*THE INTERNATIONAL JOURNAL OF SCIENCE & TECHNOLEDGE*

# Stature Estimation from Hand Dimensions in Bekwarra Ethnic Group of Cross River State, Nigeria

**Lukpata P. U.**
Anatomy Demonstrator/Lecturer, Department of Anatomy, Faculty of Basic Medical Sciences,
Cross River University of Technology, Okuku Campus, Cross River State, Nigeria
**Ojim E. O.**
Associate Professor, Department of Anatomy, Faculty of Basic Medicine, Ebonyi State University, Abakaliki, Nigeria
**Esomonu U. G.**
Associate Professor and Dean, Department of Anatomy, Faculty of Basic Medical Sciences,
Cross River University of Technology, Okuku Campus, Cross River State, Nigeria
**Okori S. O.**
Assistant Lecturer, Department of Anatomy, Faculty of Basic Medical Sciences,
Cross River University of Technology, Okuku Campus, Cross River State, Nigeria
**Egwu A. O.**
Senior Lecturer, Department of Anatomy, Faculty of Basic Medicine, Ebonyi State University, Abakaliki, Nigeria
**Ude R.**
HOD, Department of Anatomy, Faculty of Basic Medicine, Ebonyi State University, Abakaliki, Nigeria

***Abstract:***
*In establishing the individuality of a person when fragmentary and dismembered of unknown human remains, is a first step in identifying the peculiarity of individual. It is a useful tool in medico legal and forensic examination. Our aim is to find out correlation between stature and hand dimensions, and to derive a regression formula to predict the height of an individual using hand dimensions in Bekwarra indigenes of Cross River State between 18-43years. Stature of 1028 healthy subjects, 412 Males and 616 females, in the age group 18-43 years were included. Gender differences for the two parameters were determined using Student t-test. Pearson's correlation coefficient (r) was used to examine the relationship between two anthropometric parameters and standing height (stature). The findings of the study indicate that the males mean values are significantly difference in all measured parameters. The males mean values (169.1±6.37) for stature are significantly higher ($p<0.05$) than the females (162.3±12.16) and the hand dimensions; hand length (males-18.51±1.15 and females-17.78±1.13) and hand breadth (males-8.83±0.65 and females-8.60±5.33), were found significantly higher ($p<0.05$) in males than females. Regression equations; 12.05×HL+54.00 (male hand length) and 37.34×HL+ (501.8 (female hand length) and 22.68×HB+31.19 (male hand breadth) and 74.76×HB+ (-481.1) (female hand breath) for stature estimation were formulated for the males and females. There is strong correlation between stature ($p<0.05$) and hand dimensions. The hand length provides accurate and reliable means in establishing the height of an individual. This study will be useful for forensic scientists and anthropologists as well as anatomists in ascertain medico-legal cases.*

***Keywords:*** *Stature, Hand length, Hand breadth, Bekwarra, Cross River State*

## 1. Introduction

Upright posture is one of man's greatest achievements over a long period of early human evolution, since this freed most of the body parameters, the hand, arm, thigh, leg, and foot for activities other than movement (Ulijaszek and Mascie-Taylor, 2005). These body segments are very important in establishing stature. Stature provides insight into various features of a population including nutritional health and genetics. It is considered as one of the parameters for personal identification (Krishan and Sharma, 2007; Anitie, 2007). Indeed, it stands as a tool used in measurement and comparison of human variation (Patel *et al.*, 2012). The tremendous value of the body parameters as a functional device is its usefulness in anthropological finding of racial differences, identifying ethnic variation (in stature), estimating stature and analyzing data used in forensic medicine, as well as other activities very paramount to the field and future of the anthropologist (Damon, 1963). This relationship of different body parts is used to establish the sex as well as stature of an individual (Ebite*et al.*., 2008). This is also very useful in anthropology and forensic sciences to find the racial differences, when only parts of the deceased body are available. Estimation of height of an individual has obvious significance in identification. Height is

fundamental to assessing growth and nutrition, calculating body surface area, and predicting pulmonary function in childhood (Gauld et al.., 2004). Establishing the identity of an individual from mutilated and amputated body parts has become an important necessity in recent times due to natural disasters like earthquakes, tsunamis, cyclones, floods, and man-made disasters like terrorist attacks, bomb blasts mass accident, plane crashes. Different studies have been done in the past to establish correlation between height and various anthropometric parameters like hand-length, hand-breadth, foot-length, foot-breadth, and arm span (Abdi, et al., 2012).

