Breath (HB):** The greatest transverse diameter on the head is from euryon to euryon. Euryon is bilaterally paired point that forms the terminus of the line of greatest breadth of the skull. Not a fixed point but determined with calliper.

Both measurements were taken with spreading calliper.

All the above measurements were taken by author at a fix time between 2 to 5 pm only to eliminate the discrepancies due to diurnal variation. The measurements were taken three times and their mean value was taken as a final measurement. The data were analyzed using regression analysis and correlation coefficient.

RESULTS

In the study 470 subject were taken, 260 males and 210 females. The mean age was 19.42 years (standard deviation of 1.29). Table no. 1 shows the age and sex wise descriptive statistics. Table no. 2 shows the basic statistical constants of parameters of males are longer than that of female with statistically significant p value ($p < 0.05$). Due to this significant sex differences the data were treated separately for computing correlation regression analysis. Table no. 2 shows the descriptive statistics of various para-

Table 1: descriptive age and sex-wise statistics.

Sex	N %	Mean age	±S D	Median	Minimum	Maximum	Mode
Male	260 (55.31)	19.68	1.39	19	18	24	19
Female	210 (44.68)	19.06	1.06	19	18	24	19
Combined	470 (100)	19.42	1.29	19	18	24	19

N- Total number of subject, SD - Standard deviation

Table 2: Descriptive statistics for height, head length (HL) and head breadth (HB) (in cm).

Sex	Variable	N	Mean	± SD	Minimum	Maximum	Median	CV (%)
Male	Height	260	170.97	6.8	151	189.6	171	3.97
	HL	260	18.5	0.72	15.4	20.4	18.6	3.89
	HB	260	14.64	0.63	10.2	16.3	14.6	4.3
Female	Height	210	156.89	5.89	142	172.7	156.6	3.75
	HL	210	17.53	0.81	12.2	19.8	17.5	4.62
	HB	210	14.16	0.66	12.2	18.8	14.2	4.66

SD – standard deviation, CV – coefficient of variation, HL – Head length, HB – Head breadth

Table 3: Statistical analysis with derivation of regression equation.

Sex	Variable	b	r	p value of 'r'	SEE	a	Regression equation
Male	HL	2.63	0.279	0.000,S	±6.54	122.32	Stature(cm) = 122.32 + 2.63 × HL
	HB	0.57	0.053	0.394,NS	±6.80	162.63	Stature(cm) = 162.63 + 0.57 × HB
Female	HL	1.49	0.206	0.000,S	±5.77	133.76	Stature(cm) = 133.76 + 1.49 × HL
	HB	2.33	0.262	0.000,S	±5.69	123.9	Stature(cm) = 123.9 + 2.33 × HB

b – regression coefficient, r – correlation coefficient, a – intercept, SEE – standard error of estimate, HL – head length, HB – head breadth.

-meters taken in study. In the table no. 3 there is derivation of regression equation for stature estimation along with multiplication factor using head length (HL) and head breadth (HB) for male and female with their respective Standard Error of Estimate (SEE) and Correlation Coefficient (r). On rare occasion when it is necessary stature can be estimated, even sex of skull fragment cannot be opined. It is evident from the table that HL had greater correlation coefficient 'r' and lesser SEE than that of HB in the males. Similarly HB had greater correlation coefficient 'r' and lesser SEE than that of HL in the females. Hence HL is better criteria in males and HB is better parameter in females for stature estimation when fragmentary remains of skull are brought for medico legal examination.

DISCUSSION

The regression analysis is considered as the best criteria for stature estimation from fragmented body remains [9]. It is evident from the present study that HL is better in males and HB is better in females for estimation of stature of a person if the fragmentary remains of skull are brought for medico legal examination.

Glaister [10] had reported head length was 1/8th of total height of the person. Chiba and Terazawa [11] also derived regression equation for height from head length in Japanese cadavers. In males, the regression equation has standard error of estimate of 7.09 and correlation coefficient of head length with height was 0.39 and for female standard error of estimate of 6.97 and correlation coefficient of head length with height was 0.003, while in our study standard error of estimate was 6.54, correlation coefficient of head length with height was 0.279 for males and for female standard error of estimate was 5.77 and correlation coefficient of head length with height was 0.206. Study by Bardale and Dixitl [12] in males, found correlation coefficient for head length with height as 0.39 with standard error of estimate as 6.08. In females, for the same they found correlation coefficient of 0.32 with standard error of estimate of 5.67. Study by Kalia et al [13] on lateral skull radiographs noted correlation coefficient of 0.13 for males and 0.000 for females. But as Kalia et al conducted study on radiographs, it might have shown values which are highly different from our values as our study was carried out on living subjects.

Sarangi et al [14] reported that there was no significant correlation between stature and skull parameters. The correlation coefficient of stature for skull parameters (HL, HB, and HC) was found to be non significant.

Bardale and Dixit [12] found correlation coefficient of head breadth with height as 0.26 which was not coincide with our study (0.053) and standard error of estimate for regression formula on head breadth was 6.40 which is similar to our study (6.80). For female the correlation coefficient of head breadth with height was 0.23 and standard error of estimate was 5.81. The values of SEE and r for females are very much similar to our results.

Study on male Gujjars of India by Kewal Krishnan [14] showed that correlation coefficient for head breadth in females was found to be 0.682 and SEE was 4.792. The regression equation given by them for stature estimation in males is 98.056 + 5.320 x Maximum head breadth.

For highly correlated variates, regression equation can become practically useful for prediction and they are widely used in reconstruction formulae for stature, from the measurements of certain long bones [15].

Thus we can say that regression equations, SEE and correlation coefficients are different for different geographical locations, as stature is influenced by number of factors like race, regional and environmental factors etc.

CONCLUSION

We conclude that maxillofacial anthropometry in the form of head length and head breadth can be a better predictor of stature if cephalo-facial remains are brought for forensic examination. Regression equations are population specific and will not yield exact stature if applied to other population.

Conflicts of Interests: None

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