

# Height: Ulna Ratio: A Method of Stature Estimation In A Rural Community in Edo State, Nigeria

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## Abstract

This anthropometric study was to assess stature in individual by determining height: ulna ratio measurement. One hundred and nine (109) healthy adults (45 males and 66 females) aged between 20-45 years were studied in the year 2007 at Uromi, Edo state. The result of the study showed that on the average, the ulna is longer in males than females. Also adult males at Uromi are taller than the females. We present a simple formula for stature estimation thus;

Estimated stature (cm) = Ulna length\*Height ulna ratio+/-0.10 (if male) +/-0.21(if female) It is therefore recommended that further studies aimed at corroborating or assessing the level of accuracy of this formula and other observations be carried out.

## INTRODUCTION

Anthropometric characteristics have direct relationship with sex, shape and form of an individual and these factors are intimately linked with each other and manifestation of the internal structure and tissue components which in turn are influenced by environmental and genetic factors <sup>1</sup>. It is a fact especially familiar not only to anatomists but also to artists that trunks and limbs exhibit consistent ratios among themselves and relative to total height. The ratios are linked to age, sex and race <sup>2</sup>.

As infants grow, they change their body proportions gradually towards adult shape; these proportions diverge toward one sex at puberty. Estimation of stature from measurement of limb bones have long been formulated <sup>3</sup> and the accuracy of such estimations improved over time <sup>4</sup>.

Most forensic and biological anthropological studies use stature-estimation developed by eminent scientist <sup>4,5</sup>. Stature estimation usually is based on measurement of long bones. Most commonly used is the tibia. Trotter and Glessner however expressed concerns regarding the use of population specific formulae on other human population <sup>6</sup>. In fact recent studies of secular change and allometry have observed differential limb proportions between sexes and among population <sup>7,8</sup>.

Negroes have comparatively long legs and arms consequently formulae designed to estimate height from long bones in one population may not apply to another. In

fact when a formula derived from Caucasians, mean errors greater than 10 cm were observed and this was attributed to the high tibia to height ratio among blacks <sup>2,5</sup>.

Establishment of reliable formulae for stature estimation is important as estimates must sometimes be made from fragments of bones especially in forensic examination after disasters or genocide <sup>9</sup>. Sexual differences in height and of course long bones exist so there is need for studies to emphasize the need for standards of sexual dimorphism in different populations <sup>10</sup>.

It must be noted however that estimates are mean values with appropriate standard derivation, so estimated stature of unidentified remains may be inaccurate by several centimeters. The major difficulty in developing a stature estimation formula is the non-availability of skeletal series with known body height data <sup>11</sup>.

The ulna is a long bone, prismatic in form, placed at the medial side of the forearm, parallel with the radius. The ulna is broader proximally, and narrower distally. Proximally, the ulna has a bony process, the olecranon process which prevents hyperextension and forms a hinge joint with the trochlea of the humerus. There is also a radial notch for the head of the head of the radius, and ulnar tuberosity to which muscles can attach. Distally there is a styloid process. The posterior border of the ulna is rounded and descends from the apex of the olecranon's posterior aspect, curving laterally to reach the styloid process. This border is subcutaneous and

palpable throughout its length. Ossification of the ulna starts at the 8<sup>th</sup> fetal week and the proximal epiphysis fuses with the shaft in the 14<sup>th</sup> year in females and 16<sup>th</sup> year in males. The distal epiphysis unites with the shaft in the 17<sup>th</sup> year in females and 18<sup>th</sup> year in males<sup>2,12</sup>.

Our aim here was to establish a relationship between ulna length and height as a tool for forensic and anthropometric studies. This study was carried out at Uromi in Edo state and the subjects are indigenes of the town.