Anthropometric parameters show variations in different populations according to genetics, geography, race, religion, nutrition, and socioeconomic condition of local population (Patel *et al.*, 2012). Many studies have shown that the length of foot, hand, hand with forearm, arm, upper extremity, length of head, height of head, distance between sterna notch and pubic symphysis were significant body segments for estimation of stature (Kumar, 2014). In the present study an attempt has been made to establish correlation between height and hand dimensions among Bekwarra indigenes in Cross River State of Nigeria and regression equations formulated to estimate stature for Bekwarra indigenes in Cross River State of Nigeria.

**2. Materials and Methods**

A total of 1028 alive and healthy human subjects, 412 Males and 616 females, between the ages 18-42 years were selected from various areas in Bekwarra of Cross River State.

Stature of the subjects was measured in an upright anatomical position with a standing height measuring instrument. The measurements were recorded in centimeters to the nearest 0.1 cm. The subjects were asked to stand erect with their feet flat on the floor with their heels together and the weight evenly distributed between both feet. The subjects stood erect with the Frankfort plane (line passing horizontally from the ear canal to the lowest point of the eye orbit) of his head parallel to the floor. Measurement was taken with an anthropometer from the ground to the highest point on the subject's head while firmly contacting the scalp. The measurement was recorded in centimeters (Roebuck, 1995).

The hand-length was taken by asking the subject to place the hand on a table with the fingers together and thumb abducted. Hand length was measured as a direct distance from the level of tip of the most distal point on the styloid process of the radius to the tip of the middle finger by using the spreading caliper (Figure 1).

The hand-breadth was taken between the landmarks at metacarpal II and metacarpal V, as shown in Figure 1.

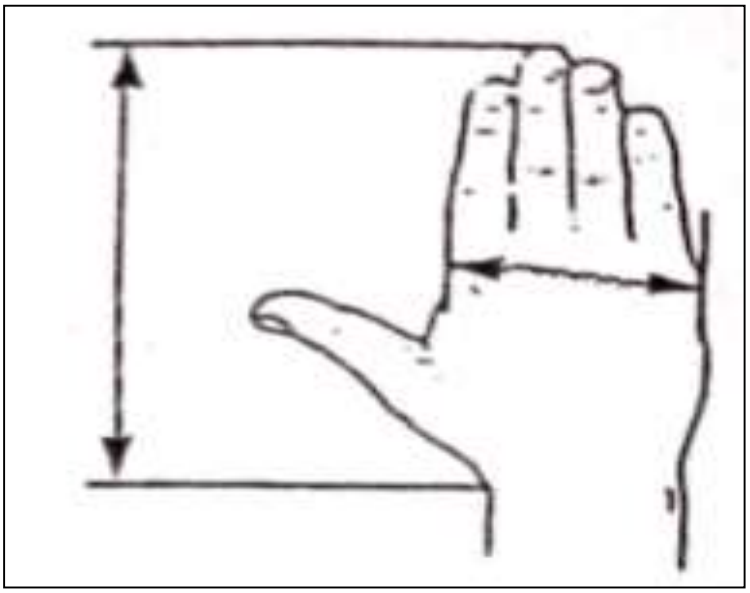

*Figure 1: measurement of hand length*

**3. Results**

Table 1 presents the mean values, standard deviation (S.D), and standard error of mean (S.E) for stature and hand dimensions among Bekwarra males and females. It was observed that the Bekwarra males have higher values for stature and hand dimensions than Bekwarra females as showed in Table 1.

