EUROPEAN JOURNAL OF BIOMEDICAL AND PHARMACEUTICAL SCIENCES
http://www.ejbps.com

ISSN 2349-8870
Volume: 7
Issue: 3
155-160
Year: 2020

COMPARATIVE CIRCUMFERENTIAL BODY ANTHROPOMETRIC FEATURES OF THE IGBO, IJAW AND YORUBA OF SOUTHERN NIGERIA

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Article Received on 14/01/2020 **Article Revised on 04/02/2020** **Article Accepted on 24/02/2020**

ABSTRACT
Circumferential anthropometry is a branch of physical anthropology which measures precisely and systematically the body. The study aimed at investigating and comparing the circumferential body anthropometric dimensions of the Igbo, Ijaw and Yoruba of southern Nigeria. The research design was a cross-sectional design. The study utilized a total number of one thousand two hundred (1200) participants with four hundred (400) randomly selected from Igbo, Ijaw and Yoruba ethnic groups whose ages ranged from 21 to 40 years and BMI range of 18.50 to <30.00. Minimum sample size determination was done using the Taro Yamane's formula. Statistical analysis was done using statistical package for the social science (SPSS version 25.0). Continuous variables were presented as mean±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 – 30.0 designated ≥ 25.0). Independent sample t-test was therefore carried out to determine significant difference in the measured anthropometric variables across age and BMI groups. The confidence interval was set at 95%, therefore $p < 0.05$ was considered significant. Impact of age and variations in BMI were also observed in the anthropometric parameters. These anthropometric values will find use in medical sciences and forensics.

KEYWORDS: Linear, body, anthropometric, dimensions, southern Nigeria.

INTRODUCTION
Southern Nigeria has the Igbo, Ijaw and Yoruba as its predominant ethnic groups. Of the three, the Igbo and Yoruba alongside the Hausa of northern Nigeria are the three major ethnic groups in Nigeria. The Igbo are found predominantly in southeastern and midwestern (Delta State) of Nigeria. They are also found in other African countries[1][2] and outside Africa. The Igbo people are one of the largest ethnic groups in Africa.[3] The Ijaw are found in the southernmost part of Nigeria. They dwell in riverine locations near many sea trade routes.[4] The Yoruba are predominantly found in southwestern Nigeria, where they make up to about 21% of the country's population, according to the CIA World Factbook.[5]

Among its many usefulness, anthropometry also plays very important roles in industrial designing, clothing design, ergonomics and architecture where statistical data about the distribution of body dimensions in a given population are used to optimize products. Changes in lifestyles, nutrition, and ethnic composition of populations lead to changes in the distribution of body dimensions, and require constant updating of anthropometric data collections. Circumferential anthropometry entails precise and systematic measurement of the body circumferences. This is very important in identification, for the purpose of understanding human physical variations and in various attempts at correlation of physical with racial traits. Body circumferences commonly used include chest, abdominal, hip, waist, thigh, ankle, calf, arm, forearm and wrist. Comparative measurement of human body is a well-established practice for many clinical purposes including screening and health risk assessment.[6][7] This has many usefulness especially in a paediatric population as these measurements can be used to track growth rate and identify abnormal growth trends, and nutritional status.[8] Studies on different circumferential studies have been carried out.[9][10][11][12][13][14] Documented reports on the body circumferential parameters of adult male southern Nigerians are scarce. Against this backdrop, having access to normative values of these parameters for southern Nigeria becomes difficult, thus the need for this study.

The aim of the study was to generate normative values of circumferential body parameters for the Igbo, Ijaw and Yoruba ethnic groups of southern Nigeria, compare the obtained values among the three ethnic groups as well as compare southern Nigerian normative mean values for each of the parameters to those of other populations.

MATERIALS AND METHODS

Research Design

The research design was a cross-sectional design which investigated the circumferential body anthropometry of adult males of three southern Nigerian ethnic groups.

Population for the Study

The population for the study included participants drawn from Yenegoa, Amassoma, Ogbia, Kaima and Igbogene in Bayelsa State, Owerri, Mbaitoli, Ngor-Okpala, Orlu, Mbaise and Okigwe in Imo State; Akure, Idanre, Akoko and Okitipupa in Ondo State constituted the study areas.

