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Girth Anthropometric Variation: a cross-sectional study between Hausa, Igbo, and Yoruba ethnic groups of Nigeria

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ABSTRACT

Girth anthropometry involves measuring the circumferences of various body parts, including the neck, upper arm, chest, mid-thigh, waist, and hips. These measurements are essential in numerous fields, impacting health, fitness, fashion, and forensic investigations. The study aims to evaluate grith anthropometric variation between the Hausa, Igbo and Yoruba ethnic groups of Nigeria. The study adopted a cross-sectional descriptive study design where it comprised 1500 subjects (500 Hausa, 500 Igbo and 500 Yoruba) between 18-40 years. The subjects were sampled using a multi-stage random sampling technique and the minimum sample size was determined using Taro Yamane. The data were collected using a non-stretchable measuring tape and the data obtained were analyzed using IBM SPSS version 25. T-test and ANOVA were used as inferential statistics. The analysis of sex-related differences in girth anthropometry among the Hausa, Igbo, and Yoruba ethnic groups in Nigeria reveals that males generally have higher mean values than females in various body measurements. Significant differences were found in neck and mid-arm circumferences for the Hausa ethnic group, while the Igbo ethnic group showed significant differences only in neck circumference. The Yoruba group exhibited significant differences in neck, mid-arm, chest, hip, and mid-thigh circumferences. Ethnic variations in girth measurements were observed among both males and females across all three groups. The study found noticeable sex-and ethnic-related differences in girth anthropometry among the Hausa, Igbo, and Yoruba ethnic groups in Nigeria. The findings will have health, forensic, and industrial implications.

Keywords: anthropometry, health, forensic investigation, Hausa, Igbo and Yoruba

INTRODUCTION

Girth anthropometry is referred to as the circumferential measurements of the human body such as the neck, upper arm, chest, midthigh, waist and hip circumferences ¹. These measurements play a crucial role in many disciplines and different areas of our lives, from health, fitness and fashion to forensic investigations². The measurements help understand body fat distribution and assess the risk of obesity-related health issues, giving valuable insights into our nutritional status and tracking changes over time ^{3,4}. It is further, important in studying human physical variation in research settings. Which in turn reveals differences in body composition across various ages and genders, informing tailored health interventions.

In our society today, factors such as diet, lifestyle, cultural practices, environment, and so on are said to influence body composition, but the question remains: Are these factors affecting us negatively? Are they trends in our body morphology or do we need a health intervention? However, studies have tried to answer these questions in their studies by evaluating anthropometric variables across various population ⁵⁻¹⁷ but there are gaps in the literature in our country Nigeria. The comparison of the grith anthropometry among the three major tribes has not been explored greatly, to this effect, the importance is under mind because girth anthropometry is a vast area that crosses various disciplines and there is always a need for reevaluations to remain current and relevant.

The study aims to evaluate the girth anthropometry between the Hausa, Igbo and Yoruba ethnic groups of Nigeria exploring the sex and ethnic-related differences.

MATERIALS AND METHODS

Study design

Our study adopted a cross-sectional descriptive study design to generate girth anthropometric variables of Hausa, Igbo, and Yoruba ethnic groups of Nigeria using a quantitative research approach. The study comprised one thousand five hundred subjects (500 Hausa, 500 Igbo and 500 Yoruba) between the age of 18-40 years. A multi-stage random sampling technique was used to recruit the subjects without being biased and the minimum sample size was calculated independently across the different ethnic groups studied.

Selection criteria

The study recruits' subjects of the same origin (paternal and maternal same origin) between the ages of 18-40 years among the Hausa, Igbo, and Yoruba ethnic groups of Nigeria and subjects aside the studied age (18-40 years) parents and grandparents are of the same origin are excluded from the study.

Method of data collection

Anthropometric data were collected using the international standardized methods, semistructured questionnaires were administered to every subject to gather the socio-demography of the study and the girth anthropometric values measured using a non-stretchable were measuring following the standard tape anatomical landmarks of the measurements.

