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Height: Ulna Ratio-A Method of Stature Estimation Used in Comparing the Stature of Ikwerre and Kalabari Tribes in Rivers State, Nigeria

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Abstract: This study was aimed at comparing the height predicted from ulna lengths in the adults (aged between 20 to 50 years old) from the two different ethnic groups. Analysis of stature of 600 healthy males and 600 females from Ikwerre and Kalabari ethnic groups, both in Rivers State, Nigeria, Height was measured using a stadiometer, while ulna length was taken with a sliding vernier calliper. The measurements were recorded in centimetres to the nearest 0.1 cm. A multiplication factor i.e ratio of the stature to the respective physical measurements was then calculated for each measurement. The multiplication factors were multiplied with the ulna length to give the estimated value which correlated with the measured stature. The mean male Ikwerre stature was 173.1 while the female was 160.77. The mean stature for Kalabari male was 166.83, while the female was 158.83. Correlation coefficient in the study for Ikwerre males is 0.96 and females 0.997 I and that of the Kalabari males is 0.996 and females 0.996. Regression coefficient for Ikwerre males is 7.89 and females 6.48 and that of Kalabari males is 6.31 and female 6.15. The observed data was subjected to 'z' test for correlation coefficient. The value for 'z' test was found to be statistically not significant. It was concluded that ulna length can be used as a surrogate in measuring height. Also, there was no significant difference in the stature of the two different tribes.
Keywords: Height, Ulna, Stature, Ikwerre and Kalabari.

INTRODUCTION

The measurement of height is an important clinical indicator to derive body mass index (BMI), creatinine height index, and also to estimate basal energy expenditure, basal metabolic rate and predict pulmonary function in childhood [1]. It is known that trunks and limbs exhibit consistent ratios among themselves and relative to total body weight. The ratios between body segments are linked to age, sex, heredity, climate and race [2]. Estimation of stature from measurement of limb bones has long been formulated and the accuracy of such estimations improved over time.

Assessment of height from different parts of the body by anthropometric of skeleton is an area of interest to Anatomists, Anthropologist, and to forensic experts. Stature usually is based on the estimation of long bones. Most especially used is the tibia. The ulna length has been shown to be a reliable and precise means in predicting the stature of an individual [3].

There have been works on stature estimation by different authors using various long bones for personal height estimation, height estimates from fragments of bones in archaeological procedures or in forensic examinations after mass disasters or genocide, estimates of pharmacokinetic parameters and evaluation of nutritional status rely upon accurate measurement of not only body weight but also height [4-10].

Negroes have comparatively long upper and lower limbs and consequently formulae designed to estimate height from that particular population may not apply to other populations in Asia [11]. As such we need indigenous data to enable us do stature estimation of indigenous population. Hence, this work was done to have a formula for estimating the stature of Ikwerre and Kalabari people using Height: Ulna Ratio.

Anatomy of ulna bone

The ulna is a long bone, prismatic in form, placed at the medial side of the forearm, parallel with the radius. It is divisible into a body and two extremities. Its upper extremity, of great thickness and strength, forms a large part of the elbow-joint; the bone diminishes in size from above downward, its lower extremity being very small, and excluded from the wrist-joint by the interposition of an articular disk [12]. The Upper Extremity (proximal extremity). The upper extremity presents two curved processes, the olecranon and the coronoid process; and two concave, articular cavities, the semilunar and radial notches. The Olecranon (olecranon process). - The olecranon is a large, thick, curved eminence, situated at the upper and back part of the ulna. It is bent forward at

AIM AND OBJECTIVES

This was aimed at assessing the extent to which ulna length can be used to predict the height of Kalabari and Ikwerre people, reveal any similarity between both Kalabaris and Ikwerres, establish a relationship between height: ulna ratio with sex in the two different tribes, establish a relationship between ulna length and height as a tool for forensic and anthropometric studies.

MATERIALS AND METHODS

The study was non-experimental and analytical. A purposive convenient sample size of 1,200 healthy adults, comparising 600 (300 males, 300 females) each from both Kalabari and Ikwerre tribes. The ages ranged between 20-50 years. Using simple random sampling. Individuals with a pure genetic line were used as subjects for the research. This criterion was authenticated by tracing back each subject's lineage to the third generation.

Duration of Study and Area**:** November 10, 2016 – August 30, 2017 on subjects who were residents in Buguma, Degema and Abonema of the Kalabari tribe and also residents in Choba, Aluu and Alakahia all of the Ikwerre tribe in Rivers State, Nigeria.

Inclusion Criteria

Healthy mature individuals whose limbs were properly functioning were included as subjects for the study. Individuals who knew their exact age, and also with ages that fell within the study age range were included in the study.

