ORIGINAL ARTICLE

CORRELATION OF STATURE WITH MAXIMUM HEAD LENGTH OF MALE ADULTS OF UPPER PUNJAB

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Background: In the field of forensic medicine, stature estimation in unknown skeletonized bodies is one of the most significant biological parameters. It is done many times when highly mutilated or decomposed bodies or fragmentary remains of skull are brought for forensic examination. The objective of this study was to correlate stature with maximum head length in male adults of 21–30 years in Upper Punjab. This study was designed to evaluate the effectiveness of correlation as a tool to predict relationship of stature from maximum length of head. **Methods:** This was a cross-sectional, quantitative study. Data was collected from the 382 males of Kharian City in Upper Punjab selected with non-probability, purposive sampling. Head measurements were taken using blunt ended spreading callipers and the stature of individual was measured standing erect in anatomical position using a stadiometer. SPSS-25 software was used for data analysis. **Results:** The mean stature was 170.4±6.85 Cm. Mean head length was 16.95±0.6 Cm. Prediction accuracy tests were performed which indicated that regression models of this study can estimate the height with accuracy. **Conclusion:** This study established a correlation between stature and maximum head length. It will help the forensic experts to estimate stature from measuring head length, especially when only head is available as a result of some natural or human caused calamity.

Keywords: Stature, Head length, Correlation, Estimation, Male adults, Punjab, Forensic

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INTRODUCTION

Anthropometry is mostly used in the forensic sciences to assist law enforcement authorities in determining the identification of unidentified human remains. Routine techniques fail to work well on severely decayed and disfigured corpses, making it impossible to identify the deceased. In these circumstances, assessment of height is just as essential as other characteristics such as age, gender, and race.[1] Every component of the human body, including the head, face, trunk, and extremities, has a proportionate biological connection with stature, which is important in forensic investigation when estimating stature from dismembered and damaged corpse parts.[2] Estimation of standing height of an individual help to ascertain distinctiveness to someone.[3]

Estimation of stature has successfully been calculated by using regression equation developed by measuring various dimensions of different bones and body parts.[4] Human stature is calculated as measurement from highest part of head to the inferior most part of the foot. Height is a characteristic which is studied the most, as it is measurable quite readily, at negligible cost and with least consumption of time. Height measurement not only gives useful information about health status of someone or the nation but also indicates the financial condition of individuals as well as country.[5]

Height is such an observable characteristic, which depends upon inborn as well as internal and external environmental factors. It is influenced by environmental temperature, sunlight, personal hygiene, repeated infections, access to medical facilities, financial status and food.[5] In late 19th century a French criminologist, Alphonse Bertillon, developed certain principles of identification depending upon measurements of different parts of body. In this way anthropometry became one of the basic tools in criminology for identification of offenders.[6]

People constantly face dangers of instinctive and unnatural calamities; such calamities may lead to human body disintegration into pieces and disfigurement in such a way that individualization becomes difficult.[7] The possession of even fragmented or mutilated dead body gives the opportunity to the relatives to perform their loved one's funeral ceremony as per directions of their binding.[8] There are two different ways to measure height of fragmented or mutilated bodies. When only fragmented body is available, still height can be estimated by measuring any dimension of bone or any part of the body. Then either a statistical equation is used or some multiplication factor is used, which gives estimated living height. On the other hand, when all bones whose summation results in formation of height, are available then height of individual bones is measured and added up. A few centimetres are added in it to compensate the soft tissue thickness. Second method gives more authentic results.[9]

Among regression and multiplication methods error rate is less in regression method as compared to

multiplication method.[10] Many studies have been carried out throughout the world to form their own regression equations as development of height largely depends upon environmental factors along with inborn factors. As environmental factors vary from one geographical area to the other. So, a single regression equation cannot be universally applied.[11] Every country must have its own regression equation.[12]

This pioneering study aimed at developing regression equation with head length which can be applied to the adults of Punjab. As Pakistan has faced terrorist activities since long so fragmented bodies are brought to get identified. This regression equation will help in estimation of height which will further help to get the bodies to be individualized.

METHODOLOGY

This cross-sectional study was carried out in the Department of Forensic Medicine and Toxicology, PGMI/AMC, Lahore, for one-year duration after approval of the synopsis by the ethical committee of the institute. A total of 382 male adults of 21–30 years age from the Kharian city were included. The sampling technique was non-probability sampling method (Purposive sampling). The patients with dwarfism, gigantism, skeletal, spine and long bone deformities (acquired or congenital), persons with obvious head deformity and persons with surgical correction after injury to facial bones were excluded.

Measurements were taken using blunt ended spreading callipers by placing the anterior tip of calliper on glabella while allowing the posterior calliper tip to slide inferiorly along the median plane of occipital bone until the maximum length was reached. Undue pressure was avoided while taking the measurements. When measuring head length or any other body part, the skin thickness is typically not compensated for directly in most standard measurements and the skin and subcutaneous fat layer are included in the measurement.

The stature of individual was measured standing erect in anatomical position using a stadiometer. It was measured as the vertical distance between the vertex and the floor. All readings (in Cm.) were recorded on a proforma.

Three hundred and eighty-two male Punjabi adults of age group 21–30 years in Kharian city were included in this study. Informed consent was taken after giving full explanation of the purpose of this study to the subjects. By non-probability purposive sampling, 21–30 years old male adult attendants of patients coming to OPD of Civil Hospital, Kharian were selected.

RESULTS

Data collected was subjected to numerical extrapolation through SPSS-25. Mean height was 170.4±6.85 Cm (Range: 148–188 Cm). Mean head length was 16.9±0.6 Cm (Range: 15.1–18.8 Cm). (Table-1).

