

Anthropometric Correlation between Hand and Foot Dimensions amongst Adult Males and Females of Obudu Local Government Area, Cross River State

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Abstract: The hand and foot dimensions are important in forensics and ergonomics as they can be used to identify victims of mass disasters, estimate height of individuals and also to produce good fitting hand gloves and foot wears. The aim of this study was to correlate and compare the hand and foot dimensions of Obudu people of Cross River State. A total of 500 subjects (300 males and 200 females), aged 20-40 years were used for this study. Hand length was measured from the wrist to the tip of the longest finger, with hand extended. Hand breadth was measured from the head of the first metacarpal to the head of the fifth metacarpal. Foot length was measured in centimeters using a meter rule from the traced foot outline of the subject, which was traced with the subjects standing erect and their foot placed on a flat surface; the foot breadth was measured using a sliding calipers with the foot placed on a flat surface. Data obtained were analysed statistically using GraphPad Prism 5. The independent T-test was used to compare the mean within and between sexes, and Pearson correlation coefficient was used to correlate the parameters of males and females. The results of T-test were expressed as mean \pm standard deviation using tables, and those of Pearson correlation coefficient were expressed as Pearson correlation (*r*) using tables. The results showed that at $P < 0.05$ the males have significantly longer and broader hands and feet than females and there was a significant correlation between males and females.

Key words: Hand, foot, dimensions, anthropometry, Obudu

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I. Introduction

Anthropometry refers to the measurement of human individuals for the purpose of understanding human physical variation and plays an important role in plastic surgery, prosthetics, Industrial design, clothing design, ergonomics and architecture, where statistical data about the distribution of body dimensions in a population are used to optimize products¹. The human hand is a prehensile, multi-fingered organ located at the end of the forearm². Fingers contain some of the densest areas of nerve endings on the body, are the richest sources of tactile feedback and have the greatest positioning capability of the body; thus the sense of touch is intimately associated with hands. Like other paired organs (eyes, feet, legs), each hand is dominantly controlled by the opposing brain hemisphere, so that handedness—preferred hand choice for single handed activities such as writing with a pencil, reflects individual brain functioning. The human hand has five fingers and 27 bones, not including the sesamoid bone, the number of which varies between people³, 14 of which are the phalanges (proximal intermediate and distal) of the fingers. The metacarpal bones connect the finger and the carpal bone of the wrist. Each human hand has five metacarpals and eight carpal bones.⁴ Among humans, the hand plays an important function in body language and sign language.

The foot is the foundation of bipedal locomotion. It is a highly complex multi bone structure having 26 bones with numerous articulations.⁵ It is required to be stable, for supporting body weight in standing, resistance for working and accommodation in variations of surface in which it is placed.⁶ The normal human foot shows individual variations in length and in breadth. Hence, understanding the variations in foot shape among different populations necessitate a basic understanding of variations among populations. The application of foot anthropometry to design good-fitting footwear has been difficult due to the lack of appropriate presentation of anthropometric data. Using footwear often becomes difficult and creates many problems. Most of these problems are associated with wearing of ill-fitting footwear, as it leads to biomechanical imbalance and ultimately gives rise to different foot problems⁷. Similarly, the use of fingerprints in crime detection becomes difficult if the wrong data is presented. Measures taken or recorded with inaccuracy could seldom, if ever, be corrected and would defeat all chance of a successful search. The presentation of valid information from

measurements of foot and hand is therefore necessary. This study is designed to generate anthropometric, normative cross-sectional data on the adult hand and foot in Nigerians of Obudu origin.

II. Methodology

This study was carried out on adult volunteers with no evidence of congenital limb anomalies. The volunteers were all indigenes of Obudu and were randomly selected from several communities which cut across the whole Local Government Area. The study was conducted on 500 volunteers and the cohort consists of 300 males and 200 females, aged 20-40 years. Age and sex were recorded against each volunteer to be used for further statistical analysis. Informed consent was obtained from each volunteer before measurements. The choice of the age range was based on the assumption that the limbs have attained full maturation and all evidences of anomalies known. All the measurements used for this research were taken and recorded by the researcher and all the measurements were carried out by the same person in order to minimize error of identification of the parts of the body (hand and foot) involved in the measurements.

