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Young Adult Female Upper Limb Dimensions of Hausa, Igbo and Yoruba in Nigeria

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ABSTRACT

Background: *Upper limb dimension and ethnic variation according to surface anatomical landmarks is applicable for personal identification and ethnic assumption in forensic medicine. The present study aimed to measure and evaluate a comprehensive reference of the upper limb anthropometric dimensions of young female Igbo, Hausa and Yoruba population in Nigeria.*

Method: *In this cross-sectional study, the anthropometric dimensions of the upper limb, including arm length, forearm length, arm span, elbow breadth and wrist breadth of 1500 Nigerian female young adults aged 16 - 34 years, were measured according to surface anatomical landmarks. We divided the collected measures into two categories for married (9.8%) and single (90%). Ethnic variation was carried out by comparing the mean value using ANOVA, the ethnic variations were validated according to the test group.*

Result: *All upper limb measurements were potent to determine ethnic differences, with mean values for the arm length for Hausa (35.24±0.12), Igbos (33.55±0.17) and Yoruba (31.85±0.16): forearm hand length for Hausa (35.24±0.12), Igbos (33.55±0.17) and Yoruba (31.85±0.16): arm span for Hausa (35.24±0.12), Igbos (33.55±0.17) and Yoruba (31.85±0.16): elbow breadth for Hausa (35.24±0.12), Igbos (33.55±0.17) and Yoruba (31.85±0.16): and wrist breadth for Hausa (35.24±0.12), Igbos (33.55±0.17) and Yoruba (31.85±0.16).*

Conclusion: *Ethnic differences of female the upper limbs dimension were observed, these findings can improve on the field forensic investigation and clinical trials.*

Keywords

Surface Anthropometric Measurements, Upper Limb, Ethnicity Nigeria.

Introduction

In medical sciences, anthropometry is essential in accessing health status, nutritional needs and growth pattern in individuals particularly pediatrics [1,2]. Overall, anthropometry serves as a foundational tool across disciplines, providing essential data that can inform practices, enhance understanding of human diversity, and aid in various applications from criminal justice to healthcare [3-5]. Its interdisciplinary relevance underscores the importance of human measurement in both practical and theoretical contexts [6]. The upper limb is an appendage attached to the axial part of the skeleton via the sternoclavicular joint. The upper limb is a highly specialized and complex structure that consists of mostly long bones, muscles, nerves and blood vessels. which work together to enable a wide range of movements and function [7]. The bones of the upper limbs are the clavicle, scapula, humerus, radius, ulna, carpals, metacarpals and phalanges.

Despite the knowledge from Anatomy of the detailed description

of the Human species, the place of variation in physique and measurements in different body parts in a wide range cannot be overlooked [8]. Humans evolved relatively recently, but with complex culture and technology they have been able to spread throughout the world and to occupy a wide range of environments. This resulted in species that are highly variable in physical appearance, despite their similar genetic identity. Variation and genetic composition can likely influence upper limb dimension during anthropometric evaluations among human species [9]. Studies have been carried out by various researchers to demonstrate the relationship between long bones and linear anthropometric parameters such as standing height and how they vary across different ethnic and racial groups, and regions [10-13]. This study will focus on the variations in upper limb dimensions among the Hausas, Ibos, and Yorubas will valuable on the relationship between physical characteristics and cultural, environmental, and occupational factors.

The Hausas are the largest ethnic group, primarily located in the Northern Region of Nigeria (found particularly in states like Kano, Katsina, Kaduna, Bornu, Sokoto etc). They are known for their rich cultural heritage and language (one of the widely spoken languages in Nigeria). The Hausas are mainly involved in trade and Agriculture [14]. The Yorubas are the second largest ethnic group in Nigeria, primarily located in South-Western Region particularly in states like Lagos, Ogun, Osun, Ondo etc. The Yoruba people are engaged in diverse economic activities, including agriculture, trade, and various industries [15].

The Ibos form the third largest ethnic group in Nigeria, located in states like Imo, Enugu, Anambra, Abia, Ebonyi [16]. The Igbo are known for their entrepreneurial spirit, engaging in commerce, trade, and agriculture. Many are involved in small businesses and markets, contributing significantly to Nigeria's economy.

