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ORIGINAL ARTICLE

Estimation of Stature from Head Length in Adults in a Tertiary Care Teaching Hospital of Bareilly, Uttar Pradesh

Chahal P,[1] Sharma A,[2] Singh M.[3]

Assistant Professor,[1,3] Medical Officer Specialist.[2]

1. Department of Forensic Medicine, Dr. S S Tantia Medical College and hospital
2. Joint district Hospital, Sikandrabad, Bulandshahr U.P.
3. Department of Community Medicine, Dr. S S Tantia Medical College and hospital

Abstract:

Stature is the height of the person in upright posture. It is one of the most important elements in the identification of an individual. In the recent times, due to natural disasters like tsunamis, earthquakes, floods, cyclones, and man-made disasters like bomb blasts, terror attacks, wars, plane crashes, mass accidents and other accidents, the need of establishing the identity of the person has become an important necessity for both legal and humanitarian reasons. Many a times, only skull is brought for medico legal identification, this necessitates to correlate the metric traits of the skeletal remains with the stature. The present study was conducted on 300 individuals in a tertiary care hospital of Bareilly, Uttar Pradesh. The study showed a significant co-relation between head length and stature.

Keywords: Stature; Head length; Anthropometry; Identification; Forensic.

Introduction:

Stature is the height of the person in upright posture. It is one of the most important elements in the identification of an individual.[1] In forensic anthropology; stature is among the four major categories of the basic biological profile along with sex, age and ancestry. Anthropometry constitutes the means of giving quantitative expression to the variations which different individuals or traits exhibit. It is well known that there is a definite relationship between the height of the person and various parts of the body like head, trunk and lengths of upper and lower limbs.[2]

Many studies have shown the correlation of stature with body appendages & with long bones. But there are inter-racial & inter-geographical differences in measurements & their correlation with stature. What may be true for one race or one region may not be true for the other. One of the most durable and recognized part of human skeleton is skull. Human skull survives post-mortem taphonomic process and be reported to the authorities. Many a times, only skull is brought for medico legal identification and this is prevalent in the regions where the attacks by wild animals from deep forests are common. In such situations forensic experts always face difficulties to correlate the metric traits of the skeletal remains with the stature. Although a number of long bones are used for this purpose but cranial dimensions are more reliable and precise mean of predicting the stature. The length of the skull is approximately one eighth of the stature of the person as reported by Glaister (1957).[3]

Aim and rationale for the study: To investigate the relationship between head length and stature in adults. By this investigation this study aims to contribute to the existing body of knowledge in the fields of anthropometry, Forensic Medicine and healthcare. The findings may have implications for biometric analysis, age estimation, sex determination and other related areas of research and practical applications.

Materials and Methods:

The present analytical cross-sectional study was conducted to measure stature and head length of the study participants and to derive correlation between these measurements. The study was conducted in the Department of Forensic Medicine, Shri Ram Murti Smarak Institute of Medical Sciences, Bareilly, Uttar Pradesh after getting approval from Institutional Ethical Committee. The aim and objectives of the intended study were explained to the subjects and informed consent was taken. Prior ethical approval was obtained from the Institutional Ethical Committee. Study population comprised of students of MBBS and paramedical institute belonging to Uttar Pradesh state only. The study's inclusion criteria comprised students willing to participate, exclusively belonging to Uttar Pradesh, apparently healthy at the time of measurements, and within the age group of 18 to 30 years. On the other hand, students unwilling to participate, appearing unhealthy during measurements and those with skeletal or craniofacial deformities were excluded from the study. Additionally, students with Dwarfism and Gigantism were also excluded from the research sample. These criteria were implemented to ensure a suitable and representative cohort for the study, enhancing the accuracy and reliability of the results in exploring the correlation between stature and head length in the specified population. $N=4+\{(Z\alpha+Z\beta)\backslash C\}$

Corresponding Author
Dr. Manveer Singh
Email : drmanveersingh21@gmail.com
Mobile No. : +91 8559018276

