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Anthropometric indices of male and female Nigerians of different age groups

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Summary

The body weight (W), height (H), Quetelet index W/H^2), and Ponderosity index (W/H^3) of 1,040 healthy (520 male and 520 female) volunteers (age ranged from 6-80 years) from various urban and rural communities in Oyo and Osun States, Nigeria were measured. We observed that the subjects body weight, height and Quetelet index increased with chronological age uptil the third decade of life (20-29 years) when they peaked and gradually declined thereafter. The combined mean data for all ages revealed that males were significantly ($p < 0.001$) taller and heavier than the females. The Quetelet of index of the males were comparable ($p > 0.05$) to the females, but the Ponderosity index of the females were significantly ($p < 0.001$) higher than the males. The anthropometric normative data presented in this study will find useful application in bariatric practice in Nigeria. It will serve as a reference to which patients data in Oyo and Osun States can be compared.

Résumé

Nous avons mesuré le poids (W), la taille (H), l'index Quetelet (W/H^2) et l'index de pondérosité (W/H^3) de 1040 volontaires (520 hommes et 520 femmes) âgés de 6-80 ans de différentes communautés urbaines et rurales dans l'état d'Oyo et Osun, au Nigéria. Nous avons observé que le poids, la taille et l'index Quetelet de chaque sujet augmetait selon l'âge chronologique jusqu'a la troisième décennie (de 20 à 29 ans) où ils atteignent le maximum et déclinent graduellement par la suite. Les chiffres moyens des données pour tous les ages ont montré que les hommes avaient une taille et un poids ($P < 0.001$) beaucoup plus que les femmes. L'index Quetelet des hommes était comparable ($P > 0.05$) à celui des femmes mais l'index de pondérosité des femmes était beaucoup plus élevé ($P < 0.001$) que celui des hommes. Les données anthropométriques normatives relevées dans cette étude pourraient avor une bonne application pour la pratique bariatrique au Nigéria. Elles pourraient servir de références pour la comparaison des données de d'autres patients de l'Etat d'Oyo et Osun.

Introduction

Assessment of body composition in infants and adults has been of research interest for many years[1,2]. Anthropometric studies have enhanced the understanding of human growth, maturation and ageing processes. Currently there is growing appreciation of the relevance of body composition evaluation in the diagnosis and prevention of chronic diseases such as obesity, hyperlipidemia, diabetes, hypertension and certain musculo- skeletal disorders[2].

In developed countries, population specific anthropometric data are used to identify individuals with growth disorders, as well as to assess the nutritional status of the healthy and of patients[2]. In Africa, where famine, war and other natural disasters are not uncommon, anthropometric data has potential for clinical use to evaluate the biologic impact of food deprivation. Unfortunately, there is paucity of anthropometric data on Africans.

Normative data on the body composition of Nigerians are few[3-9] and majority of the existing data are for children under 5 years of age[3-7]. In these studies[3-9], body weight, stature, arm circumference and skin fold thickness were measured, but data on body adiposity of Nigerians is not available. In other populations, derivates of body weight and height are commonly used as estimates of

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body adiposity[2,10]. There is currently lack of agreement as to the best index[2] but the two widely used are Quetelet and Ponderosity indices.

In our recent work[11], we found that body weight, Quetelet index and triceps skinfold thickness are strong determinants of blood pressure of Nigerian children. Our findings suggest that anthropometric indices can be used as markers of hypertension in Nigerian children[11]. Similarly, we have also found that anthropometric indices are valid predictors of certain upper and low extremities[12,13] and back[14] muscle strength. Currently, there is dearth of anthropometric data on adolescent and adult Nigerians to which patients' data can be compared.

In this report, we present the body weight, height, Quetelet index and Ponderosity index distribution of male and female Nigerians at different ages.

Materials and methods

A cross-sectional purposive (judgmental) sampling technique[15] was employed in this study. A basic assumption of the purposive sampling technique is that possible errors of judgement in selection, will in general tend to balance out, thus providing a typical sample of the population[15]. Prior to data collection, we purposely decided to recruit 130 (65 males and 65 females) subjects at each decade of life in our community.

