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Original Article

Prediction of stature from length of Ulna – An Anthropometric study on 100 Bangladeshi adult Muslim male of lower socioeconomic status group

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Abstract

Background: Anthropometric study of bones conveys information about race, sex, age and height of a person as well as the effect of climatic, hereditary and nutritional status on stature and length of long bones which is very important for anatomist in the academic field. Stature of an individual can be estimated from measurements of long bones with the help of established formulae which plays an important role in medico-legal practice and thus length of long bones plays an important role in identifying unknown bodies.

Objective: The present study was undertaken to measure the stature as well as some length of ulna and to determine whether there is any correlation between stature and length of ulna and to estimate the stature using respective multiplication factor and to asses the effectiveness of the above estimations by comparing the 'estimated' values with the 'measured' values.

Material and Methods: It is descriptive type of study. Ulnar length with their stature were measured directly from the subjects by using Anthropometric spreading caliper, steel plate and measuring tape. The data were then statistically analyzed by computation to find out its normative value. Multiplication factors were estimated for estimating stature and comparisons were made between measured and estimated stature using paired "t" test.

Place and period of study: The study was carried out with a total number of 100 Bangladeshi adult Muslim males of age between 25 to 30 years of lower socio-economic status group. The analyses were conducted in The Department of Anatomy of BSMMU, Dhaka during the study period of January 2006 to December 2006.

Result: The mean measured values of the right and left ulnar length and the stature were 28.625 (± 1.170) cm, 28.235 (± 1.244) cm, and 163.70 (± 5.986) cm respectively. The multiplication factors were estimated for the ulnar lengths with the stature. Significant positive correlations were found between the stature and the ulnar length and the differences between the measured statures and the estimated statures were not statistically significant.

Conclusion: This study will be helpful for the Anatomists, Anthropologists and also Forensic Medicine department of Bangladesh. For better result further study should be done on large samples of different socio-economic status groups, sexes and ethnic groups.

Keywords: Stature, ulnar length, adult Muslim male, lower socio-economic status group.

Introduction

It is well known that anthropometric study of bones conveys information regarding race, sex, age and height of a person. This information is of interest to the anatomist in the academic field as well as medico-legal work. Climate, heredity and nutritional status of population are reported to have an effect on stature and length of long bones. In medico-legal practice Opinion on the stature of a person has to be calculated from skeleton or isolated bone sent by police for expert opinion.[1]

The co-relational calculus into the field of work for the prediction of stature from the measurement of long bones[2] was first introduced by Pearson.

It was reported that world population is getting taller and therefore relationship between stature and length of long bones is changed and fresh formulae are needed for each generation.[3]

Estimation of stature from measurement of various long bones of the extremities has been attempted by many scientists with varying degree of accuracy. All such calculations depend on the fact that limbs exhibit consistent ratios relative to the total height of a person.[4]

Establishment of alternative methodologies for personal height estimation is important for a number of reasons.

Firstly in instances where height estimates needed to make from fragments of bones in archeological procedures or in forensic examinations after mass disasters or genocide.

Secondly estimation of pharmacokinetic parameters or evaluation of nutritional status rely on accurate measurement of not only body weight but also height of the bed ridden, old or frail patients or in patients who have limb or vertebral column deformity.[5]

Each racial group needs a separate formula for the estimation of stature.[2]

Siddique and shah stated opinion based on the study of residents of one state are not necessarily applicable to another state.

Workers in some countries have derived formulae for calculating stature from known lengths of long bones but no universally applicable formulae have been accepted. It is therefore agreed that different formulae will be required for calculating stature from long bones.[6]

It should be borne in mind that equations delivered from taller stature population (eg. Caucasians) may be less accurate when applied to the shorter stature population.[7]

The ulna has easily identifiable surface landmarks which make the measurements possible in compromised posture than any other bones. Therefore, it can be utilized to formulate the height indirectly.

Many of the previous workers have done this study on cadavers but cadavers can not represent a population and cadavers are largely of persons who are aged and have suffered from chronic debilitating diseases and likely to have been lying in an abnormal posture and may not be possible to straighten the body to get accurate stature measurement.

There is increase in height of 2.5 cm after death when measurement is taken in recumbent posture.[8]

The objective of this study is to estimate the height of an individual from the length of ulna using a derived equation from Bangladeshi adult Muslim male of lower socioeconomic status group, and to compare the results of our study with other studies done in different populations.

Materials

In 1951 used 30 years as the age when stature decrease begins but in 1988 and 1989 reported that stature loss begins around 45 years of age[9]. Investigators have shown that mean stature loss is 1.2 cm (1/2 inch) in every 20 years after the age of 30.[3]

For aging it has been shown that the older the individual (after 30 years of age) the greater will have been his loss of stature. It was found that the average rate of decline is .06cm per year after 30 years of age.[3] Studies have shown that females lose more stature with aging than males.[10]

By Keeping in mind the above citation the age limit of the subjects in this study was determined from 25 to 30 years because this age limit is safe and there is no chance for change in the maximum stature and the study was carried out on 100 adult Muslim males of lower socio-economic status group of Bashaboo slum areas of Dhaka City.

