Height prediction from right ulnar length among students of Delta State University, Abraka, South - Southern Nigeria

* Okolie Emmanuel Ikechukwu[1], Apuyor Hanna[2], Umukoro Mamuyovwi Joysour[3], Edonyabo Mary Nemi[4], Ogwude Desmond[5], Oshili Onuwa Agatha[6], Okonkwo Ngozi Peter[7]

[1-7]**Delta State University, Abraka, Delta State, Nigeria**

QR CODE

Doi: https://doi.org/10.21816/ijfmi.v4i2

[1]corresponding author email: **okoike111@gmail.com**

ABSTRACT

Introduction: Estimating height from different parts of the human body has been an area of interest to anatomists, anthropologists and forensic experts. Surface landmarks such as ulnar bone as compared to other bones have made measurements possible in compromised postures; in the estimation of height. The research aimed at estimating height from the morphometry of the right ulnar bone as well as finding the correlation between height and right ulnar length among students of Delta State University, Abraka.

Materials and Methods: Simple random sampling was adopted in this cross-sectional study. A total of 150 participants comprising of 74 males and 76 females who were 18+ were investigated. Measurement was done with a measuring tape; Height from the vertex to the heel in an erect posture; ulnar length from the tip of the olecranon process to the tip of the styloid process. Data were analyzed using the Statistical Package for the Social Sciences 20. Pearson's correlation coefficient between variables was computed. Significance was accepted a $p<0.01$.

Results: Findings from this study showed that the mean height, right ulnar length also the correlation between height and ulnar length for males was 179.22$\pm$18.58; 29.99$\pm$1.61; r=0.434 while that of the females was 161.37$\pm$ 8.44; 26.20$\pm$1.69; r=0.807 respectively. Estimated Height (cm) = Regression constant+ Regression coefficient x Right ulnar length (cm) ± (1.96 x STE).

Conclusions: Findings from this study showed that males exhibited a greater correlation between the measured height and ulnar length as compared to the females

Key-words: Ulnar length; Height; Delta State University; Regression constant; Regression coefficient.

INTRODUCTION

The ulnar bone has been described by Standring (2005) as one of the main bones of the forearm.[1]In collaboration with the radial bone, it plays an indispensible role in rotating the forearm.[1] Measuring long bones has been an indirect technique in evaluating stature for both living and cadaveric bodies.[2-3] The significance of long bones is that they are retained for years after death and are subcutaneous.[2-3] A number of procedures have been proposed to predict stature from long bones, especially with the use of regression analysis which has been reported to be the easiest and most reliable method.[4-7]Several authors had established a correlation, linking stature with the length of various bones.[8-9]Stature offers one of the most confirmed means of identifying an individual and its determination is one of the outstanding steps during forensic analysis.[8]

In predicting height, linear measurement of the ulnar bone proved to be supercilious to that of the hand and arm span.[10] Furthermore linear regression equations of height on ulnar length have definitive advantages over that of tibia length because of its use in cases where the lower extremities and trunk are impaired.[10] Height prediction has been computed from the morphometry of the ulnar bone among several races with linear regression models.[10-15]Trotter and Glesser , (1952) estimated the stature of American whites and Negroes from the ulna bone.[11] A study by Lundy, (1985) analyzed the regression equation and the mathematical and anatomical technique in determining stature from long bones of south Africans.[12] The reports of Agnihotri et al. (2009) from Mauritius and those of Barbaosa et al. (2012) from Portugal also found a linear regression model which clearly depicted an individual's stature from ulnar length.[13,15]In India, Lal et al. (1972) investigated a population in North Bihar, and their stature was estimated from the ulnar and tibia bones.[15]

Previous studies have estimated stature of both living and cadaveric bodies from the length of long bones[6-9] but they are extensive gaps on the morphometry of the right ulnar bone and estimating height from its values among students of Delta State University. To assist in bridging this gap, this study therefore estimated statue from the morphometry of the right ulnar bone on the population investigated. The research also aimed at finding the correlation between height and right ulnar length.

Based on the principle that the dimensions of various long bones correlate positively with human stature,[16] the study will be highly imperative in forensic anthropology. Findings will also be useful in comparative studies.

