RBCDH Revista Brasileira de CINEANTROPOMETRIA e Desempenho Humano

DOI: http://dx.doi.org/10.5007/1980-0037.2014v16n5p494

original article

Anthropometric reference values for community-dwelling older adults from northeastern Brazil

Valores antropométricos de referência para idosos residentes em comunidade do nordeste Brasileiro

Adriano Rodrigues Brandão Correia[1]
Raildo da Silva Coqueiro[1]
Mateus Carmo Santos[1]
João de Souza Leal Neto[1,2]
Bruno Morbeck de Queiroz[1,2]
Aline Rodrigues Barbosa[1,2]
Marcos Henrique Fernandes[1]

Abstract – The aging process is continuous and irreversible and is characterized by physiological and structural alterations and changes in body composition. The aim of this study was to report anthropometric reference values for community-dwelling older adults from northeastern Brazilaccording to gender and age group. This cross-sectional study used data from an epidemiological population-based study involving 316 older adults. The following measures and anthropometric indicators were evaluated: weight, height, body mass index (BMI), triceps skinfold (TSF), waist circumference, arm circumference, calf circumference, and arm muscle circumference (AMC). All data are reported as means, standard deviations, and percentiles. Comparisons between age groups were performed using one-way ANOVA. The study included 173 women (54.7%) and 143 men (45.3%). Body weight and BMI were higher in younger women (60-64 years) compared to older ones (80 years or older). Arm circumference, TSF and AMC were lower in women aged ≥ 75 years compared to women aged 60-64 years. For men, arm circumference and AMC were lower in the oldest age group (≥ 80 years) compared to the youngest group (60 to 74 years). These differences were significant. The present study indicates that changes in body measures occur differently between genders with advancing age. The reduction in muscle mass and body fat is more prominent in women than in men and anthropometric changes are more noticeable in the older age group.

Key words: Aging; Anthropometry; Elderly health; Nutritional status; Reference values.

Resumo – *O processo de envelhecimento é contínuo e irreversível, no qual podem ser observadas alterações fisiológicas, estruturais e na composição corporal. O objetivo deste estudo foi apresentar valores antropométricos de referência para idosos residentes em comunidade do Nordeste do Brasil, de acordo com sexo e grupo etário. Trata-se de estudo descritivo, baseado em dados originados de uma pesquisa epidemiológica, de base populacional, envolvendo 316 idosos. Foram avaliadas as seguintes medidas e indicadores antropométricos: massa corporal, estatura, índice de massa corporal (IMC), dobra cutânea tricipital (DCT), perímetros da cintura, do braço e da panturrilha e a circunferência muscular do braço (CMB). Os dados foram apresentados como médias, desvios padrões e percentis. Comparações entre grupos etários foram realizadas por Anova one-way. Participaram do estudo 173 mulheres (54,7%) e 143 homens (45,3%). Os valores de massa corporal e IMC foram maiores nas mulheres de 60-64 anos, comparadas às mulheres com 80 anos e mais. Os valores do PB, DCT e da CMB foram menores nas mulheres de 75 anos e mais, comparadas às mulheres do grupo etário de 60-64 anos. Para os homens, os valores de PB e CMB foram menores nos indivíduos do grupo etário velhos (≥ 80 anos), comparado aos homens de 60 a 74 anos Essas diferenças foram significativas. Os resultados indicam a ocorrência de alterações nas dimensões corporais, distintas entre os sexos, com o avanço da idade. A redução da massa muscular e da gordura corporal é mais acentuada nas mulheres e as alterações antropométricas são mais perceptíveis no grupo etário mais velho.*

Palavras-chave: *Antropometria; Envelhecimento; Estado nutricional; Valores de referência; Saúde do idoso.*

1 Universidade Estadual do Sudoeste da Bahia. Departamento de Saúde. Núcleo de Estudos em Epidemiologia do Envelhecimento. Jequié, BA. Brasil

2 Universidade Federal de Santa Catarina. Programa de Pós-Graduação em Educação Física. Centro de Desportos. Florianópolis, SC. Brasil.

