

Comparison of the Foot Height, Length, Breadth and Foot Types between Males and Females Ga'anda People, Adamawa, Nigeria

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Abstract: *The human foot shows great variation in length, width and height in males and females due to genetic, natural and environmental factors; and it has anthropological, clinical and forensic importance. The aim of the study was to measure the anthropometric parameters of foot of adult males and females Ga'anda people, to find out racial characteristics of their own, determine their difference and to classify their foot shapes. The study was carried out on sixty five (65) male and sixty five (65) female adult Ga'anda people. Foot length, foot breadth and foot height was measured. Foot index was calculated and foot shape was determined. The results revealed that male foot length, height and breadth were significantly higher than their female counterparts. Regarding the foot shape, proportion of broad foot was higher among the males; however, the slender and standard foot types were higher among the females. The anthropometric data provided serves as a template for the Ga'anda people on whom 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.*

Keywords : *Anthropometry, Foot and Breadth, Foot index, Foot length, Foot types.*

I. Introduction

Anthropometry, the typical and the traditional tool of physical anthropology, provides the scientific methods and techniques for estimating the various measurements and the observations on the living as well as skeleton of man [1]. Anthropometry is highly objective and reliable in the hands of trained anthropometrists [2].

Quantitative analysis of foot anthropometry is important to the study of ergonometics, orthotics designing and forensic science [3].

An important determination for a functional and comfortable foot support is how well the planter foot is shaped [4]. The foot shapes are corresponding to different weight bearing conditions [5]. Both the foot length and foot width were found to be increased during weight bearing. The shapes of human feet are changed due to their habit and presence of disease [4].

Several studies elsewhere have investigated the anthropometric characteristics of foot of adults of different ethnic groups [6],[7],[8],[9]. There is paucity of information on the anthropometric characteristics of various tribal population in Nigeria. Ga'anda is one of the populations devastated by Boko Haram insurgency in North-Eastern Nigeria. They live in Gombi local government of Adamawa state. There is no any data to the best of my ability about the foot shapes of Ga'anda people. So the aim of this work was to measure the anthropometric parameters of foot of adult males and females Ga'anda people, to find out racial characteristics of their own, determine their difference and to classify their foot shapes.

II. Materials And Methods

A total number of one hundred and thirty (130) subjects aged between 18-45, comprising of 65 males and 65 females of Ga'anda tribe were randomly selected in Gombi town of Adamawa state, belonging to various religions who voluntarily agreed after a verbal consent. The parameters obtained from the participants include: age, gender, foot length, foot breadth and foot height of the subjects. Instruments used included plain sheet of paper, marker, rigid transparent meter rule and a measuring tape.

All the measurements were done according to Pervin, 2006. All measurements were done on the right lower limb according to Jung, 2001.

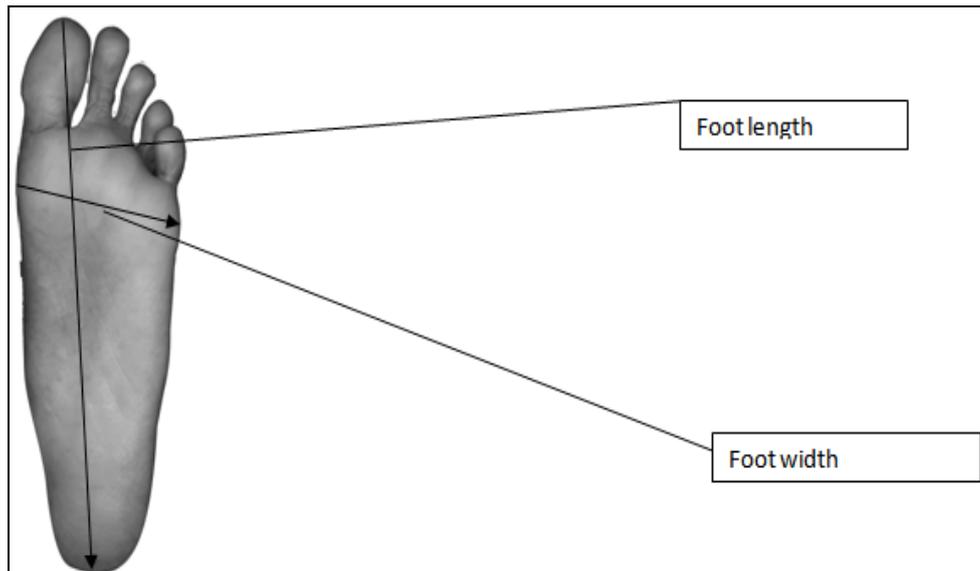


Figure 1: Length And Breadth Measurements (Tobias et al., 2014)

Foot height was measured by a transparent meter rule from the most prominent part of medial malleolus of the tibia to the sole of the foot along the medial aspect of the leg.