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Where, C=0.5*1n ([1+r]/[1-r]), Zα as 1.96, (for 5% error), Zβ as 2.58 (for 95% power)

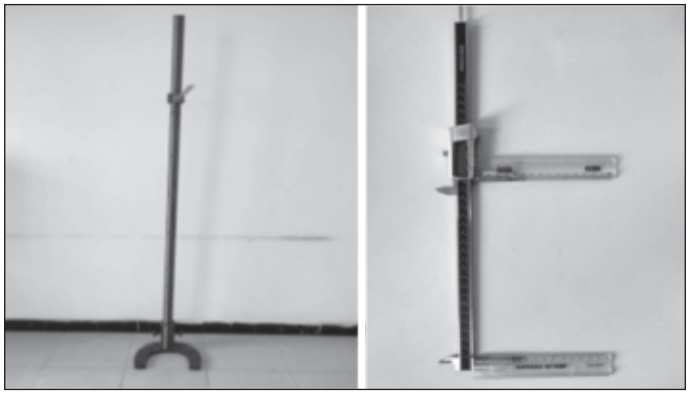
and value of r as 0.5. The minimum number of sample required came out to be 72. For better precision of results a sample of 150 males and 150 females was taken.

Parameters and Anatomical Landmarks: In this study, two primary parameters were measured: stature (height) and head length. Stature referred to an individual's height, measured from the ground to the highest point on their head when standing erect. It is a fundamental anthropometric measurement used in various fields, including forensic medicine and healthcare. Head length was considered as the linear measurement from a specific anatomical landmark to another on the head. The anatomical landmarks used for head length measurement were "glabella" (the most prominent point on the forehead between the eyebrows) to "inion" (the external occipital protuberance at the back of the head). Vernier callipers were modified by addition of a common scale on the extended jaws (Illustration attached).

Data Collection: The study utilized several standard anthropometric instruments, including a Stadiometer and Vernier Calipers. To ensure consistency and minimize potential confounding factors, all measurements were conducted in a well-lit room at a fixed time between 2 pm and 5 pm, thus eliminating any diurnal variation that could affect the results.[5] The primary measurements taken from each student were their stature (height) and head length, and these measurements were recorded in centimeters to the nearest millimeter. To maintain accuracy and reduce potential errors, all measurements were taken by a single observer to avoid inter-observer bias. The process of recording measurements adhered to the guidelines provided by Singh and Bhasin, further ensuring the reliability and standardization of the data collection method.[6] By using these well-established anthropometric instruments and strictly adhering to standardized procedures, the study aimed to provide robust and valid data for analyzing the correlation between stature and head length in the study population.

Statistical Analysis: Data analysis involved entering the collected data into MS Excel 2010 and performing statistical analysis using SPSS software (V 20.0, IBM, U.S.A.). The computed statistical values encompassed mean, standard deviation, and median, providing a comprehensive overview of the data distribution. To determine the correlation between stature and head length, Pearson's correlation coefficient was calculated. Additionally, regression equations were derived to predict stature based on head length measurements. A significance level of $p < 0.05$ was applied, indicating that results with a p-value below this threshold were considered statistically significant. These statistical procedures were employed to explore and quantify the relationship between stature and head length, facilitating the study's aim of establishing a correlation and enabling the prediction of stature from head length in the study population.

Illustration of the instruments used. (a) Stadiometer (b) Vernier Callipers.



Results:

A total of 300 students participated in the study, out of which 150 were males and 150 were females. Participants belonged to the age group of 18-30 yrs. Mean age of the male study participants

Table 1. Distribution of the study participants based on sociodemographic characteristics:

Gender	N	Min (cms)	Max (cms)	Mean (cms)	SD (cms)	Median (cms)
Male	150	154	189	171.66	7.11	171
Female	150	142	172	157.89	6.03	158.75
Total	300	142	189	164.77	9.53	164