Received: 29 October 2013
Accepted: 3 March 2014

INTRODUCTION

Physiological and structural alterations and changes in body composition occur during the process of aging, which involve a reduction in height, muscle mass and bone mass and an increase in body fat[1,2]. Body weight increase until about 75 years of age[3-5] and the pattern of body fat distribution undergoes changes characterized by a reduction in subcutaneous fat and an increase in visceral and intramuscular fat[6].

Body measures reflect the general health and well-being of individuals and populations and are widely used for the evaluation of nutritional status based on anthropometric measures and indicators. Anthropometry is a method of determining body measures that can be easily applied in clinical practice, health services and epidemiological studies since it is noninvasive and inexpensive[7].

In the 1990s, the World Health Organization published recommendations[8] for each country to develop its own anthropometric reference data in view of the diversity among populations in terms of genetic, environmental, socioeconomic, cultural, lifestyle, and health conditions, among others[9]. Anthropometric reference values were published for the elderly population of the United States[3], Italy[9] and Ireland[10] in order to distinguish this population and to accurately evaluate anthropometric characteristics and nutritional status. Studies conducted in Chile[11], Cuba[5] and Mexico[12] reported anthropometric reference data for the elderly population of their respective capitals.

In Brazil, a literature search (Scopus, Medline and Lilacs) identified four studies reporting anthropometric reference values for noninstitutionalized older adults from specific localities, including three cross-sectional studies and one longitudinal study. The cross-sectional studies involved older adults living in the cities of São Paulo[4], Joinvile[13] and Fortaleza[14]. The follow-up study was conducted in São Paulo[15]. However, the study conducted in Fortaleza[14] reported only indicators of fat and muscle mass. These studies provided reference data that could be used in clinical practice and surveillance studies of elderly populations with similar characteristics.

Since Brazil is a large, multiracial country characterized by cultural, economic and social diversity, anthropometric studies conducted in different localities, in addition to reflecting regional characteristics, may serve as a reference for similar populations. Therefore, the objective of the present study was to report anthropometric reference values for noninstitutionalized older adults from a small town in the northeastern region of Brazil according to age and gender.

METHODOLOGICAL PROCEDURES

Participants

This was a descriptive study using data from a cross-sectional epidemiological population-based household study, called “Nutritional status, risk behaviors and health conditions of older adults from Lafaiete Coutinho, Bahia". Data regarding the characteristics of the municipality studied, population and data collection have been published previously[16] and will be summarized briefly.

The study population was identified by a census (January 2011) and all subjects aged 60 years or older who lived in the urban area (n = 355) were contacted to participate in the study. The households were localized based on data from the Family Health Strategy (Estratégia Saúde da Família) program, which covers 100% of the municipality. A total of 316 subjects (89%) participated in the study; 17 (4.8%) subjects refused to participate and 22 (6.2%) could not be localized after three home visits on alternate days and were considered to be losses.

The data were collected in two steps: first, a home interview was conducted and then the anthropometric measurements were performed at the two Family Health Units of the municipality. The second step was scheduled at an interval of 1 to 3 days after the home interview.

The study protocol was approved by the Ethics Committee of Universidade Estadual do Sudoeste da Bahia (Permit No. 064/2010) and was conducted in accordance with the Declaration of Helsinki of the World Medical Association.

Anthropometry: procedures and instruments

The anthropometric data were collected by three students of the Physical Education course who received theoretical and practical training in order to standardize the anthropometric techniques. The precision and accuracy of the examiners had been confirmed prior to data collection in 20 volunteers by the analysis of inter- and intraexaminer technical errors of measurement[17]. All examiners showed precision and accuracy compatible with those of experienced examiners.

Body weight was measured with a portable digital scale (Zhongshan Camry Electronic scale, G-Tech Glass 6, China), with the subject barefoot and wearing minimum clothing. Height was measured as described by Frisancho[18] using a compact portable stadiometer (Wiso, China).