Foot length was measured with the subject in a relaxed sitting position. The ankle was kept perpendicular to the foot. It was measured from an imaginary vertical line drawn from the posterior prominence of the heel, to the tip of the longest toe, on the plantar aspect of the foot. In some people, the first toe is the longest, in other people; the second toe is the longest [7]. 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 [10]. 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 Standard Deviation (SD) were calculated and three types of foot shapes were determined according to the foot index [7].

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

III. Results

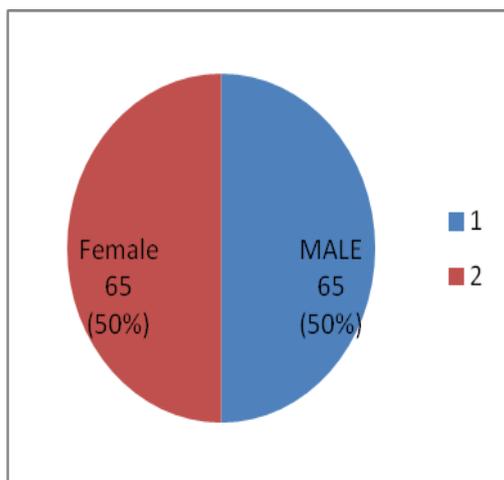


Figure 2: Pie Chart Showing Gender

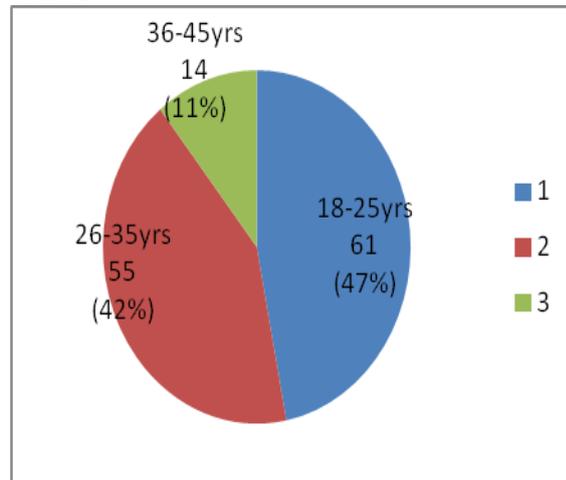


Figure 3: Pie Chart Showing Age Distribution

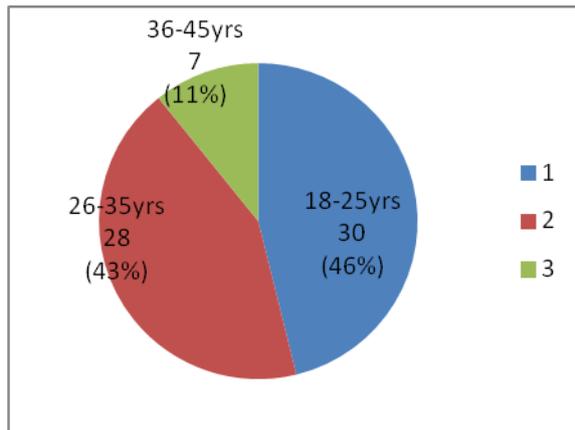


Figure 4: Pie Chart Showing Age Group Distribution Among Study Population in males

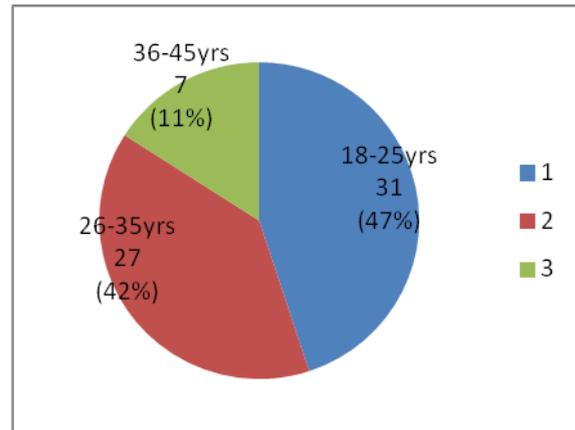


Figure 5: Pie Chart Showing Age Group Distribution Among Study Population in females

