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Circumferential Body Anthropometry of Igbos of Southern Nigeria

¹Okoh, PD and ²Didia BC

¹Department of Surgery, Faculty of Clinical Sciences, University of Port Harcourt Teaching Hospital, Port Harcourt, Nigeria.

²Department of Anatomy, Faculty of Basic Medical Sciences, College of Health Science, University of Port Harcourt, Port Harcourt, Nigeria.

Corresponding Author: Okoh, PD

E-mail: peterdoneokoh56@gmail.com; +2348036750996

ABSTRACT The concept of anatomical modelling was brought to the fore as a result of difficulty in procurement and preservation of cadavers and the attendant overcrowding in dissecting rooms, variations present in cadaveric specimen and the need to learn layout to recreate common surgical operations. This study aimed investigating the circumferential anthropometric body characteristics of adult male Igbos of southern Nigeria for the reconstruction of three-dimensional negroid gross anatomical model. The research design was a non-experimental, cross-sectional design. A total number of four hundred (400) subjects whose ages ranged between 21 to 40 years with BMI of 18.50 to <30.00 were used. Minimum sample size was determined using the Taro Yamane's formula. Circumferential body anthropometric measurements and BMI were taken using standiometer, digital callipers, calibrated flexible meter tape and weighting scale. Statistical analysis was done using statistical package for the social science (SPSS version 25.0) and Microsoft Excel 2019. Continuous variables were presented as mean \pm SD; minimum and maximum. Age was categorized into two groups (21 – 30 and 31 – 40) years while Body Mass Index (BMI) was also categorized into two; normal weight (18.5 – 24.9 designated 25.0) and slightly overweight (25.0 – 30.7 designated 25.0). Independent sample t-test was therefore carried out to determine significant difference in the measured anthropometric parameters according to age. The confidence interval was set at 95%, therefore $p < 0.05$ was considered significant. Results were presented in tables. Age related changes and variations in BMI were also observed in the anthropometric parameters. On comparison with other racial populations, certain parameters were close while others varied greatly which underscores racial variation. These anthropometric values will be useful in the standardization of negroid gross anatomical models for medical studies and forensics.

Key Words: Circumferential, Whole body, Gross, Anatomical Modelling, Igbo, Negroid

INTRODUCTION

Most anthropologists recognize that there are four major race classifications in the world, which include Caucasian, Mongoloid or Asian, Negroid and Australoid. The Igbo which is a negroid race^[1], are an ethnic group of southern Nigeria directly indigenous to East and West of the lower Niger River, with very significant population found in the eastern side of the river^[2]. They speak Igbo, which includes various Igbo languages and dialects^[3,4]. Igbo people are one of the largest ethnic groups in Africa^[5]. Anatomical Modeling is the production of three-dimensional representation of the human body using design from different materials. The concept was brought to the fore due to difficulty in obtaining and preserving cadavers and the attendant overcrowding in dissecting rooms, variations present in cadaveric specimen and the need to learn layout to recreate common surgical operations^[6]. Although human anatomy describes the structure of the body as observed in most people and has traditional value in surgery, there exists a wide range of ethnic and racial variation in the physical appearance and body proportions of different populations^[7]. These

anatomical variations are observed when dissecting or inspecting prosected specimens and could leave medical students confused. To this end, anatomical models have found use in the study of Human Anatomy, and they come in various forms. Variation in human features exists across populations, and study of this physical variation relies on external measurements of the human body. Anthropometric measurements have been adopted as methods in clinical and public health works, as they are applicable to large samples and can provide national estimates and data for the analysis of secular changes^[8]. Having in mind these racial variations that exist in human anthropometry, a purposeful search for an alternative method of teaching Gross Anatomy in our medical schools in Nigeria to complement the use of cadaver became necessary.

MATERIALS AND METHODS

Research Design: The research design was a non-experimental, cross-sectional design which catalogued values of the circumferential anthropometric body features of adult male Igbos of southern Nigeria using anthropometric standards for the reconstruction of a three – dimensional negroid gross anatomical

modelling.