We recruited 1,040 healthy (520 male and 520 female) volunteers from various urban and rural communities in Oyo and Osun States, Nigeria. Specifically, the subjects under 30 years of age, were recruited from different primary, secondary and post-secondary schools in Ile-Ife. The other subjects were recruited from the communities markets and industries in Ile-Ife, Ilesha, Oshogbo and Ibadan. The subjects motivation for participating was the opportunity to have an objective assessment of their body weight and height. The sample represented various age groups (ranging from 6-80 years), different socioeconomic classes and occupations. Pregnant women were excluded from the study.

Following a brief interview to elicit the subjects age, we measured all the participants weight and height with a weighing scale and meter rule, respectively. The weighing scale was regularly calibrated against standard known weights. Weight was measured with minimal clothing while height was measured barefooted. Subsequently, we computed the Quetelet and Ponderosity indices of each subject using standard formulae[10]:

$$\text{Quetelet index} = \frac{\text{Weight (kg)}}{\text{Height (m)}^2}$$

$$\text{Ponderosity index} = \frac{\text{Weight (kg)}}{\text{Height (m)}^3}$$

For data analysis, the subjects were stratified into 8 groups using 10 years interval as classification criteria. A one-way analysis of variance (ANOVA) was used to determine differences in the anthropometric indices across the 8 age groups. Scheffé post-hoc test was employed to evaluate significant differences between the various means. The student t-test was used to determine differences in the anthropometric indices between sexes. Pearson product moment correlation coefficient (r) was calculated to determine relationship between age, body weight, height, Quetelet and Ponderosity indices. The above statistical procedures were performed on an IBM - 370 computer using the SPSS statistical software.

Results

The physical characteristics of the subjects at the different age groups is presented in Fig. 1. The graph showed that height, body weight and Quetelet index increased with chronological age up till the third decade of life (20-29 years) when they peaked and gradually declined. Quetelet index and body weight also increased from the fourth decade of life (30-39 years) and again peaked at the sixth decade of life (50-59 years) after which a progressive decline was obtained thereafter.

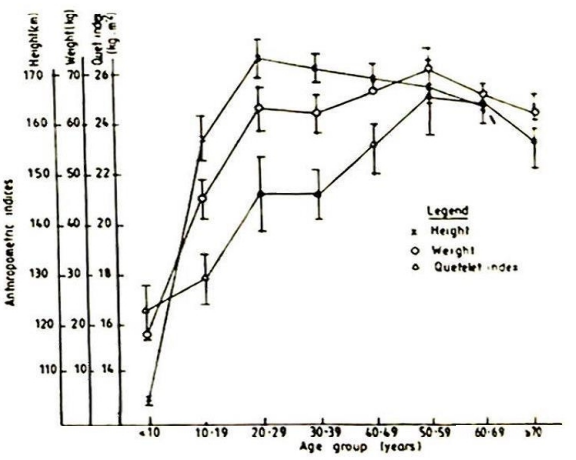

Fig. 1: Anthropometric paramaters at the different age groups

A summary of the one way ANOVA and Scheffé post-hoc test for height, body weight, Quetelet index and Ponderosity index are presented in Tables 1, 2, 3 and 4, respectively. The result of the ANOVA revealed significant main effects between groups for all the anthropometric indices. The Scheffé post-hoc analyses also indicated that in general, there was significant differences ($p < 0.05$) in anthropometric parameters with each corresponding decade (Tables 1-4).

Table 1: Summary of the analysis of variance and Scheffé post hoc test for height

Source	Df	SS	MS	F-ratio	P-value
Between groups	7	423360	60480	1163	0.001
Within groups	1033	53264	52		
Total	1040	476624			

Age groups (years)	Mean ± SD (cm)	Age groups (years)							
		Less than 10	10-19	20-29	30-39	40-49	50-59	60-69	≥ 70
Less than 10	104.9 ± 4.8		+	+	+	+	+	+	+
10 - 19	156.5 ± 9.8			+	+	+	+	+	+
20 - 29	167.7 ± 9.2				—	—	—	+	+
30 - 39	167.2 ± 7.3					—	—	+	+
40 - 49	166.1 ± 7.0						—	+	+
50 - 59	165.8 ± 6.7							+	—
60 - 69	162.0 ± 6.4								—
≥ 70	164.3 ± 5.0								

+ indicate that the contrast is statistically significant at 0.05 alpha level.
— indicate that the contrast is not statistically significant at 0.05 alpha level.