The circumference parameters were measured with an inelastic anthropometric tape and triceps skinfold (TSF) was measured with a skinfold caliper (WCS, Brazil). Waist circumference was measued at the level of the umbilical scar. Arm and calf circumferences were measured as described by Callaway et al.[19]. TSF was obtained according to Harrison et al.[20]. All anthropometric measurements, except for body weight, were obtained in triplicate and the mean values were used for analysis. The body mass index [BMI = body weight (kg)/height^2 (m^2)] and arm muscle circumference [AMC = arm circumference – π x TSF] were calculated.

Statistical analysis

Means, standard deviations and percentiles (P5, P10, P25, P50, P75, P90 and P95) were calculated according to gender and age group (60-64, 65-

69, 70-74, 75-79 and ≥ 80 years). One-way analysis of variance (ANOVA) and Tukey's and Bonferroni's tests (multiple comparisons) were used to determine differences between the means of the anthropometric variables according to age group. The level of significance was set at 5% ($\alpha = 0.05$). All analyses were performed using the IBM SPSS Statistics software for Windows (IBM SPSS. 21.0, 2012, IBM Corp., Armonk, NY).

RESULTS

A total of 173 women (54.7%) ranging in age from 60 to 103 years (74.9 ± 10.0 years) and 143 men ranging in age from 60 to 105 years (73.4 ± 9.4 years) were studied. All measurements were performed on subjects who were able to walk. Bedridden subjects (n = 5) and wheelchair users (n = 2) were excluded and 12 subjects refused to perform the measurements.

Table 1 (women) and Table 2 (men) show the body weight, height and BMI (means, standard deviations and percentiles) according to age group. Body weight and BMI were higher in women aged 60-64 years when compared to women aged 80 years or older. When women of the youngest age group (60-64 years) were compared to the oldest age group (≥ 80 years), the reductions in the values of the 2nd quartile were 17.5% (10.8 kg) and 17.9% (5 kg/m^2) for body weight and BMI, respectively. No differences between age groups were observed for body weight and BMI in men and for height in men or women.

Table 1. Body weight, height and body mass index of women ≥ 60 years.

Variable	Age group (years)	n	Mean†	SD	Percentile						
					5th	10th	25th	50th	75th	90th	95th
Body weight (kg)*											
	60-64	29	62.17^{a}	12.61	43.10	47.30	53.00	61.80	70.05	81.00	90.10
	65-69	28	55.41^{ab}	13.69	34.83	40.00	45.85	55.90	64.00	71.34	88.04
	70-74	31	56.79^{ab}	11.29	38.74	40.98	50.40	56.40	63.00	72.90	82.02
	75-79	24	56.52^{ab}	8.97	43.10	44.95	49.12	55.45	64.12	68.75	75.55
	≥80	49	51.40^{b}	10.35	34.30	36.90	44.55	51.00	58.05	65.80	72.15
Height (m)											
	60-64	29	1.51	0.07	1.35	1.40	1.48	1.51	1.55	1.58	1.64
	65-69	28	1.49	0.06	1.38	1.40	1.45	1.50	1.53	1.58	1.59
	70-74	31	1.49	0.06	1.38	1.42	1.44	1.48	1.53	1.58	1.60
	75-79	24	1.48	0.06	1.35	1.41	1.45	1.49	1.53	155	1.57
	≥80	50	1.47	0.06	1.37	1.38	1.42	1.47	1.52	1.53	1.58
BMI (kg/m^2)*											
	60-64	29	27.34^{a}	5.25	19.97	20.68	22.92	27.94	32.15	34.36	37.40
	65-69	28	24.77^{ab}	5.31	16.19	18.65	21.17	24.40	27.63	32.61	37.77
	70-74	31	25.63^{ab}	4.94	16.66	19.00	22.59	25.38	29.22	32.68	34.75
	75-79	24	25.69^{ab}	3.40	20.29	21.78	22.64	25.18	28.07	30.80	33.02
	≥80	49	23.88^{b}	4.96	16.03	17.83	20.36	22.94	26.84	30.73	32.65

SD, standard deviation; BMI, body mass index. *$p \leq 0.05$, significant difference in mean values between age groups (analysis of variance). †Means followed by different superscript letters differ significantly (Tukey test).