All measurements were taken at fixed time from 7.30 Am to 2 Pm to prevent the discrepancies of diurnal variation. The duration was from July/ 2006 to October/2006. The analyses were conducted in the department of Anatomy of BSMMU, Dhaka during the study period of January 2006 to December 2006.

Common exclusion criteria:

Subjects with bowing legs and bent knees.
Subjects with vertebral column curvature abnormality i.e. kyphosis, lordosis, scoliosis etc.
Persons who are suffering from chronic ailment.
Left handed subjects
Subjects with missing limb or part of limb.

Methods

In this study each subject was measured twice and the mean value of the two measures was taken as true value of the subject as the mean value of the two measurements is considered the best estimate of the true value.[10]

Procedure of the measurement of the stature (Height of the body in a standing position)

The subject stood with heel together and back as straight as possible. The heels, buttocks, shoulders and head touched the wall. The arms were hung freely by the sides with the palm facing the thighs'.[11]

After taking a deep breath and holding it, a carpenter's square was placed against the head and the wall to determine maximum height on the wall and this was marked.

Participants were then told to breathe and to step away from the wall. Height was then measured from the floor to the mark on the wall with steel tape.[12]

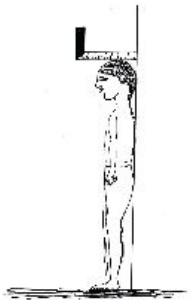

Fig-1: Procedure of the measurement of stature.

Procedure of the measurement of the length of the ulna:

The ulnar length was measured by spreading caliper from the level of the tip of olecranon process to the styloid process and recorded in cm to the nearest 0.5 cm.[13] It was done with the help of surface anatomy of ulna.

Surface anatomy of ulna - When the elbow is extended, the apex of the olecranon can be felt and seen to lie in a line with the two epicondyles of the lower end of the humerus. When the elbow is flexed, the apex of the olecranon process of ulna descends. The posterior surface of the olecranon is subcutaneous and tapers from above downward and it can be felt with ease immediately below the apex.[14]

Fig-2: Procedure of the measurement of the length of the ulna.

Calculation of multiplication factor

The multiplication factor is the ratio of the stature to the length of ulna. The mean multiplication factor was then calculated. This mean multiplication factor would be used for estimating the stature from the length of the ulna.

Multiplication factor (M.F.) =

$$\frac{\text{Stature in cm}}{\text{Length of ulna in cm}} \quad 1$$

Statistical analyses of data

The collected data were calculated using a computer based programme (SPSS and MS Excel) to get mean values, correlation, frequency distribution and significant of the differences etc.

Result

The lowest value of both the right and the left ulna were similar and the highest value of the right side was greater than that of the left side. The mean value of the right ulna was greater than that of the left ulna. so, the multiplication factor for the length of left ulna is greater than that of the right ulna (Table-1.). More than four fifth subjects had the length with in 26.1 cm to 30.ocm for both the right and the left sides. In both sides only one subject had the length within 22.1 cm to 24.0cm. In left side no subject had the value within 30.1cm to 32.0cm. (fig. 3). Highly positive correlations both for the stature with the length of the right ulna and the stature with the length of the left ulna were present (fig. 4 and fig. 5).

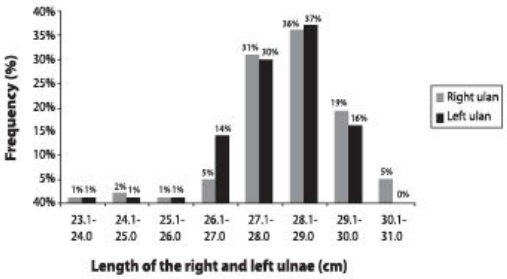

Fig.-3: Multiple bar diagram showing the frequency distribution of the length of the right and the eft ulna of the individual (n=100).

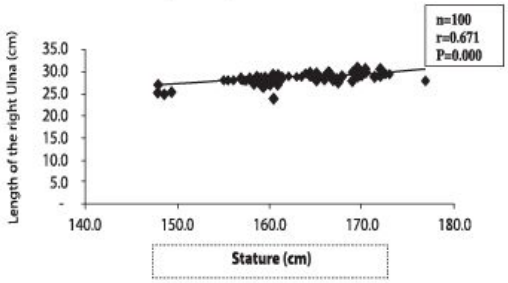

Fig.-4: Scatter diagram with regression analysis showing highly significant (P<0.001) positive correlation between the stature and the length of the right ulna of the individuals.

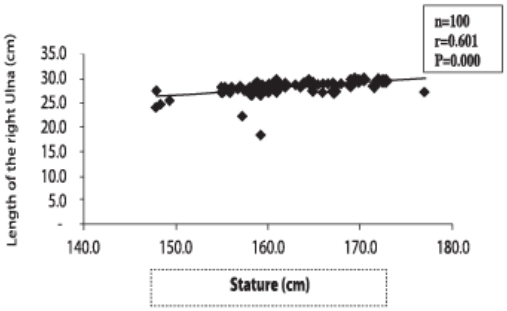

Fig.-5: Scatter diagram with regression analysis showing highly significant (P<0.001) positive correlation between the stature and the length of the left ulna of the individuals.

