Orthopedic & Muscular System: Current Research

Normative Values of Selected Anthropometric Variables in Lagos Nigerian Population

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Abstract

Background/Objective: Anthropometric measures are important to physical fitness and weight control programmes because adiposity indices which are often used to measure the outcomes of such programmes are derived from them. The aim of this study was to determine normative values of selected anthropometric measures of participants in Lagos, Nigeria.

Method: This cross-sectional survey involved 5342 (2741 males, 2601 females) apparently healthy individuals, aged 5-90 years who were recruited consecutively. Participants' weight, height, waist circumference, hip circumference, percent body fat were measured using standard methods. Body Mass Index (BMI) was computed. Data were analyzed using mean, standard deviation, percentages, percentiles, and 95% confidence interval of the distribution.

Results: The 95% confidence intervals of distribution for the entire study sample were 67.62-68.46 kg for weight, 1.65-1.66 m for height, 24.72-26.53 kg/m^2 for BMI, 26.53-27.05% for percent body fat, 69.53-70.73 cm for waist circumference, 78.68-79.96 cm for hip circumference, and 0.87-0.88 for waist-hip ratio. The values for all the variables increased with age until the 60-69 years age group after which it dropped.

Conclusion: Normative values of selected anthropometric variables of Nigerians fall within the upper and lower bounds of the 95% confidence interval of the distribution.

Keywords: Normative values; Anthropometric measures; Adiposity indices; Nigerians

Introduction

The disease risk stratification is based on anthropometric data such as weight, height, body diameters, circumferences and body mass index which are used to estimate the degree of adiposity [1,2]. Previous studies have been carried out in the first century using anthropometric measures in the estimation of various indices of adiposity [1-5]. Indices of adiposity include body mass index (BMI), weight/height, percent body fat, waist circumference, waist hip ratio. Body mass index (BMI) has been found to be a useful indicator of fatness in population studies. Man has always been concerned about his body size [6], one reason for this is probably the association between obesity and health related problems [3,7,8]. According to Meginnis and Foege, overweight and obesity accounted for approximately 300,000 deaths per year in the United States [9]. Premature death, disability, increased health care cost and lost productivity have been shown to be associated with overweight and obesity [10].

Although, there are no general values/norms for the various anthropometric measures, average values that are population specific are available [11]. Despres et al. submitted that in the African population that there are no average values (norms) for these anthropometric measures though some are available in the American population [11]. The situation appears to remain the same even now. There is hence the need to provide average values of indices of adiposity of Nigerian population as a guide in the estimation of fatness.

The overall aim of this study was therefore to describe the anthropometric indices and determine the normative values by sex and age of apparently healthy individuals in a Nigerian population.

Materials and Method

Five thousand three hundred and forty two (5342) participants comprised of male and female Nigerians within the age range of 5 yrs to 70 years and above were involved in this study. The participants were consecutively recruited from three Local Government Areas (Ifako-Ijaiye, Ikeja, and Somolu) in Lagos (one of the largest cities in Nigeria). The following anthropometric measures and indices of adiposity of participants were measured: weight, height and waist and hip circumferences.

The study was approved by the UI/UCH Institutional Review Committee. All adult participants gave consent after detailed explanation of the procedure to them while parents or guardians gave informed consent on behalf of participants under 18 years of age.

Procedure

(a) Demographic data: Age, gender and state of origin were collected on each subject.

(b) Weight: Each subject with minimal clothing on stood barefooted on the weighing scale, looking straight ahead. The weight was recorded to the nearest 1.0 kg [12].

(c) Height: Each subject stood barefooted, with the heels together, knees extended and the back against the scale, while looking straight ahead, without any head cover. The horizontal projection of the height meter was adjusted to touch the

vertex without undue pressure [12]. The weight was recorded in centimeters to the nearest 0.1 cm.

(d) Percent body fat: This was analyzed using a non-invasive, indirect, relatively easy means of estimating   percent body fat. It requires simple inexpensive instrument which demands little handling. The bioelectrical impedance analysis is based on the concept that electrical flow is facilitated through hydrated fat-free body tissue and extracellular water compared to fat tissue [13]. This is due to the greater electrolyte content, and thus lower electrical resistance of the fat-free component. An example of bioelectrical impedance analysis is the Omron BF 306. This is a simplified instrument with a small computer microprocessor which computes the percent body fat after it has been fed with the weight, height, sex and age of the individual. The individual, after taking off all metal objects on him or her, stands erect with the two feet together and holding the machine with both arms stretched forward at the shoulder, a painless, localized electrical signal is introduced and the impedance or resistance to current flow is determined. The apparent advantage of this method over skin fold measurement is that it is less prone to rater's error.

