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RESEARCH ARTICLE

ESTIMATION OF STATURE FROM HEAD LENGTH IN LIVING ADULTS IN MARATHWADA REGION OF MAHARASHTRA

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ABSTRACT

Introduction: - Growth - the vital process is measured by measuring the height of a person, which itself is a sum of length of certain bones and appendages of the body represent certain relationship with form of proportion to the total stature. Assessment of height from different parts of body by anthropometric study of skeleton is an area of interest to anatomist, anthropologist and forensic expert.

Aims :- Aim of present study is to estimate stature from head length, to derive correlation between two, to derive regression formulae.

Method and Materials: - The present study was carried out on 250 (125 males and 125 females) medical students Government Medical College of Maharashtra in the age group of 18 – 28 years. The parameters studied were stature and head length. The observation were analysed by Pearson's correlation to examine the relationship between head length and stature according to gender.

Results: - The mean ages of the study subjects (male 21.192 ± 3.25 and female 21.02 ± 3.22) were not significantly different between genders. Mean head lengths of the male were significantly larger than that of the females of all ages. Positive Correlation was found between stature and head length 0.26 in males and 0.22in females and 0.44 in both sexes together.

Conclusion:- Definite proportion exist between the stature and head length in all individuals.

INTRODUCTION

Greek anthropos means "man" and metron is "measure" therefore measurement of man- provides scientific methods and techniques for taking various measurements and observation on the living being and the skeleton**.(** http://en.wikipedia. Anthropometry, September 2009.)

It is a fact that no two persons are ever alike in all their measurable characters. Every person tends to undergo change in varying degrees from birth to death, in health and in disease. Since persons living under different conditions and members of different ethnic groups and the offspring of unions between them, present interesting differences in bodily form and proportions frequently.

Anthropometry constitutes the means of giving quantitative expression to the variations which different individuals or traits exhibit. (MF Ashley Montagu 1960.)

Assessment of height from different parts of body by anthropometric study of skeleton is an area of interest to Anatomists, Anthropologists, Archaeologist and to Forensic experts. (Mondal MK et.al. 2009.)

There are two basic methods for calculating height from skeletal remains. The mathematical method i.e. also called as regression method and the anatomical method i.e. also called as multiplication method. . The method mostly used is someversion of a mathematical model or regression method. (De Mendonca MC 2000.)

The mathematical method makes use of one or more bone lengths to estimate the stature of the individual. This method employs bone length and stature tables, and regression formulae to estimate total skeletal height or living stature from long bone lengths. In 1899, Karl Pearson developed the first formal stature regression formulae from long bones. **(**Pearson K 1899.)

Skull is composed of hard tissue and is the best preserved part of skeleton after death, hence in many cases it is the only available part for examination. **(**Introna F et. al. 1993.) In such a situation, estimation of stature becomes equally important along with other parameter like age, sex, race, etc. So estimation of stature from length of head has also attracted many workers like (Chiba M.et. al.1998), (Introna F *et al*. 1993), (Krishan K 2008.), (Ilayperuma I 2010).

Aims and objectives

- Estimation of Stature from Head length in living.
- To derive the Correlation between Stature and head length.
- To derive a regression formulae to predict the height of an individual using head length.

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MATERIAL AND METHODS

The design of the study was cross sectional type of observational study comprised of total 250 (125 M and 125 F) asymptomatic healthy young adult medical students from Government medical college. Their ages ranged between 18 to 28 years. This age range comes in an age range during which height remains more or less static. A slow decline in the height is known to occur as the age advances and therefore older subjects were not studied. (**Qamra SR et. al. 1980.)** Subjects having old fractures or any significant disease, orthopaedic deformity, metabolic or developmental disorders which could have affected the general or bony growth were excluded from the study.

In each case, the stature and head length were recorded. The measurements were always taken at a fixed time, between 3 – 5 pm, to eliminate discrepancies of diurnal variation and by the same person to avoid error in methodology.

Measurement of Stature

Stature is measure of vertical distance from vertex to floor.(http://en. wikipedia. Anthropometry, September 2009.)

vertex: It is the highest point on the head in the midsagittal plane, when the head is held erectly or in Frankfurt's plane. Stature was measured from vertex to floor by Anthropmeter rod with subject standing barefooted, erect on an even floor, in the Frankfurt's plane.

Measaurement Of Head Length

Head length measures the straight distance between glabella and inion. (Singh I P et. al. 1989.)