Sample Size and Sampling Technique: Subjects were randomly selected from amongst adult male Igbos resident in Owerri, Mbaitoli, Orlu and Okigwe in Imo State. A total number of four hundred (400) participants were used. The minimum sample size was determined using the Taro Yamane's formula which states that:

$$n = \frac{N}{1+N(e)^2} \quad \text{where } n = \text{minimum sample size, } N = \text{population size, } e = \text{error margin} = 0.05$$

Only adult males between the ages of 21 and 40 years with BMI of 18.50 to <30.00 were included in this study. It was ascertained that recruited subjects had both parents and four grand parents from the same ethnic group.

Exclusion criteria included factors that might affect the outcome of the measurements.

Ethical Considerations: Ethical clearance was sought and obtained from the Ethics Committee of the College of Health Sciences, University of Port Harcourt. Informed consent was obtained from all subjects.

Method: The study employed circumferential body anthropometric measurements. Using the appropriate landmarks, the following circumferential measurements were taken Midarm Circumference, Chest Circumference, Abdominal (Waist) Circumference, Hip Circumference and Midthigh Circumference. Measurements were taken with the aid of standiometer, digital callipers, calibrated flexible meter tape, meter rule and weighing scale.

Before each subject was measured, Body Mass Index (BMI) of the individual was taken. This was done by collecting weight of the subject using a weighing scale, and meter rule, to determine the height.

BMI is calculated thus;

$$BMI = \frac{\text{weight (kg)}}{\text{height}^2 (\text{m}^2)}$$

Identification of landmarks

Mid-arm circumference: This is the point between the acromion process of scapula and olecranon process of ulna.

Chest circumference: This is the region corresponding to the nipples - the xiphoid process.

Waist circumference: This is the region, corresponding to the superior iliac crest and then crosses the line to indicate the mid-axillary line of the body.

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

Thigh circumference: This is the mid-point between the greater tubercle of femur and the lateral epicondyle of the femur.

Data collection method: The following procedures describe how to set up the anthropometric measurements for each of the parameters:

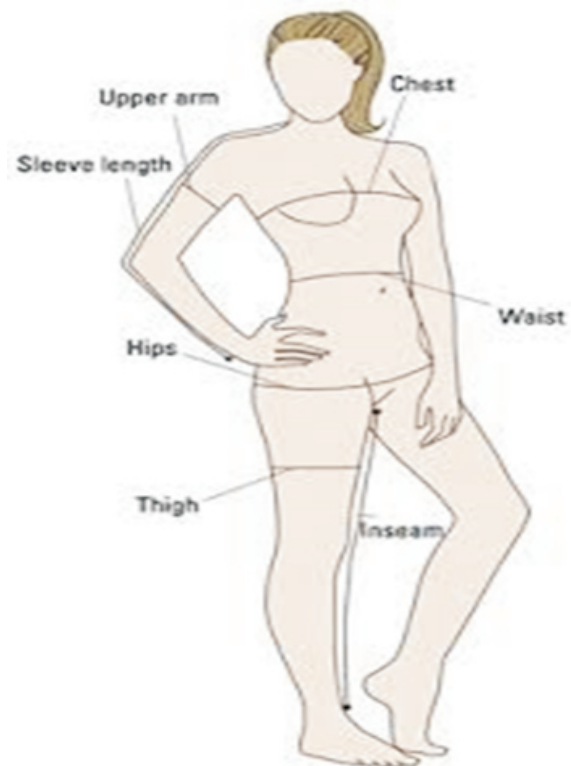


Figure 1: Circumferential landmarks

Upper arm circumference: The subject stands with the elbow relaxed so that the right arm hangs freely to the side. The measuring tape is placed around the mid-upper arm at the point perpendicular to the long axis of the upper arm (at the medial part of the mid-arm).

The tape is held so the zero end is held below the measuring value.

The tape rests on the skin surface but not pulled tight enough to compress the skin.