(e) Waist Circumference: The waist circumference was taken with the subject in standing position (erect posture) using a tape measure. Measurement was taken mid-way between the lowest rib and the iliac crest at the end of gentle expiration, without compressing the soft tissues. Measurement was taken to the nearest 0.1cm [14].

(f) Hip circumference: The hip circumference was taken with the subject standing erect while keeping the feet together. A tape measure was used to measure the circumference around the fullest part of the glutei   Measurement was taken to the nearest 0.1 cm [14].

(g) Waist/Hip ratio: This was obtained by expressing the circumferences of waist and hip in the ratio.

The participants were recruited into each of the following age groups, <10 years, 10-19 years, 20-29 years, 30-39 years, 40-49 years, 50-59 years, 60-69 years and 70+ years [15]. Descriptive statistics of mean, standard deviation, percentages, and 95% confidence interval of distribution were used to analyze each of the height, weight, waist circumference, hip circumference, body mass index, waist/hip ratio and percentage body fat in the different age groups. Independent z-test was used to compare each of the height, weight, waist circumference, hip circumference, body mass index, waist/hip ratio and percentage body fat in male and female participants in the different age groups. Level of significance was set at 0.05.

Socio demographic data and physical characteristics of participants

A total of 5342 residents of Ikeja, Lagos state participated in the study. They comprised of 2741 (51.3%) males and 2601 (48.7%) females. Their ages ranged from 5 years to 90 years. The geopolitical distribution of the participants indicated that participants were from all the geopolitical zones in Nigeria. The frequency of distribution of participants in the eight age groups is shown in Table 1. The highest number of participants was in the 20-29 years age group with 1869 (35.0%); with 1342 (2.5%) of the participants in the youngest age group <10 years with 55(1%) of the participants in the older 70 years and above age group.

Results

Anthropometrics measures of participants by Sex and age group

Variable	Category	N	%
Sex	Male	2741	51.3
	Female	2601	48.7%
Age group	<10	135	2.5
	10-19	463	8.7
	20-29	1869	35.1
	30-39	1156	21.6
	40-49	572	10.7
	50-59	707	13.2
	60-69	386	7.2
	70±	55	1

Table 1: Socio Demographic Data of Participants

The mean weight of the participants was 66.04 ± 15.60 kg. The mean was higher for male participants (69.54 ± 14.29 kg) than the female (66.46 ± 16.73 kg). The peaked between age group 70 years and above for female (86.36 ± 41.20 kg), and 60-69 years (78.14 ± 10.58 kg) for the male participants (Table 2 and 3). The mean height of the participants was 1.66 ± 0.012 m. The mean for male (1.69 ± 0.001 m) was higher than the female participants (1.61 ±0.0012 m). The mean peaked within the age group of 30-39 years (1.72 ± 0.09 m) for the males, and age group 50-59 years (1.66 ± 0.07 m) for the females.

The mean hip circumference of participants was 79.33 ± 23.83 cm. The mean hip circumference of the male participants (86.14 ± 15.58 cm) was higher than the female participants (72.14 ± 28.47 cm). The mean peaked between 50-59 years age group (90.82 ± 21.25 cm) for the female, and age group 60-69 years (91.28 ± 10.82) for the male participants. The mean BMI of participants was 24.81 ± 5.01 kg/m^2. The mean for the female participants (25.67 ± 5.54 kg/m^2) was higher than the male participants (24.23 ± 4.56 kg/m^2).

The mean peaked between age group 40-49 years (28.71 ± 4.87 kg/m^2) for the female participants, and in age group 50-59 years (26.87 ± 3.372 kg/m^2) for the male participants. The mean waist circumference for the participants was 70.l3 ± 22.2l cm. The mean waist circumference was higher in the male participant (77.45 ± 15.66 cm) than the female participants (62.42 ± 25.27 crn). The mean peaked between the age group 50-59 years (81.31 ± 19.24 cm) for the female participants, age group 70 years and above (8 7.44 ± 10.97 cm) for the male age group, Table 4.

The mean waist-hip ratio for the participants was 88 ± 0.8 cm. The mean waist hip ratio was higher in the male participants (0.89 ± 0.07) than in the female participants (0.87 ± 0.09). The mean peaked between age group 70 years and above (0.96 ± 0.07 1.04 ± 0.32) in both male and female participants respectively. The mean percent body fat for age group <10 years is not included in the Table 4, the 10-19 years age group involved only ages 18-19 years. The mean percent body fat for the participants was 26.79 ± 9.70%. The mean percent body fat was higher in the female participants (32.19 ± 7.88% vs 21.80 ± 8.47%). The mean peaked between age group 40-49 years (35.58 ± 7.51%) for the females; and age group 60-69 years (28.2 ± 6.03%) for the male participants.