Table 2 shows the values of correlation coefficient 'r' to estimate stature from hand dimension in Bekwarra indigenes, which was found to be higher among males as compared to the females.

| Sex | Height | SE | HL | SE | HB | SE |
|---|---|---|---|---|---|---|
| Male | 169.1±6.37*** | 0.459 | 18.51±1.15*** | 0.083 | 8.83±0.65 | 0.047 |
| Female | 162.3±12.16 | 0.859 | 17.78±1.13 | 0.080 | 8.60±5.33 | 0.376 |

*Table 1: descriptive statistics for stature and dimensions (cm) of hand in male and female.*
*Values are mean ± SD. * denotes significant difference (P<0.05) between males and females using Student's t-test.*

| Sex | HT and HL | p-value | HT and HB | p-value |
|---|---|---|---|---|
| | r | | r | |
| Male | 0.459*** | 0.0001 | 0.432*** | 0.0001 |
| Female | 0.289*** | 0.0001 | 0.030 | 0.667 |

*Table 2: Correlation coefficient of stature and hand measurements*
*Values are Pearson's correlation coefficient (r). * denotes significant correlation (P<0.05)*

Table 3 shows linear regression equations for estimation of stature from hand dimension in Bekwarra males and females.

| Sex | HT and HL | HT and HB |
|---|---|---|
| Male | 12.05×HL+(54.00* | 22.68×HB+(31.19* |
| Female | 37.34×HL+(501.8* | 74.76×HB+(-481.1) |

*Table 3: Simple regression equations to predict stature from hand dimensions.*
*Prediction equations for estimation of stature from hand dimension. * denotes significant effect (P<0.05) on linear regression.*

**4. Discussion**

Personal identification is a vital device used by forensic scientists for medico-legal cases and anthropologist as well as anatomists in identifying an individual when only segments and fragments of unknown body part is left. Studies have shown that hand dimensions vary in different races therefore formulae derived for one ethnic group may not be applicable to another ethnic group and this may be attributed to biological and environmental factors (Eveleth et al.., 1976; Krishan et al.., 2007; Malina, et al.., 1983). Studies have also reported of individual difference. Dubois et al. (2012) and Silventoinen et al. (2007) revealed that no two individuals are exactly alike genetically, even identical twins differ in some aspects, and the variability is strongly influenced by genetic and environmental factors. The present study shows that stature and the hand dimensions were statistically significant between the males and females. The findings from this study is in agreement with other studies done by Numan et al. (2013); Agnihotri et al. (2007); Ilayperuma, (2009); Jasuja et al. (2004); Rastogi et al. (2008). The Bekwarra males are significantly taller and have longer and wider hands than the females (table 1). When compared the study of Numan et al. (2013), on the three major ethnic (Hausa, Igbo and Yoruba) groups in Nigeria, with our study, we find out that the mean values (174.79 ± 0.86 and 167.03 ± 1.04; male and female respectively) for three major ethnic (Hausa, Igbo and Yoruba) groups and hand dimensions (hand length recorded 20.62 ± 0.13 and 19.85± 0.18; male and female respectively with the hand breadth recorded 9.73 ± 0.01and 9.00 ± 0.07; male and female respectively) of the three major ethnic are higher than the mean values of Bekwarras ethnic group which recorded mean values169.1±6.37 and162.3±12.16 for stature, hand length; 18.51±1.15 and 17.78±1.13 and hand breath; 8.83±0.65 and 8.60±5.33 males and females respectively. The present study also showed similar results with the study done by Patel *et al.* (2012) on a study sample of 273 living cases (138 male and 135 female students) between the ages of 17 and 23 years shows that a significant correlation between stature and hand length( r= 0.806) while hand breadth was found to show the lowest correlation (0.467). Similarly, Nihal et al. (2014) revealed that the high degree of correlation was found in hand length (r=.597) and hand width (r=.482). A study done by Jitendra P. P et al. **(**2014**)** on total 150 (72 males and 78 females) in age group 18-22 years of age shows significant correlation between stature and hand length r= 0.510 and 0.504 for right and left hand respectively. Chikhalkar B. G. et al. (2010) study on 300 medical students (153 females and 147 males) in age group of 19-23 years shows significant correlation between stature and Hand length (r=0.5902). Ibegbu A. O. et al. (2013) study on 300 males and 300 females in age group 5-10 years show significant correlation between stature and Hand length (r=0.706; 0.703). Modibbo M. H. et al. (2012) study on 501 neonates (271 males and 230 females) born to Hausa parents of Kano State origin, show significant correlation between stature and Hand length (r= 0.60). Linear regression equations for estimation of stature were derived for hand length measurements for males as well as females (Table3). Many researchers have found that the regression equations using various anatomical dimensions of one population do not apply to another **(**Davies et al., 1980; Williams, 2000**)**. The same was found in our study, where our data differs from data of previous studies of other ethnic groups **(**Abdel-Malek et al., 1990; Bhatnagar, et al., 1984**).** Within the sexes, we also found that the regression equations of one sex cannot be applied to the other even when estimating stature in the same ethnic group (Kanchan et al., 2009; Saxena; Sanli et al. 2005). The same is observed when we compared the regression equations of our study and other studies (table 3).