The upper arm circumference is recorded to the nearest 0.1 cm.

Chest circumference: The subject stays in a standing position with both hands spread side by side. The measuring tape is placed horizontally at the medial part of the chest (the region corresponding to the nipples - the xiphoid process).

The measuring tape is then placed at the right side and passed round through the back and back to the starting point.

The chest circumference is then carried out with minimal respiration to the nearest 0.1 cm and recorded.



Figure 2: Measurement chest circumference

Waist circumference: The subject stays in a standing position. The measuring tape is placed horizontally at the waist region, corresponding to the superior iliac crest and then crosses the line to indicate the mid axillary line of the body.

The measuring tape is placed at the right side around the trunk in a horizontal plane at this level marked on the right side of the trunk.

The measuring tape is then carried around the subject to make sure the tape is parallel and ensure the tape is snug but not compressing the skin.

The measurement is then carried out at minimal respiration to the nearest 0.1 cm and recorded.

Hip circumference: The Subject stands erect with feet together and weight evenly distributed on both feet. The measuring tape is placed at the inguinal region, the area relating to the groin (the area between the abdomen and thigh).

The sides of the tape are then adjusted and the front side is checked to ensure that the plane of the tape is horizontal.

The zero end of the tape is then held under the measurement value.

The tape is held snug but not tight.

Measurement is then taken from the right side and recorded.



Figure 3: Measurement of hip circumference

Mid-thigh circumference: The subject stands with the right leg just in front of the left leg and the weight shifted back to the left leg.

A table may be used to maintain the subject's balance.

The measuring tape is placed around the medial part of the mid-thigh, the tape is positioned perpendicular to the long axis of the thigh with the zero end of the tape held below the measuring value.

The tape rests firmly on the skin without compressing the skin and ensured the tape is placed correctly.

The thigh circumference is then carried out to the nearest 0.1 cm and recorded.

Statistical Analysis: Statistical analysis was done using statistical package for the social science (SPSS version 25.0) and Microsoft Excel 2019. Continuous variables were presented as mean \pm SD; minimum and maximum. Age was categorized into two groups (21 – 30 and 31 – 40) years while Body Mass Index (BMI) was also categorized into two; normal weight (18.5 – 24.9 designated ≤ 25.0) and slightly overweight (25.0 – 30.7 designated > 25.0). Independent sample t-test was therefore carried to determine significant difference in the measured anthropometric parameters according to age. The confidence interval was set at 95%, therefore $p < 0.05$ was considered significant.

RESULTS

Table 1: Descriptive statistics of the measured circumferential body measurements (cm)

Circumferential body measurements	[N = 400]		
	Mean \pm SD	Min	Max
BMI (Kg/m ²)	23.98 \pm 3.50	18.50	30.00
Age (years)	25.00 \pm 4.54	21.00	40.00
MAC	28.22 \pm 2.95	24.10	36.15
CC	94.25 \pm 6.58	83.39	115.70
WC	94.47 \pm 3.24	88.72	101.20
HC	95.00 \pm 4.19	86.50	103.50
MTC	53.13 \pm 3.61	47.90	61.40

MAC = Mid arm circumference, CC = Chest circumference, WC = Waist circumference, HC = Hip circumference, MTC = Midthigh circumference, SD = Standard deviation, Min = Minimum, Max = Maximum

Table 1 shows that the mean mid arm circumference (MAC) was 28.22 \pm 2.95, chest circumference (CC) 94.25 \pm 6.58, waist circumference (WC) 94.47 \pm 3.24, hip circumference (HC) 95.00 \pm 4.19 and mid-thigh circumference (MTC) 53.13 \pm 3.61.

