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Original Articles

Estimation of Stature from Head Circumference in Bangladeshi Santal Female Population: A Correlational Analysis

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Abstract:

Context: *Craniofacial anthropometry is an important stem of anthropometry in which the dimensions of the head and face are measured. Stature being one of the criteria of personal identification has a definite and proportional biological relationship with each and every part of the human body eg. head, face, trunk and extremities. The Santal community being one of the major tribes of Bangladesh, there are few recorded data in the literature on the craniofacial anthropometry of the Santal female population. The present study was designed to document the standard normal craniofacial measurements and stature of this tribal population and also to determine whether there is any correlation between the measured value of the stature and the physically measured cranial variable.*

Methods*: The study was cross-sectional and descriptive type with some analytical components and was conducted on 100 Santal females. The study was carried out in the Department of Anatomy, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, between July 2012 and December 2013. The head circumference was measured by using a flexible measuring tape. The stature was taken by using a hard board and steel tape.*

Results: *The head circumference showed significant positive correlation with stature. No significant difference was found between the "measured" and "estimated" stature for head circumference*

Key words: *Anthropometry, stature, correlation and head circumference*

Introduction:

The significant correlations between the stature and the different anthropometric measurements are used to predict the stature in forensic examination especially in unknown, highly decomposed, fragmentary bone and mutilated body, and correlations among different anthropometric measurements are used to plan reconstructive surgery, to identify dysmorphic syndromes by genetic councillors, to design goods by ergonomic engineers. The craniofacial anthropometric data are also used in forensic medicine, plastic surgery, oral surgery, pediatrics, dentistry, treating congenital or post traumatic disfigurement and diagnostic knowledge between patient and normal population. People of different religions and ethnic groups vary genetically and geographically in their craniofacial features. Therefore, a single standard of anthropometric variables is not appropriate for being applied to diverse racial and ethnic groups. The Santal community is one of the oldest ethnic groups in Bangladesh and India. Craniofacial anthropometric studies on the Santal communities are not very abundant in the available literature. However, to the best of the present researcher's knowledge, there is probably no recorded data of

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the craniofacial measurements of Bangladeshi Santal females. The people from the Santal ethnic group are visibly somewhat different in their physical characteristics from the Bengali population, the largest ethnic group of Bangladesh. Broadly speaking, they carry the racial characteristics of the Proto-Australoid.[1] In addition, estimation of the stature from the measured values of different craniofacial variables would have wide range of academic and practical implications in different fields. The Santal are one of the oldest and largest tribal population in Bangladesh which migrated from the mainland of Australia to India and belongs to the "Proto-Australoid" race. According to Bangladesh population census of 1994 the total Santal population in Bangladesh is almost 2,25,000.[2] Most of the Santals live in Northern part of Bangladesh.

Materials and methods:

A cross sectional and descriptive type with some analytical component was conducted on the adult Bangladeshi 100 Santal females at the Ranirhat, Belghoria and Nawpan areas of Sirajgonj district in Bangladesh. Data analysis was carried out in the Department of Anatomy, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka. Prior permission was taken from relevant authorities from the local community leaders before commencement of the study. All the participants aged from 25 to 45 years, female by sex, Santal by ethnicity, Bangladeshi by nationality were selected using convenience sampling technique. Individuals with mixed ethnic origin, any craniofacial abnormality, pregnancy, history of respiratory distress, heart failure, renal failure, malocclusion of teeth, common genetic, endocrine or neurological disorders were excluded from the study.

The anatomical landmarks

Ophyron (on)**-** It is the point, at the mid-plane, of a line tangent to the upper limits of the eyebrows.

Opisthocranion (op)**-** It is the most prominent posterior point of the occiput.

Frankfurt horizontal plane: It is a horizontal plane from the top of the external auditory canal to the lowest point on the inferior border of the orbit.