Table 2: Summary of the analysis of variance and Scheffé post hoc test for body weight

Source	Df	SS	MS	F-ratio	P-value
Between groups	7	271813	38830	747	0.001
Within groups	1033	54037	52		
Total	1040	325850			

Age groups (years)	Mean ± SD (kg)	Age groups (years)							
		Less than 10	10-19	20-29	30-39	40-49	50-59	60-69	≥ 70
Less than 10	17.5 ± 4.8		+	+	+	+	+	+	+
10 - 19	44.5 ± 9.8			+	+	+	+	+	+
20 - 29	59.4 ± 9.2				+	+	+	+	—
30 - 39	63.7 ± 7.3					—	+	—	—
40 - 49	64.7 ± 7.0						+	—	+
50 - 59	70.2 ± 6.7							—	+
60 - 69	65.5 ± 6.4								+
≥ 70	60.9 ± 5.0								+

+ indicate that the contrast is statistically significant at 0.05 alpha level.
— indicate that the contrast is not statistically significant at 0.05 alpha level.

Table 3: Summary of the analysis of variance and Scheffé post hoc test for Quetelet index

Source	Df	SS	MS	F-ratio	P-value
Between groups	7	10308	1473	164	0.001
Within groups	1033	8855	9		
Total	1040	19163			

Age groups (years)	Mean ± SD ($kg.m^{-2}$)	Age groups (years)							
		Less than 10	10-19	20-29	30-39	40-49	50-59	60-69	≥ 70
Less than 10	16.1 ± 1.9		+	+	+	+	+	+	+
10 - 19	18.0 ± 2.4			+	+	+	+	+	+
20 - 29	21.2 ± 3.0				+	+	+	+	+
30 - 39	23.0 ± 4.0					—	+	+	—
40 - 49	23.4 ± 2.9						+	+	—
50 - 59	25.8 ± 3.1							—	+
60 - 69	25.2 ± 3.3								+
≥ 70	22.6 ± 2.4								

\+ indicate that the contrast is statistically significant at 0.05 alpha level.
— indicate that the contrast is not statistically significant at 0.05 alpha level.

Table 4: Summary of the analysis of variance and Scheffé post hoc test for Penderosity index

Source	Df	SS	MS	F-ratio	P-value
Between groups	7	2035	291	58	0.001
Within groups	1033	4736	5		
Total	1040	6771			

Age groups (years)	Mean ± SD ($kg.m^{-2}$)	Age groups (years)							
		Less than 10	10-19	20-29	30-39	40-49	50-59	60-69	≥ 70
Less than 10	15.6 ± 2.2		+	+	+	+	—	—	+
10 - 19	11.6 ± 1.7			+	+	+	+	+	+
20 - 29	12.6 ± 20				+	+	+	+	+
30 - 39	13.8± 2.6					—	+	+	—
40 - 49	14.2 ± 1.9						+	+	+
50 - 59	15.7 ± 2.4							—	+
60 - 69	15.7± 2.5								+
≥ 70	13.8± 1.6								

\+ indicate that the contrast is statistically significant at 0.05 alpha level.
— indicate that the contrast is not statistically significant at 0.05 alpha level.

The anthropometric indices of the male and female subjects at the different decades of life are presented in Tables 5-8. After the first decade of life, the males in our study were significantly ($p < 0.05$) taller than the females uptil the eighth decade of life when body sexes has comparable ($p > 0.05$) height. The combined data for all ages revealed that males were significantly ($p < 0.001$) taller than the females (Table 5). In general, the males in our study were heavier ($p < 0.05$) than the females exception were in the fourth, sixth and seventh decades of life (Table 6). Similarly, the Quetelet index data of the males were comparable ($p > 0.05$) to the females except in the first, fourth and sixth decades of life (Table 7).

The Ponderosity index of the females were significantly ($p < 0.001$) higher than the males except in the first and seventh decades of life. The combined Ponderosity index data for all ages revealed that the females had higher ($p < 0.001$) body adipository than males (Table 8).

