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Original Research Article

CORRELATION AND REGRESSION ANALYSIS OF STATURE IN RELATION TO HEAD LENGTH IN CHILDERN IN NORTH KARNATAKA

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ABSTRACT

Background: Anthropometric measurements vary in different races, sex and age groups. Stature prediction occupies relatively a central position for identification both in forensic medico legal investigations and anthropologists.

Materials and Methods: The study was done on 200 children of both sexes between 8 to 12yrs from school in Department of Anatomy VIMS Bellary. Staturemeter was used to measure height and spreading calliper to measure head length. Pearson correlation was used to see correlation between height and head length and regression analysis to derive an equation.

Results: Head length and height are positively correlated among boys with correlation coefficient of 0.20 which is statistically significant. Among girls also it is positively correlated with correlation coefficient of 0.41 which is statistically highly significant. When both boys and girls were combined it also showed positive correlation with correlation coefficient being 0.39 which is statistically highly significant.

The regression formula obtained is Y = 93.611+2.518(X) for boys, Y = 27.643+6.226(X) for girls and Y = 47.928+5.084(X) when combined where Y is stature and X is head length.

Conclusion: If either of the measurement (head length or total height) is known, the other can be calculated which can be practically used for identification by forensic experts and anthropologists.

KEY WORDS: Stature, Height, Head length, Anthropometry, Correlation, Regression.

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INTRODUCTION

Anthropometry the biologic science of human body measurement constitutes the means of giving quantitative expression to the variations which different individuals or traits exhibit [1]. Physical anthropology, the study of man's behavior in time and space is not only concerned with the origin and the evolution of mankind, but also with the growth and development [2]. Anthropometry forms a very important tool in ergonomics i.e. study of man in relation to his working environment. It is concerned with dimensions, shape, proportions and formulation of the standard sizes and design for various equipments, clothes and furniture as per the sizes of human body. Stature an important data of identification is primly used by athropologists and medico-legal experts for identification during murder, accident or natural disaster [3].

The stature is a measure of biological development and is determined by a combination of genetic and environmental factors [4]. Universally applicable formulae have not been derived because the relationship between height and long bones or other measurements differ according to race, age, sex and side of body. It is proved that each race and age group require its own table [1]. Artists use dimensional relationships in depicting the ideals of beauty, and this has resulted in creation of the rules of body proportions [5]. Anthropologists observe and compare the relation between body and segments to highlight variations between their origins [6].

The significant body segments for estimation of stature are length of foot, hand, hand with forearm, arm, upper extremity length of head, height of head, distance between sternal notch and pubic symphysis.[5] Stature bears a direct relation to length of various bones and linear regression equations are derived to estimate stature from length of bone [7].

Stature is usually determined by employing mathematical or anatomical method. The anatomical method requires the presence of all skeletal elements that contribute to height while mathematical methods extrapolate stature from the size of a single bone or body part using regression formulae [3]. Recent trends in forensic anthropology have shown an increased interest in forensic age diagnosis using regression analysis [8].

According to Glaister, nasion-inion (head length) is 1/8 of the total height of an individual. Although a no of long bones are used, cranial dimensions are more reliable and precise mean of predicting the stature in Indians [9].

The estimation of height from various parameters has been done by many workers but not much data is available in literature regarding the estimation of stature from head length in children. In the present study an attempt has been made to find out correlation and derive a regression formula between head length and stature in children.

MATERIALS AND METHODS

The study was done on 200 children (100 boys, 100 girls) studying in a school in Bellary between 8 and 12 years from January 2012 to September 2013. Consent of school head master was taken before collecting data. Measurements were taken at fixed time of day to avoid diurnal variation.

Staturemeter was used to measure height and spreading caliper to measure head length from glabella to opisthocranion in cms. Weight was collected to calculate BMI and asses the nutritional status of the student to include in the study. Pearson correlation was used to see correlation between height and head land regression analysis to derive an equation.

Subjects beyond age group, suffering from chronic diseases and malnutrition, congenital abnormality affecting head and vertebral column deformity were excluded from the study.

Figure 1 shows how head length is measured.

Statistical Methods: This is an analytical study to measure the association between the variables head length and height [10].

Pearson Correlation has been used to find the degree of relationship between total body height and head length.

Student t test (Two tailed) for correlation has been used to find the significance of degree of correlation.

Regression analysis has been carried out to find the exact relationship between total body height and head length.

RESULTS

Fig. 1: Measuring head length.

A Cross-sectional study on 200 school children between 8 to 12 years with each 100 boys and girls were taken to evaluate the correlation of body height and head length, and develop the prediction model to predict body height using the head length.

In the present study, the proportion of children in each age group 8 years, 9 years, 10 years, 11 years, 12 years was equal for all being 20% in each.

Height: Mean and S.D in Boys = 137.06 ± 9.23, In Girls = 131.45 ± 10.40

Head Length: Mean and S.D in Boys = 17.25 ± 0.74, In Girls = 16.70 ± 0.72

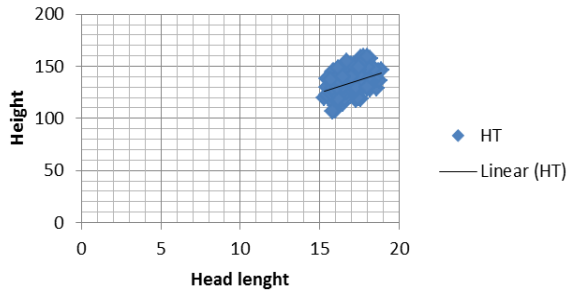
RESULTS OF CORRELATION

There is a positive correlation of 0.204 between Head length and height among boys which is statistically significant.