This study rationale was to establish variations in the linear anthropometry of the upper limb amongst the three major ethnic groups in Nigeria. In this regard, this study therefore aimed at investigating and comparing the linear anthropometric upper limb features of young adult female Hausas, Ibos, and Yorubas of Nigeria and how they vary with those of other populations. This research will contribute to our knowledge of human diversity.

Materials And Methods

Study Design

This study was carried out in Imo state University, Owerri Imo state, Lead city University and Federal school of Statistics, Ibadan Oyo state and Yusuf Sule Maitama University Kano state all in Nigeria. Where natives of the three major tribes in Nigeria can be localized. A total of one thousand five hundred (1500) female subjects (500 subjects from each of the three major tribes in Nigeria).

Selection Criteria

Inclusion Criteria

Participants in the study were limited to those of Igbo, Yoruba and Hausa ancestry in their parents and grandparents and were free of any medical conditions or traumas that would have impacted the human morphology or stature under investigation. Additionally, to make sure that no hard tissue formation or changes were seen, the study only included participants who were between the ages of 18 and 40 and gave their consent.

Exclusion Criteria

The study eliminated subjects who were not of Igbo, Yoruba and Hausa heritage, did not meet the age requirements, had undergone surgery, or had physical characteristics that might have impacted their standing height or the human morphology under examination.

Method of Data Collection

The sociodemographic information for Nigeria's Igbo, Yoruba, and Hausa people was gathered by a semi-constructive descriptive questionnaire and in-person interview. This made sure the participants were healthy enough to take part in the study and that they fulfilled the inclusion requirements. Using a mega-size calliper and the proper anatomical markers, the arm length, forearm-hand length, elbow breadth, wrist breadth, and horizontal fingertip-reach were measured. The writers recorded and stored data readings.

Anthropometric landmarks

Upper limb measurements such as the arm length, forearm-hand length, elbow breadth, wrist breadth and horizontal fingertip reach were measured by same person to avoid inter- observer bias. Upper limb measurements were taken on the right side of each individual using a life size caliper that was designed and fabricated following a collaborative research between the Anatomy Department and Faculty of Engineering of the University of Port Harcourt, and a digital venier caliper.

Arm length

the subjects were asked to flex the elbow of the right arm parallel to the trunk and the distance from the tip of the shoulder to the Olecranon process of the Ulna bone was measured.

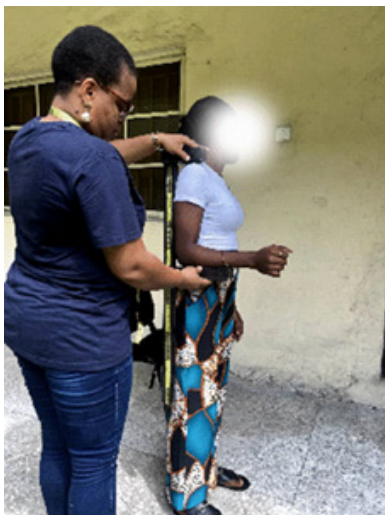

Figure 1: Showing measurement of arm length.

Horizontal Fingertip Reach or Upper Limb Length

This is the distance from the acromion to the fingertip with the elbow and wrist stretched. It was measured using a mega-size calliper.

Figure 2: Showing measurement of fingertip reach.

Fore-arm-hand length

was measured from the tip of the Olecranon process of the Ulna bone to the tip of the extended middle finger.

Figure 3: Showing measurement of forearm-hand length.

Elbow breadth

was measured using a digital caliper from the tip of the medial epicondyle of the humerus so that of the lateral epicondyle.

Wrist breadth

was measured with the digital caliper.

Figure 4: Showing the measurement of the wrist breadth.

Method of Data Analysis

Data analysis was done using an advanced computer program known as international business machine special package for social sciences (IBM SPSS) to calculate the mean, standard deviation of mean, and comparison between the ethnic groups was by means of one-way analysis of variance (ANOVA) and a Turkey's Post hoc test was done to ascertain at what point the variations were observed. The significance of the results between each two ethnic groups was tested using student's t-test (independent). 'P' value of less than 0.05 was considered significant.