The anatomical landmarks and their measurement are as follows;

Chest circumference: this is the region corresponding to the nipples - the xiphoid process. To measure chest circumference, the subject stands with arms relaxed at their sides. A measuring tape is placed horizontally across the chest at the level of the nipples (near the xiphoid process). The tape is positioned on the right side, passed around the back, and brought to the starting point. The measurement is recorded to the nearest 0.1 cm while the subject maintains minimal respiration.



Figure 1 measurement of chest circumferences (David, 2001)

Waist circumference: this is the region corresponding to the superior iliac crest and then crossing the line to indicate. For waist circumference measurement, the subject stands, and a measuring tape is placed horizontally around the waist at the level of the superior iliac crest, crossing the mid-axillary line. Starting from the right side, the tape is wrapped around the trunk, ensuring it remains level, and snug, and not compress the skin. The measurement is recorded to the nearest 0.1 cm with the subject maintaining minimal respiration.



Figure 2 Measurement of waist circumferences (David, 2021)

Hip circumference: this is the area corresponding to the inguinal region, the area relating to the groin (the area between the abdomen and thigh). To measure the inguinal

region (groin area), the subject stands upright with feet together, distributing weight evenly. The measuring tape is positioned at the groin area between the abdomen and thigh, and adjusted to ensure a horizontal alignment. The zero end of the tape is placed below the measurement point, held snugly but not tight. The measurement is taken from the right side and recorded.



Figure 3 Measurement of the hip circumference (field survey)

Mid-thigh circumference: this is the midpoint between the femoral greater tubercle and femoral lateral epicondyle to measure thigh circumference, the subject stands with the right leg slightly in front of the left, shifting weight to the left leg for stability. A table may be used for balance. The measuring tape is placed around the middle of the thigh on the inner side, positioned perpendicular to the thigh's length, with the zero end below the measurement value. The tape should be firm but not compress the skin. The measurement is taken to the nearest 0.1 cm and recorded.

Mid-arm circumference: this is the distance between the acromion of the scapula and the olecranon process of the ulna. To measure upper arm circumference, the subject stands with their right arm relaxed and hanging freely at their side. The measuring tape is wrapped around the mid-upper arm, perpendicular to its length, with the zero end positioned below the measurement value. The tape should rest gently on the skin without compressing it. The measurement is recorded to the nearest 0.1 cm.

Method of instrument and data reliability

The reliability of the instruments tested and the data consistency was further determined using Cronbach alpha and the output shows that the data produced is reproducible and consistent.

Method of data analysis

The data obtained was subjected to statistical analysis using the International Business Machine of Statistical Package for Social Science (IBM SPSS version 23) results were presented as mean \pm Standard deviation. An Independent T-test was used as an inferential statistic to compare sex and ethnic variation was tested using ANOVA. A probability less than 0.05 was considered statistically significant and 95% was denoted as a confidence level.

RESULTS

The descriptive statistics for the Hausa ethnic group and the findings present that the mean value for neck circumference was 31.95 ± 3.22 , mid-arm circumference 24.83 ± 3.19 , chest circumference was 82.42 ± 6.72 , waist circumference 70.97 ±8.46 , hip circumference 87.46 ± 7.10 and mid-thigh circumference was 44.55 ± 5.47 (Table 1).

Table 2 shows the descriptive statistics for the Igbo ethnic group in Nigeria and the findings present that the mean value for neck circumference 34.28±3.89. mid-arm was circumference was 28.85 ± 8.55 . chest circumference 87.82±8.89, waist circumference 77.86±26.94, circumference was hip 95.49±26.35, mid-thigh circumference was 51.76±7.02.

Table 3 shows the descriptive statistics for the Yoruba ethnic group of Nigeria and the findings present that the mean value of neck circumference 33.47±9.47, was mid-arm circumference 27.35 ± 8.55 . chest was circumference 86.26±24.78, was waist circumference 73.61±10.52, hip circumference 93.17±31.21, and mid-thigh circumference 50.10±7.76.

The sex-related difference in the girth anthropometry among the Hausa ethnic group of Nigeria the finding presents that males had a higher mean value in males compared to females and it was observed that neck circumference and mid-arm circumference were observed to be statistically significant with sex (p<0.05) (Table 4).