The measured values of the length of the ulna of both sides and the stature and also the multiplication factor for estimating stature are mentioned in table- I.

Table I:

Variable	Range (cm)	Mean (cm) ± SD	Mean multiplication factor
Stature	148.00-177.00	163.70 ± 5986	
Length of right ulna	24.00-31.00	28.625 ± 1.170	5.696 ± 0.232
Length of left ulna	24.00-30.00	28.235 ± 1.244	5.775 ± 0.254

In this study each ulnar length of both sides was multiplied by mean multiplication factor and then estimated stature was obtained and after then calculating the mean for 100 estimated values and comparison between measured stature and estimated stature were done.

All are shown in table- II

Table II:

Measurements from which the stature was estimated	Measured stature (cm) Mean ± SD	Estimated stature (cm)		Significance of difference (P value)
		Range	Mean ± SD	
Length of right ulna	163.70 ± 5.986	136.70 -176.57	163.01 ± 6.776	P = 0.923 Non-significant
Length of left ulna		141.48 -173.25	163.245 ± 6.546	P = 0.760 Non-Significant

Discussion

In as study on 546 American white and Negro males and reported that the mean value of the length of the right and the left ulna of the American white and Negro males were 27.035 (± 1.283) cm and 28.509 (±1.323) cm respectively and the ratio of the stature to the length of the ulna of the American white and Negro males were 6.432 and 6.037 respectively.[3] There was significant positive correlation between the stature and the length of ulna. The ulnar length of American white is lesser than that of the present study. The ulnar length of the American Negro is lesser than that of the right side but greater than that of the left side of the present study. The ratios of the stature to the length of the ulna of both the American White and the Negro are greater than that of the right and the left sides of the present study.

In Gujarat state of India the mean left ulnar length of 50 healthy Hindu male adults of medical students of 27.0 cm and the ratio between the stature and the length of left ulna was 6.177. There was significant positive correlation between the stature and the length of the left ulna.[13] The length of left ulna is lesser and the ratio between the stature and the length of the left ulna is greater that of the right and left sides of the present study.

In 1968 it was reported that the ratios between the stature and the ulnar length were 6.0, 6.3, 6.0, 5.92 and 6.018 respectively.[1] The above ratios are greater than that of right and left sides of the present study.

In North Bihar the ratio between the stature and the ulnar length was 6.196 which is greater than that of the right and the left sides of the present study.[1]

In 52 Spanish adult healthy males the mean value of the right ulnar length was 22.57 (± 1.82) cm and the ratio of the stature to the length ulna was 7.452. There was significant positive correlation between the stature and the right ulnar length.[15] The mean value of the right ulnar length of the Spanish male is lesser and the ratio is greater than that of the right and left sides of the present study.

In a research work on 300 male subjects in Burdwan medical college, Burdwan, west Bengle it was found that the stature, the length of right and the left ulna and their multiplication factors were 164.315 cm, 27.13 cm, 27.01cnm 6.05 and 6.08 respectively.[2] A study was done over the asymptomatic healthy 150 male medical students of Gujarat Medical Education and Researeh society Medical College and Hospital, Valsad and reported that the stature, the length of the right and the left ulna and their multiplication factors were 169.82 cm, 27.81 cm, 27.79 cm, 6.10 and 6.11 respectively.[5] In case of 150 male healthy students of Narayana medical college, Nellore, Andhra Pradesh the mean height, length of the right and the left ulna and their multiplication factors were 168.93 (± 6.73) cm, 27.84 (± 1.45) cm, 27.75 (± 1.44) cm, 6.06, 6.08 respectively.[16] A study on male patients, attenders visiting the outpatient deportment of General Medicine of Sri Muthukumaran Medical college Hospital and Research Institute, Chennai, Tamil Nadu,

India showed that the mean height, length of the right and the left ulna and their multiplication factors were 164.4 (± 6.4) cm, 27.7 (± 1.3) cm, 27.6 (± 1.4) cm, 5.93 and 5.95 respectively.[17]

In all these above cases, the stature was greater but the length of the both right and the left ulna were lesser and the multiplication factors were greater than that of the present study.

A work was done on 191 male medical students, students of other faculties, staff, patient relatives of Sir T. Hospital, Bhavnagar and other persons belonging to Gujarat and showed that the mean stature and the length of the right and the left ulna and the multiplication factors were 169.87 cm, 28.48 cm, 28.39 cm, 5.96 and 5.98 respectively.[4] The stature and the left ulnar length were greater and the right ulnar length was lesser and the multiplication factors were greater than that of the present study.

Conclusion

The aim of the present study was to make an independent formula for Bangladeshi people for the measurement of stature from the length of ulna as because there is no formula upon which the Bangladeshi can estimate their stature. This study will be helpful for anatomists, anthropologists and also forensic medicine department of Bangladesh. The present study is based on only 100 living Bangladeshi Muslim males of lower socio-economic status group. So, for better result further study should be done on large samples of different socio-economic status groups, sexes and ethnic groups.

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