Anthropometric measurements:

i) **Head circumference (on-op):** The maximum circumferential distance passing through just above the supraorbital rim (ophyron) and the occipital protuberance (opisthocranion) is known as head circumference.

ii) **Stature:** Stature is the distance from the plane where the participant stands to the vertex on the head.

Head circumference was taken with the participants sitting on the chair with the head in anatomical position.[3] The head circumference was measured by using a flexible measuring tape. The stature was taken by using a hard board and steel tape. At first the participant was requested to take off her shoes, to remove any hair ornaments, jewellery, buns, or braids from the top of her head. Then the participant stood with her heel together and toes apart. The toes pointed slightly outward at approximately 60 º angle. Her back was kept as straight as possible so that her heels, buttocks, shoulders, head touched the wall. After asking the participant to take a deep breath and holding it, a hard board was placed against the head and wall to determine maximum height on the wall and this was marked. The participant was then told to release the breath and to step away from the wall. The height was then measured in centimetre from the floor to the mark on the wall with steel tape .[4]

Calculation of multiplication factors

Each 'multiplication factor' is the ratio between the stature to the respective craniofacial variables. Mean multiplication factor is calculated for each craniofacial variable. The mean multiplication factor is used for estimating stature from those particular craniofacial variables.

Multiplication factor (MF) of the head circumference is calculated using following formulae:

$$\text{M.F.} = \frac{\text{Stature}}{\text{The head circumference}}$$

Ethical clearance

Ethical clearance was obtained from the Institutional Review Board (I.R.B) of BSMMU.

Results

"Multiplication factor" was used to estimate stature from the head circumference. Regression analysis was used to find the correlation between the head circumference and stature. Value of the head circumference was found to be significantly correlated with stature. Correlation between the stature and the head circumference was assessed and the findings are displayed using scatter diagram.

For the head circumference, the measurement in each individual was multiplied by the mean multiplication factor for the head circumference to get the "estimated stature" for the head circumference. Then for the head circumference the "measured and estimated" statures were compared for any significant difference, using the paired "t" test. No significant difference was found between the "measured" and "estimated" values of the stature.

Table I

Values of the head circumference and stature in adult Santal females

Measurement (cm)	Value(cm)	
	Range	Mean (± SD)
Head circumference	49.10-57.10	52.47 (± 1.51)
Stature	139.10-157.10	148.07 (± 4.63)

n (no. of the participant) = 100 females
SD = Standard deviation

Table II

Correlation coefficients of several of selected craniofacial measurements with the stature in adult Santal females

Measurement (cm)	Correlation coefficient (r)	Significance (p) of correlation with the stature	Mean multiplication factor MF (±SD) to estimate the stature
Head circumference	0.433	0.000 (S)	2.82 (± 0.09)

n(no. of the participant)=100 females
SD = Standard deviation p ≤0.05 was considered as significant
S = significant at 5% level in regression analysis. NS = Non significant at 5% le vel in regression analysis

Table III

Comparison between the 'measured' stature and the' estimated' stature in adult Santal females

Measurement (cm)	Measured stature Mean (± SD)	Estimated stature* Mean (± SD)	Difference between mean of the 'measured' and the 'estimated' value of the stature	Significance (p) of difference†
Head circumference	148.07 (± 4.63)	147.96 (± 4.2)	0.11	0.829 (NS)

n (no. of the participant) = 100 females SD = Standard deviation S = Significant NS = Non significant
* The mean estimated value of stature was obtained by multiplying each individual value (n=100) for selected each selected variable by the respective mean multiplication factor (as shown in Table II) and then calculating the mean of the 100 value. p ≤0.05 was considered as significant.
† paired t test was done to see significance of difference between the' measured' and 'estimated' value of the stature.

The head circumference of the adult Santal female participants showed a significant positive correlation (r = 0.433, p = 0.000) with their stature. The mean multiplication factor (mean MF) calculated for estimating the stature from the head circumference of the individual participants was 2.82 (±0.090) (Table II).