FOOT LENGTH MEASUREMENT A paper was taped to a flat surface, while the subject stands erect with his or her weight fully distributed and allowed to rest naturally on the paper, after which a pen was used to trace the foot outline on the paper. The length of the foot was measured as the distance between the rearmost point of the heel and the tip of the longest toe.

FOOT BREADTH MEASUREMENT Foot breadth was measured on standing subjects holding good posture. A sliding caliper was used to take the measurement as the distance from the medial margin of the head of the first metatarsal to the lateral margin of the head of the fifth metatarsal.

HAND LENGTH MEASUREMENT Hand length was measured using a ruler, from the wrist joint to the tip of the middle finger or the longest finger.

HAND BREADTH MEASUREMENT Hand breadth was measured equally with a ruler from the lateral margin of the head of the first metacarpal, to the medial margin of the head of the fifth metacarpal, with all the digits freely suspended.

The data collected were analyzed statistically using GraphPad Prism 5 (USA). Student t-test and Pearson correlation coefficient were used respectively to compare and correlate the parameters of the males and females subjects. Results are expressed as mean \pm standard deviation for t-test and (*r*) for Pearson correlation coefficient. Significant difference was set at $P < 0.05$.

III. Results

The results (both t-test and correlation) showed that the males had higher significant value ($P < 0.05$) in all the measured parameters (hand length, hand breadth, foot length and foot breadth).

HAND LENGTH: it was observed that the right hand length was greater in males (20.070 ± 1.180) than in females (18.380 ± 0.901). Also, the left hand length was greater in males (20.070 ± 1.158) than in females (18.350 ± 0.896). **HAND BREADTH:** the right hand breadth was greater in males (9.502 ± 0.831) than in females (8.579 ± 0.703). Also, the left hand breadth was greater in males (9.464 ± 0.816) than in females (8.551 ± 0.683).

FOOT LENGTH: it was observed that the right foot length was greater in males (23.650 ± 1.414) than in females (22.060 ± 1.156). Also, the left foot length was greater in males (23.600 ± 1.296) than in females (22.020 ± 1.148). **FOOT BREADTH:** the right foot breadth was greater in males (8.684 ± 0.797) than in females (7.988 ± 0.648). Also, the left foot breadth was greater in males (8.669 ± 0.804) than in females (7.960 ± 0.641).

IV. Discussion

This study was performed to find out the differences in hand and foot dimensions among the Obudu people of Cross River State, Nigeria; and also to provide normal anthropometric data for hand length, hand breadth, foot length and foot breadth to add to the existing data on limb dimensions.

All the parameters studied were significantly higher ($P \leq 0.05$) in males than females. The right hand length and breadth of males in this study were found to be longer and larger than that of the females, the same with the left hand, right foot and left foot. This is in agreement with the findings of Wunderlich and Cavanagh⁷ that for a given stature, males have longer and broader hands and feet than females. These higher values in males compared to females may be as a result of the males having longer bones than females⁸.

From student t-test analysis, statistically significant difference ($P < 0.05$) occurred in hand length and breadth as well as foot length and breadth of within and across both sexes.

From Pearson correlation coefficient, statistically significant correlation occurred between the sexes. Therefore, males have significantly longer and broader hands and feet than females. The hand length, hand breadth, foot length and foot breadth in males were all greater than those of the females. Also, the right hand length, right hand breadth, right foot length as well as right foot breadth were greater than the left hand length, left hand breadth, left foot length and left foot breadth in both males and females which showed the level of significance ($P < 0.05$) between the extremities

The greater dimensions of the right extremities may be due frequent usage since only right handed subjects were selected for this study. The results of this research work will be of use in gloves and shoes industries when designing hand gloves and foot wears.

V. Conclusion

This study revealed that there are differences in hand length, hand breadth, foot length and foot breadth between males and females in Obudu, Cross River State, with males having higher figures in all the measured parameters. This study also showed that there is a relationship between the upper and lower extremities; the length and breadth of one extremity is directly proportional the length and breadth of the other.

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