

Original Article**Study of Correlation Between Length of Ulna and Body Height Among Delta State University Students in Nigeria**O. A. Udi¹, Okoro Ogheneyeborue Godswill¹, H. Ovie², L.E. Chris-Ozoko²**Abstract**

Background: The height of an individual is one of the most important parameters contributing greatly to the process of identification of a person from their skeletal remains and it is dependent greatly on the age, race, gender, body composition and nutrition of the person. **Objective:** The study aims to correlate between body height and subcutaneous ulnar length among Delta State University students and to see if any difference exists between right and left ulnar lengths. **Methods:** A total of 240 (105 males and 135 females) students from Delta State University, Abraka, Delta State, Nigeria, aged between 20 and 33 years, without any known disability participated in this study. **Results:** The mean age was 22.81 ± 2.43 . The mean body height and ulna length of adult male were significantly higher than the adult females. Positive correlation was found between total body height and ulna length of 0.50. **Conclusion:** Our data suggest a definitive and strong correlation between the body height and ulnar length.

Keywords: Anthropometry, forensic medicine, human anatomy, body height, ulnar length

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Introduction

Height is one of the various parameters of identification for establishing individuality of a person. It is well known that there is a definite relationship between the height of a person and various parts of the body like head, trunk and lengths of upper and lower limbs. Height, like other phenotypic traits, is determined by a combination of genetics and environmental factors.¹ According to Gauld, height is fundamental to assessing the growth and nutrition and calculating body surface area.² It is sexually dimorphic and statistically more or less normally distributed. The height of an individual is one of the most important parameters contributing greatly to the process of identification of a person from their skeletal remains and are dependent greatly on the age, race, gender, body composition and nutrition of the person.^{3,4} The height as a measure of biological development of

both an individual and a population is commonly used in physical anthropology. Stature evaluation based on the length of the limb bone, is one of the oldest problem in the history of anthropology. However, a number of common disabilities and diseases processes make it difficult to accurately measure standing height in many patients.⁵

The most commonly used bones for height correlation of long bones such as femur, tibia, fibula, humerus, ulnar and radius because they are strong, large and easy to find. Forearm bone (ulnar bone) length gives more accuracy in devising estimation of Height than the length of leg bone like tibia.⁶ The forearm bone (ulnar) is mostly subcutaneous throughout its length and easily approachable for measurement. Hence, it is selected for this present study. The ulnar is a long bone on the medial side of the forearm. Proximally the ulna has a bony process called the olecranon

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process which articulates with the humerus. Distally the ulnar bears a styloid process. The olecranon is subcutaneous and easily palpable. Its position depends on the angle of flexion-extension of the elbow joint. In extension, its tip is in line with the epicondyles of the humerus and in full flexion three bony points make an equilateral triangle. The whole length of the subcutaneous border of the ulnar is palpable down to the styloid process.^{7,8} Ossification of the ulnar begins at the 8th fetal week and the proximal epiphysis fuses with the shaft in the 14th year in females and 16th year in males. The distal epiphysis unites with the shaft in the 17th year in Females and 18th year in Males.⁹ Therefore, ossification of long bones of upper limb is usually completed within 20-25 years of age and after age of 50 years there occurs some degenerative changes in joints and cartilages. Hence, the present study was done on subject of 20-35 years age group. Moreover, the ulnar length has showed to be more reliable and precise means in predicting the stature of an individual.^{2,10} Therefore, we proposed the present study to see the correlation of ulnar length with body height of an individual.

Methods

The present study was conducted on 240 (135 females and 105 males) Medical Students of the Faculty of Basic Medical Science, Delta State University, Abraka, Delta State, Nigeria. The subjects were apparently healthy and without any physical deformity, they were from different socio-economic status. The age of the subject ranged from 20 to 33 years. Individuals with congenital deformities, pathological conditions of limb and spine, those who had undergone amputation of forearm were excluded from the study.

To ensure accurate results, all the measurement was taken twice and the mean was recorded and all the measurement was done by one person to avoid interpersonal errors. Informed consent from the volunteers was collected prior to undertaking measurements.

The students were measured for the following parameters:

Ulnar length: It was measured with the help of a standard measuring tape between the tip of the olecranon process of the ulna to the tip of the styloid process of the ulnar with fully flexed elbow and the dorsum of hand facing forward. The ulnar lengths were taken independently of both

left and right of each individual. Ulnar length was measured to the nearest 0.1cm.