Sample Size and Sampling Technique

The sampling technique was multistage random sampling. Subjects were randomly selected from amongst adult males from the 3 major tribes (Yoruba, Ijaw and Igbo) residing in Imo, Ondo and Bayelsa states all in southern Nigeria.

The research design was a cross-sectional design. The study utilized a total number of one thousand two hundred (1200) participants with four hundred (400) randomly selected from Igbo, Ijaw and Yoruba ethnic groups whose ages ranged from 21 to 40 years and BMI range of 18.50 to <30.00. Minimum sample size for the study was determined using the Taro-Yamane formula, where n = minimum sample size, N = total population and *e* = margin of error = 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 research. It was ascertained that recruited subjects have both parents and four grand parents from the same ethnic group. This was determined through direct personal interviews with the participants.

Before measurements were taken, Body Mass Index (BMI) of the participants were taken.

The following circumferential parameters were measured:

Mid-arm (upper arm) circumference

Distance between the acromion of the scapula and olecranon process of ulna.

Chest circumference

The region corresponding to the nipples - the xiphoid process.

Waist circumference

The region corresponding to the superior iliac crest and then crossing the line to indicate the mid-axillary line.

Hip circumference

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

Mid-thigh circumference

Midpoint between femoral greater tubercle and femoral lateral epicondyle.

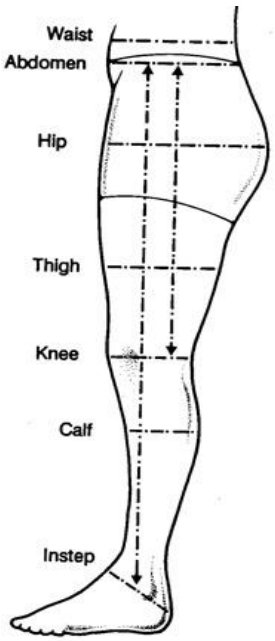

Figure 1: Lower body circumferential measurements: waist, hip, thigh, knee, calf, and ankle (instep) circumferences.

Measurement of Circumferential Parameters

The following procedures describe the procedure for the anthropometric measurements for each of the circumferential parameters:

Mid-arm (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.
- 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 0.1cm.

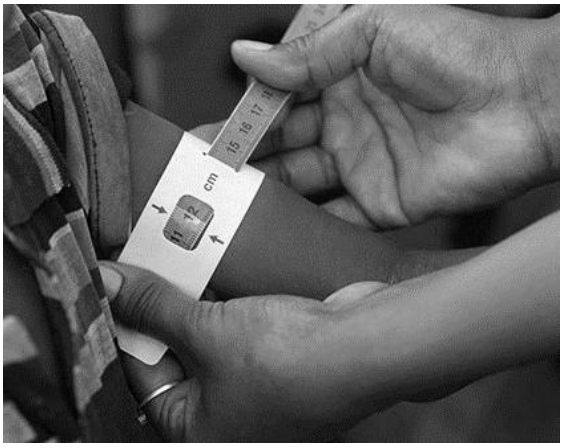

Figure 2: Measurement of upper arm circumference.

Chest circumference

- The subject stays in a standing position with both hands spread side by side.
- The measuring tape is placed horizontally at 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 0.1cm and recorded.

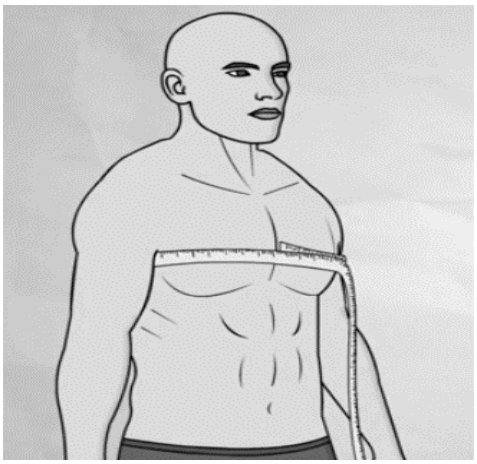

Figure 3: Chest circumference measurement.