Table 5 shows the sex-related differences in girth anthropometry among the Igbo ethnic group of Nigeria and the finding present that males had a higher mean value compared to females and it was observed that only neck circumference was statistically significant with sex (p<0.05).

Table 6 shows the sex-related difference in girth anthropometry among the Yoruba ethnic group and the findings present that the males had a higher mean value compared to females and it was observed me neck, mid-arm, chest, hip, and mid-thigh circumferences were statistically significant (p<0.05).

Table 7 shows ethnic variation in girth anthropometry between the Hausa, Igbo, and Yoruba ethnic groups of Nigeria and the findings present that there were ethnic variations in neck, mid-arm, chest, waist, hip, and mid-thigh circumference among the male population of Nigeria and Table 8 shows the ethnic variation between the Hausa, Igbo, and Yoruba female and it was that there were ethnic variations in neck, mid-arm, chest, waist, hip and mid-thigh circumference among the male population of Nigeria.

	Range	Min	Max	Mean	SEM	SD
Neck circumference	33.00	23.00	56.00	31.95	0.10	3.22
Mid-arm circumference	21.50	18.00	39.50	24.83	0.10	3.19
Chest circumference	60.00	56.00	116.00	82.42	0.21	6.72
Waist circumference	68.50	34.50	103.00	70.97	0.26	8.46
Hip circumference	85.00	43.00	128.00	87.46	0.22	7.10
Mid-thigh circumference	38.00	30.00	68.00	44.55	0.17	5.47

Table 1:Descriptive Statistics of girth anthropometry for Hausa

Min=minimum, max=maximum, SEM=Standard Error of Mean, SD=Standard Deviation

Table 2:	Descriptive Statistics of girth anthropometry for Igbo
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	Range	Min	Max	Mean	SEM	SD
Neck circumference	68.10	20.50	88.60	34.28	0.11	3.86
Mid arm circumference	231.70	2.00	233.70	28.85	0.26	8.55
Chest circumference	102.30	20.50	122.80	87.82	0.27	8.89
Waist circumference	874.10	17.00	891.10	77.86	0.83	26.94
Hip circumference	848.00	40.00	888.00	95.49	0.81	26.35
Mid-thigh circumference	81.00	18.00	99.00	51.76	0.21	7.02

Min=minimum, max=maximum, SEM=Standard Error of Mean, SD=Standard Deviation

Table 3: Descriptive Statistics of girth anthropometry for Yoruba

	Range	Min	Max	Mean	SEM	SD
Neck circumference	291.10	20.00	311.10	33.47	0.29	9.47
Mid arm circumference	215.60	19.40	235.00	27.35	0.26	8.55
Chest circumference	818.50	6.50	825.00	86.26	0.76	24.78
Waist circumference	192.00	7.00	199.00	73.61	0.32	10.52
Hip circumference	1013.00	42.00	1055.00	93.17	0.96	31.24
Mid-thigh circumference	119.20	24.80	144.00	50.10	0.24	7.76

Min=minimum, max=maximum, SEM=Standard Error of Mean, SD=Standard Deviation

	MALE	FEMALE	T-test	p-value	inference
Neck circumference	34.12±0.11	29.80±0.09	28.59	0.00	S
Mid-arm circumference	25.72±0.12	23.95±014	9.16	0.00	S
Chest circumference	82.56±0.27	82.28±0.32	0.66	0.50	NS
Waist circumference	71.24±0.32	70.71±0.41	0.98	0.32	NS
Hip circumference	87.12±0.30	87.80±0.32	-1.53	0.12	NS
Mid-thigh circumference	44.40±0.20	44.70±0.27	-0.85	0.39	NS

 Table 4:
 Sex Differences of Girth Anthropometry Among Hausa Ethnic Group

S=significant (p<0.05), NS=non-significant (p>0.05)