Discussion

Anthropometric parameters such as weight, height, body diameters and circumferences have been used to enumerate the degree of fatness or adiposity [16]. In this study the male participants (2741) were slightly more than the female participants (2601). The people were generally interested in knowing the values of their anthropometric measures, though the females were slightly reluctant in putting off their clothes

Variable	All Participants Mean ± S.D	Participants Mean ± S.D by Sex	
		Males	Females
Weight (kg)	68.04 ± 15.60	69.54 ± 14.29	66.46 ± 16.73
Height (m)	1.66 ± 0.00	1.69 ± 0.01	1.61 ± 0.12
Hip circumference (cm)	79.33 ± 23.83	86.14 ± 15.58	72.14 ± 28.47
Body mass index (kg/m²)	24.781 ± 4.97	24.15 ± 4.31	25.15 ± 5.50
Waist circumference (cm)	70.13 ± 22.21	77.45 ± 15.66	62.42 ± 25.27
Waist hip ratio	0.88 ± 0.08	0.89 ± 0.07	0.87 ± 0.09
Percent body (%) fat	26.79 ± 9.70	21.82 ± 8.32	32.11 ± 7.82

Table 2: Mean Values of Anthropometric Variables of Participant Key: SD – Standard deviation

Age group percent (years)	Weight π±SD (kg)	Height π±SD (m)	HipCircum BMI (cm) π±SD kg/m²		Waist Circum	Waist/Hip ratio π±SD	% Body ft
<10	26.69 ± 7.19	1.30 ± 0.12	67.76 ± 8.91	15.49 ± 2.01	54.3 ± 6.34	0.81 ± 0.06	
10-19	52.50 ± 15.07	1.06 ± 0.15	76.06 ± 18.00	21.02 ± 5.30	63.24 ± 16.45	0.84 ± 0.07	20.00 ± 8.83
20-29	64.42 ± 10.96	1.67 ± 0.10	76.18 ± 23.12	23.26 ± 3.93	55.28 ± 17.42	0.86 ± 0.08	23.58 ± 2.02
30-39	72.50 ± 12.47	1.67 ± 0.09	73.01 ± 27.12	26.04 ± 4.56	65.70 ± 22.12	0.89 ± 0.09	28.63 ± 9.60
40-49	75.80 ± 12.87	1.67 ± 0.09	85.68 ± 25.33	27.29 ± 4.84	77.74 ± 22.94	0.90 ± 0.80	29.91 ± 9.38
50-59	76.29 ± 11.21	1.68 ± 0.07	90.77 ± 18.22	27.44 ± 4.34	82.91 ± 19.24	0.92 ± 0.06	31.27 ± 7.28
60-69	77.49 ± 11.35	1.68 ± 0.08	90.37 ± 18.22	27.34 ± 4.18	83.58 ± 16.47	0.93 ± 0.07	30.14 ± 7.16
70±	76.02 ± 27.98	1.57 ± 0.35	83.80 ± 21.12	24.86 ± 3.85	77.03 ± 15.73	0.95 ± 0.08	26.98 ± 7.56
Total	**68.04 ± 15.60**	**1.66 ± 0.12**	**80.45 ± 19.65**	**24.86 ± 5.10**	**69.95 ± 20.47**	**0.88 ± 0.48**	**26.7 ± 5.1**

Table 3: Mean Values of Anthropometric Variables of Participants by Age Group

Age Group years	Weight Lower Bound	Upper bound	Height Lower Bound	Upper Bound	Hip Circum. Lower Bound	Upper Bound	BMI Lower Bound	Upper Bound	%Body Fat Lower Bound	Upper Bound	Waist Circum. Lower Bound	Upper Bound	Waist/ Hip Lower Bound	Ratio Upper Bound
<10	25.47	27.92	1.28	1.32	66.26	69.26	15.16	15.82	-	-	53.25	55.47	0.72	0.82
10-19	51.13	53.88	1.59	1.61	74.42	77.71	20.55	21.51	19.20	20.80	62.30	65.18	0.83	0.85
20-29	63.92	64.92	1.66	1.67	75.18	77.23	23.11	23.14	23.14	24.20	64.45	66.37	0.85	0.86
30-39	71.78	73.22	1.67	1.68	71.40	74.63	25.80	26.32	28.05	29.18	63.74	66.71	0.89	0.90
40-49	74.75	76.86	1.66	1.68	83.60	87.76	26.93	27.73	29.14	30.68	76.00	79.83	0.90	0.92
50-59	75.46	77.12	1.67	1.68	89.42	92.11	27.12	27.76	30.74	31.80	81.56	84.06	0.90	0.91
60-69	76.35	78.62	1.68	1.70	88.82	91.92	26.92	27.76	29.43	30.85	82.96	86.04	0.92	0.94
70±	68.46	83.59	1.48	1.66	78.09	89.50	22.77	25.10	25.00	28.98	75.56	84.93	0.94	1.04
Overall 95%C:	67.62	68.46	1.65	1.66	78.68	79.96	24.72	25.00	26.53	27.05	69.53	70.73	0.87	0.88

Table 4: 95% Confidence interval of distribution for Anthropometric measures of Participants

especially for the measurement of waist and hip circumferences. The youngest age group (<10 years) and the oldest age group (70 and above) were few, this may be due to the fact that most of the parents of the younger age group were reluctant to give consent for their children and the older group were not readily available. The sample size had a representation of participants from all the six geopolitical zones of Nigeria, Lagos being a cosmopolitan city.

