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Original Research Article

Estimation of stature from cephalometric measurements among male Muslims of Manipur, India

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ABSTRACT

Background: Stature as is one such important anthropometric parameter which helps in personal identification of an individual. The present study attempts to reconstruct stature from some selected cephalometric measurements among 200 male Muslims of Manipur by using standard measurement techniques.
Methods: For the purpose of present study, eight cephalometric dimensions of each subject along with their stature were collected from 200 male Manipuri Muslims, (age between 20 to 60 years) of the four valley districts of Manipur viz. Imphal east, Imphal west, Thoubal and Bishnupur following the methods of Singh and Bhasin and Nath.
Results: Data analysis reveals significant co-relation between stature and various cephalometric measurements under study. Total facial height shows the highest correlation co-efficient value (r=0.381) while Upper facial height the least (r=0.112). Multiplication factors are found to vary from other populations of Manipur so far studied thus revealing inter- population variation within the state. Simple regression equations for estimating stature are also formulated for these population.
Conclusions: The findings of the estimation of stature using multiplication factor and Linear regression equation on the present population varies from the findings on other populations studied by other researchers. Hence in conclusion, it is confirmed that means of stature estimation i.e. multiplication factors and regression equations are population specific. Therefore, derived formulae for a population should not be used to other populations.

Keywords: Cephalometric, Correlation co-efficient, Forensic anthropology, Multiplication factor, Regression equation, Stature estimation

INTRODUCTION

Forensic anthropology primarily pertains to the personal identification, may it be of a living person or a dead body or partly decomposed or mutilated bodies or the skeletonised remains to recognize the individuality of that person. This identification may be complete or partial. Complete identification means the absolute fixation of the individuality of the person and the determination of the exact place in the community occupied by him, whereas partial identification deals with ascertainment of only some facts about identity while others remain still unknown.

Estimating Stature from dry bone length or from the size of other body parts continues to be of particular interest to forensic and biological anthropologists, and to geriatricians.[1] Several authors studied this subject in different populations, and observed significant inter-population differences in body proportions.[2,3] In certain situation, when decomposition sets in a body, simple means of identification becomes more complicated due to

natural putrefactive processes. The problems associated with the personal identification of the recently dead are identical with those of the living.

Many studies have proved beyond doubt that there is positive co-relation between stature and length of long bones.[4-6] It is well known that estimates based on upper limb long bone measurements are highly accurate and of all the mathematical methods used, regression formulae based on long-bone measurements yield the most accurate results.[7] In a similar approach, many workers have demonstrated positive co-relation between stature and other body dimensions.[8-15]

Though research works on reconstruction of stature from long bones as well as from certain body dimensions have been put forward for some of the Indian populations, only a few research works have attempted to reconstruct or estimate stature from different facial measurements.[16] As any part of the human skeleton can be found as the evidences, there is perhaps a need to investigate whether there is any possible significant co-relation between stature and cephalometric dimension in human body. Moreover, research and experience has advanced considerably enabling to estimate what someone looked like from his skull by the technique of facial reproduction.[17]

Keeping the above discussions in view, the present work attempts to reconstruct stature from some selected cephalometric measurements among male Manipuri Muslims of Manipur who are locally known as Meitei Pangal.

METHODS

Data for the present study were collected from 200 male Manipuri Muslims of the four valley districts of Manipur viz. Imphal east, Imphal west, Thoubal and Bishnupur whose age range from 20 to 60 years. Eight cephalometric dimensions of each subject along with their stature were measured following the methods of Singh and Bhasin and Nath.[10,18]

All the subjects included in the present study who were randomly selected were free from any apparent symptomatic deformities. The following are the cephalometric measurements and their respective abbreviations considered for the study. The data were subjected to systematic statistical treatment using SPSS-17.00 for calculation of multiplication factors, co-efficient of correlation and formulation of linear regression equation.

Table 1: Cephalometric measurements and their respective abbreviations.

Measurement	Landmark	Instrument used
Stature (HV) vertical distance between the plane where the subject stands to the vertex on the head	Vertex (v)-the highest point on the head when the subject stands erect and head in eye ear plane	Anthropometer
Total head height (THH)- straight vertical distance between Tragion to vertex of on the head	Tragion (tr)-point in the notch just above the tragus of the ear; Vertex (v)-the highest point on the head when the subject stands erect and head in eye ear plane	Rod compass
Maximum head length (MHL)- straight distance between Glabella and Opisthocranion	Glabella (g)-prominent point in between two eyebrows just above the nasal root in mid sagittal line; Opisthocranion (op)-most posterior point on the head in mid sagittal plane	Spreading caliper with blunt knob
Maximum head breadth (MHB)- straight distance between Euryon to Euryon	Euryon (eu) - most lateral point on the lateral prominence of parietal bone	Spreading caliper with blunt knob
Nasal height (NH): measured from nasion to subnasal	Nasion (n) - the point on the root of the nose where it intersects with the mid- sagittal plane; Sub nasal (sn) - the point at which the nasal septum merges with the upper cutaneous lip in the mid-sagittal plane.	Sliding calliper
Nasal breadth (NB): straight horizontal distance between alare to alare	Alare (al) - the point at the most laterally prominent point on the nasal wing	Sliding calliper
Morphological facial height (MFH)-straight vertical distance between nasion and gnathion	Nasion (n) - the point on the root of the nose where it intersects with the mid- sagittal plane	Sliding calliper
Morphological Upper Facial Height (MUFH)-straight vertical distance between nasion and prosthion	Nasion (n) - the point on the root of the nose where it intersects with the mid- sagittal plane	Sliding calliper
Breadth of bizygomatic arch (BBA)- straight horizontal distance between two zygia points.	Zygion (zy)-most lateral point on the lateral prominence of zygomatic process	Spreading calliper with blunt knob