Table 2. Body weight, height and body mass index of men ≥ 60 years.

Variable	Age group (years)	n	Mean	SD	Percentile						
					5th	10th	25th	50th	75th	90th	95th
Body weight (kg)											
	60-64	23	63.74	12.82	41.52	49.00	52.60	62.20	73.00	80.84	92.76
	65-69	30	62.55	12.41	42.98	49.80	53.27	60.20	70.45	83.91	90.68
	70-74	26	65.41	13.60	47.28	48.71	55.47	63.20	74.45	86.36	94.10
	75-79	21	66.03	13.19	40.12	51.28	58.05	65.50	74.85	83.16	96.23
	≥80	35	56.92	12.59	39.30	40.96	45.90	57.30	66.00	71.18	80.80
Height (m)											
	60-64	23	1.64	0.07	1.51	1.55	1.59	1.61	1.69	1.75	1.79
	65-69	30	1.63	0.08	1.51	1.54	1.57	1.62	1.68	1.73	1.77
	70-74	26	1.62	0.08	1.50	1.53	1.56	1.61	1.68	1.75	1.81
	75-79	21	1.62	0.06	1.50	1.54	1.56	1.63	1.67	1.71	1.72
	≥80	35	1.59	0.08	1.45	1.50	1.54	1.58	1.64	1.70	1.77
BMI (kg/m^2)											
	60-64	23	23.68	4.49	17.68	18.08	20.22	23.36	26.45	29.48	35.76
	65-69	30	23.54	4.21	16.87	18.49	20.08	23.61	26.43	29.73	31.21
	70-74	26	24.65	3.44	19.70	20.70	21.96	23.64	27.93	29.50	31.74
	75-79	21	25.13	4.22	16.24	20.65	22.40	25.30	27.33	29.41	36.55
	≥80	35	22.30	4.03	15.39	17.13	19.11	22.69	24.75	28.96	29.44

SD, standard deviation; BMI, body mass index.

The distributions (means, standard deviations and percentiles) for arm circumference, AMC, TSF and waist and calf circumferences are shown in Tables 3 and 4 for women and men, respectively. In women, arm circumference and AMC were higher in the age group of 60-64 years compared to women aged ≥75 years and ≥80 years, respectively. In men, a significant difference was observed for arm circumference, with higher values in the age group of 70-79 years compared to the oldest adults (≥ 80 years). AMC was higher in men aged 60-74 years when compared to the oldest age group (≥ 80 years).

There was a significant difference in TSF and calf circumference according to age group in women. Reductions in these two parameters were observed at 75 years and 80 years, respectively.

DISCUSSION

A literature search (Scopus, Medline, Lilacs) indicates that this is the first population-based household study conducted in northeastern Brazil which reports gender- and age-specific reference values (means and percentiles) of the main anthropometric measures and indicators for noninstitutionalized older adults.

The results showed more expressive changes in women when compared to men. In women, body weight, BMI, TSF and calf circumference differed

Table 3. Anthropometric values obtained for women ≥ 60 years.