Table 5: Comparison of the male and female subjects height (cm)

Age group	Males		Females		%	t-value	P-value
(years)	n	Mean ± SD	n	Mean ± SD	difference		
Less than 10	65	104.5 ± 5.3	65	103.7 ± 4.3	0.8	1.02	0.308
10 - 19	65	158.9 ± 9.4	65	153.8 ± 9.5	3.2	3.04	0.003
20 - 29	65	173.3 ± 8.1	65	162.1 ± 6.4	6.5	8.78	0.001
30 - 39	65	171.9 ± 6.2	65	162.5 ± 5.1	5.5	9.44	0.001
40 - 49	65	169.0 ± 5.9	65	163.3 ± 6.8	3.4	5.17	0.001
50 - 59	65	167.6 ± 6.1	65	164.1 ± 6.8	2.1	3.14	0.002
60 - 69	65	163.3 ± 6.8	65	160.7 ± 5.8	1.6	2.35	0.020
≥ 70	65	163.8 ± 5.2	65	164.8 ± 4.8	0.6	-1.12	0.263
6 - 80	520	159.0 ± 22.1	520	154.4 ± 20.5	2.9	4.16	0.001

SD = Standard deviation

Table 6: Comparison of the male and female subjects body weight (kg)

Age group	Males		Females		%	t-value	P-value
(years)	n	Mean ± SD	n	Mean ± SD	difference		
Less than 10	65	18.0 ± 1.8	65	16.9 ± 2.4	6.2	2.95	0.004
10 - 19	65	45.7 ± 7.8	65	43.1 ± 9.3	5.8	1.76	0.081
20 - 29	65	63.1 ± 6.8	65	55.7 ± 8.4	11.8	5.54	0.001
30 - 39	65	62.5 ± 8.1	65	65.0 ± 9.9	3.9	-1.62	0.109
40 - 49	65	66.7 ± 7.5	65	62.8 ± 9.4	5.8	2.60	0.010
50 - 59	65	70.4 ± 7.6	65	71.3 ± 5.3	1.2	-0.76	0.448
60 - 69	65	66.0 ± 6.3	65	65.1 ± 6.8	1.4	0.82	0.416
≥ 70	65	65.4 ± 4.7	65	59.4 ± 4.5	9.1	3.62	0.001
6 - 80	520	56.8 ± 17.5	520	54.9 ± 18.0	1.2	1.77	0.001

SD = Standard deviation

Table 7: Comparison of the male and female subjects Quetelet index ($kg.m^{-2}$)

Age group (years)	Males		Females		% difference	t-value	P-value
	n	Mean ± SD	n	Mean ± SD			
Less than 10	65	16.5 ± 1.6	65	15.8 ± 2.2	4.6	2.29	0.024
10 - 19	65	17.9 ± 1.9	65	18.0 ± 2.9	0.6	-0.24	0.815
20 - 29	65	21.2 ± 2.7	65	21.2 ± 3.3	0.0	-0.14	0.891
30 - 39	65	21.1 ± 2.5	65	24.9 ± 4.3	15.1	-6.12	0.001
40 - 49	65	23.3 ± 2.3	65	23.5 ± 3.3	1.0	-0.47	0.642
50 - 59	65	25.2 ± 3.1	65	26.5 ± 3.0	4.9	-2.76	0.007
60 - 69	65	25.0 ± 3.3	65	25.4 ± 3.4	1.5	-0.67	0.502
≥ 70	65	23.4 ± 2.4	65	21.9 ± 2.2	6.3	3.64	0.001
6 - 80	520	21.7 ± 3.9	520	22.2 ± 4.7	2.1	1.70	0.090

SD = Standard deviation

Table 8: Comparison of the male and female subjects Ponderosity index ($kg.m^{-3}$)