RESULTS

The relevant statistical constants and their respective standard errors of the eight cephalometric parameters are presented in Table 1. It is evident from the Table that the average height of the male Manipuri Muslims falls under the range 150.6 cm to 178.9 cm with a mean value of 164.07±0.38 cm, and a standard deviation of 5.47±0.27 cm. The average THH falls under the range 17.5cm to 26.4 cm which give a mean value of 24.02±0.09 cm. The mean value of MHL, MHB and BBA are 19.41±0.04 cm, 15.41±0.03 cm and 14.32±0.01 cm respectively. NH and NB show a mean value of 5.22 ±0.03 cm and 3.92 ±0.02 cm respectively. The mean value of UFH is 7.06±0.04 cm while that of the TFH is 11.99±0.05 cm.

Table 1: Mean and standard deviations of cephalometric measurements among male Muslims of Manipur.

Parameter	Min. (cm)	Max. (cm)	Mean. (cm)	S.D. (cm)
HV	150.6	178.9	164.07±0.38	5.47±0.27
THH	17.5	26.4	24.02±0.09	1.14±0.07
MHL	18.1	20.7	19.41±0.04	0.56±0.03
MHB	14.5	15.9	15.41±0.03	0.38±0.02
BBA	12.2	15.5	14.32±0.01	0.44±0.02
NH	4.2	6.2	5.22±0.03	0.37±0.02
NB	3.2	4.6	3.92±0.02	0.24±0.01
UFH	6.6	7.8	7.06±0.04	0.52±0.03
TFH	10.3	13.9	11.99±0.05	0.70±0.04

Table 2 presents various multiplication factors of cephalometric measurements under study. It reveals that NB shows the maximum value of MF (41.98±0.18) which is followed by NH (31.56±0.15). The minimum value is observed for THH (6.86±0.03) which is followed by MHL (8.45±0.02).

Table 2: Multiplication factors of cephalometric measurement among male Muslims of Manipur.

Parameter	Multiplication factors
THH	6.86±0.03
MHL	8.45±0.02
MHB	10.65±0.03
BBA	11.46±0.03
NH	31.56±0.15
NB	41.98±0.18
UFH	23.35±0.12
TFH	13.71±0.05

Table 3 highlights the correlation co-efficient (r) values between stature and cephalometric measurements among male Manipuri Muslims of Manipur. It suggests that TFH gives the maximum 'r' value with stature (0.381) at the significant level of 0.01. It is followed by THH (r = 0.369) at the same significant level. The least 'r' value 0.112 is for UFH which is followed by MHB (r = 0.168) at the significant levels of 0.05.

Table 3: Correlation values between stature and cephalometric measurements among Male Muslims of Manipur.

Parameter	Correlation (r) values
TFH	0.381**
THH	0.369**
MHL	0.343**
NB	0.320**
NH	0.301**
BBA	0.294**
MHB	0.168*
UFH	0.112*

**Correlation is significant at 0.01 levels (2-tailed),
*Correlation is significant at 0.05 levels (2-tailed).

Table 4 displays the linear regression equations for estimation of stature from all the cephalometric measurements under study. It is observed that the two facial dimensions viz. TFH (r = 0.381) and UFH (r = 0.112) exhibit the highest and lowest correlation with stature respectively.

It is also observed that the 'r' value of the two nasal dimensions viz. NB and NH with stature stood at the midway between TFH and UFH. The maximum standard error of estimate is also observed in case of UFH (±5.438) while the minimum is observed in case of TFH (±5.068).

Table 4: Linear regression equations for estimating stature from cephalometric measurements among male Muslims of Manipur.

Regression equation	S.E.E.	Value of 'r'
S= 128.206+ 2.989 (TFH)	± 5.068	0.381
S= 128.081+ 1.501 (THH)	± 5.095	0.369
S=98.451+ 3.383 (MHL)	± 5.151	0.343
S= 135.419+ 7.308 (NB)	± 5.193	0.320
S= 151.794+ 2.338 (NHT)	± 5.398	0.301
S= 112.132+ 3.626 (BBA)	± 5.240	0.294
S= 135.366+1.858 (MHB)	± 5.345	0.168
S= 155.981+ 1.150 (UFH)	± 5.438	0.112

A comparison was made between the observed and estimated stature calculated using both linear regression equation and multiplication factor (Table 5). The findings of the same reveals that the difference between observed and estimated statue using regression equation ranges between 0.01 cm (for THH, MHL, NH, MHL, UFH) to 0.5 cm (for NB).