Obesity as assessed by indices of adiposity for example BMI and waist circumference is clearly associated with significant morbidity and mortality and the prevalence of obesity has risen dramatically and continues to rise in the United States and around the world [17]. Balogun et al. concluded that weight was a more important determinant of blood pressure than age in the Nigerian population [18]. Sayannwo et al. carried out a cross-sectional survey of the population of Gassim of Saudi Arabia and computed the BMI of 6044 individuals [19]. Anthropometric studies have also been carried out on the Nigerian population. The height of 1242 Urban Nigerians above 10 years ranged from 142 cm to 162 cm and their weight ranged from 33.6 kg to 63.6 kg [20]. Anthropometric survey of Nigerian farmers in the south eastern zone of Nigeria to obtain information on body dimensions that may be used in ergonomic design of farm equipment was carried out by Onuoha [21]. Studies on anthropometric measures and indices

of adiposity of a large population of Nigerian participants were not available. Mean weight was higher in male participants than the female participants. The mean height was higher in the male participants than the female participants. Waist circumference was higher in the male participants that the female participants. Hip circumference was higher in the male participants than female participants. The mean BMI and percent body fat were higher in the female participants than the male participants especially in the age groups 30-39 years, 40-49 years, 50-59 years which essentially represent the middle age spread period in the females when they usually accumulate fat. Currently Body mass index (BMI) is most commonly used to determine adiposity [22].

Comparing the BMI values of this study with WHO BMI cut off Table 4, (Overweight - > 25, Obese -25:00 – 29:99) [23]. Overall 95% confidence interval of this study is 24:72 – 25:00.

Percent body fat is the percentage of fat relative to total body weight [22]. The 95% confidence interval of distribution of percentage body fat in this study, when compared with WHO recommendation [23,24], shows Nigerians could be in the healthy range. Waist circumference, waist/hip ratio as indices of adiposity are not greatly influenced by height, central fat (abdomen and trunk) increases the risk of cardiovascular problems than peripheral fat [2]. This has made

waist circumference important in estimating indices of adiposity. In the American population, waist/hip ratio value exceeding 0.95 for males and 0.80 for females are considered obese [25]. Waist Circumference has been shown to be well correlated with abdominal and visceral adiposity [26], and abdominal adiposity and increased waist circumference especially greater than 100 cm, have been shown to be highly correlated with risks of cardiovascular disease [27]. Participants within this study with waist circumference greater than 100 cm may hence be at risk of cardiovascular diseases. The waist circumference at overall 95% confidence interval by distribution was 69.53 in the lower bound and 70.73 cm in the upper bound. The waist-hip ratio at 95% confidence interval by distribution was 0.87 in the lower bound and 0.88 in the upper bound. These values are different from the values from the WHO Monica project by Molarius et al. on varying sensitivity of waist action levels; to identify participants with overweight or obesity in 19 populations [27]. This may be due to the fact that these values are influenced by race and culture [27]. There is a general drop in all the values of anthropometric measures except in the waist-hip ratio in the age group 70 years and above. This may imply that the anthropometric measures are low in this age group. When the general trend was compared with other populations, it was found that BMI of Nigerian participants were higher in women than men, like the BMI of the Saudi's [19]. The British population was the reverse with men with higher values than women [28].

In this study, mean values of anthropometric measures varied with age. The general trend of gradual increase in BMI and percent body fat from age group <10 years to 50-59 year age group and decrease from 60-69 age group to 70 and above age group could be due to the life style (eating habits and sedentary habits) of the people.

Conclusion

Normative values of selected anthropometric variables of Nigerians fall within the upper and lower bounds of the 95% confidence interval of the distribution. The male participants had higher weight, height, hip circumference, waist-hip ratio and waist circumference, while the female had higher BMI and percent body fat. All anthropometric measures were lowest for the <10 year age group, increased steadily thereafter and dropped at the 70+ age group. The values of this study can serve as a data for the Nigerian population.

The survey can be a guide in standard examination procedures, analysis and evaluation, especially in fitness and weight control programs of Nigerians. It can be a guide for health practitioners to compare clinical data of patients to those of healthy persons. The normative data can be useful in reducing the risk of improper examination interpretation.

It is recommended that studies of similar large samples on the anthropometric measures of Nigerians (urban and rural) be carried out in other parts of the country.

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