MATERIALS AND METHODS

The study was a descriptive cross sectional study. The work described the morphometry of the right ulnar bone and estimated height from its length. Population for this study was male and female students of Delta State University, Nigeria. Participants were randomly selected within Abraka campus, Delta state. One hundred and seventy students within the ages of 19 to 30years were investigated. Ethical consent was sourced from the Research and Ethics Committee of the Faculty of Basic Medical Sciences, Delta State University, Abraka, Nigeria with reference number DELSU/CHS/ANA/68/168. Socio-demographic factors were age and gender which were obtained by personal interviews.

Height and ulnar length were measured with a measuring tape. The vertex to the heel height (in centimeters) was measured for each subject in erect posture. Participants were bare footed. A ruler was placed on their heads tangentially, so that it could touch the highest point of their head. Then, with the pencil, that level was marked on the wall. With the measuring tape, the height of that point was measured from the floor level. The ulnar length (right) was measured from the tip of the olecranon process to the tip of the styloid process, with the elbow flexed and the palm spread over the opposite shoulder. Informed consent was obtained from participants eligible for this study.

Data was represented in frequencies and tables to show distribution of ulnar length and height. Pearson's correlation coefficient was used simply because both variables (Stature and right ulnar length) were independent continuous variables. Significance was accepted a $p<0.01$. Stature estimation formula was derived and obtained from Malay et al.,(2008). [17]

RESULTS

Gender distribution in the population	
Gender	**Frequency**
Male	**74**
Female	**76**

Inter-relationship of right ulnar length and height

Gender		Mean	Sd.	St.e	Regression constant	Regression Coefficient	Pearson correlation	P-value
Male	**Ulnar Length(cm)**	**29.99**	**1.61**	**16.85**	**28.48**	**5.02**	**0.434**	**0.01**
	Height(cm)	**179.22**	**18.58**					
Female	**Ulnar Length(cm)**	**26.20**	**1.69**	**5.02**	**55.71**	**4.03**	**0.807**	**0.01**
	Height(cm)	**161.37**	**8.44**					

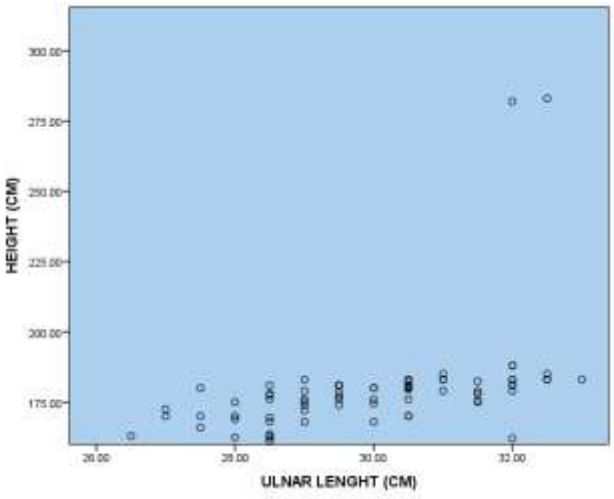

Fig i: Interrelationship between ulnar length and height in males

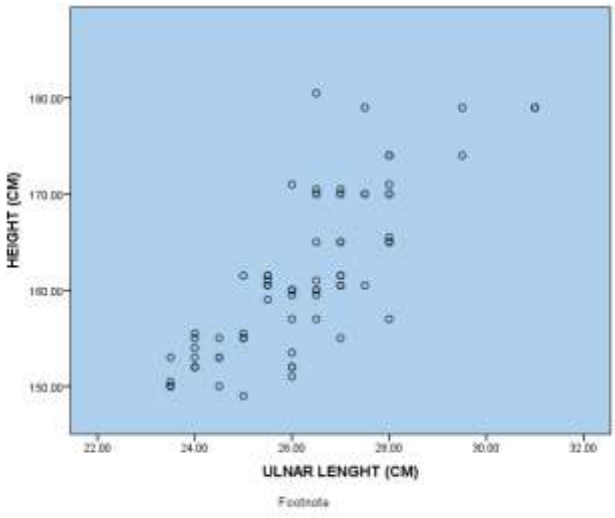

Fig ii: Interrelationship between ulnar length and height in females

Fig i present the frequency of both males and females in the studied population. Findings from this study showed that 49% of the populations were males while 51% were females. The mean of the heights in the studied population was extrapolated as 179.22cm for males (with

a Std. deviation of 18.58) and 161.37cm for females (with a Std. deviation of 8.44). Similarly, the mean of the right ulnar lengths were calculated as 29.99cm for males (with a Std. deviation of 1.60) and 26.20cm for females (with a Std. deviation of 1.69) respectively (Table 1&2). A significant relationship amongst the variables was ascertained by Correlation coefficient (Fig iii &iv).