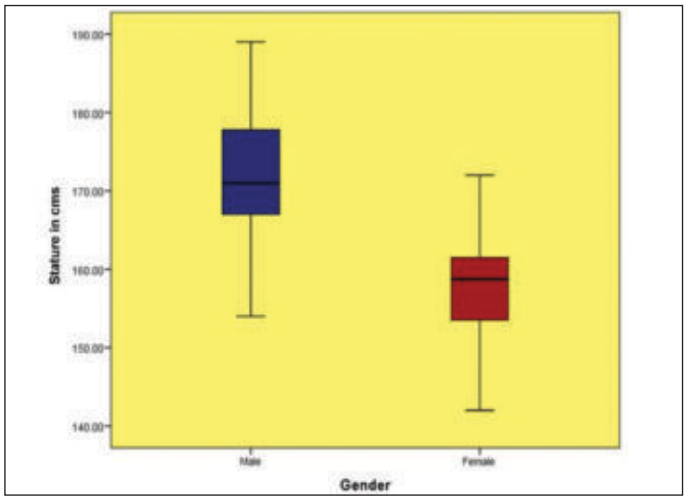


Figure 1. Box and whiskers plot showing the distibution of stature of study participants according to the gender.

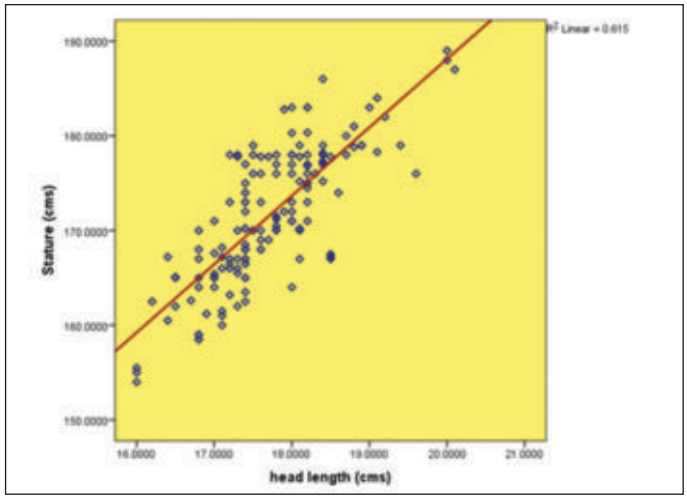


Figure 2. Scatter plot showing relationship between stature and head length along with regression trend line.

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was 21.01±1.55 years while it was lower 20.34±1.029 years among the females. Min and Max age of the study participants as reported in this study was 18 years and 25 years for both the gender groups respectively. The difference was noted in the median age among the males that was 21 years and females which was 20 years.

The mean stature of the males was 171.66±7.11 cms and it was 157.89±6.03 cms among the females. The stature of the tallest male and female was 189 cms and 172 cms respectively while the stature of the shortest one was 154 cms for male and 142 cms for female. Median stature among the males was 171 cms and among the females was 158.75 cms (Table 1). Overall mean stature of the study participants came out to be 164.77±9.53 cms, ranging from 142 cms to 189 cms and median stature was 164 cms (Fig. 1).

The relationship of stature with head length in male study participants. Pearson's correlation coefficient value was found out to be + 0.784 which is showing that stature is positively correlated with head length and the strength of correlation is strong. The correlation coefficient between the stature and the head length was found to be statistically significant ($p<0.01$) (Table 2). The relationship of stature with head length in male study participants. The figure shows a positive correlation between stature and head length. The value of regression coefficient (R2) is found to be 0.615 which states that 61.5% of the values of stature can be predicted using the head length (Fig. 2: Scatter diagram).

The relationship of stature with head length in female study participants. Pearson's correlation coefficient value was found out to be + 0.629 which is showing that stature is positively correlated with head length and the strength of correlation is strong. The correlation coefficient between the stature and the head length was found to be statistically significant ($p<0.01$) (Table: 3).

The regression model presented here depicts the value of constant as 43.684 with the standard error of 8.333. The value of the intercept is found to be 7.222 with standard error 0.470. The model is tested for significance and the value of t came out to be 5.242 for the constant and 15.372 for the intercept. Both the values are found to be statistically significant at $p<0.01$ (Table: 4).

