

Metric Analysis of the Foot of Yoruba Students at the University Of Maiduguri, Nigeria

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Abstract: Personal identification is the most important part of investigation and examination in cases of mass disasters, where disintegrated and amputated body organs are frequently found. The norms regarding determination of sex, age and race are well established. Studies on foot length, foot breadth and foot height have been carried out by many researchers in different populations. So the aim of the study was to do the Metric Analysis of the Foot of Yoruba Students at the University of Maiduguri and to find out racial characteristics of their own. The study was carried out on sixty (60) males' and sixty (60) females' Yoruba students of University of Maiduguri. Foot length, foot breadth and foot height was measured. Foot index was calculated and foot shape was determined, and then index of sexual dimorphism was also calculated. The results revealed that male foot length, height and breadth were significantly higher than their female counterparts. The study also showed that foot parameters are sexually dimorphic. Regarding the foot shape, proportion of standard and broad feet was higher among the males; however, the slender foot types were higher among the females. The anthropometric data provided serves as a template for the Yoruba students in University of Maiduguri on whom the study was carried out, and confirms that there is a geographical and sexual difference in anthropometric parameter. Therefore should be considered in shoe industries and forensic investigations.

Keywords – Anthropometry, foot and breadth, Foot index, Foot types, foot length.

I. Introduction

The biological profile of a person such as age, sex, ethnicity and stature can be determined with the help of anthropometry [1]. Sex differences in foot morphology have been studied by many investigators [2],[3],[4],[5]. Studies have shown that the normal human foot shows great individual variation in length, width and generally in males and females [6],[7], [8] reported that women generally tend to have a narrower heel in relation to the forefoot and narrow feet than men relative to length. [9] concluded that proportional to stature, women have larger feet than men. Other investigators are of the opinion that generally, men have longer and broader feet than women for a given stature [10],[11],[12],[13],[14]. However, [15] concluded that the lower limb demonstrates little sexual dimorphism in asymmetry. The morphology of human foot shows variation due to the combined effect of hereditary, lifestyle and climate factors [16]. Personal identification is the most important part of investigation and examination in cases of mass disasters, where disintegrated and amputated body organs are frequently found. The norms regarding determination of sex, age and race are well established. Studies on foot length, foot breadth and foot height have been carried out by many researchers in different populations [17], [18], [19].

Despite the anthropological, clinical and forensic importance of the foot, the metric analysis of the feet of Yoruba students in North-Eastern Nigeria is scarce. This present research is therefore carried out to evaluate the metric analysis of the feet and to determine any sexual dimorphism among the Yoruba students of University of Maiduguri, Maiduguri, Nigeria.

II. Materials And Methods

The study was carried out on 120 Yoruba students in the University of Maiduguri, which comprised of 60 males and 60 females. All the Yoruba students measured had Yoruba grandparents and after a verbal consent, their data was collected. The foot dimensions were measured with the foot placed on a horizontally flat surface, while the subject was standing. All the measurements were done on the right lower limb according to [17].

All measurements were done by one person to avoid error that could be caused by individual differences or any discomfort. All subjects who had recognized foot deformities and those who did not know their age were excluded from this study. The parameters obtained from the participants include: age, gender, foot length, foot breadth and foot height of the subjects. Instruments used included; transparent metre rule, measuring tape, plain papers, and a pencil and note book.

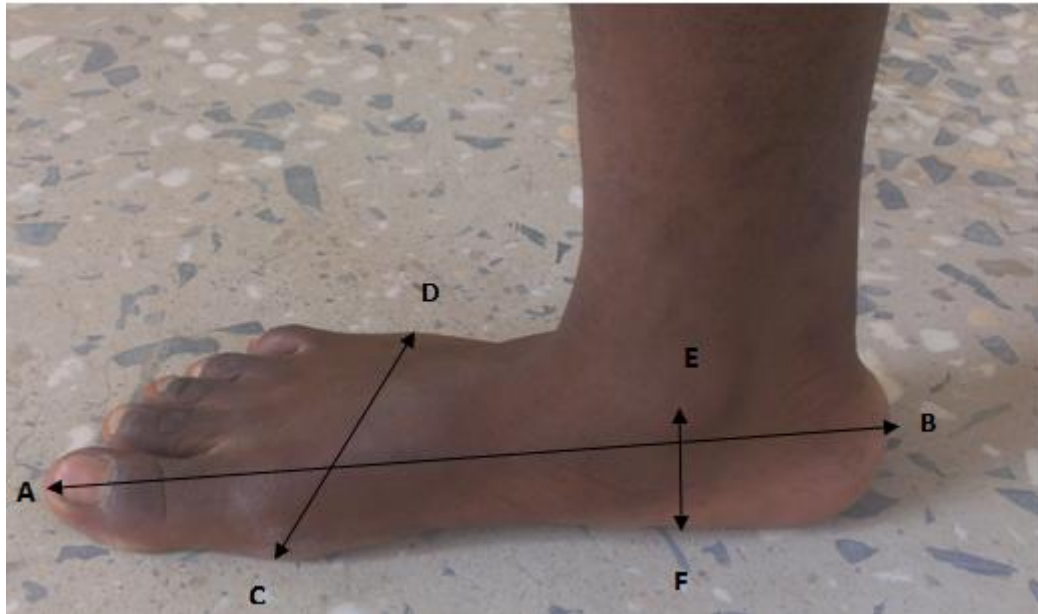


Figure 1: A Picture Showing The Measurements Of Foot Parameters

* --AB: Foot Length; CD: Foot Breadth; EF: Foot Height

Foot height was measured from the most prominent point on the medial malleolus of the tibia to the sole of the foot along the medial aspect of the leg, using a measuring tape.