On the other hand, difference between observed and estimated stature using multiplication factor ranges between 0.01 cm (for MHB) to 3.0 cm (for TFH). This finding clearly says that estimation of stature by using

linear regression equation is more reliable than multiplication factor.

Table 5: Difference between observed and estimated stature using multiplication factor and linear regression equation among male Manipuri Muslim population.

Cephalometric measurement	Observed stature (cm)	Estimated stature (cm)		Difference between observed and estimated (cm)	
		RE	MF	RE	MF
TFH	163.8	163.6	160.8	0.2	3.0
THH	163.8	163.7	162.9	0.1	0.9
MHL	163.8	163.9	163.5	0.1	0.3
NB	163.8	164.3	165.8	0.5	2.0
NH	163.8	163.9	163.5	0.1	0.3
BBA	163.8	164.0	164.8	0.2	1.0
MHB	163.8	163.9	163.9	0.1	0.1
UFH	163.8	163.9	161.7	0.1	2.1

Table 6 highlights a comparative study of multiplication factors for cephalometric measurements among different living populations of Manipur so far studied. Data available for comparison is TFH, MHL, MHB, NH, NB and BBA. In case of TFH, MF of Manipuri Muslim (13.71) is found to be the least while the highest (14.80) is observed for the Lois of Phayeng.[20] In case of MHL, MHB, NH, NB and BBA, record of two populations including the present study is available. Comparing the MFs of MHL for the Lois of Phayeng and the Manipuri Muslims, the Lois of Phayeng (MF= 9.06) is found to be greater than the present study (MF= 8.45). Same is the case in case of MHB as MF for the Lois of Phayeng is found to be 11.26 while that of the Manipuri Muslim is 10.65.

Again, in case of NB, MF of Lois of Phayeng (45.63) is higher than the MF of Manipuri Muslims (41.98). MF of NH for the Meiteis of Manipur (32.53) is also found to be higher than the Manipuri Muslims (31.56).[19] Comparison of MF for BBA is made between Kabui Naga of Imphal Valley and the present study.[16] It is observed that the MF of Kabui Naga (15.48) is much higher than the Manipuri Muslims of Manipur.

Table 6: Multiplication factors for cephalometric measurements among different living populations of Manipur.

Population (male)	Author/year	Multiplication factor					
		TFH	MHL	MHB	NL	NB	BBA
Meiteis of Manipur[19]	Devi and Nath	14.14	-	-	32.53	-	-
Lois of Phayeng[20] Manipur	Singh J et al	14.80	9.06	11.26	-	45.63	-
Kabui Naga of Imphal Valley [16]	Jibon KR and Lilin	14.46	-	-	-	-	15.48
Muslims of Manipur	Present study	13.71	8.45	10.65	31.56	41.98	11.46

DISCUSSION

In the present study eight cephalometric measurements were recorded for estimation of stature from 200 randomly selected Manipuri Muslim individuals sampled from four valley districts of Manipur. The findings of the present study reveal that average stature is 164.07±0.38 cm, with a standard deviation of 5.47±0.27 cm. The value of coefficient of correlation (r) values of all the cephalometric measurements under study show positive correlation ranging between 0.112 for UFH to 0.381 for TFH, with 'r' value of six measurements significant at 0.01 level (two tailed). On the other hand, only two MHB and UPH significant at 0.05 level (two tailed) which agrees with the findings of Jervas et al.[21] In agreement with the findings of Krishan who worked among the North Indian population, a positive correlation is observed between stature and cephalometric measurements among the male Manipuri Muslim population.[22]

However, the 'r' value is all less than 0.05 sharing a similar finding with Sahni et al.[23] who studied North West Indian Population and Agnihotri et al.[24] who worked on Indo-Mauritian population and found that the correlation coefficients (*r*) of cephalo-facial measurements was less than 0.5 in all the cases and they

concluded that the cephalo-facial dimensions are not good predictors for estimating stature. Even though 'r' value is less than 0.05 the findings of the present findings were exposed to verification for validity through comparison of observed and estimated stature using both linear regression equation and multiplication factor. On comparison, it is seen that using regression equation is more reliable and accurate measure of estimation of stature than using multiplication factor. Similar findings were also reported by Krogman and Iscan and Iscan.[25,26]

CONCLUSION

While comparing with other population it is observed that multiplication factors and regression equations formulated for Manipuri male Muslims exhibits variation from those of other populations studied so far by various researchers. Further it is also observed that the Manipuri male Muslims are found to differ in their body proportions when compared with other population groups of India. These conclusions are in support of the findings of various researchers. Similarly, the regression equations both linear and multiple formulated for stature estimation among Manipuri male Muslims also exhibit variation from other Indian counterparts.

Hence, it is well confirmed that means of stature estimation i.e. multiplication factor, linear and multiple regression equations are population specific. Therefore, means of stature estimation formulated for a population should not be used to other population and to opposite sex. In conclusion, it is confirmed that means of stature estimation i.e. multiplication factors and regression equations are population specific. Therefore, derived formulae for a population should not be used to other population.

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