Table 1: Showing the Distribution of the subjects foot measurements

Variation (cm) of the foot	Subjects		P Value
	Males (n=65)	Females (n=65)	
Height	8.01 ± 0.77 (6.20 – 9.00)	7.34 ± 0.79 (6.00 – 9.00)	0.0001*
Length	26.45 ± 1.51 (22.5 – 29.8)	25.17 ± 1.75 (19.90 – 28.40)	0.0001*
Breadth	9.85 ± 0.94 (7.00 – 11.50)	9.47 ± 0.89 (7.00 – 11.00)	0.0202*
Index	37.21 ± 3.18 (28.30 – 44.50)	37.60 ± 2.64 (28.30 – 43.30)	0.0536*

p value reached from unpaired t test

Results are shown as ranges and mean ± SDs.

*--Statistically significant

From TABLE 1 above, the foot index of the subjects was calculated based on foot length and foot breadth. The mean foot index for the males was 37.21±3.18 and for the females 37.60±2.64. The mean foot index was a little bit higher among the females but mean difference was not statistically significant.

Table 2: Descriptive Statistics of Foot index of Adult Ga'anda Male subjects in centimetre (cm) by age group

Age group	Mean FI	SD	Sample No	Minimum	Maximum	P value
18-25	37.12	3.35	30	28.30	43.40	> 0.10
26-35	37.30	3.13	28	31.90	44.50	> 0.10
36-45	37.28	2.97	7	32.00	41.00	> 0.10

SD = standard deviation

FI= foot index

From TABLE 2 above, there is no statistically significant difference in foot index among males of various age groups.

Table 3: Descriptive Statistics of Foot index of Adult Ga'anda Female subjects in centimetre (cm) by age group

Age group	Mean FI	SD	Sample No	Minimum	Maximum	P value
18-25	37.47	2.42	31	32.70	43.30	> 0.10
26-35	37.78	2.98	27	28.30	42.10	> 0.10
36-45	38.48	2.54	7	33.10	40.50	> 0.10

SD = standard deviation

FI= foot index

From TABLE 2 above, there is no statistically significant difference in foot index among females of various age groups.

Table 4: Distribution of the subjects by shape of the foot

Foot shape according to foot index	Males (n=65) No	%	Females (n=65) No	%
Slender (Mean-1SD)	11	16.9	14	21.5
Standard (Mean ± SD)	21	32.3	36	55.3
Broad (Mean +1SD)	33	50.7	15	23.0

From TABLE 4 above, the proportion of standard foot was higher among the females (55.3%) than that of the males (32.3%), slender foot was also higher among the females (21.5% vs 16.9%). Broad foot shape was higher among the males (50.7%) than those of the females (23.0%).

IV. Discussion

All the parameters studied was significantly higher ($P < 0.001$) in males than females. This is in agreement with earlier study by [11] who studied the foot length of Igbos and Hausas 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. 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. Tobias et al., (2014) 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 ($P < 0.01$). [10] 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 of the study population is 7.67cm. [4] Reported lower values among the the Bangalees (7.1 ± 1.1 cm) and Santhals (7.0 ± 1.1 cm). The foot dimension in males and females in this study is comparatively larger than Caucasian values [13],[14],[15]. 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. [16] 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 [12].

Foot index in the present study were 37.21 ± 3.18 and 37.60 ± 2.64 for males and females respectively. [10] Reported a similar trend among Mauritius populations. However opposite findings were reported by different workers in different populations [3], [10], [18]. These could be due to environmental and genetic factors.

Foot shape was categorized according to foot index. In the present study, the proportion of broad foot was higher among the males (50.7%) than the females (23.0%) whereas slender and standard foot was higher among the females (21.5% & 55.3%) than the males (16.9% & 32.3%) respectively. The higher percentage of broad foot in males and slender and standard foot in females may be genetic and weight bearing functions among the male Ga'anda who are predominantly farmers and hunters. [19], [20] reported in their respective study that males have longer and broader feet than females for a given stature. Beside, [21] 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 Ga'anda people 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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