**5. Conclusion**

Hand dimensions are strongly correlated with stature, which can be used to predict stature. Linear regression equations derived in this study for estimation of stature are reliable and accurate that can be of utmost importance to forensic scientists for medico-legal cases and anthropologist as well as anatomists.

**6. References**


i. Abdel-MalekAK, Ahmet AM., Sharkawi SAA, Hamid NMA. (1990) Prediction of stature from hand measurements. Forensic Sci. Int. 46:181-7.
ii. Agnihotri AK, Agnihotri S, Jeebun N, Googoolye K. (2008). Prediction of stature using hand dimensions. Journal of Forensic and legal Medicine.;15:479-482.
iii. Arti L. N. Dongre A. P. (2013) Body Height Estimation Based on Foot Length and Foot Breadth Indian Acad Forensic Med. July-September, Vol. 3.
iv. Bhatnagar DP, Thapar SP and Batish MK. 1984 Identification of personal height from somatometery of hands in the Punjabi males, Forensic science international, 24 : 137- 141.
v. Chikhalkar B.G. et al.. 2010 Estimation of stature from measurements of long bones, hand and foot dimensions, J Indian Acad Forensic Med.32(4):329-331.
vi. Damon, A. and H. V. Stoudt. (1963)The Functional Anthropometry of Old Men. Human. Factors. Vol. 5, No. 5, 485 491.
vii. Davis K. T., (1990).The foot length and hand length to stature ratio. A study of racial variance.MA thesis, Department of Anthropology, Texas Tech University, Lubbock, TX.
viii. Dubois L, Ohm Kyrik, Girard M, Tatone-Tokuda F, Perusse D, et al.. (2012). Genetic and Environmental contributions to weight, height and BMI from birth to 19yrs of age. An international study over 12,000 twin pairs. PLOS ONE 7(2), e30153.; Doi: 10.1371/Journal. Pone.0030153.
ix. Ebite, L. E.; Ozoko, T. C.; Eweka, A. O.; Otuaga, P.O.;Oni, A. O. & Om'Iniabohs, F.A.E. (2008) Height: Ulna Ratio: A Method of Stature Estimation In A Rural Community in Edo State, Nigeria. The Internet Journal of Forensic Science, 3(1).
x. Gauld, L. M., Kappers, J, Carlin, J. B. & Robertson, C.F. (2004) Height prediction from ulna length.Dev. Med.Child Neurol. 46(7):475-80.
xi. Ibegbu A. O. , David E. T., Hamman W.O., Umana U.E., Musa S. A. (2013). Association of Hand Length with Height in Nigerian School Children.Journal of Biology and Life Science, Vol. 4, No. 2.
xii. Ilayperuma I, Nanayakkara G, Palahepitiya N. (2009). Prediction of personal stature based on the hand length. Galle Medical Journal.; 14(1):15-18.
xiii. Jasuja OP, Singh G.( 2004). Estimation of stature from hand and phalange length. Journal of Indian Association of Forensic Medicine; 26(3):100-106
xiv. Kanchan T., Menezes RG., Moudgil R., Kaur R., Kotian MS., Garg RK. 2008 Stature estimation from foot dimensions. Forensic Sci. Int. 179:241.e1-e5.