Variable	Age group (years)	n	Mean†	SD	Percentile						
					5th	10th	25th	50th	75th	90th	95th
Arm circumference (cm)*											
	60-64	29	30.65[a]	4.36	24.33	25.23	27.28	30.60	33.50	30.96	41.43
	65-69	28	28.38[ab]	4.43	20.14	22.56	25.60	27.91	31.32	35.81	37.44
	70-74	31	28.31[ab]	3.66	22.10	23.05	25.93	28.30	30.03	35.07	35.91
	75-79	24	27.63[b]	2.20	23.08	24.86	26.08	27.61	29.25	30.39	32.15
	≥80	51	25.97[b]	4.34	18.29	20.78	22.86	25.96	29.03	31.67	33.93
Arm muscle circumference (cm)*											
	60-64	29	22.65[a]	2.14	18.65	19.79	21.47	22.07	24.18	25.63	26.76
	65-69	28	21.54[ab]	2.36	17.52	18.43	20.03	21.26	22.54	24.60	27.48
	70-74	31	21.46[ab]	2.21	16.72	18.15	20.24	21.53	23.29	23.73	24.73
	75-79	24	21.45[ab]	1.84	17.94	18.28	20.55	21.53	22.73	23.97	24.94
	≥80	50	20.79[b]	2.45	16.57	17.40	19.15	20.83	22.06	24.54	26.19
Triceps skinfold (mm)*											
	60-64	29	25.49[a]	9.55	12.33	14.00	16.66	23.83	31.33	38.50	46.74
	65-69	28	21.81[ab]	8.56	6.97	9.66	15.53	22.66	29.08	32.31	37.33
	70-74	31	21.82[ab]	7.04	12.06	13.27	16.16	21.83	25.66	33.80	36.90
	75-79	24	19.71[b]	5.94	11.66	12.74	16.16	17.99	22.99	29.24	34.70
	≥80	50	16.78[b]	8.16	4.06	6.55	11.16	15.74	21.66	27.68	34.95
Waist circumference (cm)											
	60-64	29	96.36	12.44	75.13	80.30	87.59	95.13	106.08	116.40	119.58
	65-69	28	90.84	12.73	68.56	75.87	80.85	91.09	98.65	105.52	117.72
	70-74	31	96.68	13.06	71.72	79.54	85.70	96.30	107.56	112.72	118.46
	75-79	23	97.89	10.14	76.51	83.34	91.23	100.33	104.33	109.66	114.21
	≥80	49	93.44	13.08	70.88	72.76	84.11	93.76	101.33	111.33	115.16
Calf circumference (cm)*											
	60-64	29	34.70[a]	2.75	30.38	30.93	32.58	34.86	36.61	38.33	40.50
	65-69	28	32.93[ab]	3.39	26.87	28.51	31.05	32.41	34.34	38.37	40.95
	70-74	31	33.71[a]	3.02	28.28	29.22	31.40	33.66	36.26	37.05	39.59
	75-79	24	32.52[ab]	2.43	27.50	29.55	30.83	32.21	34.10	36.03	37.22
	≥80	51	30.75[b]	3.75	23.31	24.72	28.10	30.80	33.46	35.53	36.85

SD, standard deviation. * $p \leq 0.05$, significant difference in mean values between age groups (analysis of variance). † Means followed by different superscript letters differ significantly (Tukey test).

significantly between age groups. A significant difference in arm circumference and AMC was observed in both genders.

Female body weight differed between the age group of 60-64 years and the oldest age group (≥ 80 years), with a difference of 10.7 kg (17.3%). The same reduction was not observed in men. These results differ from studies conducted in Brazil[4,15] and in other countries[3,5,9-11], which demonstrated weight reductions in both genders.

The present results showed no changes in height with increasing age in men or women. Similar results have been reported by Cheserek et al.[12] and Mastroeni et al.[13] in an international and a national study, respectively. However, the results differ from those reported in studies conducted in Italy[9],

Table 4. Anthropometric values obtained for men ≥ 60 years.