Glabella: It is the point on protuberance of lower forehead above nasal root and between the eyebrow ridges intersected by mid sagittal plane.

Inion: inion is the most prominent posterior point on the external occipital protuberance of head in the mid sagittal plane. Measurements were taken using blunt ended spreading caliper.

The measurements were tabulated and statistically an alysed. The mean and standard deviation were obtained. Pearson's correlation co- efficient and linear and multiple regression equations were derived for males, females and both sexes together of study group by using Epi Info version 3.4.3 software.

RESULTS

The mean ages of the study subjects (male 21.192 ± 3.25 and female 21.02 ± 3.22) were not significantly different between genders. Gender differences in mean stature and head length were found to be highly significant (P< 0.05). Mean head lengths of the male were significantly larger than that of the females of all ages.

Table no. 1.A shows that, the mean Stature of total subjects was 168.69 ± 5.76. Mean of Head length was 19.02 ± 1.55 with range of 16 to 24 cm. **Table no. 1.B** shows that mean stature of male subjects was 171.93 ± 5.99. Mean of Head length in male subjects was 19.76 ± 1.57, with range of 17 to 24 cm. **Table no.1.c** shows that mean stature of female subjects was 165.43 ± 3.07. Mean of Head length in female subjects was 18.28 ± 1.13, with range of 16– 21 cm.

Table no. 1 Mean, SD and Range for all the parameters A.Both sexes together

Parameter (cm)	Mean	SD	Range
Stature	168.69	5.76	150 – 185
Head length	19.02	1.55	16 – 24

Table no. 1.A shows that, the mean stature of total subjects is 168.69 ± 5.76. Mean of head length is 19.02 ± 1.55, the minimum being 16 cm and the maximum is 24 cm. **B. Male Cases:**

Parameter	Mean	SD	Range
Height	171.9	5.99	157 - 185
Head length	19.76	1.57	17 – 24

Table no. 1.B shows that mean stature of male subjects were 171.93 ± 5.99.Mean of head length was 19.76 ± 1.57, the minimum being 17 cm and the maximum was 24 cm.

C. Female Cases:

Parameter	Mean	SD	Range
Height	165.4	3.07	150 – 175
Head length	18.28	1.13	16 - 21

Table no.1.c shows that mean stature of female subjects were 165.43 ± 3.07. Mean of head length was 18.28 ± 1.13, the minimum being 16 cm and the maximum was 21cm.

Table No.2 Comparison of study parameters between male and female

Parameters	Mean ± SD (Min – Max)		Z value	P value
	Male	Female		
Stature	171.93 ± 5.99 (157 - 185)	165.43 ± 3.07 (150 – 175)	10.79	P < 0.01
Head length	19.76 ± 1.57 (17 – 24)	18.28 ± 1.13 (16 – 21)	7.45	P < 0.01

Table no. 2 and Graph no.1 shows that mean stature of male subjects are significantly larger (171.93) as compared to female subjects (165.43) owing to early maturity in girls. Similarly head length in males (19.76) are stastically significantly larger as compared to female subjects (18.28).

Graph No. 1: Comparison of study parameters between male and female subjects.

In above bar diagram, parameters to be compared between males and females are plotted on X axis and total height/length of parameters on Y axis. Above bar diagram indicates that there is differences in mean for all parameters between male and female subjects.

Correlation Coefficient

Pearson's correlation coefficient was used to examine the relationship between Head length and Stature. Correlation coefficient between Stature and Head length was found to be statistically significant and positive in both males and females.

Table no. 3 Pearson's correlation coefficient

Subjects	Correlation Coefficient (r)	Coefficient of determination (%)	P value
Male	0.26	06	
Female	0.22	04	
Both sexes together	0.44	19	P < 0.01

Table no. 3 shows that the correlation of Stature with Head Length was 0.26 in males, 0.22 in females and 0.44 in both together, which are positive and statistically highly significant

(P < 0.01) i.e. if Head length increases or decreases, the Stature of the subject also increases or decreases and vice versa.

Table no. 3 shows that the correlation of stature with head length was 0.26 in males, 0.22 in females and 0.44 in both sexes together, which was positive and statistically highly significant (P < 0.01) i.e. if head length increases or decreases, the stature of the subject also increases or decreases and vice versa.

