

Estimation of Stature by Head Length in Central India

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ABSTRACT

Determination of stature is a major step in the identification. Some definite proportional relationship exists between stature and other body parts. Therefore, in the estimation of stature, various other parts of human body can be used specially in cases like highly decomposed bodies, mutilated bodies and fragmentary human remains. So, to estimate the relationship between head length and height this study was taken up. The study was carried out on 196 medical students belonging to different regions of central India with their ages ranging between 18 to 25 years. By using stadiometer, stature was measured and head length was measured by spreading calliper with blunt ends from glabella to inion. We found that certain correlation exists between height and head length of a person and that was statistically significant also. Regression equations were derived in males and females for estimating height from head length. It was $148.88 \pm 1.21*HL$ for males and $140.07 \pm 1.14*HL$ for Females. The regression equations for height with head breadth were also derived for males and females.

Key words: Stature, Head length, Glabella, Inion, Spreading caliper, Regression equation

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INTRODUCTION

The determination of stature is a major step in the identification of dismembered remains, in natural calamities and archaeological exploration. In some medico-legal cases, it is very important to estimate the stature by taking the help of various available body parts only [1]. In the estimation of stature various other body parts can be used. Forensic pathologist often has to opine for establishing identity of the deceased in cases of bodies which are highly decomposed, bodies which are extensively mutilated or when only fragmentary remains are available [2]. Many different studies have been conducted for determination of stature by using different body part measurements specially those lying subcutaneously, from bony skull, from X-ray skull lateral views and dimensions of face. Some of these could show positive correlation between stature and the body part while other studies could not do so [3]. Using measurements of different body parts for determination of stature of any person is of very much interest for an anthropologist [4]. In determining the height, cranial dimensions have been proved as reliable means in South Africans, Italians, Japanese people [5,6].

There is no universally acceptable formula available for expressing the specific relationship between head length

and height of any person. Error of 5-8% is always involved in prediction of height of an individual when the formulae given by western workers are used. For the variations in the ratios of length of different bones to that of stature, factors like Race, sex, side of body, climate, heredity and nutritional status are attributed [7]. Therefore present study was undertaken to find out if any positive and consistent correlation exists between head length and height of an individual.

METHODS AND MATERIALS

The present study was conducted in the department of Forensic Medicine & Toxicology, JNMC, Wardha. It was an observational study and was approved by the Institutional ethics committee. Our study comprised of a total 196 medical college students belonging to different regions of central India. Their age ranged between 18 to 25 years. After obtaining informed consent from the study participants, we recorded the data in our proforma. Students having significant growth disorders, deformities, trauma or surgery to the skull, bony anomalies, developmental disorders, metabolic and endocrinal disorders were excluded from the study as these can affect the reconstruction of stature. All observations were taken between 1 to 4 pm in the afternoon to eliminate diurnal discrepancy.

In both male and female subjects, anthropometric measurements of height and head length were taken. These measurements were recorded in centimetres. The

person was asked to sit comfortably on a stool and then head length was taken. With the help of a blunt ended spreading caliper, head length was taken from glabella toinion. After keeping the head in Frankfurt's Plane, stature was recorded by measuring the distance from vertex to the heel with the help of a stadiometer.

All the measurements were recorded in the proforma. The data thus obtained was analyzed using SPSS version 24 statistical package. The linear regression formulae for determining stature from head length were derived for male as well as female subjects.

RESULTS

The mean height in male subjects was 171.09 ± 6.08 cm and in female subjects it was 159.50 ± 6.01 cm. So significantly higher stature was seen in males compared to females and gender difference was significant. We observed the mean head length in male subjects as 18.41 ± 0.51 cm and in female subjects it was 16.54 ± 0.53 cm.

It was larger in males as compared to females which was significant. By using Pearson's correlation coefficient, correlation between head length and stature was examined. Correlation coefficient of head length and stature in males was 0.775 and in females it was 0.604.

It was found to be positive in both male and female subjects and was statistically significant. Correlation between stature and head breadth was also examined by using Pearson's correlation coefficient. It was found to be 0.188 in males and in females it was 0.196. This was found to be positive in females only where it was statistically significant.

This table shows regression equation derived for prediction of height in male subjects when head length and head breadth are known. Similarly, this table shows regression equation derived for prediction of height in female subjects when head length and head breadth are known (Tables 1 to 6).

Table 1: Comparison of stature (cm) of the study subjects:

Sex	N	Mean stature	Standard deviation	p-value
Male	92	171.09	6.08	13.38
Female	104	159.5	6.01	P=0.0001, S

Table 2: Comparison of head length between male and female:

Sex	N	Mean head length	Standard deviation	p-value
Male	92	18.41	0.51	24.87
Female	104	16.54	0.53	P=0.0001, S

Table 3: Comparison between stature and head length.

Parameter (with stature)	Male	Female
Head Length(mm)	0.775	0.604
	p=0.0001,S	p=0.0001,S

Table 4: Comparison between stature and head breadth.