Variable	Age group (years)	n	Mean†	SD	Percentile						
					5th	10th	25th	50th	75th	90th	95th
Arm circumference (cm)*											
	60-64	23	27.76[ab]	3.56	20.71	21.88	25.90	27.20	30.90	32.56	33.10
	65-69	30	28.17[ab]	2.87	23.49	24.62	25.89	28.31	29.90	32.96	33.83
	70-74	27	28.20[a]	3.32	21.04	24.26	25.86	28.63	31.06	32.23	33.40
	75-79	21	28.00[a]	3.11	20.99	25.31	26.13	27.60	29.44	31.29	36.47
	≥80	35	25.71[b]	3.57	20.12	21.32	22.86	25.26	28.50	30.47	31.87
Arm muscle circumference (cm)*											
	60-64	23	24.21[a]	2.74	18.28	19.64	22.66	24.33	26.27	27.83	28.36
	65-69	30	24.83[a]	2.01	21.59	22.19	23.25	24.42	26.15	28.36	28.56
	70-74	27	24.53[a]	2.61	17.90	21.25	23.44	24.98	26.23	27.34	28.41
	75-79	21	23.98[ab]	1.91	18.81	21.38	23.30	24.20	24.80	26.54	27.62
	≥80	35	22.38[b]	2.50	18.73	19.39	19.97	22.75	24.10	25.50	27.20
Triceps skinfold											
	60-64	23	11.30	5.09	5.73	6.06	7.66	11.16	13.33	17.20	26.27
	65-69	30	10.61	5.55	3.60	4.68	5.87	9.24	15.33	18.44	23.24
	70-74	27	11.70	4.82	5.50	6.56	9.33	10.16	12.16	20.37	22.93
	75-79	21	12.82	5.27	5.73	6.36	9.99	12.66	14.66	19.65	28.71
	≥80	35	10.61	4.41	3.76	4.63	7.83	10.50	13.00	16.23	19.29
Waist circumference (cm)											
	60-64	23	87.39	12.28	68.82	72.85	77.60	88.30	93.90	101.40	120.67
	65-69	30	88.37	13.12	69.86	71.84	78.10	88.44	95.23	110.25	115.23
	70-74	26	91.23	11.07	74.56	76.30	81.33	91.25	102.37	106.69	110.11
	75-79	21	94.38	12.37	67.73	77.69	88.23	91.66	102.30	107.69	123.79
	≥80	35	89.26	21.53	66.43	71.99	78.20	87.36	91.96	102.59	125.80
Calf circumference (cm)											
	60-64	23	34.68	3.94	26.95	29.31	31.56	34.56	37.23	40.67	41.10
	65-69	30	34.49	3.14	29.42	30.10	32.18	34.13	36.61	38.91	40.89
	70-74	27	34.72	3.47	27.30	30.49	32.66	34.63	36.80	39.15	41.05
	75-79	21	33.66	3.25	25.50	29.75	32.11	33.50	36.28	38.26	39.40
	≥80	35	32.75	4.04	25.39	26.86	30.20	33.86	35.63	38.22	39.85

SD, standard deviation. *$p \leq 0.05$, significant difference in mean values between age groups (analysis of variance). †Means followed by different superscript letters differ significantly (Bonferroni test for arm circumference and Tukey test for arm muscle circumference).

Ireland[10], Chile[11], Cuba[5] and São Paulo[4], which showed a shorter height in older seniors compared to younger ones. The differences between results can be attributed to the peculiar characteristics of the older adults studied, or to the sample size of those studies which involved a larger number of participants, thus guaranteeing greater statistical power.

A significant reduction in BMI was only observed for women aged ≥ 80 years, a finding also demonstrated in previous studies conducted in Brazil[4] and in other countries[5,9-11]. Considering the cut-off values adopted by the Food and Nutritional Surveillance System (Sistema de Vigilância

Alimentar e Nutricional - SISVAN)[21], which classifies a BMI < 22 kg/m^2 as low weight, this condition is present in both genders in an important proportion of the population. Values < 22 kg/m^2 were observed for P10 (age groups: 60-64, 70-74 and 75-79 years) and P25 (age groups: 65-69 and ≥ 80 years) among women, and particularly for P25 among men. This finding might be related to the poor health indicators and socioeconomic conditions of the population studied[22].

In both genders, mean arm circumference was significantly lower in the older age groups, ≥ 75 years (women) and ≥ 80 years (men), suggesting a reduction with increasing age as identified in other studies[4,5,10,11]. This reduction is due to a loss of subcutaneous fat and muscle mass with advancing age[23].

With respect to muscle mass indicators, significant differences in AMC with increasing age were observed in men and women, in agreement with other studies[4,5]. Calf circumference was only reduced in women, although other authors have observed a reduction in this measurement in both genders[4,5]. Calf circumference and AMC are estimates of muscle reserves. A reduction in muscle mass is associated with sarcopenia which, in turn, can reduce functional capacity and increase the risk of falls[24].