Graph No.2: Correlation of Height with Head length in both sexes together. (n =250)

Graph no.2 shows positive correlation of Head Length (mean =19.02 cm) on X axis and Stature of subjects (mean =168.69 cm) on y axis, indicating that increase in head length leads to increase in total height of subjects. (r= 0.44, P<0.01). The significant correlation was further interpreted by linear regression. 19% variation observed in height is due to the increase in head length. (r^2= 0.19).

Graph No. 3: Correlation of Height with Head length in Males (n =125)

Graph no.3 shows positive correlation of Head Length (mean =19.76 cm) on X axis and Height of male subjects (mean =171.93 cm) on y axis, indicating that increase in head length leads to increase in stature of male subjects. (r= 0.26, P<0.01). The significant correlation was further interpreted by linear regression. Only 06% variation observed in height is due to the increase in head length. (r^2= 0.06)

Graph No.4: Correlation of Height with Head length in Females (n =125)

Graph no.4 shows positive correlation of Head Length (mean =18.28 cm) on X axis and Stature of female subjects (mean =165.43 cm) on y axis, indicating that increase in head length leads to increase in total height of female subjects. (r= 0.22, P<0.01). The significant correlation was further interpreted by linear regression. Only 04% variation observed in height is due to the increase in head length. (r^2= 0.04)

Linear Regression Equation

Regression analysis was performed for estimation of stature using Head length as independent variable.

Table no. 4 shows the linear regression equation for stature with Head length in male, female and both together, where,
Y = Stature (cm)
X = head Length (cm)
152.59, 153.91, 137.06 are intercept (constant) for male, female and both together respectively.

0.97, 0.63, 1.66 are regression coefficient for male, female and both together.

From the above table it is seen that the regression formula within a region also varies between male and female population of that region.

Table 4 Regression equation for Stature with Head length in male, female and both together.

Subjects	Correlation Coefficient (r)	Regression Equation	P value
Male	0.26	Y = 152.59 + 0.97X	P < 0.01
Female	0.22	Y = 153.91 + 0.63X	
Both sexes together	0.44	Y=137.06 +1.66X	

DISCUSSION

All human beings occupying this globe belong to the same species i.e Homo sapiens. No two individuals are exactly alike in all their measurable traits, even genetically identical twins (monozygotic) differ in some respects. The present study deals with observation on correlation of human stature with head length.

Over many decades, a close relationship between stature & dimensions of various body segments are reported & the results are frequently used in medico legal investigation. There are studies, in which an attempt has been made to establish the correlation between stature and head length. Various workers (Saxena SK et.al.1981,) (Chiba M et. al 1998), (Jadhav H.R et.al. 2004), (Ryan I et.al 2007), (Krishan K 2008), (Kalia S.et.al.2008), (Ilayperuma I et. al. 2010) have shown significant correlation between stature and head length as well as other dimensions of skull.

(Saxena SK et.al.1981) studied 346 adult males of Uttar Pradesh population between age group 25 – 30 years and derived correlation coefficient of 0.204.

(Chiba M et. al 1998) studied Japanese cadavers and derived regression equations

$S(m) = 96.3 + 3.89\ X_1 \pm 7.09$
$S(f) = 153.4 + (- 0.02)X_2 \pm 6.97$
$S(c) = 85.0 + 4.34X_3 \pm 8.59$
Where, S = Stature
m = male
f = female
c = both sexes combined
And X = head length

(Jadhav R et.al. 2004) studied 727 Guajarati population and derived regression equations
$S(m) = 138.77 + 1.77X_1$
$S(f) = 128.03 + 1.72X_2$
$S(c) = 78.92 + 4.93X_3$

(Krishan K 2008) studied 996 adult male gujjars in age group 18 – 30 years and derived regression equation
$S = 88.67 + 4.65X \pm 4.13$

(Ilayperuma I 2010) studied 400 srilankan population of age group 20 – 23 years and derived regression equations
$S(m) = 101.83 + 3.69X_1$
$S(f) = 226.60 + 3.86X_2$
$S(c) = 103.72 + 3.38X_3$

CONCLUSION

From the present study, it has been concluded that

- Mean stature and head length is more in males than in females.
- Gender differences in mean stature and head length were found to be highly significant (P <0.05)
- There is positive correlation between stature and head length.
- Simple linear regression equation so far derived can be used for estimation of height in Marathwada region.
- If either of the measurement (head length or Stature) is known, the other can be calculated.
- This fact will be of practical use in Medico legal investigations and in anthropometry. Study would be useful for Anthropologist and Forensic Medicine experts.

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