**MATERIALS AND METHODS**

One hundred and nine (109) healthy adults (45 males and 66 females) aged between 20-45 years were studied in the year 2007 at Uromi, Edo state. The ulna length was measured with a tape rule from the apex of the olecranon to the styloid process with the elbow in full flexion. Their height was also measured with a calibrated standing meter rule. The results were tabulated and a height—ulna ratio derived thus:

$$\text{Height-ulna ratio} = \text{height (cm)} / \text{ulna length (cm)}$$

**RESULTS AND DISCUSSION**

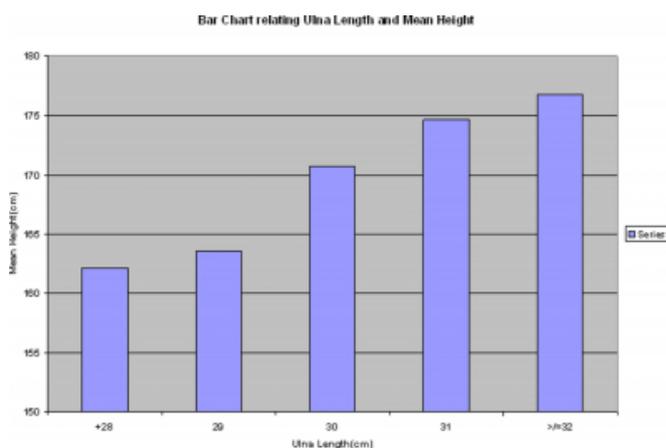
Table 1 outlines mean height for various levels of Ulna length. As expected there is a significant relationship between the two (Table 1 and Figures 1&2)

**Figure 1**

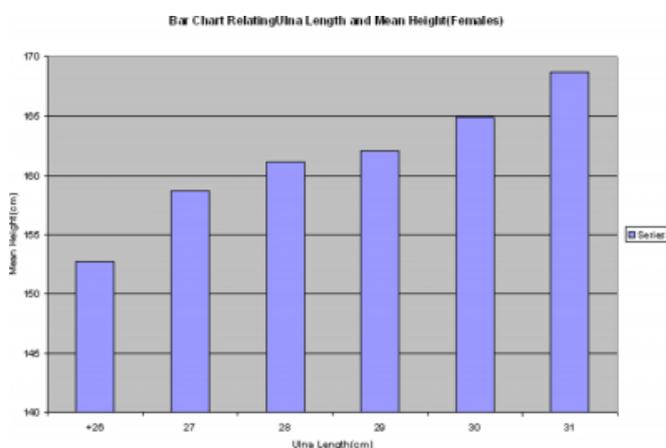
Table 1: Comparative analysis of Male and Female Ulna Lengths and Heights

	MALE			FEMALE		
	Ulna Length	Mean Height (cm) (S.D in bracket)	Height-ulna ratio(ht/ul)	Ulna Length	Mean Height (cm) (S.D in bracket)	Height-ulna ratio(ht/ul)
	26	---	---	26	152.750 (2.120)	5.865
	27	---	---	27	158.710 (3.199)	5.878
	28	162.167 (5.307)	5.792	28	161.150 (3.150)	5.755
	29	163.583 (4.833)	5.641	29	162.095 (5.893)	5.590
	30	170.727 (3.036)	5.691	30	164.875 (3.356)	5.496
	31	174.625 (2.615)	5.633	31	168.714 (2.890)	5.442
	32	176.750 (4.166)	5.523	32	---	---
MEAN	30.33 (1.53)	169.444 (6.824)	5.656 (0.097)	28.50 (1.87)	162.200 (5.574)	5.652 (0.206)

**Figure 2**



**Figure 3**



The results show that on the average, the ulna is longer in males than females. Also adult males at Uromi are taller than the females. There is distinct sexual dimorphism in the sample and stature of this population can be estimated using the following formula based on ULNA length.

$$\text{Estimated stature (cm)} = \text{Ulna length} * \text{Height ulna ratio} \pm 0.10 \text{ (if male)} \pm 0.21 \text{ (if female)}$$

This present work for the first time documents a relationship between the ulna and height in Esan indigenes of Edo state Nigeria and attempts to provide a tool for forensic estimation of stature as well as establish an anthropometric norm. It is therefore recommended that further studies aimed at corroborating or assessing the level of accuracy of this formula and other observations be carried out.

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