Results

Table 1 demonstrates the distribution of samples by ethnic group as presented. Comparative study of the upper limb dimensions mean values using Anova showed a significant difference within the Hausa, Igbo and Yoruba tribes irrespective of their age. The Hausas have the largest stature and hand length among the three tribes while the Igbos have larger stature and hand length than Yorubas. The difference was significant in the Hausas when compared to Yorubas (p0.05). No difference was observed in hand breadth between the ethnic groups.

Table 2 demonstrates the distribution of samples by ethnic group as presented. Comparative study of the upper limb dimensions means values using ANOVA showed a significant difference within the Hausa, Igbo and Yoruba tribes irrespective of their age. The Hausas have the least mean value for Elbow breadth when compared to the Igbos and Yoruba. The difference was significant in the Hausas when compared to ($\rho<0.05$).

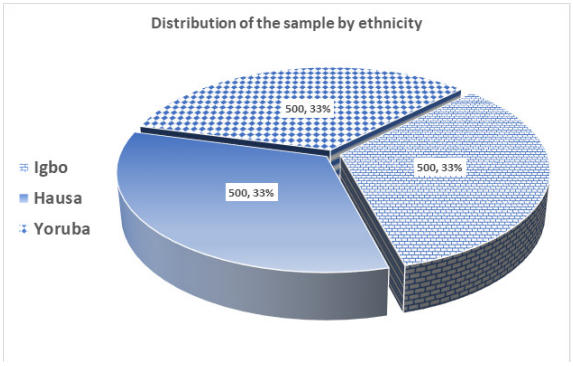

Figure 5: Distribution of the subjects by ethnicity.

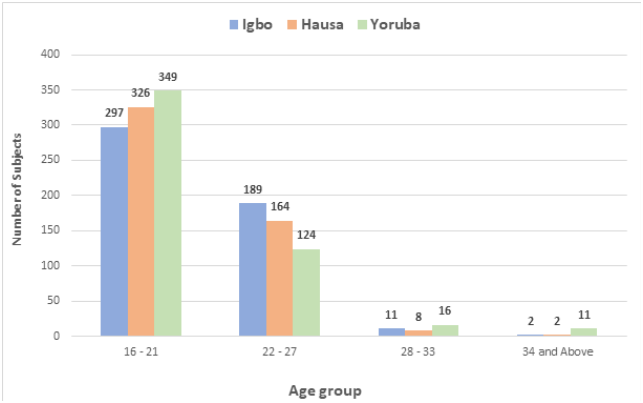

Figure 6: Distribution of the subjects by age category.

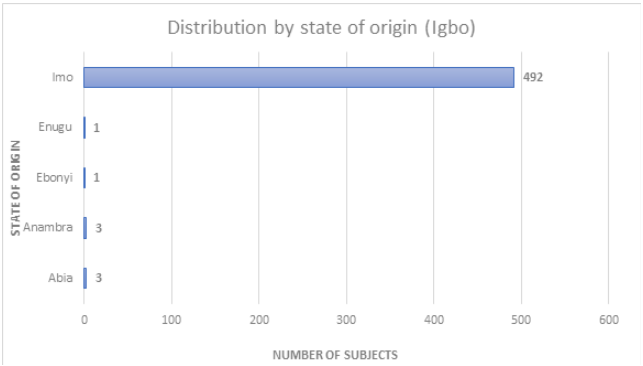

Figure 7: Distribution of the Igbo subjects by state of origin.

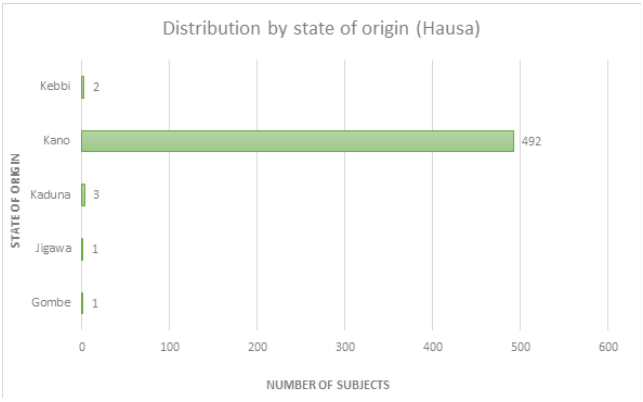

Figure 8: Distribution of the Hausa subjects by state of origin.