Exclusion Criteria

Individuals who did not know their correct age or are illiterates were excluded from the study. Non-ambulatory individuals who are either bedridden due to arthritis, surgery or showed signs of deformities such as rotational kyphosis and lordosis were excluded from this research. Old people were excluded from the research because their bone mass or density is lost as results of the bones loss of calcium and other minerals. Therefore, overall height decreases, mainly because of shortening of the trunk and spine

DATA COLLECTION

The ulna length was defined as the direct distance between the tip of olecranon process and the styloid process while the elbow is in full flexion [21]. Ulna lengths were taken on the right sides of each individual using a sliding caliper capable of measuring to the nearest 0.01cm. The sliding caliper was spread between the tip of the olecranon process and the tip of the styloid process with elbow flexed and palm spread over the left shoulder. The height of the individual were measured from the vertex (crown) to the heel in standing erect posture in anatomical position and the head in the Frankfort plane, using a height measuring instrument (Stadiometer). Height was measured to the nearest 0.1cm. All measurements were made by one person, to avoid inter observer error and repeatedly until a constant value is obtained. Due to substantial diurnal variation in stature, one should avoid taking measurements at different times of the day in order to make standards or reference data of estimation.

CALCULATION OF MULTIPLICATION FACTOR

Each multiplication factor is the ratio of the stature to the respective physical measurements. A mean multiplication factor is calculated for each measurement. These mean multiplication factor is used for estimating stature from the variables.

Multiplication factor = stature divided by ulna length.

STATISTICAL METHODS

The data so collected were analysed statistically using the following parameters: Mean, Standard deviation, Coefficient of variation, Correlation coefficient, Regression coefficient/simple linear regression.

RESULTS

The statistical data were extracted from the calculation and analyses were tabulated in the table above to show the different parameters at a glance. The mean of the study subjects for the two tribes are: Ikwerre – male height = 173.41, ulna = 29.857, female height = 160.77, ulna length = 26.457 while that of the Kalabari – male height = 166.83, ulna length = 29.106, female height = 158.83, ulna length = 27.894. This shows that the mean of the height and ulna length of both the females and the males of both tribes are not significantly different. The correlation coefficient (r) of height and ulna length of Ikwerre male is 0.96 and female is 0.997 while that of Kalabari male is 0.996 and

that of female is 0.996. The value of correlation coefficient implies that there is a positive correlation between the height and ulna length of Ikwerre and Kalahari.

Table-1: The height and ulna length of Ikwerre and Kalahari People

	IKWERRE		KALABARI	
	Male	Female	Male	Female
Total No	300	300	300	300
Height Range	19	21.6	44.1	30.7
Mean height	173.41	160.77	166.83	158.83
S.D Height	1440.25	1175.90	1373.67	34.68
S.E Height	83.15	67.89	79.31	2.00
Ulna Height	7	4.4	8.4	5.5
Mean Ulna	29.86	26.45	29.11	27.26
S.D Ulna	270.54	248.41	344.91	232.89
S.E Ulna	15.62	14.34	19.91	13.45
Correlation	0.96	0.997	0.996	0.996
Regression	7.89	6.48	6.31	6.15
Intercept	-59.54	-10.64	-16.78	-8.74

P<0.05

Table-2: The statistical significance of height and ulna length of Ikwerre and Kalahari People

Gender /Tribe	Measurement	Calculated Z-Value	Critical Z-Value	Inference
Ikwerre Males Kalabari Males	Height	0.0572	1.96	Not Significant
Ikwerre Females Kalabari Females	Height	0.020	1.96	Not Significant
Ikwerre Males Kalabari Males	Ulnar Length	0.020	1.96	Not Significant
Ikwerre Females Kalabari Females	Ulnar Length	0.020	1.96	Not Significant

P<0.05

DISCUSSION

Ulna length and height like any other anthropometric measurements used to estimate among other things, body mass index (BMI) and nutritional status is subject to comparative analysis before any far reaching conclusions can be arrived at. This is so because anthropometric characteristics vary all over the world. Therefore, it becomes necessary to compare results of observed anthropometric measurements, so as to arrive at an acceptable universal standard [13].

However, height measurement is not always practical in bedridden, old or frail patients that cannot stand or are suffering from deformities of the vertebral [14]. In forensic examinations and anthropological studies, prediction of stature from incomplete and decomposing skeletal remains is vital in establishing the identity of an unknown individual [15]. Therefore the formulae based on the ulna length provide an alternative stature predictor under such circumstances. The ulna has easily identifiable surface landmarks making the measurements possible even in compromised conditions.

The average height of adult males within a population is significantly higher than that of adult females [16-18]. The results obtained in this study are in agreement with the above statement. There was distinct sexual dimorphism in the ulna length in my study group where it was significantly longer in males than in females, a result that reinforces the previous observations [19].