The relationship between the changes of a dependent variable and an independent variable was ascertained by simple linear regression, with the "Regression coefficient (b)"; where the model of the regression equation was y = a + bx [where a = y intercept, when x = 0]. A 95% confidence interval (which was equivalent to 1.96 standard deviation) was accepted and the standard error of regression (STE) was calculated. The final equation model was y = (a + bx) ± (1.96 x STE).

Thus, the regression equations became:

Estimated Height (cm) for males and females = Regression constant+ Regression coefficient x Right ulnar length (cm) ± (1.96 x STE)

DISCUSSION

The ulnar bone has been one of the major bones for stature estimation. Estimating stature from different parts of the body is an area of allurement to anatomists, anthropologists and forensic experts.[17] According to Patel et al. (2007) this feature is directly associated with osteometric indices of the long bones.[18] This study showed that males were taller than females. Findings are in concordance with previous studies.[19-22] This investigation demonstrated a statistically significant correlation between the measured height and ulnar length of all participants. Findings were similar with previous observations among Ghanians, Indians, Caucasians and Europeans.[15,21-23]

However, males exhibited a greater correlation between the measured height and ulnar length as compared to the females. Findings were similar to a study carried out among English and Portuguese individuals and Emmanuel et al., 2017 who carried a study among students of Nkrumah University in Ghana .[15,19] Findings from the latter study depicted a positive correlation between ulnar length and height with correlation being highest in male than female participants .[19]

The shorter length of the female ulna as reported by Emmanuel et al.,2017 could be as a result of increased levels of oestrogen during puberty which causes early cessation of bone growth .[19]Oestrogen causes fusion of the proximal epiphysis with the shaft of the ulna in the 14th year and fusion of the distal epiphysis with the shaft in the 18thyear.[24-25] In contrast, it has been reported that increased levels of testosterone in males during puberty allowed bone growth up to 21 years which prolonged the growth phase of the long bones resulting in longer male bones.[20, 24]Singh et al stipulated that sexual dimorphism observed in ulnar length among males and females could be due to males indulging in more physical activities, thereby causing the extension of their ulna as a means of adaptation to the excessive stretching of the hand.[25]

The mean ulnar length of male and females from our study differed from those of Ghanaian students, [19] south African whites,[27] Indians and the greeks.[28]According to Charisi et al. (2011) race, nutritional status and occupation which all have been shown to contribute significantly to inter-population variation could be determining factors.[27]

Conclusion:

Findings from this study showed a significant correlation between the measured height and ulnar length of all participants. The regression formula proposed in this study will be useful for clinicians, anatomists, archeologists, anthropologists and forensic scientists when such evidence provides the investigator the only opportunity to determine that aspect of an individual's physical description.

REFERENCES

1. Standring S. Gray's Anatomy The Anatomical Basis of Clinical Practice. 39th ed. Edinburgh:Churchill Livingstone . 2005; 2703-2704.
2. Gauld LM, Kappers J, Carlin JB, Robertson CF. Height prediction from ulna length. Dev. Med. Child Neurol.2004; 46: 475–480.
3. Gupta P, Kumar P, Gaharwar A, Ansari H, Hussein M. Correlation of percutaneous length of tibia with body height and estimation of stature in living North Indian males. Schol J of Appl Med Sci 2014:, 848-852.
4. Krane DE, Ford F, Gilder JR, Inman K, Jamieson A, Koppl R, Kornfield IL, Risinger DM, Rudin N, Taylor MS, Thompson WC. Sequential unmasking:a means of minimizing observer effects in forensic DNA interpretation. J. Forensic Sci. 2008;53: 1006–1007.
5. Meadows L, Jantz RL. Secular changes in long bone length and proportion in the United States 1800-1970. Am. J. Phys. Anthropol.1999; 110: 57-67.