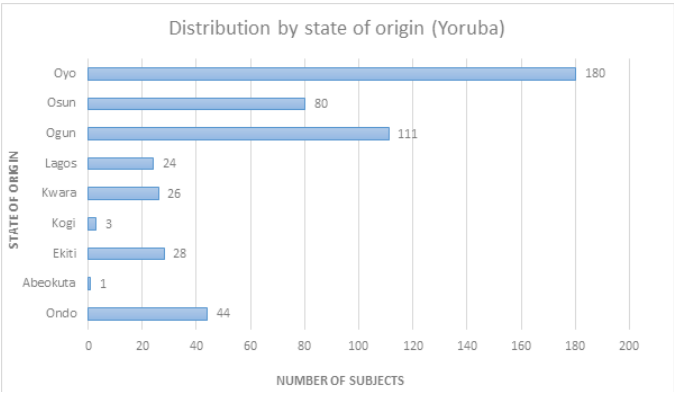

Figure 9: Distribution of the Yoruba subjects by state of origin.

Table 1: Sociodemographic characteristics of the study population.

Socio-demographic characteristics	Frequency (%)		
	Igbo	Hausa	Yoruba
Age (years)			
16 – 21	297 (59.5)	326 (65.2)	349 (69.8)
22 – 27	189 (37.9)	164 (32.8)	124 (24.8)
28 – 33	11 (2.2)	8 (1.6)	16 (3.2)
34 and above	2 (0.4)	2 (0.4)	11 (2.2)
Marital status			
Single	496 (99.2)	468 (93.6)	487 (97.4)
Married	4 (0.8)	32 (6.4)	13 (2.6)

Table 2: Female population For Upper Limb Parameters.

Ethnic	Hausa	Igbo	Yoruba	P-text	P value
Elbow breadth	19.66±0.07	21.17±0.13	21.74±0.10	94.44	**0.02**
Arm length	35.24±0.12	33.55±0.17	31.85±0.16	115.33	**0.00**
Forearm-hand length	45.59±0.13	50.24±1.02	45.20±0.18	21.29	**0.00**
Arm span	168.21±0.32	183.73±3.07	168.50±0.52	24.00	**0.00**
Wrist breath	4.98±0.01	5.85±0.17	5.00±0.01	23.96	**0.00**

Table 3: Tukeys HSD Post Hoc Test comparing the measured parameters according to ethnic group.

Dependent Variable	Ethnicity (I)	Ethnicity (J)	MD (I-J)	S.E.M	P-value
Arm length	Igbo	Hausa	-1.868	0.217	**0.000***
		Yoruba	1.634	0.217	**0.000***
	Hausa	Yoruba	3.502	0.217	**0.000***
Forearm-hand length	Igbo	Hausa	1.365	0.215	**0.000***
		Yoruba	1.804	0.215	**0.000***
	Hausa	Yoruba	0.439	0.215	0.103
Arm span	Igbo	Hausa	3.808	0.536	**0.000***
		Yoruba	3.190	0.536	**0.000***
	Hausa	Igbo	-3.808	0.536	**0.000***
Elbow breadth	Igbo	Hausa	0.267	0.104	**0.028***
		Yoruba	0.048	0.104	0.890
	Hausa	Yoruba	-0.219	0.104	0.088
Wrist breath	Igbo	Hausa	0.130	0.024	**0.000***
		Yoruba	0.112	0.024	**0.000***
	Hausa	Yoruba	-0.018	0.024	0.737

Discussion

Peoples are distinguished on the basis of common origin; on whether they were living or had lived together in certain defined regions and had possessed different characteristic features in their appearance. Variations observed in different races and groups could be due to certain factors such as biological, environmental, nutritional, geographical, and social among others [17].