Foot length was measured with a transparent meter rule with the subject in a relaxed sitting position, with the ankle perpendicular to the foot. It was measured by pinning the posterior prominence of the heel to the tip of the longest toe on the planter aspect of the foot. In some people, the first toe is the longest, in other people; the second toe is the longest [20]. The person kept the foot on a plain sheet paper, the length of the foot is marked by a marker; the points were measured by measuring tape.

Foot breadth was measured between the most medial points on the head of the first metatarsal to the most laterally placed point on the head of the fifth metatarsal [21]. The person kept the foot on a plain sheet paper, the breadth of the foot is marked by a marker; the points were measured by measuring tape.

Foot shape was determined by calculation of foot index. Foot index was calculated for each individual by dividing the foot breadth by the foot length $\times 100$. The mean foot index and SD were calculated and three types of foot shapes were determined according to the foot index [20].

- (1) Slender type : $FI < FI - SD$
- (2) Standard type : $FI - SD < FI < FI + SD$
- (3) Broad type : $FI > FI + SD$

III. Results

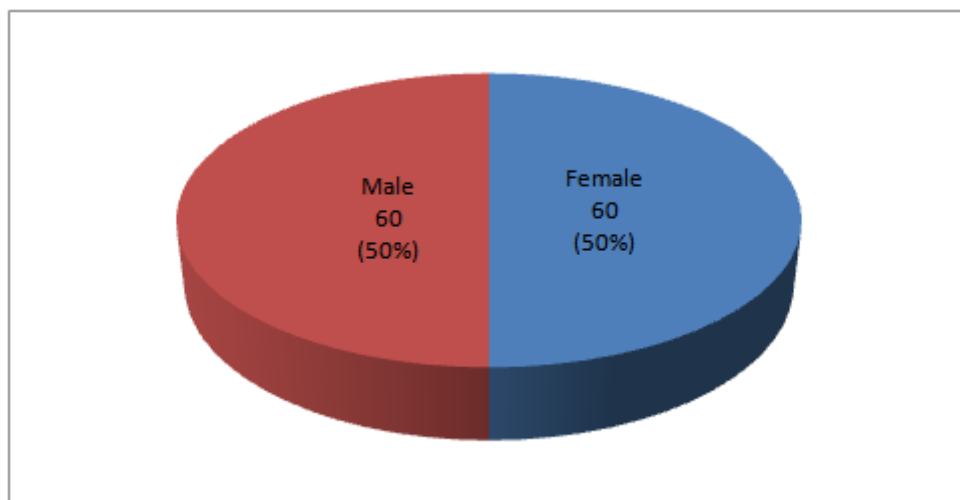


Figure 2: Pie Chart Showing Gender

Table 1: Showing the Distribution of the subjects foot measurements

Variation (cm) of the foot	Subjects		P Value
	Males (n=60)	Females (n=60)	
Height	7.51 ± 1.13	6.76 ± 0.81	0.001
Length	27.08 ± 1.31	24.77 ± 0.98	0.001
Breadth	10.45±0.75	9.35 ± 0.58	0.001
Index	38.58	37.74	0.001

P-value of $p < 0.05$ was considered significant
Results are shown as mean and ± SDs.

From TABLE 1 above, in all the parameters males have higher values than the females. The foot index was calculated based on foot length and breadth. The foot index for the males was 38.58 and for females 37.74. The mean foot index was significantly higher in males' $p < 0.001$ than females.

Table 2: Shapes of the Foot in male and female Yoruba students

Foot Shape	Males (N=60)		Females (N=60)	
	No	%	No	%
Slender (FI* < FI-SD)	11	18.33	20	33.33
Standard (FI-SD < FI* < FI+SD)	34	56.67	30	50.00
Broad (FI* > FI+SD)	15	25.00	10	16.67

(*-- FI* – Individual foot index; FI = Mean Foot Index; SD = Standard Deviation)