The regression model presented here depicts the value of constant as 72.066 with the standard error of 8.719. The value of the intercept is found to be 5.113 with standard error 0.519. The model is tested for significance and the value of t came out to be 8.266 for the constant and 9.854 for the intercept. Both the values are found to be statistically significant at $p<0.01$ (Table: 5).

Table 2. Correlation of stature with head length in male study participants.

		Stature	Head Length
Stature	Pearson's Correlation	1	0.784**
	Sig. (2 Tailed)		<0.01
	N	150	150

Table 3. Correlation of stature with head length in female study participants.

		Stature	Head Length
Stature	Pearson's Correlation	1	0.629**
	Sig. (2 Tailed)		<0.01
	N	150	150

Table 4. Regression analysis between the stature and head length in male study participants.

	B	Std. Error	Beta	t	Sign. (p value)
Constant	43.684	8.333		5.242	<0.01
Head length	7.222	0.470	0.784	15.372	<0.01
Dependent variable is considered to be stature.					

Table 5. Regression analysis between the stature and head length in female study participants.

	B	Std. Error	Beta	t	Sign. (p value)
Constant	72.066	8.719		8.266	<0.01
Head length	5.113	0.519	0.629	9.854	<0.01
Dependent variable is considered to be stature.					

Linear equation for derivation of stature from head length in study participants:

Males	Y=43.684+7.22x	{p value <0.01 }
Females	Y=72.066+5.113	<0.01

The equation is represented in the form of y=a+bx, where, y is the value of the stature, a is the constant, b is the intercept and x is the value of the predictor variable.

Discussion:

This study contributes valuable evidence by establishing a clear correlation between stature and head length in a specific population of adults from Uttar Pradesh. It provides quantitative data on the relationship between these anthropometric parameters, which can aid in various applications, including identification from mutilated remains and solving critical forensic cases. Additionally, the study presents regression equations that allow for the estimation of stature from head length measurements. Such findings can enhance our understanding of human body proportions and assist in diverse fields such as forensic medicine, healthcare assessments and biometric analysis.

Anthropometry means the measurement of human beings, whether living or dead or on skeletal material.[7] No two individuals are exactly alike in all their measurable traits, even genetically identical twins (monozygotic) differ in some respects. In the present study majority 133 (44.33%) of the study participants were in the age-group of 20 completed years followed by 86 (28.67%) of the study participants who belonged to the age group of 21 completed years.

Similar age group has been included in the study of P Kanchan et al. where the age group of the study participants was 18 to 24 years and in the study of Varghese M Alex where the age group of the study participants was 18 to 25 years.[8,9]

The present study shows that the mean stature of the males was 171.66±7.11 cms and it was 157.89±6.03 cms among the females. Similar have been reported in the findings of SM Patel where the mean height of the males were 170.96 and of the females was 156.14 cms and also in the study of Arti LN where the mean height of males were 170.75 cms and of the females was 156.28cms.[10,6]

This study found that the mean head length of the males was 17.72±0.77 cms and it was 16.78±0.74 cms among the females. The head length of the males and females ranged from 16.00 cms to 20.10 cms and 14.80 to 18.80 cms respectively.

Median head length among the males was 17.60 cms and among the females was 16.80 cms. Overall mean head length of the study participants came out to be 17.25±0.88 cms, ranging from 14.80 cms to 20.10 cms and median head length was 17.30 cms.

In P Kanchan et al. mean head length for males was 18.5±0.72 cms which is slightly higher than the present study and also it was the same with the mean head length of females that was 17.53±0.81 cms.[8]

In this study pearson's correlation coefficient value was found out to be +0.784 between stature and head length in males and in female sit was +0.629. The correlation coefficient between the stature and head length was found to be statistically significant in both males and females ($p<0.01$).