There is a positive correlation of 0.416 between Head length and height among girls which is statistically highly significant. *P*<0.01.

There is a positive correlation of 0.390 between Head length and height when combined and is statistically highly significant. *P*<0.01.

Fig. 2: Correlation between head length and height.



r = 0.390 *P* = < 0.001 N = 200

Table 1: Regression analysis for prediction of height using head length (y = a+bx).

Variable	Formula	R^2
Boys	y=93.611+2.518(x)	4.10%
Girls	y=27.643+6.226(x)	17.30%
Combined	y=47.928+5.084(x)	15.20%

Where Y = Height in cm X = Head length in cm

Table 2: Comparison of similar previous studies with present study.

Workers	Age group	Correlation coefficient	Statistical significance	Formula
Saxena ey al 1981 [11]	25-30yrs	0.2048	Significant	Y=134.42+1.504X
Jadhav H R et al. 2004 [12]	17-22yrs	0.53	Significant	Y=78.92+4.93X
Harsh M P et al. 2007 [16]	8-12yrs	0.45	Significant	Y=16.39+6.91X
Seema et al (2011) [9]	18-23yrs	0.52	Significant	Y=77.89+4.98X
Syed HissamuddinUzair 2011 [17]	21-48yrs	0.66	Significant	Y=66.25+5.46X
Parth M. Pandya ey al. 2012 [1]	8-18yrs	0.3	Significant	Y=12.33+7.75X
Present study	8-12yrs	0.39	Significant	Y=47.928+5.084X

The Regression analysis was carried out to find the strength of relationship between head length with body height. The relationship between head length and height is positive and with every unit increase in head length there is significant 2.518 in boys, 6.226 in girls and 5.084 in combined increases in body height.

DISCUSSION

In the present study head length and height of 200 randomly chosen healthy children with no physical abnormality of 100 each male and female were taken. Regression analysis is carried out to find the strength of relationship between height and head length using spss 16 package software. Using linear regression analysis a constant (a) and a regression coefficient (b) were estimated with height as dependent variable and head length as independent variable.

Stature can be estimated using the linear regression formula y = a + bx where

y is height or stature ,a is constant, b is regression coefficient, x is head length

Tables and statistics clearly show that head length (independent variable) is strongly related to height (dependent variable) with a strong linear association between them. Boys and girls were considered both separately and as a whole. Correlation is significant in males and strongly significant in females and as a whole.

Head length measurements were taken between glabella and inoin in the studies done by Saxena et al in 1981 [11] and Jadav et al in 2004 [12] and the correlation coefficient was not derived separately for males and females.

In present study, head length is measured from glabella to opisthocranion. The point opisthocranion is chosen to measure the head length, as it eliminates the human errors of judgement and therefore more accurate and inion is difficult to locate accurately.

Intorna et al performed somatometry on maximum antero posterior and lateral diameter of skull in 358 young males ranging from 17 – 27 years, and reported the feasibility of obtaining estimation of stature from the skull through calculating correlation coefficients by multiple linear regressions [13].

M Chiba and K Terazawahave estimated stature with head diameter in 124 japenese cadavers. Head diameter in their study is similar to head

length in present study [14]. Measurements in the present study are taken in the living subjects rather than cadavers.

Patil and Mody used radiographs to estimate stature and derived regression equation using maximum length of the skull.[15] As per principles of statistics, finding a multiplication factor by considering averages is not accepted as a sound and satisfactory method.

The estimation of height from various parameters of the body in different age groups is available. Various parameters used are long bones of upper limb, superior extremity and its segments, cervico – thoraco – lumbar (C-T-L) segments of spine, dimensions and maturity of second metacarpals, scapula, lower extremity, clavicle, middle finger length, length of sternum, foot and shoe dimensions, hand length and breadth to name a few.

In 2012 Sonali Khanapurkar, AshishRadke used multiple parameters foot length, hand length and head length to estimate stature of 1000 students aged 19-22 years. All the parameters correlate significantly with stature but foot length when combined with hand length in both the sexes depicts higher correlation co-efficients with stature than head length individually. Hence it was concluded that multiple linear regression analysis is better over simple linear regression analysis for estimating accurate stature [18].

It is important to note that every race of particular age group and sex should have its own table for estimation of height using various parameters. In the present study head length is correlated with stature in children both boys and girls aged between 8 to 12years in North Karnataka region. The relationship between height and head length in all the cases (boys and girls) as well as independently of boys and girls are positively correlating as shown in Figure 2.

Regression analysis (Equations) for the prediction of total height from head length in boys, girls and combined are shown in Table no 1.

Comparison of similar previous studies with the present study is shown in Table no 2.

CONCLUSION

The present study has shown the usefulness of head measurement in stature estimation of children aged between 8 to 12yrs in and around Bellary. Correlation coefficient between head length and height is 0.204 in boys, 0.416 in girls and 0.390 when combined.

The regressions equation derived are

For Boys: Y = 93.611+2.518 X

For Girls: Y = 27.643+6.226 X

For both Boys and Girls (combined):

Y = 47.928+5.084 X

Where Y = Total height, X = Head length

If either of the measurement (head length or total height) is known, the other can be calculated and this can be used practically in medico legal investigations and in anthropometry.

Estimation of stature from head length is easy, economical and convenient where specialized equipment or training is not required. Anthropologists, forensic experts and investigating officers can use this formula for stature estimation when only head or part of the head or only a dry skull is available.

This study is able to add another method to estimate stature from head length of children in Bellary region which is reliable, practical, and simple and to be encouraged to use more often.

Conflicts of Interests: **None**

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