Age group (years)	Males		Females		% difference	t-value	P-value
	n	Mean ± SD	n	Mean ± SD			
Less than 10	65	15.9 ± 2.0	65	15.2 ± 2.3	4.0	1.66	0.098
10 - 19	65	11.5 ± 1.5	65	11.7 ± 1.8	1.9	-0.76	0.045
20 - 29	65	12.1 ± 1.6	65	13.2 ± 2.3	7.8	-2.97	0.004
30 - 39	65	12.3 ± 1.6	65	15.3 ± 2.7	19.3	-7.67	0.01
40 - 49	65	13.8 ± 1.6	65	14.5 ± 2.2	4.8	-2.10	0.038
50 - 59	65	15.2 ± 2.2	65	16.3 ± 2.4	6.8	-2.76	0.007
60 - 69	65	15.4 ± 2.5	65	15.9 ± 2.5	2.8	-1.03	0.305
≥ 70	65	1.43 ± 1.7	65	13.3 ± 1.5	6.7	3.47	0.001
6 - 80	520	13.8 ± 2.4	520	14.4 ± 2.7	4.2	3.85	0.001

SD = Standard deviation

The correlation matrix showing the relationship between physical characteristic indices is presented in Table 9. Significant ($p < 0.01$) positive correlations were obtained between age, body weight, height, and Quetelet index. However, an inverse relationship was obtained between height and Ponderosity index ($p < 0.001$). As would be expected, body weight and height were the two anthropometric parameters most highly correlated.

Table 9: Relationship[a] between age and anthropometric indices (N = 1040)

	Age	Height	Body weight	Quetelet index	Ponderosity index
Age					
Height	0.53**				
Body weight	0.65**	0.85**			
Quetelet index	0.59**	0.45**	0.83**		
Ponderosity index	0.12*	-0.38**	0.18*	0.68*	

[a]Pearson product moment correlation coefficient
*$p < 0.05$; **$p < 0.001$

Discussion

The primary objective of this study was to compile anthropometric norms that could be used for general reference in our population. Anthropometric normative data for other population may not be valid for Nigerians because of the variation in the growth pattern across races[2,16]. Only two previous studies[8,9] have reported on the body weight and height norms of adult Nigerians. To our knowledge, this study is the first to document the Quetelet and Ponderosity indices normative data for male and female Nigerians of different ages.

A summary of the mean height and body weight data reported in the two earlier studies[8,9] is presented in Table 10. The two reference studies were conducted in Lagos[8], and Kainji Lake area of Kwara State[9]. Our mean height and body weight data are comparable with the values reported in the two earlier studies[8,9]. The standard deviation in our study is generally higher than in the two reference studies because of the wider age range of our sample. Detailed comparison of the data is made difficult because of the different age grouping used in our study and the two earlier studies[8,9].

Table 10: Summary of the mean height and body weight in previous studies on Nigerian adolescents and adults

Reference	Height (cm)	Body weight (kg)
Male norms		
Lagos (Johnson[8])	168	59.7 — 61.9
Kainji (Adekolu-John[9])	160.3 ± 11.6	53.5 ± 10.3
Oyo/Osun States (Present study)	159.0 ± 22.1	56.8 ± 17.5
Female norms		
Lagos (Johnson[8])	159	55.2 — 58.2
Kainji (Adekolu-John[9])	154.9 ± 9.0	51.0 ± 10.7
Oyo/Osun States (Present study)	154.4 ± 20.5	54.9 ± 18.0

Body composition studies is still at its infancy in Africa because of lack of the required equipment for such investigation in most developing countries. In an ideal setting, body adiposity is measured by densitometric, radiographic, ultrasonographic, and bioelectrical impedance techniques[2]. More reliable and sensitive clinical information will no doubt be provided by the above testing procedures; however,

the cost of the equipment is prohibitive. Clinicians in developing countries will continue to rely on the use of simple testing devices to monitor changes in body composition.

The use of stadiometer though less sensitive to changes in body composition is however valid because of the significant correlations obtained between age and the anthropometric indices (Table 9). Body surface area is yet another easily monitored anthropometric index that can be used to evaluate growth pattern. Currently, normative data for body surface area amongst Nigeria is lacking. The normative data presented in this study can be used in bariatric practice as a reference to which patients in Oyo and Osun States, Nigeria can be compared. The external validity of our study is delimited to the two states because of the plausible variation in growth pattern amongst Nigerians. It is hereby recommended that anthropometric studies should be undertaken in other parts of Nigeria to support the above speculation.

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