The results showed that the differences in TSF occurred only in women and after 75 years of age, following the same trend as observed for arm circumference. These findings agree with Corish and Kennedy[10] who, studying Irish older adults, suggested that the reduction in fat mass is more intense in women than in men. However, studies conducted in Chile[11], Cuba[5] and Brazil[4] have shown a reduction in TSF in both genders. TSF is an indicator of body adiposity and is recommended for the assessment of nutritional status in older adults[7].

Male and female waist circumference did not show significant changes as a function of age. Analysis of the cut-off values related to cardiovascular risk[25] (≥ 88 cm for women and ≥ 102 cm for men) showed an increased risk for developing cardiovascular diseases in women on P25 for waist circumference (age group of 75-79 years) and especially on P50 (other age groups). In men, this condition was observed for P75 (age groups of 70-74 and 75-79 years) and P90 (age groups of 60-64, 65-69 and ≥ 80 years), indicating a lower prevalence of central obesity among men. It should be noted that the risk values were established for adults younger than 60 years and no reference values are available for older adults. The high prevalence of inadequate waist circumference among women might be explained by the postmenopausal period, which is characterized by a decrease in estrogen and a consequent increase in abdominal fat[26].

The design of the present study does not permit to determine how the anthropometric variables studied would affect the anthropometric characteristics of these older adults. In this respect, the cross-sectional design of the study limits inferences about body changes. However, the results are consistent with those of longitudinal studies.

The present study provides anthropometric reference data that can be used in clinical practice, as well as for the evaluation and follow-up of the nutritional status of older adults designed to establish public policies in communities with characteristics similar to those of the population studied.

CONCLUSION

The anthropometric data obtained here can be used as reference values for the older adults studied and for populations with similar characteristics. The present study indicates that changes in body measures occur differently between genders with advancing age.

Acknowledgements

We thank the Municipal Health Department of Lafaiete Coutinho, Bahia, and the older adults who participated in the study. The financial support of Universidade Estadual do Sudoeste da Bahia - UESB (Grants 117/2009 and 011/2010) and Fundação de Amparo a Pesquisa do Estado da Bahia - FAPESB (Grant PPP0070/2011) is acknowledged.

REFERENCES

1. Nair KS. Aging muscle. Am J Clin Nutr 2005;8(5)1:953-63.
2. Goodpaster BH, Park SW, Harris TB, Kritchevsky SB, Nevitt M, Schwartz AV, et al. The loss of skeletal muscle strength, mass, and quality in older adults: the health, aging and body composition study. J Gerontol A Biol Sci Med Sci 2006;61(10):1059-64.
3. Kuczmarski MF, Kuczmarski RJ, Najjar M. Descriptive anthropometric reference data for older Americans. J Am Diet Assoc 2000;100(1):59-66.
4. Barbosa AR, Souza JMP, Lebrão ML, Laurenti R, Marucci MF. Anthropometry of elderly residents in the city of São Paulo, Brazil. Cad Saúde Pública 2005;21(6):1929-38.
5. Coqueiro RS, Barbosa AR, Borgatto AF. Anthropometric measurements in the elderly of Havana, Cuba: Age and sex differences. Nutrition 2009;25(1):33-9.
6. Sepe A, Tchkonia T, Thomou T, Zamboni M, Kirkland JL. Aging and regional differences in fat cell progenitors - a mini-review. Gerontology 2011;57(1):66-75.
7. World Health Organization. Physical status: the use and interpretation of anthropometry. Report of a WHO Expert Committee. World Health Organ Tech Rep Ser 1995;854:1-452.
8. de Onis M, Habicht JP. Anthropometric reference data for international use: recommendations from a World Health Organization Expert Committee. Am J Clin Nutr 1996; 64(4):650-8.
9. Perissinotto E, Pisent C, Sergi G, Grigoletto F, Enzi G. Anthropometric measurements in the elderly: age and gender differences. Br J Nutr 2002; 87(2):177-86.
10. Corish CA, Kennedy NP. Anthropometric measurements from a cross-sectional survey of Irish free-living elderly subjects with smoothed centile curves. Br J Nutr 2003; 89(1):137-45.
11. Santos JL, Albala C, Lera L, Garcia C, Arroyo P, Perez-Bravo F, et al. Anthropometric measurements in the elderly population of Santiago, Chile. Nutrition 2004;20(5):452-7.
12. Velasquez-Alva MC, Irigoyen CME, Zepeda ZM, Sanchez MVM, Garcia JL, Cisneros MP, et al. Anthropometric measurements of sixty-year and older Mexican urban group. J Nutr Health Aging 2003; 7:1-5.
13. Mastroeni MF, Mastroeni SS, Erzinger GS, Marucci MFN. Antropometria de idosos residentes no município de Joinville-SC, Brasil. Rev Bras Geriatr Gerontol 2010;13(1):29-40.
14. Menezes TN, Marucci MF. Trends in body fat and muscle mass among elderly individuals in Fortaleza, Ceara State, Brazil. Cad Saude Publica 2007;23(12):2887-95.