Table 5: Sex Differences of Girth Anthropometry among Igbo Ethnic Group

	MALE	FEMALE	T-test	p-value	inference
Neck circumference	33.61±0.17	34.99±0.15	-5.87	0.00	S
Mid-arm circumference	$28.82{\pm}0.46$	28.89±0.24	-0.13	0.89	NS
Chest circumference	88.01±0.41	87.61±0.35	0.73	0.46	NS
Waist circumference	78.51±1.57	77.16±0.43	0.80	0.41	NS
Hip circumference	96.99±1.54	93.90±0.36	1.89	0.05	NS
Mid-thigh circumference	51.97±0.32	51.53±0.28	1.00	0.31	NS

S=significant (p<0.05), NS=non-significant (p>0.05)

Table 6: Sex Differences Girth Anthropometry among Yoruba Ethnic Group

Male	Female	T -text	p-value	Inference
35.03±0.15	31.92±0.55	5.37	0.00	S
27.95 ± 0.45	26.76±0.26	2.24	0.02	S
84.61±0.34	$87.90{\pm}1.49$	-2.14	0.03	S
73.30±0.38	73.92±0.52	-0.94	0.34	NS
89.79±0.34	96.54±1.89	-3.50	0.00	S
48.34±0.35	51.85±0.31	-7.47	0.00	S
	Male 35.03±0.15 27.95±0.45 84.61±0.34 73.30±0.38 89.79±0.34 48.34±0.35	MaleFemale35.03±0.1531.92±0.5527.95±0.4526.76±0.2684.61±0.3487.90±1.4973.30±0.3873.92±0.5289.79±0.3496.54±1.8948.34±0.3551.85±0.31	MaleFemaleT -text35.03±0.1531.92±0.555.3727.95±0.4526.76±0.262.2484.61±0.3487.90±1.49-2.1473.30±0.3873.92±0.52-0.9489.79±0.3496.54±1.89-3.5048.34±0.3551.85±0.31-7.47	MaleFemaleT -textp-value35.03±0.1531.92±0.555.370.0027.95±0.4526.76±0.262.240.0284.61±0.3487.90±1.49-2.140.0373.30±0.3873.92±0.52-0.940.3489.79±0.3496.54±1.89-3.500.0048.34±0.3551.85±0.31-7.470.00

S=significant (p<0.05), NS=non-significant (p>0.05)

Ethnic	Hausa	Igbo	Yoruba	F	p-value	inference
Neck circumference	34.12±0.11	33.61±0.17	35.03±0.15	23.15	0.00	S
Mid-arm circumference	25.72±0.12	28.82±0.46	27.95±0.45	16.75	0.00	S
Chest circumference	82.56±0.27	88.01±0.41	84.61±0.34	61.40	0.00	S
Waist circumference	71.24±0.32	78.51±1.57	73.30±0.38	14.73	0.00	S
Hip circumference	87.12±0.30	96.99±1.54	89.79±0.34	28.59	0.00	S
Mid-thigh circumference	44.40±0.20	51.97±0.32	48.34±0.35	155.83	0.00	S

 Table 7:
 Ethnic Variations of Girth Anthropometry among the Male Population

S=*significant* (*p*<0.05)

Table 8:	Ethnic Variations of Girth Anthropometry among the Female Population
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	Hausa	Ισho	Voruba	P-text	Р	Inference
	IIuusu	1500	101404	і селе	value	
Neck circumference	29.80±0.09	34.99±0.15	31.92±0.55	57.19	0.00	S
Mid-arm circumference	23.95±0.14	28.89±0.24	26.76±0.26	120.84	0.00	S
Chest circumference	82.28±0.32	87.61±0.35	87.90±1.49	11.84	0.00	S
Waist circumference	70.71±0.41	77.18±0.43	73.92±0.52	48.24	0.00	S
Hip circumference	87.80±0.32	93.93±0.36	96.54±1.89	15.30	0.00	S

S=significant (p<0.05)

DISCUSSION

The body measurements among the Hausa, Igbo, and Yoruba ethnic groups in Nigeria have shown noticeable differences in the girth anthropometry where the Igbo data were observed to have a higher mean value as compared to Hausa and Yoruba. These differences highlight the unique body dimension among the Hausa, Igbo, and Yoruba groups, and stand as a standard model for industrial and prostatic design.