6. Bidmos MA. Metatarsals in the estimation of stature in South Africans. J Forensic Leg Med.2008; 15: 505–509.
7. Cardoso HF. A test of three methods for estimating stature from immature skeleton remains using long bone lengths. J Forensic Sci 2009; 54: 13–19.
8. Dupertius CW and Hadden JA . On the reconstruction of stature from long bones.Am J Phys Anthropol .1951; 9: 15–54.
9. Krogman WM and Iscan MY. Calculation of stature. The human skeleton in forensic medicin, 2nd ed.Springfield, IL: Charles C Thomas, 1986, pp.302–351
10. Ilayperuma I, Nanayakkara BG, Palahepitiya KN. (2009) Prediction of personal stature based on the hand length. Galle Med. J. 14: 15-18.
11. Trotter M, Glesser GC. Estimation of stature from the long bones of American whites and negroes. Am. J. Phy. Anthropol. 1952;(10):463–514
12. Lundy JK. The mathematical versus anatomical methods of stature estimation from the long bones. Am J Forensic Med Pathol. 1985;6(1):73–76.
13. Agnihotri AK, Kachhwaha S, Jowaheer V, Singh AP. Estimating stature from the percutaneous length of the tibia and the ulna in an Indo-Mauritian population. Forensic Sci Int. 2009 30;187(1-3):109.
14. Barbosa M, Stratton RJ, Lafuente E, Elia M. Using the ulnar length to predict the height in English and Portuguese patient populations. Euro J of Clini Nutri. 2012; 66:209–215.
15. Lal CS, Lala JK. Estimation of height from the tibial and the ulnar lengths in north Bihar. J Indian Med Assoc. 1972; 58(4):120–21.
16. Telekka A. The prediction of the human stature from the long bones. Acta Anatomica. 1950;(9):103–11.
17. Malay KM, Tapan KJ, Susmita G, Hironmoy Roy. Height Prediction from Ulnar Length in Females: A Study in Burdwan District of West Bengal. The Int J of Forensic Sci, 2008 ;2(1):192-194.
18. Patel SM, Shah GV, Patel SV. Estimation of height from measurements of foot length in Gujarat region. Anat Soci of India, 2007;56(1):25-27.
19. Emmanuel OA, Chrissie SA , Thomas D, Joshua T, Atta KA, Obed ODA, Nancy DD. A preliminary anthropometric study of height and sex determination using percutaneous ulnar and femoral lengths. Int J Anat Res 2017, 5(1):3638-43
20. Ebite L, Ozoko T, Eweka A, Otuaga P, Oni A, et al. Height: Ulna Ratio: A method of stature estimation in a rural community in Edo state, Nigeria. The Int J. forensic Sci .2007;3:1-4
21. Anjali KP, Satya NS, Abhishek DK.Estimation of human stature from ulnar length in rural region of Maharashtra.Ind. J. Clinic Anat.& Physio.2016;3(3); 343-347
22. Illayperuma I, Nanayakkara G. Palahepitiya N. A Model for the Estimation of Personal Stature from Length of Forearm. Int. J. Morphol. 2010;28(4):1081-1086.
23. Devi S, Das H, Purnabati BK, Singh SD, Devi J. Estimation of stature from the upper arm length among the Marings of Manipur. Ind Med J. 2006 Aug;100(8):271–73.
24. Sah RP, Shrestha A. Estimation of stature from percutaneous length of tibia in the population of Birgunj, Nepal. Journal of Kathmandu medical college . 2014 ; 3(2) : 58-62.
25. Singh S, Nair KS, Anjankar, V, Bankwar V, Satpathy DK et al. Regression equation for estimation of femoral length in central Indians from inter-trochanteric crest. Journal of Indian Academy and Forensic Medicine, 2013;35(3):34-37.
26. Bansal KA, Vaghela CP, Lad KS, Mittal P, Kapadiya KI. A study of relation between stature and ulnar length. Forensic Science International,2014;3(4):137-139.
27. Charisi D, Eliopoulos C, Vanna V, Koilias CG, Manolis SK. Sexual dimorphism of the arm bones in a Modern Greek population. Forensic Science International, 2011;56(1): 10-18