15. Almeida MF, Marucci MF, Gobbo LA, Ferreira LS, Dourado DA, Duarte YA, et al. Anthropometric changes in the Brazilian cohort of older adults: SABE survey (health, well-being, and aging). J Obes 2013;2013:695496.
16. Leal Neto JS, Coqueiro RS, Freitas RS, Fernandes MH, Oliveira DS, Barbosa AR. Anthropometric indicators of obesity as screening tools for high blood pressure in the elderly. Int J Nurs Pract 2013;19(4):360-7.
17. Pederson D, Gore C. Erros de medição em antropometria. In: Norton K, Olds T. Antropométrica. Porto Alegre: Artmed; 2005.
18. Frisancho AR. Anthropometric standards for the assessment of growth and nutritional status. Ann Arbor: The University of Michigan Press; 1990.
19. Callaway WC, Chumlea WC, Bouchard C, Himes JH, Lohman TG, Martin AD, et al. Circumferences. In: Lohman TG, Roche AF, Martorell R; editors. Anthropometric Standardization Reference Manual. Champaign: Human Kinetics, 1988; p. 39-54.
20. Harrison GG, Buskirk RE, Carter JEL, Johnson FE, Lohman TG, Pollock ML, et al. Skinfold thicknesses. In: Lohman TG, Roche AF, Martorell R, editors. Anthropometric standardization reference manual. Champaign, Illinois: Human Kinetics, 1988. p.55-70.
21. Sistema de Vigilância Alimentar e Nutricional/SISVAN. Brasil. 2008. Available from:<http://www.fag.edu.br/professores/fabiana/Est%E1gio%20ESCOLA/protocolo_sisvan.pdf> [2013 Jan 1].
22. Instituto Brasileiro de Geografia e Estatística (IBGE). IBGE Cidades: Brasil.2010; Available from: <www.ibge.gov.br/cidadesat/xtras/perfil.php?codmun=291870> [2013 Jul 16].
23. Buffa R, Floris GU, Putzu PF, Marini E. Body composition variations in ageing. Coll Antropol 2011;35(1):259-65.
24. Fielding RA, Vellas B, Evans WJ, Bhasin S, Morley JE, Newman AB, et al. Sarcopenia: an undiagnosed condition in older adults. Current consensus definition: prevalence, etiology, and consequences. J Am Med Dir Assoc 2011;12(4):249-56.
25. Han TS, van Leer EM, Seidell JC, Lean ME. Waist circumference action levels in the identification of cardiovascular risk factors: prevalence study in a random sample. BMJ 1995;311(7017):1401-5.
26. Santosa S, Jensen MD. Adipocyte fatty acid storage factors enhance subcutaneous fat storage in postmenopausal women. Diabetes 2013;62(3):775-82.

Corresponding author

João de Souza Leal Neto
Universidade Estadual do Sudoeste da Bahia.
Departamento de Saúde. Núcleo de Estudos em Epidemiologia do Envelhecimento.
Av. José Moreira Sobrinho, S/N, Jequiezinho,
45206-190 - Jequié - BA, Brasil.
E-mail: joao.sln@hotmail.com