Numerical description of coefficients of regression (independent variable=head length) is depicted in Table-2.

Cross validation testing is shown in Table-3 when independent variable was head length.

Table-1: Numerical values of stature and head length

Parameter	Minimum	Maximum	Mean±SD
Standing Height	148	188	170.4±6.85
Head Length	15.1	18.8	16.95±0.6

Table-2: Numerical description of coefficients of regression (independent variable was head length)

Parameter	B	S.E.	*t*	*p*
Constant	104.5	9.32	11.206	0.000
Head length	3.88	0.55	7.07	0.000

Table-3: Correlation between actual and predicted values when independent variable was head length

Sample			Height	Predicted
20% Sample (Observed)	Height	Pearson Correlation	1	0.413**
		Sig. (2-tailed)		0.000
		N	75	75
	Predicted	Pearson Correlation	0.413**	1
		Sig. (2-tailed)	0.000	
		N	75	75
80% Sample (Extrapolated)	Height	Pearson Correlation		0.324**
		Sig. (2-tailed)		0.000
		N	307	307
	Predicted	Pearson Correlation	0.324**	1
		Sig. (2-tailed)	0.000	
		N	307	307

**Significant at $p<0.01$

DISCUSSION

Establishment of personal identity of an individual, alive or dead, is one of his/her fundamental rights which has been assigned to the Forensic experts. The ever-increasing brutality of human beings like dismembering bodies after murder, suicide bombing, blasts, accidents, and natural disasters like earthquakes are very common in this era, and in this region. The main aim of forensic experts is positive identification of human bodies at disaster sites by different methods including anthropometry.

Measurements in anthropometry are collected through careful and organized processes with the primary aim of providing data which is useful in the fields of forensic medicine, ergonomics, reconstructive surgery, and prosthesis. Most of the time, head and neck is presented for identification or is the only part of body available. The facial features of such unidentified persons are usually mutilated. Height is one of the most useful parameters for establishment of identity of any individual. In many countries, anthropometric

measurements of face have been correlated with height and to narrow down the number of suspected victims in establishment of personal identity.

Standing mean height of adult males in the current research was 170.4±6.85 Cm. Many researches carried out in Pakistan give almost the same male height on average. In a research carried out in University of Health Sciences, Lahore, average height of males was 170.5 Cm.[13] In another study the male height noted was 173.16 Cm.[14] A study carried out in Rawalpindi found that average male height was 171 Cm.[15] Average height in males in India was 174.74 Cm.[1] In another research in India male height was 165.5 Cm.[16] Male height in Kosovo was found to be 178.79 Cm.[17]

Mean head length in this study was 16.95±0.6 Cm. It varied between 15.10 Cm and 16.95 Cm. Some studies show variance in numerical values of variables used in this study. Numerical quantity of correlation coefficient between standing height and head length was 0.335. Although it was a positive but a weak correlation. The strength of correlation depends on age, gender, environmental factors, ethnic and genetic variations. Since this positive correlation, albeit weak, was with statistically significant *p*-value, it will have significant practical implications in the field of forensic medicine. A study carried out in Kathmandu Nepal showed that there was strongly positive correlation between height and head length with r=0.734.[18] Another study carried out in India showed almost same value of r (0.715) between height and head length.[19] Adults from Haryana showed very weak correlation between head length and height. In that study value of r was 0.174.[20]

According to the findings of this study, the best correlation coefficients between head length and body height are seen in men. Patil and Mody[21] found that head length was the greatest predictor of height. This is quite similar to our work. The most accurate estimates of antero-posterior head length and circumference were made by Chiba and Terazawa.[22] High correlation coefficients between cephalometric measures and stature have been recorded by Krishan and Kumar[23] who found that the diameter of the head was the most accurate predictor of stature. It is possible that the classification of the lower limb bones has some influence on the assessment of height. By the time a person reaches the age of around 18–20 years, the femoral condyles, proximal end of the tibia, first metatarsal base, and heads of the 2nd and 5th metatarsals fuse completely. Because the ossification process is dependent on a variety of variables, ossification activities begin earlier in Indians than in Westerners.[24]

The findings of this study are comparable to those of other research conducted on diverse people throughout the world. In Japanese cadavers, Chiba and Terazawa[22] found a SEE of 6.97 Cm when they used regression models to estimate stature from the sum of the skull diameter and circumference. Except for head length, which demonstrated a high level of dependability in assessing height (SE=3.71), Patil and Mody[21] found slightly larger standard errors for most variables. In their study of Koli male adolescents from north India, Krishan and Kumar[23] found a 4.41–7.21 Cm SEE from 16 cephalo-facial measures. In their research on the assessment of height from the skulls of indigenous South Africans from Raymond Dart's collection, Ryan and Bidmos[25] reported SEE ranging from 4.37 to 6.24 Cm. The SEE value in this study is lower than in previous investigations, ranging from 3.726 to 5.820 Cm. To put it another way, the height estimation using cephalo-facial measurements used in this study was shown to be more accurate than in previous ones of its kind. An endogamous (or genetically diverse) population provides a more reliable sample for this study because of the higher degree of homogeneity. Krishan and Kumar[23] used study samples from a mixed population, as did the others.

CONCLUSION

This study discovered a positive correlation between maximal head length and stature in Upper Punjab male adults aged 21–30 years. In forensic cases requiring the prediction of stature from head length, this regression equation is a useful tool. It is essential for estimating height from incomplete and deteriorated skull remains in forensic and anthropological studies. Regression modelling can be used to determine the other variables if one of the parameters is known.

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