Our results demonstrates dimensions of the upper limb viz, arm length, forearm-hand length, wrist breadth and elbow breadth, using standardized anatomical landmarks among the Hausas, Ibos and Yorubas which are the three major tribes in Nigeria. The application of anthropometry is very vital in the fields of ergonomics, medicine, research and other industries. In the present study, all measured body parts showed significant difference among the three ethnic groups that were studied.

Forearm length with mean value 45.59±0.13 for Hausa, 50.24±1.02 for Igbo and 45.20±0.18 for Yoruba displayed a significant difference within the Igbo and Hausa and within the Igbo and Yoruba, but there was no difference between the Hausa and Yoruba in this evaluation. Based on literature the Hausa and Yoruba shares common traits and cultural involvement, the forearm dimension of both tribes.

According to Ahmed, [18] on Sudanese adults, forearm length with surface anthropometric landmarks was the most reliable to differentiate tribes with 78.5 and 89.5% accuracy among the four main upper limb dimensions, which was similar to our study. On the other hand, Barrier and L'Abbe, [19] reported the correlation between forearm bones length and the modern South African osteological evaluation. They concluded a significant relationship between forearm bone lengths shows ethnic variation with an accuracy of 76 to 86%. In addition, Celbis and Agritmis, [20] in a Turkish corpse sample showed that forearm bones length provides ethnic variation with an estimation accuracy of 96% by discriminant function analysis.

In our study, Arm span had a mean value of 168.21±0.32 for Hausa, 183.73±3.07 for Igbos and 168.50±0.52 for Yoruba with significant difference within and amongst the three tribes. These results agreed with Karadayi et al. [21] that evaluated the relationship between surface arm dimensions and ethnicity of the Turkish population using discriminant function analysis which reported an accuracy of 83.4% with arm span. Also, Dey and Kapoor, [22] revealed that in arm surface dimensions, arm span (accuracy 80 - 83%) was a better ethnic predictor (accuracy 77 - 80%) especially with people that does throwing exercise. Moreover, based on Krishan et al. [23] in the north Indian population, the arm span surface dimension was more correlated with ethnicity. Nevertheless, Jayanth et al., [24] in the South Indian population, reported contrary results showing that hand length is more valuable than arm span for ethnic variation. Indeed, various body parts show various variations between populations and even within populations; hence, surface landmarks, tools, and methods of evaluation must be regarded as potential causes [25].

The present study showed ethnic variation with a mean value of 35.24±0.12 for Hausa, 33.55±0.17 for Igbos and 31.85±0.16 for Yoruba arm length, which aligns with the findings of Ahmed [18] in a Sudanese population with an accuracy of 77.5 - 78.5% prediction of ethnic variants of the arm length. However, according to Ali and Abd Elbaky, [26] arm length shows an acceptable accuracy (93.3%) dissected Egyptian cadavers. Differences in cadaver and live persons' surface anthropometric dimensions are usual, especially across nations.

However, there is shorter length in females due to high estrogen levels during puberty, which leads to earlier stopping of bone growth [27]. Also, in the study of a southern Nigerian population, arm length indicated a higher regression coefficient than ulnar length in ethnic variation [28].

The elbow breadth showed significant only with Igbo and Hausa when compared while the Yoruba and Hausa was not significant while wrist breadth although showed significant differences within Igbo and Hausa and Igbo and Yoruba indicates that this tribe share common craftsmanship, compared among the three ethnic groups, these observed variations as earlier stated were minimal compared to the marked variation seen on comparison with the caucasoid race.

Conclusion

There are inadequate data on surface anthropometric body dimensions of Nigerians especially the Igbos Yoruba and Hausa on some limb dimensions. Also, previous studies focused dominantly on radiological and osteological aspects of body segments or specific limb dimensions, focusing on stature estimation. The present study measured main upper limb surface anthropometric dimensions to detect ethnic variations amongst the Igbos, Yoruba and Hausa population.

Based on our results it is shown that upper limb dimension has some level of accuracy for ethnic variation and comparison.

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