Studies on secular change and allometry have demonstrated differential limb proportions between sexes and among population [7, 8]. The need for gender specific formulae is proved as the rate of skeletal maturity in males and in females tends to vary during the course of development [10].

Allbrook [20] derived regression formulae for estimation of stature from the ulna length as - stature= 88.9+ 3.06 (ulna length) ± 4.4 (standard error). Athawale [22] studied one hundred Maharastrian males of age ranging from 25 to 30 years. With the help of various graphs, he showed that there is definite correlation between stature of an individual, length of forearm bones, as well as length of upper limb. The regression formula derived for estimation of stature

from length of long bones was, Stature = 59.2923 cm + 4.1442 x average length of right and left radius (cm) ± 3.66cm. Stature = 56.9709cm + 3.9613 x average length of right and left ulna (cm) ± 3.64cm.

Lal and Lala [19] worked on a population 258 of age ranging from 12 to 21 years in North Bihar for the estimation of long bones e.g. tibia and ulna. The ulna mean multiplication factor was comparable in all series. They claimed that ulna multiplication is a better guide for calculation of height when it is not definitely known to which part of the country the individual belongs.

Sandhya [18] computed correlation (r =0.6199 for male and 0.584 for female) and regression equation formula for estimation of stature by using upper arm length among living population of Maring tribes of parallel area, Chandel district, Manipur. In the present study, the correlation coefficient (r) of height and length of ulna in Ikwerre males is 0.96, in Ikwerre females is 0.997, in Kalabari males is 0.996 and in Kalabari females is 0.996. The value of r implies that there is a positive correlation.

The value of 'z' after comparing the height of Ikwerre males to the height of Kalabari was found to be 0.0572, after comparing their ulna lengths was found to be 0.000425. The value of 'z' after comparing the height of Ikwerre females to the Kalabari females was found to be 0.020, after comparing their ulna length was found to be 0.020. Thus, Ho is rejected implying that there is no significant difference in the height and ulna lengths between the similar sexes.

DIFFERENCE BETWEEN MALES AND FEMALES OF SAME ETHNIC GROUP

Males generally show a longer body height than in females. Studies on height estimation conducted by Ilayperuma *et al*., [15] on Sri Lankan male and female adults aged between 20-23 years, confirms this assertion.

The differences are accounted for by endocrine factors. Steroid hormones have organizing and activating effects which manifest themselves in differences between males and females. Males produce androgens while females produce estrogens. The estrogens are released such that in a short time, it causes rapid growth, and in like manner lead to early ossification of bones which thereby inhibit growth. Androgens on the contrary are released moderately and act for a longer period of time, leading to an overall longer frame of body for males than for females. Differences could also be accounted for by the type of activity carried out by either sex. Males generally perform more limb stretching exercises than females and this in fact in no small measure affects body height.

VARIATION FROM STANDARDS

This study is handicapped by the fact that from available literature, no standards for stature estimation have been set. However, like anthropometric parameters, it is suggested here that variations in the present height and ulna being measured; as well as occurring between members of the same population, will also occur between people occupying different geographical locations and also between different races. These differences, assuming standards are available, would be accounted for by the following;

Plasticity:- this is the ability to change body form with environmental change. This was first shown by Boas in 1912 who as earlier on stated in the introduction, showed that children of long headed South Italians born in America were progressively broader headed than their parents. Thus, it is suggested that plasticity could be responsible for the variations that may occur when results obtained from the present study is compared with a standard, assuming such existed.

Again, socio-economic status linked with nutritional status may also play a part in making possible variation between the races and also between different populations.

CONCLUSION

The results of the present study revealed that ulna length values gotten from both the Ikwerre and Kalabari tribes had a linear correlation with height i.e. the higher the value of height, the higher the value of ulna length. Therefore, it can be concluded that the ulna length can be used as an important alternative in determining the height of an individual.

Also after comparing the values of the two parameters measured in the two different tribes, it can be concluded that the Ikwerres are slightly taller than the Kalabaris. Thus, there is no significant difference between the statures of the two tribes. Sexual differences in height and the ulna length gotten from the Ikwerre and Kalabari tribes was noticeable from the values gotten. Thus, an affirmation is drawn that there is need for studies to emphasize the need for standards of sexual dimorphism in different ethnic groups or populations.

Finally, since there is no significant difference between the statures of the two tribes, it can be concluded that the hereditary, environmental (climatic) and developmental factors which govern the outcome of growth of the indigenes of the two tribes is closely similar.

RECOMMENDATION

It is recommended that similar studies on different Nigerian ethnic groups should be carried out to compare the results of the present study. The regression models proposed will be of immense practical use in clinical practice, medico-legal, anthropological and archaeological studies where the total height of a subject can be calculated if the ulna length is known.

ETHICAL APPROVAL

Ethical clearance was obtained from the University of Port Harcourt Research Ethics Committee before commencement of the study.

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