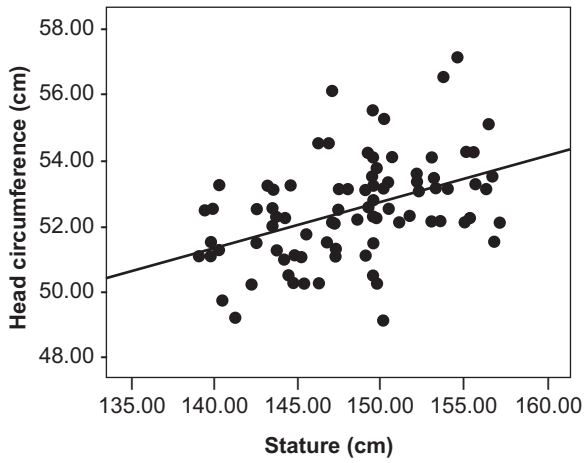

Fig-1:*Scatter diagram with regression analysis, showing significant positive correlation (r = 0.433, p = 0.000) between the head circumference and the stature.*

Discussion:

The present anthropometric study was carried out among Santal adult females with a view to measure the stature and the head circumference. It also looked for any correlation between stature and the head circumference. According to the classification by Guha[1] , the Santals are Proto-Australoids on the basis of anthropological origin. The Proto-Australoids are mostly inhabitants of Chota Nagpur, Central India and South India .[5] Craniofacial anthropometric studies have been carried out by various workers on different Negroid, Caucasoid, Mongoloid populations as well as on the Proto-Australoids residing in different geographical regions of the world. Many of these Proto-Australoid groups, again, vary in their ethnic identity. In this study, the mean stature of the Santal females observed in the present study was similar to those of the Proto-Australoid 'Santal'[6] and 'Kora Mudi'[7] females of West Bengal. However, they showed a relatively smaller mean than the other Proto-Australoid 'Juang' population of Odisha, India[8] and a greater mean than the other Proto-Australoid 'Kondh' population of Orissa, India.[9] When compared with the other Dravidian populations, the Santal females of the present study were found to have a much lower mean than the 'Gujrati' population of India.[10] But it was relatively greater than that of the other Dravidian 'Oraon' population of West Bengal .[11] Thus it is revealed that there is variation present within a race. The Santal females showed a relatively greater mean than that of the Nigreto 'Onge' population of the Little Andaman Island of India .[12] However, they showed a much lower mean stature than the 'Black Malawians' of Nigeria.[13] On the other hand, the mean value of Santal in this study was similar to that of the 'Mongoloid' group of Nepal.[14] The mean head circumference of the adult Santal females of the present study was 52.47 centimetre. The Santal females of the present study were found to have a relatively smaller mean than a Proto-Australoid 'Santal' population of West Bengal.[6] The Santal females of the present study were found to have a similar mean value to a Dravidian a 'Malaysian Indian' female population of Malaysia.[15] In our study, the stature was found to have significant positive correlation with head circumference. For each craniofacial variable, the measurement in each individual was multiplied by the mean multiplication factor for that variable to get the "estimated stature" for that variable. Then for the head circumference, the "measured" and "estimated" stature were compared for any significant difference, using the paired "t" test. No significant difference was found between the "measured" and "estimated" values of the stature. This indicates the effectiveness of the corresponding multiplication factor in this estimation.

Conclusion

Estimation of the stature from the head circumference in Santal females using multiplication factors was effective for all selected variables. This would encourage others in taking up further research in this field. Apart from in

physical anthropology and forensic anatomy, these measurements and multiplication factors would be useful in the fields of plastic surgery, oral surgery, ophthalmology and otolaryngology as well as to the beauticians. The results of the present study on the adult Bangladeshi female Santal population can provide the basic framework for formulating the standards of various anthropometric variables in the population. Some amount of comparisons made with other populations can contribute to the understanding of the relative status of Santal population in the context of the anthropometric variations around the world, especially among the Proto-Australoid population.

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