This study presents clear differences in body measurements between males and females among the Hausa, Igbo, and Yoruba ethnic groups in Nigeria. Specifically, males

generally have larger circumferences than females in certain areas. For the Hausa group, neck and mid-arm circumferences stood out as significantly different between sexes, while for the Igbo, only neck circumference showed a notable difference. The Yoruba group, however, had a wider range of significant differences, including neck, mid-arm, chest, hip, and mid-thigh circumferences. These variations could be influenced by factors like lifestyle, genetics, and dietary habits, all of which impact body shape and fat distribution. However, hormonal influence could also be attributed to the variations observed because males tend to have higher testosterone levels which promote muscle growth, reduce body fat and increase bone density but in females, estrogen tends to encourage fat storage around the hip region.

When comparing these findings to a study by Oghenemavwe *et al.*¹ which examined neck and waist circumferences in overweight and obese Nigerians, we see that measurements like neck circumference are valuable indicators of body composition and health. The study by Oghenemavwe and co also found higher average values in neck and waist circumferences for males, consistent with our findings. Additionally, research from Hingorjo et al.²⁰ highlighted neck circumferences as a reliable obesity marker, strongly linked to BMI and waist circumference, suggesting it can be a practical, simple metric for assessing obesity risks across different groups.

Other studies, like those by Rufa'i *et al.* ²¹ and McCarthy ²², emphasize the importance of waist and hip measurements for assessing central body fat and metabolic health risks. These studies reinforce the trend of larger circumferences in males, likely due to higher muscle mass and different fat distribution patterns compared to females. Similarly, Moura *et al.* ²³ observed that waist circumference typically increases with age, while neck circumference remains more consistent, which might explain why the Yoruba group shows more varied girth differences. This could reflect variations in lifestyle and age within the group.

The differences in body measurements among the Hausa, Igbo, and Yoruba ethnic groups, particularly in the neck, mid-arm, chest, waist, hip, and mid-thigh circumferences. For males and females, these variations likely reflect genetic factors, lifestyle, and environmental influences, including diet and physical activity. Cultural and biological influences could also be attributed to the variation in ethnic girth anthropometry. Oghenemavwe *et al.*¹⁹ provide support for these findings by exploring the relationship between neck and waist circumferences among overweight and obese Nigerians.

21 Rufa'i et al. emphasize waist circumference and waist-to-hip ratio (WHR) as indicators of central adiposity, especially in Nigerian female undergraduates. They identified a strong link between BMI, waist circumference, and WHR, which aligns with this study's findings on waist and hip variations among females. These measures are thus valuable for assessing obesity risk, with ethnicity and lifestyle likely influencing these variations.

However, studies by Hingorjo et al. 20 and McCarthy ²² highlight the significance of neck and waist circumferences for screening obesity and metabolic syndrome risk. Hingorjo et al.²⁰ observed a strong correlation between neck circumference, BMI, and waist circumference, suggesting neck circumference as a simple screening tool for obesity. This aligns with this study's findings, where ethnic variations in neck circumference could serve as a low-cost obesity risk indicator. McCarthy emphasizes waist circumference as a key marker of abdominal fat and related health risks, further pointing to the need to consider ethnic differences in these measurements.

These findings highlight how crucial regional body measurements are for assessing health risks, especially among Nigeria's diverse ethnic groups. Recognizing these differences can pave the way for more personalized health evaluations. Together, these studies reinforce the importance of specific girth measurements in health assessments and the necessity of tailoring anthropometric evaluations to capture the unique characteristics of Nigeria's varied ethnic backgrounds.

CONCLUSION

The study revealed that there was observable sex related difference in girth anthropometry across the various ethnic groups (Hausa, Igbo and Yoruba), however, the girth anthropometric variables studied showed ethnic variation between the Hausa, Igbo and Yoruba ethnic group of Nigeria exploring cultural, environmental, dietary, lifestyle and genetic influences that could possibly attribute the differences.

Consent

As per international standard or university standard, respondents' written consent has been collected and preserved by the Author(s).

Ethical approval

The study was approved by the ethical research committee of the University of Port-Harcourt, Port-Harcourt, Nigeria.

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Competing interests

The authors have declared that no competing interests exist.

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