Body height: The height of the individual was measured between the vertex and the floor, when the person is standing erect, in anatomical position and the head in the Frankfurt horizontal plane. The height was measured using a standing height measuring instrument in the nearest 0.2cm.

After collection of data, those were analyzed statistically for mean and standard deviation. Student 't' test, chi-square test, and Pearson Correlation Coefficient test were done for different comparison.

Results

In the present study, among 240 the participants males were 43.8% and females 56.3%. The mean age was 22.81 ± 2.43 years. The mean body height for total subject is 167.63 ± 10.03 cm. Mean Length for right and left Ulnar are 28.73 ± 2.91 cm and 28.75 ± 2.89 cm respectively (Table 1). Correlation coefficient was found to be highly statistically significant and positive between ulnar length and body weight. It means that there is a strong correlation between body height and ulnar length. There is also a significant correlation between length of ulnar of the right and the left sides (Table 2). Comparison showed that the difference between lengths of ulna of the right and the left sides was not statistically significant ($P > 0.01$) (Table 3). However, the difference between the ulnar lengths of male and female was found statistically significant ($P < 0.01$) (Table 4). Similarly, the difference in body height between male and female participants was found statistically significant ($P < 0.01$) (Table 5).

Table 1. Body height and ulnar length measurement (n=240)

Parameter (cm)	Minimum	Maximum	Mean	SD
Age (years)	20.00	33.00	22.81	2.43
Body height (cm)	107.40	194.29	167.3	10.03
Length of Ulna(Rt) (cm)	23.40	57.50	28.73	2.91
Length of Ulna(Lt) (cm)	22.00	57.20	28.75	2.89

Table 2. Correlation between body height and length of ulna

Parameter (cm)	N	Correlation	Significance
Ulnar length(right) - Ulnar length(left)	240	0.92	0.01
Ulnar length(right) - Body height	240	0.61	0.01

Parameter (cm)	N	Correlation	Significance
Ulnar length(left) - Ulna length(right)	240	0.92	0.01
Ulnar length(left) - Body height	240	0.50	0.01
Body height- Ulnar length(right)	240	0.61	0.01
Body height - Ulnar length(left)	240	0.50	0.01
Ulnar length -Body Height	480	0.50	0.01
Body Height - Ulnar length	480	0.50	0.01

Pearson's correlation coefficient test was used.

Table 3. Comparison of the lengths of right and left ulna

Parameter (cm)	Mean±SD	T	Df	P value
Ulna length (Rt)	28.73±2.91	-0.24	239	0.80
Ulna length (Lt)	28.75±2.8			

P value reached from paired Student t-test

Table 4. Comparison of ulnar lengths between sexes

Sex	Mean±SD	T	Df	Pvalue
Male	30.19±1.83	10.71	478	0.01
Female	27.63±3.06			

P value reached from Chi-square test.

Table 5. Comparison of body height between sexes

Sex	Mean±SD	T	Df	P value
Males	174.38±9.90	16.18	478	0.01
Females	162.38±6.26			

P value reached from Chi-square test.

Discussion

The present study deals with the observation on correlation between total standing height and the length of the ulna of the upper limb from a total of 240 (135 females and 105 males) students of Delta State University, Nigeria. The age range group 20-35 years was selected and the approximate height has been correlated with the length of ulnar of both right and left limbs. In this study, the mean height of an adult male within a population was significantly higher than the adult female; similar findings were

observed in previous studies.^{4,8,10,11-14} This study also showed that the means ulna lengths of male were significantly greater than female, this finding was supported by other researchers.^{3,4,15} However, no significant bilateral asymmetry was found in ulnar length. This was supported by other study on limb bilateral asymmetry.¹⁶ Similarly, the study carried out by Agnihotri et al.¹⁷ also showed no significant bilateral asymmetry in forearm bones of Indo-Mauritian population. Correlation of the body height and the length of the ulna was evident in our present study, which is also supported by the findings of Chikhalkar et al.,¹⁸ that the forearm length showed the highest degree of correlation in the region of Mumbai, India. Variety of factors such as age, race, gender and nutritional status affect the human development and growth. However, the ulnar length measurement was proved to be superior to arm span measurement,² or hand measurement¹² in predicting height of the individuals.