Table 2: Descriptive statistics of the measured circumferential body measurements according to age

Circumferential Body Measurements	Age group	N	Mean	SD	t-test			
					Df	t-value	p-value	Inference
BMI (Kg/m ²)	21 - 30	350	23.47	3.24	-8.47	398.00	0.00	Significant
	31 - 40	50	27.60	3.12				
MAC	21 - 30	350	28.30	3.00	1.59	398.00	0.11	Not Significant
	31 - 40	50	27.60	2.54				
CC	21 - 30	350	94.56	6.86	4.16	117.05	0.00	Significant
	31 - 40	50	92.05	3.40				
WC	21 - 30	350	96.70	3.20	3.82	398.00	0.00	Significant
	31 - 40	50	94.85	3.11				
HC	21 - 30	350	96.17	4.19	0.61	398.00	0.54	Not Significant
	31 - 40	50	95.79	4.16				
MTC	21 - 30	350	55.33	3.55	2.88	398.00	0.00	Significant
	31 - 40	50	53.77	3.75				

MAC = Mid arm circumference, CC = Chest circumference, WC = Waist circumference, HC = Hip circumference, MTC = Midthigh circumference, SD = Standard deviation

Table 2 shows the descriptive statistics of the circumferential body measurements according to age. Mean mid arm circumference (MAC) for age group 21 – 30 was 28.30 \pm 3.00 while that of age group 31 – 40 was 27.60 \pm 2.54. Chest circumference (CC) for age group 21 – 30 was 94.56 \pm 6.86 while that of age group 31 – 40 was 92.05 \pm 3.40. Waist circumference (WC) for age grade 21 – 30 (96.70 \pm 3.20) whereas for age group 31 – 40 was 94.85 \pm 3.11. Hip circumference (HC) for age group 21 – 30 was 96.17 \pm 4.19 while for age group 31 – 40 was 95.79 \pm 4.16. Mid-thigh circumference (MTC) for age group 21 – 30 was 55.33 \pm 3.55 while that of age group 31 – 40 was 53.77 \pm 3.75. Independent sample t-test showed that the difference in the mean of CC, WC and MTC were statistically significant ($p=0.00$) between the age groups while the others were not significant ($p>0.05$).

Table 3: Descriptive statistics of the measured circumferential body measurements according to BMI

Circumferential Body Measurements	BMI	N	Mean	SD	df	t-value	p-value	Inference
Age (years)	Normal weight	249	23.73	2.81	192.25	-6.58	0.00	Significant
	Slightly overweight	151	27.09	5.88				
MAC	Normal weight	249	28.37	3.00	327.34	1.33	0.18	Not Significant
	Slightly overweight	151	27.97	2.87				
CC	Normal weight	249	94.38	6.94	398.00	0.50	0.62	Not Significant
	Slightly overweight	151	94.04	5.95				
WC	Normal weight	249	96.34	3.27	398.00	-0.99	0.32	Not Significant
	Slightly overweight	151	96.67	3.20				
HC	Normal weight	249	95.95	4.29	398.00	-1.04	0.30	Not Significant
	Slightly overweight	151	96.40	4.01				
MTC	Normal weight	249	55.10	3.58	398.00	-0.26	0.79	Not Significant
	Slightly overweight	151	55.19	3.67				

MAC = Mid arm circumference, CC = Chest circumference, WC = Waist circumference, HC = Hip circumference, MTC = Midhigh circumference, SD = Standard deviation

Table 3 shows the descriptive statistics of the measured circumferential body measurements according to BMI. The independent sample t-test shows there was no statistically significant difference ($p > 0.05$) in the parameters.

DISCUSSION

Although human anatomy describes the structure of the body as observed in most people and has traditional value in surgery, there exists a wide range of ethnic and racial variation in the physical appearance and body proportions of different populations^[7]. Variations observed in different races and groups could be due to factors such as biological, environmental, nutritional, geographical, social factors among others.