Study by Bardale et al. 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.[11]

In another study done in Kathmandu, Nepal substantial positive correlation between head length and height was found ($r=0.734$, $P<0.001$). This correlation implies that as head length increases, height also tends to increase. The study's regression equation, $y=12.9+8.45x$, with x representing head length and y representing body height, offers a practical means to predict body height based on head length measurements.[12]

Highly significant correlation was found between height and head circumference. The equation relating stature to the head circumference was derived as stature, $y=97.19+1.11$ head circumference for females and $y=88.77+1.45$ head circumference for males.[13] While a moderate positive correlation was observed in another study, the correlation coefficient values of 0.48 for males and 0.43 for females suggest that as one variable increases, the other variable tends to increase as well, but the relationship was not very strong.[14]

However, a study anticipated that the stature estimation derived from measurements of the cranium would be less accurate compared to those obtained from long bones, which are more commonly used in forensic anthropology for this purpose. Specifically, they expected that the estimates based on cranial measurements would have broader confidence intervals, indicating lower precision in the predictions. Nevertheless, they believed that these estimations would still offer reasonably narrow prediction intervals, making it feasible to use cranial measurements for stature estimation in forensic contexts.[15]

Conclusion:

These results indicate that stature can be accurately predicted from head length, facilitating identification from mutilated remains and assisting in critical forensic cases. The correlation and regression equations derived from the study can aid in predicting stature from other parameters included in the research, helping resolve medico-legal issues. However, it's crucial to note that these equations are valid only for the specific population studied and should not be generalized to other geographical populations without further research.

Conflict of Interest: Nil

Source of Funding : Nil

References:

1. Babu RS, Vazir D, Buchiraju P. Estimation of Stature from Foot Length. Indian Journal of PBS. 2013 July-September;3(3):266-270.
2. Krogman WM, Iscan MY. The Human Skeleton in Forensic Medicine. 2nd edition. Illinois:Charles Thomas Publisher; 1986.p.302-51.
3. Glaister. Medical Jurisprudence and Toxicology. 10th Edition. Edinburg E.S Livingstone Ltd; 1957:p.80.
4. Miot HA. Sample size in clinical and experimental trials. Journal Vascular Brasileiro. 2011 December;10(4).
5. Asha KR, Subash LP. Estimation of stature from cephalic dimensions in Indian population. Anatomic a Karnataka. 2011;5(1):01-05.
6. Narde AL, Dongre AP. Body Height Estimation Based on Foot Length and Foot Breadth. J Indian Acad Forensic Med. 2013 July-September;35(3):245-248.
7. Khanapurkar S, Radke A. Estimation of stature from the measurement of foot length, hand length and head length in Maharashtra region. Indian Journal of Basic & Applied Medical Research. 2012 March;1(2):77-85.
8. Wankhede KP, Anjankar VP, Parchand MP, Kamdi NY, Patil ST. Estimation of stature from head length & head breadth in central Indian population: an anthropometric study. International Journal of Anatomical Research. 2015;3(1): 954-957.
9. Varghese MA, Vaswani VR, Shenoy V, Babu B, Ajid A. Estimation of stature using cephalic and facial measurements. JIAFM. 2022 Mar;44(1):27-30.
10. Patel SM, Shah G.V, Patel SV. Estimation of height form measurements of foot length in Gujrat region. Journal of Anatomical society of India. 2007;56(1):25-27.
11. Bardale RV, Dixit PG. Estimation of stature from somatometry of skull. Journal of Medicolegal Association of Maharashtra. 2006;1(2):22-6.
12. Manandhar B, Shrestha R. Estimation of Body Height from Head Length among Dental Students of a Dental College. JNMA J Nepal Med Assoc. 2018 Sep-Oct;56(213):861-865.
13. Patil RA, Kachare RV, Pawar VG, Dode PS. International Journal of Res Med Sci. 2022 Jul;10(7):1481-1485.
14. Prenetha R, Babu KY. Stature estimation using head circumference. J Adv Pharm Technol Res. 2022 Nov;13(Suppl 1):S140-S143.
15. Richards A. The estimation of stature from measurements of the isolated cranium [dissertation]. San Marcos: Texas State University; 2011.