Conclusion

This study showed that there was a definitive and strong correlation between the body height and the ulnar length in healthy individuals. Among the parameter used in the study, right and left ulnar length shows the highest correlation and the left ulnar length and body height shows the least degree of correlation. It will help in medico-legal cases in establishing the identity of an individual when only some remains of the body are found. In this study, only healthy individuals were included; hence, the results may not be applicable to persons having deformity or any congenital abnormality.

Conflict of interest: None declared.

Ethical Approval: The study was approved by the Ethics Committee of Department of Human Anatomy, College of Basic Health Sciences, Achievers University, Owo, Ondo State, Nigeria.

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References:

1. Marouli E, Graff M, Medina-Gomez C, Lo KS, Wood AR, Kjaer TR, et al. Rare and low-frequency coding variants alter human adult height. *Nature*. 2017;542(7640):186-90.
2. German A, Hochberg Z. Sexual dimorphism of size ontogeny and life history. *Front Pediatr*. 2020;8:387.
3. Ilayperuma I, Nanayakkara G, Palahepitiya N. A model for the estimation of personal stature from the length of forearm. *Int J Morphol*. 2010;28(4):1081-6.
4. Mohanty BB, Agrawal D, Mishra K, Samantsinghar P, Chinara PK. Estimation of height of an individual from forearm length on the population of Eastern India. *J Med Allied Sci*. 2013;3(2):72-5.
5. Best C, Shepherd E. Accurate measurement of weight and height 2: calculating height and BMI. *Nurs Times*. 2020;116(5):42-4.
6. Joshi NB, Patel MP, Dongre AV. Regression equation of height on ulnar length. *Indian J Med Res*. 1964;52:1088-91.
7. Sinnathamby CS. *Last's anatomy: Regional and applied*. 10th ed. Edinburgh: Churchill Livingstone; 1999. p.45.
8. Williams PL, Bannister LH, BerryMM, Collins P, Dyson M, Dussek JE, Ferguson MW. eds. *Gray's anatomy: The anatomical basis of medicine and surgery*. 38th ed. New York: Churchill Livingstone; 1995. p.38.
9. Williams PL, Bannister LH, BerryMM, Collins P, Dyson M, Dussek JE, Ferguson MW. eds. *Gray's anatomy: The anatomical basis of medicine and surgery*. 38th ed. New York: Churchill Livingstone; 1995. p.23.
10. Ebite LE, Ozoko TC, Eweka AO, Otuaga PO, Oni AO, Om'Iniabohs FAE. Height-Ulna ratio: A method of stature estimation in arural community in Edo State, Nigeria. *Internet J Forensic Sci*. 2008;3(1):12-8.
11. Kumar A, Srivastava AK, Verma AK. Estimation of Stature by percutaneous measurements of distal half of upper limb (forearm & hand). *J Indian Acad Forensic Med*. 2010;32(4):325-8.
12. Ilayperuma I, Nanayakkara B, Palahepitiya, K. A model for reconstruction of personal stature based on the measurements of foot length. *Galle Med J*. 2009;13(1):6-9.
13. Thummar B, Patel ZK, Patel S, Rathod SP. Measurement of ulnar length for estimation of stature in Gujarat. *Natl J Integr Res Med*. 2011;2(2):36-40.
14. Madden AM, Tsikoura T, Stott DJ. The estimation of body height from ulna length in healthy adults from different ethnic groups. *J Hum Nutr Diet*. 2012;25(2):121-8.
15. Ebeye OA, Okoro OG, Ikubor JE. Radiological assessment of age from epiphyseal fusion at the wrist and ankle in Southern Nigeria. *Forensic Sci Int Reports*. 2021;3:100164.
16. Freedman DM, Edwards GS Jr, Willems MJ, Meals RA. Right versus left symmetry of ulnar variance. A radiographic assessment. *Clin Orthop Relat Res*. 1998;(354):153-8.
17. Agnihotri AK, Kachhwaha S, Jowaheer V, Singh AP. Estimating stature from percutaneous length of tibia and ulna in Indo-Mauritian population. *Forensic Sci Int*. 2009;187(1-3):109.e1-3.
18. Chikhalkar BG, Mangaonkar AA, Nanandkar SD, Peddawad RG. Estimation of stature from measurements of long bones, hand and foot dimensions. *J Indian Acad Forensic Med*. 2010;32(4):329-31.