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 0.1cm and recorded.

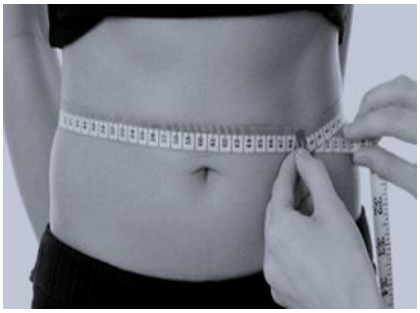

Figure 4: Waist circumference measurement.

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.

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, and 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 0.1cm and recorded.

Inclusion criteria

All participants had no bodily deformities arising from trauma or congenital malformations.

Subjects whose parents and grand-parents were of the same origin.

Participants whose BMI ranges were $\leq 30 kgm^2$ were included in the study because they looked apparently healthier than those whose BMI classification was considered to be within normal range.

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±SD; minimum and maximum. Analysis of

variance (ANOVA) was done to establish significant differences in the measured circumferential anthropometric body parameters according to ethnic group. 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) and slightly overweight (25.0 – 30.0). 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 AND DISCUSSION

Table 1 shows the descriptive statistics of the measured circumferential body measurements of all the ethnic groups showing the respective mean of each group and the total mean of all the ethnic groups. Table 2 shows an ANOVA test that compared circumferential body measurements among the ethnic groups. All parameters showed statistically significant difference ($\rho=0.00$). Mean mid arm circumference (MAC) was found to be highest among the Igbos and least among the Yorubas while chest circumference (CC) was found to be highest among the Ijaws and least in the Yorubas. Waist circumference (WC) was found to be highest among the Yorubas and least among the Igbos. Hip circumference (HC) was also found to be highest among the Yorubas and least among the Igbos while mid-thigh circumference (MTC) was highest among Yorubas and least among the Igbos. Independent t-test revealed that only the waist circumference (WC) was statistically significant ($\rho=0.04$) when compared between age groups in all ethnic groups (table 3). Similarly, only the waist circumference (WC) was found to be statistically significant ($\rho=0.00$) when compared between the BMI groups in all ethnic groups (table 4).

Table 1: Descriptive statistics of the measured circumferential body measurements of the Igbo, Ijaw and Yoruba ethnic groups.

Circumferential body measurements	IGBO [N = 400]			IJAW [N = 400]			YORUBA [N = 400]			TOTAL [N = 1200]		
	Mean± SD	Min	Max	Mean± SD	Min	Max	Mean± SD	Min	Max	Mean± SD	Min	Max
BMI (Kg/m^2)	23.98±3.50	18.50	30.00	22.15±3.21	18.60	30.00	22.70±3.47	18.60	30.00	22.95±3.48	18.50	30.00
Age (years)	25.00±4.54	21.00	40.00	27.43±5.35	21.00	40.00	26.04±4.96	21.00	40.00	26.16±5.06	21.00	40.00
MAC	28.22±2.95	24.10	36.15	27.24±2.26	2.52	36.50	27.10±2.29	2.52	36.50	27.52±2.57	2.52	36.50
CC	94.25±6.58	83.39	115.70	94.79±8.78	9.34	117.50	92.47±5.99	9.34	119.50	93.83±7.35	9.34	119.50
WC	94.47±3.24	88.72	101.20	95.73±8.22	68.32	95.12	96.44±3.27	87.41	100.62	90.88±8.49	68.32	101.20
HC	95.00±4.19	86.50	103.50	95.12±3.07	86.50	100.70	96.14±3.89	86.50	104.13	95.42±3.78	86.50	104.13
MTC	53.13±3.61	47.90	61.40	54.24±3.13	48.30	61.60	55.42±3.43	48.20	61.50	54.27±3.46	47.90	61.60

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

Table 2: Circumferential body measurements compared according to ethnic group using ANOVA.