This study provides a catalogue of the circumferential body anthropometry of the Igbo of southern Nigeria. Circumferential body measurements together with body mass index (BMI) have been implicated in various studies ranging from evaluation of nutritional status^[9,10], risk of cardiovascular disease^[11] and birth weight^[12]. Mid arm circumference has been reported in Iran. The MAC of the Igbo as lower than those reported in Iran; $280 \pm 31\text{mm}$ (28.0cm), $282 \pm 33\text{mm}$ (28.2cm), $285 \pm 29\text{mm}$ (28.5cm), $283 \pm 26\text{mm}$ (28.3cm), $282 \pm 30\text{mm}$ (28.2cm) and $284 \pm 27\text{mm}$ (28.4cm) for age groups 25 – 29, 30 – 34, 35 – 39, 40 – 44, 45 – 49 and 50 – 55 respectively^[13].

Dearth of information on most circumferential body variables with respect to anthropometry in other populations further gives novelty to this study as it

provides a catalogue on these circumferential body variables.

CONCLUSION

This catalogue will serve as normative values which will find use not only in the manufacture gross anatomical models using negroid standards but also in the data bank for of this negroid population. Further, it can also serve as a reference for future use.

REFERENCES

1. Isichei E. Igbo World. An anthology of oral histories and historical description. 1978. Institute for the study of human issues, Philadelphia.
2. Chigere N. H. Foreign Missionary Background and Indigenous Evangelization in Igbo land: Igbo land and The Igbo People of Nigeria. 2000; 17.
3. Fardon R, Fumiss G. African languages, development and the state. Routledge. 1994; 66.
4. Ogbaa K. "Cultural Harmony I: Igbo land – the World of Man and the World of Spirits". Understanding Things Fall Apart. 1999; 106.
5. Williams L. Nigeria: The Brandt Travel Guide (Travel Guides), Bradt Travel Guides; 2nd edition. 2008; 196.
6. Fawehinmi HB, Oparaocha CA, Okoh, PD. Gross Anatomical Modeling –University of Port Harcourt Experience; Journal of Experimental and

- Clinical Anatomy. 2007; 6(1 & 2): 1 – 5.
7. Moore KL, Agur AMR. Essential Clinical Anatomy 2nd Edition. Lippincott Williams and Wilkins. 2002; 3–4.
8. Brown N, Scurr J. The Need for a Standardized Anthropometric Protocol for Objective Assessment of Pre – and Postoperative Breast Surgery. *Gland Surgery*. 2012;1:3. www.glandsurgery.org/index
9. Ibegbu AO, Tosin DE, Hamman WO, Umana, UE, Musa, SA. Nutritional evaluation using different anthropometric variables in Nigerian school children. *Journal of experimental and clinical anatomy (JECA)*. 2013; 12 (2): 42–49.
10. Dale NM, Myatt M, Prudhon C, Briend A. Using mid-upper arm circumference to end treatment of severe acute malnutrition leads to higher weight gains in the most malnourished children. *PLoS One*. 2013;8(2):55404.
11. Cheng X, Tran NTT, Blizzard CL, Luong KN, Truong NLV, Tran BQ, Otahal P, Nelson M, Magnussen C, Gall S, Bui TV, Srikanth V, Au TB, Ha ST, Phung HN, Tran MH, Callisaya M. The importance of waist circumference and body mass index in cross-sectional relationships with risk of cardiovascular disease in Vietnam. *PLoS One*. 2018; 13(5): 0198202. [https:// doi: 10.1371/journal.pone.0198202](https://doi.org/10.1371/journal.pone.0198202)
12. Thi HN, Khanh DKT, Thu HLT, Thomas EG, Lee KJ, Russell FM. Foot Length, Chest Circumference, and Mid Upper Arm Circumference Are Good Predictors of Low Birth Weight and Prematurity in Ethnic Minority Newborns in Vietnam: A Hospital-Based Observational Study. *PLoS ONE* 2015; 10 (11): e 0 1 4 2 4 2 0 . <https://doi.org/10.1371/journal.pone.0142420>.
13. Ayatollahi SMT. A Systematic Review of Reference Values for Mid Upper Arm Circumference (MUAC) in Southern Iran. *Journal of Obesity and Weight loss Therapy*. 2012; 2:119. doi:10.4172/2165-7904.1000119.