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table. A block is placed below the neck so as to extend the head, then coronal incision is made extending from one mastoid process to the opposite side, and then the scalp is separated anteriorly and posteriorly exposing the cranium. Ethical clearance was obtained from Institutional ethical committee of K S Hegde Medical college, Mangaluru before the study.

The following measurements are taken in cm to the nearest millimetre in the study.

1. Maximum cranial length-distance between the glabella and opisthocranium in the mid sagittal plane measured in a straight line using a spreading calliper.
2. Maximum cranial breadth-distance between both euryon perpendicular to the mid sagittal plane using spreading caliper.

Inclusion criteria:

1. Deceased of age group between 25years - 60 years of Dakshina Kannada nativity
2. Gender of the deceased is known.

Exclusion criteria:

1. Subject with recent or known history fracture skull or long bones
2. Subjects with congenital deformities of skull, spine and limbs
3. Subjects with known history of orthopedic and cranial surgeries
4. Decomposed, charred, mutilated bodies
5. Unknown/unclaimed bodies
6. Non-native population of Dakshina Kannada District
7. Age less than 25 and more than 60 years.

Statistical Analysis:

Data collected was entered in MS- Excel-2010 and was analysed using SPSS Version 16. Quantitative variables such as age, Maximum cranial length, Maximum cranial breadth, height of the individual were expressed in terms of mean and Standard Deviation. After appropriate testing of normality distribution of the data using Shapiro Wilk test. Qualitative variables such as gender, age groups of the individual were expressed using percentages and proportions.

Inferential Statistics of Independent t test was used to determine statistical significance among males and females at p

value < 0.05. Pearson's correlation was used to correlate the craniometric measurements and the height: subsequently multiple logistic regression was applied to arrive at the formula to determine height using craniometric measurements.

Observation and Results:

The two cranial measurements, maximum cranial length and maximum cranial breadth were taken using appropriate instruments after all the criteria for inclusion in the studies were appropriately met. The study is directed at developing a regression formula for stature estimation for the native population of males and females of the Dakshina Kannada district based on cranial measurements taken. The following are the results of the study.

The frequency of study subjects is as shown in the Table no. 1.

The mean and standard deviation values of maximum cranial length and maximum cranial breadth and the length of the body is tabulated in Table no 2 along with statistical value in Table no 3.

The stature of the body is the dependent variable. It was observed that maximum cranial breadth shows a correlation with the height of the individual and was significant.

Table 1: Frequency Distribution Table of Age Range of the study subjects

Age group	Sex		Total (n)
	Male(n)	Female(n)	
25-34	18	21	39
35-44	14	12	26
45-54	8	5	13
>55	10	12	22
Total	50	50	100

The length of the body can be calculated by using the formula:

Length of the body = $63.64 + 0.482 \times \text{Maximum cranial Length} + 1.6 \times \text{maximum cranial breadth}$

The length of the body thus calculated using the formula derived was correlated with the actual height measured in the deceased and was found to have a correlation of 0.732 and was statistically significant.

Discussion:

Cranium is an important bone that has gained considerable interest among forensic anthropologist in the past. Several studies on anthropology taking various population and measurements of different

bones have been done bearing on age, ethnicity and sexual dimorphism. Various studies have shown that biological profiling pertaining to age, sex, race/ ethnicity can be estimated if cranium is available.⁴

In this study on stature estimation using craniometric measurements, maximum cranial breadth shows stronger correlation

with stature of an individual among the two measurements.

One of the earliest study published by Sarangi and co-workers (1981)⁵ was done on 220 autopsied Indian cadavers. The results did not show significant correlation

Length of the body in cm	Length of the body calculated with formula	P value
	0.732	<0.000
*Pearson's correlation: 0.05 statistically significance		

Table 2 Mean and Standard deviation of various measurements taken

Measurements (centimetres)	SEX	Mean & Std. Deviation	T value	Statistical significance
Maximum Cranial Length	Male	16.1± 1.32	4.35	0.000*
	Female	15.1± .9150		
Maximum Cranial Breadth	Male	11.8± 1.20	2.33	0.02*
	Female	11.3± 1.16		
*Statistical significance <0.05, Independent t test				

Table no 3: The mean and statistical significance of each of the cranial measurements

	Correlation-coefficient (beta)	T value	Significance
(Constant)	63.639	5.377	<0.001*
Maximum Cranial Length (cm)	0.482	0.644	0.521
Maximum Cranial Breadth (cm)	1.596	2.745	0.007*
*Statistical significance 0.05, Pearson's correlation			

between maximum anterior-posterior length, maximum breadth with stature ($p > 0.5$). In the present study, the results did show significant correlation between maximum cranial breadth and stature of an individual.

A study was done by Ryan and Bidmos (2007)⁶, to derive a correlation coefficient relation between maximum cranial length, maximum cranial breadth and other cranial measurements to estimate the stature of indigenous South African population, using 99 complete skeletons (50 males and 49 females) between the age group of 25-70 years. The results suggest that maximum cranial length and maximum cranial breadth showed correlation with the stature of the

individual. However, our study showed positive correlation with the total skeletal height only for maximum cranial breadth and not for maximum cranial length.

A study was done by Seema et al (2011)⁷ among the Punjab zone population and a similar study was done by Hansi et al (2013)⁸ on the population belonging to Bulandshahar region of Uttar Pradesh, to derive a correlation between the personal height and head length. The correlation coefficient between the stature and head length was found to be statistically significant and positive in both males and females. In our study, we could not find correlation between maximum cranial length and stature of the individual.

A study analysed by Sumita et al (2014)⁹ among 800 medical students (400 males and 400 females), ranging from the age group of 17-25 years of Western U.P, to find a correlation between the stature and cranial measurements found a correlation coefficient between the stature and maximum cranial length. However, in our study, correlation coefficient was found between maximum cranial breadth and stature of the individual. In a study done by Shrestha R et al (2015)¹ among 200 autopsied body (148 males and 52 females), to derive a correlation between stature and maximum cranial length and maximum cranial breadth, did not find a correlation between maximum cranial breadth and stature of an individual. Our study concluded that there is positive correlation between maximum cranial breadth and stature of the individual.

The stature estimation is of great help in establishing the biological profile of the deceased individual along with other methods of estimation of sex, age and ethnicity from the examination of the cranium.

The present study is of great importance in the sense that it provides data of the autopsied sample on Dakshina Kannada population which can be helpful in the identification of mutilated and dismembered skeletal remains especially when only the skull vault is brought for examination.

Conclusion:

The cranial measurement like maximum cranial length and maximum cranial breadth were taken using appropriate instruments after all the criteria for inclusion in the study were appropriately met.

It was observed that maximum cranial breadth shows a correlation with the stature of the individual and was found to be statistically significant.

There are a lot of variations in estimating stature from cranial measurements among people of different regions and ethnicity. So, the present study was directed on developing

a regression formula for stature estimation for the native population of males and females of Dakshina Kannada district based on maximum cranial breadth taken.

If measurements are available or known, it will be useful for the Anthropologists and Forensic Medicine experts. It will also be helpful in establishing the identity in civil cases.

This study has established definite correlation between stature and maximum cranial breadth. The regression equation has been established. It will be of great help for many medico-legal cases in establishing identity of an individual when only some remains of the body are available for examination as in cases of mass disaster, bomb explosion, accidents etc.

Conflict of Interest: None

Ethical Approval: Obtained from institutional ethics committee

Financial Assistance: None

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