xv. Krishan K, Sharma A. (2007) Estimation of stature from dimensions of hands and feet in a North Indian population. J Forensic Legal Med. 14:327-32.
xvi. Kumar Sushil Srivastava, A. K., Sahai, M.K.B. 2014 Estimation of stature by anthropometric examination of forearm and hand. J Indian Acad Forensic Med, 32(1) 62.
xvii. Malina RM, Little BB, Stern MP, Gaskill SP, Hazuda HP.(1983). Ethnic and social class differences in selected anthropometric characteristics of Mexican American and Anglo adults. The San Anthonio Heart study. Human Biology; 55(4):867-83
xviii. Modibbo, M. H., Taura, M. G., Agu, O. C. and Bashir, U. 2012 Estimation of stature from hand and foot dimensions in Hausa neonates: a hospital-based study, Bajopas5(2): 110 – 114.
xix. Nihal Ahmad, Fateh Mohammad, Ibrahim Farooque (2014). Estimation of Height from the Long Bones of Upper Limb and Hand Dimensions in South Indian Population. Journal of Evidence Based Medicine and Health Care; Volume 1; Page: 473-478.
xx. Numan A. I, Idris M. O, Zirahei J. V, Amaza D. S. and Dalori M. B. (2013) Prediction of Stature from Hand Anthropometry: A Comparative Study in the Three Major Ethnic Groups in Nigeria. British Journal of Medicine & Medical Research 3(4): 1062-1073.
xxi. Patel PN et al.. (2012) Correlation between Hand Length and Various Anthropometric in population of Gujarat. J International Journal of Medical Toxicology and Forensic Medicine. 2(2): 62-63.
xxii. Rastogi P, Nagesh KR, Yoganarasimha K (2008). Estimation of stature from hand dimensions of North and South Indians. Legal Medicine. 10:185-189.
xxiii. Roebuck, John A., Jr, 1995 Anthropometric Methods: Designing to Fit the Human Body, Human Factors and Ergonomics Society.
xxiv. Sanli SG, et al., 2005 Stature estimation based on hand length and foot length. : ClinAnat. Nov; 18(8):589-96.
xxv. Saxena SK. 1984 Study of correlations and estimation of stature from hand length, hand breadth and sole length. AnthropolAnz. 42(4):271-6.
xxvi. ShintakuK., & Furuyay. (1990). Estimation of stature based on the proximal phalangeal length of Japanese women's hand. JUEOH. 12(2), 215-219.
xxvii. Silventoinen K, Bartels M, Posthuma D, Estourgie-Van Burk GF, Willem Sen G, et al.. (2007). Genetic regulation of growth in height and weight from 3 to 12 years of age: a longitudinal study of dutch twin Chilfren. Twin Res Hum. Genet; 10(2):354-363.
xxviii. Ulijaszek and Mascie-Taylor C.G.N. (2005). In Anthropometry: The Individual and the Population, ed. Tomkins, A. Growth monitoring, screening and surveillance in developing countries. Cambridge: Cambridge University Press.108–16.
xxix. Williams, P. L.; Bannister, L. H.; Berry, M. M.; Collins, P.; Dyson, M. & Dussek, J. E. , 2000 Gray's Anatomy: The Anatomical basis of medicine and surgery. 38th Ed. New York, Churchchill Livingstone.