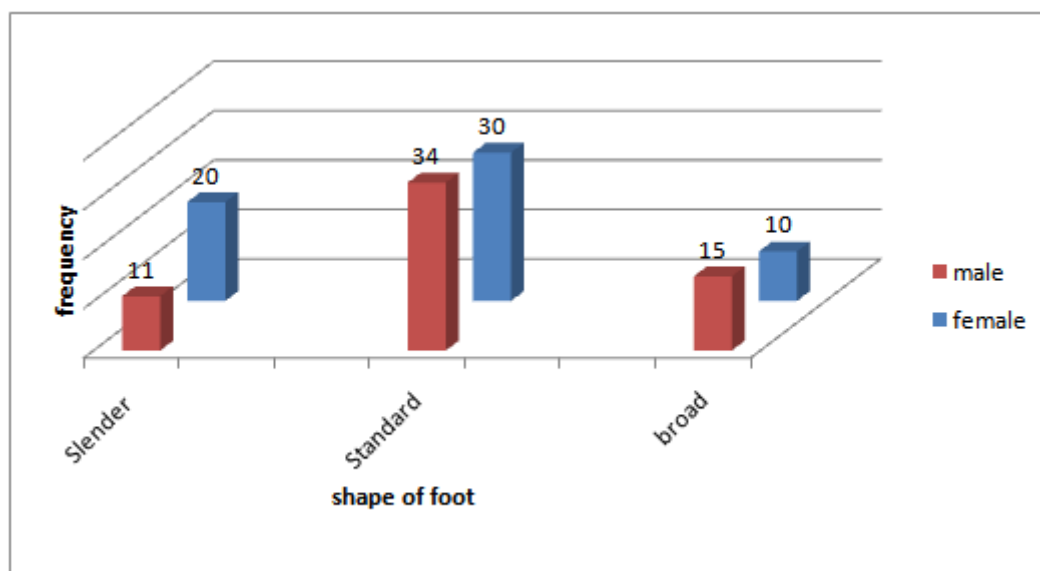


Figure 3 bar diagram showing the distribution of foot shapes in males and females

From table II above, the proportion of standard foot was higher among the males (56.67%) than that of the females (50.0%); however, the slender foot was higher among the females (33.33%) when compared to the males (18.33%). Broad foot shape was higher among the males (25.25%) than those of the females (16.67%)

Table III: Degree of Sexual Dimorphism in male and female Yoruba students.

	Length	Breadth	Height
Male mean	27.08	10.45	7.51
Female Mean	24.77	9.35	6.76
ISD (%)	109.33	111.76	111.09

From TABLE III above, the index for sexual dimorphism (ISD) is calculated by dividing the mean foot parameters of males by the mean foot parameters of the females. In all the parameters measured the index for sexual dimorphism are greater than 100%, this mean that the foot parameters are sexually dimorphic.

IV. Discussion

All the parameters measured were significantly higher ($P < 0.001$) in male Yoruba students than the females. This is in agreement with earlier study by [22] who studied the foot length of Igbo's and Hausa's and found the mean foot length as 27.23 ± 1.53 cm for Igbo male and 25.33 ± 2.37 cm for Igbo females. This shows that there is sexual dimorphism with respect to the Igbos. [23] also reported a similar trend among Ga'anda people of Adamawa, Nigeria. The mean foot length for the Hausa males was 27.24 ± 3.04 cm and 26.25 ± 1.19 cm for Hausa females. This also shows sex difference in foot length. [24] also confirmed this among undergraduates' students of a University in Western Nigeria. Their study showed males had a significantly higher foot length and breadth than the females ($P < 0.01$). [21] in their study conducted on 250 students (125 males and 125 females) age group 18-30 years concluded that the average foot length was found to be 3cm greater in males as compared to females and average foot breadth of males was about 1cm broader than females.

In the present studies, the mean foot height for males is 7.51cm while for females is 6.76 cm. [23] reported higher values among adult Ga'anda people this could be due age difference in the study populations and genetic factors. The foot dimension in males and females in this study is comparatively larger than Caucasian values [26],[26],[27]. This finding is in accord with theoretical expectation that populations living in warm climates would have longer arms and legs than populations living in cold environments. [28] Reported that tropical climate dwellers have longer limbs than temperate climate dwellers. Large foot dimensions are adaptation to tropical environment as they increase the surface area available for heat loss [24].

Foot index in the present study were 38.58 and 37.74 for males and females respectively. [29],[30],[31],[32] showed similar trend in the different populations while [23][21] in separate studies reported higher values for foot index in females. These could be due to environmental and genetic factors.

Foot shape was categorized according to foot index. In the present study, the proportion of standard foot was higher among the males (57%) than the females (50%). [23] reported higher percentage of standard foot in females than males. In the present studies males have higher percentage of broad feet while the females has higher percentage of slender foot, [23] reported a similar trend among Ga'anda people. The higher percentage of broad foot in males and slender foot in females may be genetic since all the subjects are students and are not engaged in year round farming activities. [33], [34] reported in their respective study that males have longer and broader feet than females for a given stature. Beside, [35] in their study on the Nigeria population also found that males have broader and longer foot dimensions than females.

V. Conclusion

The anthropometric data provided serves as a template for the Yoruba students of University of Maiduguri on which the study was carried out, and confirms that there is a geographical and sexual difference in anthropometric parameters, therefore should be considered in shoe industries and forensic investigations.

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