Circumferential body measurements	Sum of Squares	Mean Square	Df	F-value	p-value	Inference
MAC	293.69	146.85	2	23.11	0.00	**Significant**
CC	2547.04	1273.52	2	24.46	0.00	**Significant**
WC	51054.32	25527.16	2	862.11	0.00	**Significant**
HC	300.75	150.37	2	10.71	0.00	**Significant**
MTC	585.04	292.52	2	25.36	0.00	**Significant**

***MAC** = Mid arm circumference, **CC** = Chest circumference, **WC** = Waist circumference, **HC** = Hip circumference, **MTC** = Mid-thigh circumference.*

Table 3: Descriptive statistics of the measured circumferential body measurements according to age in all Subjects.

Circumferential Body Measurements	Age group	N	Mean	SD	*t*-test			
					df	*t*-value	*p*-value	Inference
MAC	21 - 30	985	27.58	2.59	1198.00	1.68	0.09	Not Significant
	31 - 40	215	27.25	2.45				
CC	21 - 30	985	93.52	7.53	1198.00	0.15	0.88	Not Significant
	31 - 40	215	93.44	6.53				
WC	21 - 30	985	91.12	8.36	299.17	2.06	0.04	**Significant**
	31 - 40	215	89.74	9.03				
HC	21 - 30	985	95.47	3.81	1198.00	0.88	0.38	Not Significant
	31 - 40	215	95.22	3.61				
MTC	21 - 30	985	54.34	3.47	1198.00	1.61	0.11	Not Significant
	31 - 40	215	53.92	3.44				

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

Table 4: Descriptive statistics of the measured circumferential body measurements according to BMI in all Subjects.

Circumferential Body Measurements	BMI	N	Mean	SD	*t*-test			
					Df	*t*-value	*p*-value	Inference
MAC	Normal weight	899	27.51	2.53	1198.00	-0.25	0.80	Not Significant
	Slightly overweight	301	27.55	2.69				
CC	Normal weight	899	93.53	7.11	1198.00	0.25	0.80	Not Significant
	Slightly overweight	301	93.41	8.05				
WC	Normal weight	899	90.09	8.78	632.60	-6.26	0.00	**Significant**
	Slightly overweight	301	93.23	7.08				
HC	Normal weight	899	95.32	3.74	1198.00	-1.60	0.11	Not Significant
	Slightly overweight	301	95.72	3.88				
MTC	Normal weight	899	54.20	3.45	1198.00	-1.15	0.25	Not Significant
	Slightly overweight	301	54.46	3.49				

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

DISCUSSION

Among its numerous usefulness, anthropometry also plays very important roles in industrial designing of products to fit a population, ergonomics as well as architecture where statistical data about the distribution of body dimensions in a given population are used. Changes in lifestyles, nutrition, and ethnic composition of populations lead to changes in the distribution of body dimensions, and require constant updating of anthropometric data collections. Circumferential anthropometry entails precise and systematic measurement of the body circumferences either for evaluation of nutritional status[8], health risk assessment[6][7], growth trend[8] or establishment of normative values which could describe a population. The studied circumferential parameters on comparison were observed to be statistically significant ($p<0.05$). The Ijaw exhibited the broadest chest circumference whereas the Yoruba exhibited the widest hip and waist circumference. These differences were however not marked. A marked racial variation was observed MAC (26.16±5.06) was lower than those reported in Iran; 280±31mm (28.0cm), 282±33mm (28.2cm), 285±29mm (28.5cm), 283±26mm (28.3cm), 282±30mm (28.2cm) and 284±27mm (28.4cm) for age groups 25 – 29, 30 – 34, 35 – 39, 40 – 44, 45 – 49 and 50 – 55 respectively[15]. This could be attributed to muscle skin thickness, an adaptation for the caucasoid to cold weather in the temperate region.

Numerous studies have shown that mid-arm circumference correlates well with body mass index (BMI) in adult population.[9][10][11][12][13][14] With the exception mid-arm circumference, other anthropometric parameters were difficult to come by in literature where they were studied to generating normative values for different races. They were either used in monitoring growth rate, nutritional status or health risks.

CONCLUSION

Values obtained from study describe what could be considered normal for southern Nigeria. The values could be relevant in forensic studies, surgical practice, and could aid in the reconstruction of anatomical models.

AKNOWLEDGMENT

No external funding was received for this study. No conflicts of interest were reported.

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