Parameter(with stature)	Male	Female
Head Breadth(mm)	0.188	0.196
	p=0.073,NS	p=0.046,S

Table 5: Regression equation for calculating stature in males.

Female	Regression equation	SEE
Head Length	$148.88 \pm 1.21*HL$	6.06
Head Breadth	$149.66 \pm 1.46*HB$	6.01

Table 6: Regression equation for calculating stature in females.

Female	Regression equation	SEE
Head Length	140.07 ± 1.14*HL	5.95
Head Breadth	137.85 ± 1.54*HB	5.93

DISCUSSION

Whenever bodies which are highly decomposed, bodies which are extensively mutilated or when only fragmentary remains are available, then in such cases identification of the deceased becomes very much important. There are certain anatomical landmarks on skull which are standard, well established and easy to find. Therefore, anthropometry of skull has many advantages over others. Geographic and racial variations is an important factor and population or race wise prediction equations are necessary for estimation of stature of an individual using cranial measurements.

This was a cross sectional study comprising of 196 medical students who were born and brought up in different regions of central India. In this study all the subjects were of ages ranging between 18 to 25 years. Mean height of the male subjects was 171.09 ± 6.08 cm and for female subjects it was 159.50 ± 6.01 cm. In males mean head length was 18.41 ± 0.51 cm and it was 16.54 ± 0.53 cm in females. In the study conducted by Shivanand Kadagoudar et al, the average stature in male subjects was 172.44 cm and in female subjects it was 159.49 cm. The average head length was 18.18 cm for males and 16.77cm for females, which is in accordance with our study [7]. In our study, we determined 0.775 as a correlation coefficient of height and head length for male subjects and for female subjects it was 0.604. They were statistically significant. In our study, for estimation of stature from head length, linear regression equation which was derived for male subjects was 148.88 + 1.21*HL and for female subjects was 140.07 + 1.14*HL. In study conducted by Bansal Hansi et al on the students aged between 6 -10 years, a correlation was observed between height and head length which was positive [2].

Girish Shiv Shankar et al observed in their study that head length ranged between 19.39 to 24.74 cm and the mean head length was 21.43 ± 0.94 cm. He also reported that there exists a weak positive correlation between stature and head length. So he concluded that for estimation of height, head length alone is not a reliable indicator [3]. Jadav HR, Shah GV reported mean height as 165.92 cm and mean head length as 17.65 cm. They reported 0.53 as the correlation coefficient between height and head length which was significant. In study conducted by Rajani Singh, the correlation coefficient for height and head length was 0.90 and it was 0.35 for head breadth. Correlation coefficient of 0.507 and 0.440 for males and females respectively were reported by Shivanand Kadagoudar et al in their study. Between height and head length, they observed a positive correlation in the South Indian population [4,6,7] Sumita Agarwal et al in their study observed that, there are significant gender differences in the mean head lengths and head breadths in male subjects compared to the

female subjects. They also observed that the correlation coefficient between the height and head length and head breadth were positive in both males and females and they were statistically significant. Linear regression equations were derived for estimation of height using head lengths in males and females. They derived 109.97+ 3.18 X HL for males and 121.54+ 2.03 X HL for females [5].

Rajani Singh in her study concluded that, in both males and females, head length, head breadth and head height can be used at the same time in prediction of height of a person with high degree of accuracy [6] Pooja Garg and Sangita Chauhan reported mean height for males as 171.85 ± 6.35 cm and for females was 158.07 ± 5.8 cm. They observed the mean head length in females was 17.3 ± 0.79 cm and in male subjects it was 18.6 ± 0.94 cm. Their observations are similar to our study. The correlation coefficient, they reported between stature and head length was 0.309 in male subjects and 0.31 in female subjects which were Less than ours' and statistically significant [8]. Anjali Krishna Prasad et al. in their study observed mean height as 171.33 ± 6.89 cm in males and 157.34 ± 5.31 cm in females. They observed the mean head length and head breadth in male subjects as 18.19 ± 0.81 and 13.48 ± 0.79 and that in female subjects as 17.05 ± 0.66 and 12.81 ± 0.67 respectively. In females for head length and head breadth and in males for head length, they reported a significant correlation coefficient but for head breadth in male subjects it was not significant. The regression equations derived by them for estimating height from head length and head breadth in male subjects were Ht.=130.42+2.24*HL and Ht.=164.98+0.47*HB respectively and for estimating stature in female subjects from head length and head breadth were Ht.= 121.88+2.08*HL and Ht.=141.04+1.27*HB respectively [9]. In a study conducted by Isurani Ilayperuma, the correlation coefficients were found to be positive in both male and female subjects and they were statistically significant also for the height and measured skull length and skull breadth. The correlation coefficient observed by her were 0.715 and 0.470 in male and female subjects respectively [10].

Body proportions are widely variable as age, sex and racial groups varies. This results in variations in regression equations by various workers. All the regression formulae derived by different workers are specific for that population and sex.

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