Changes in anthropometric indicators and gait speed in older adults: cohort study

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Abstract

Objective: To characterize changes in anthropometric indicators in older adults and investigate whether being overweight was associated with lower gait speed (GS), based on measurements taken at an interval of nine years. *Methods:* Cohort study with older adults (≥65 years), conducted in 2008-2009 (baseline) and 2016-2017 (follow-up) in the city of Campinas/SP and in Ermelino Matarazzo/SP, Brazil. Body weight, height, waist circumference (WC) and hip (HC) measurements were taken and used to determine the following indicators: body mass index (BMI), waist-to-height ratio (WHtR), waist-to-hip ratio (WHR) and conicity index (C index). The T and Wilcoxon tests for paired samples were used to estimate the differences. *Results:* Information from 537 older adults (70.0% women) with a mean age of 72.2 years at baseline and 80.7 years at follow-up were analyzed. After nine years, the men showed significant decreases in weight, height and BMI, and an increase in the C index. In women, decreases in weight, height and BMI, and increases in WC, HC, WHtR, WHR and C index were observed. The percentage variations observed were: -3.89% (weight), -0.36% (height), -4.18% (BMI) and +2.27% (C index) among men; -2.95% (weight), -0.65% (height), -0.73% (BMI), +3.33% (WC), +1.59% (HC), +3.45% (WHtR), +2.27% (WHR) and +4.76% (C-Index) among women. Being overweight was associated with greater odds ratio of stability and new cases of lower GS at follow-up. *Conclusion:* Changes were identified in weight, height, BMI, and indicators of abdominal obesity, especially in women, together with an association between being overweight and lower GS.

Key words: Aged. Anthropometry. Body Composition. Gait. Obesity, Abdominal. Longitudinal Studies.

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Funding: CAPES/PROCAD, Nº do processo 2972/2014-01, FAPESP Nº 2016/00084-8, CNPq Nº 424789/2016-7. Post-doctoral scholarship for D. A. PNPD/CAPES, Nº do processo: 88887.320898/2019-00.
The authors declare there are no conflict in the conception of this work.

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Received: November 28, 2021
Approved: March 22, 2022

http://dx.doi.org/10.1590/1981-22562022025.210238.en

INTRODUCTION

The aging process, or senescence, is associated with changes in body composition that include a reduction in muscle and bone tissue, and an increase in and redistribution of adipose tissue[1,2]. The loss of muscle tissue causes a decrease in the basal metabolic rate, predisposing older adults to weight gain[1,2], together with higher incidence of chronic non-communicable diseases (CNCDs), regardless of age, sex and body composition[3].

Loss of muscle mass loss and increased fat mass heighten the risk of mortality[4-6] and produce negative effects on health and quality of life, including a decline in gait speed[7,8] and functional capacity[6,9-11], higher occurrence of falls[6,11], frailty[11-13] and CNCDs[6]. A follow-up study involving North American older adults showed a higher incidence of mobility limitation (difficulty walking or climbing stairs) among overweight or obese men and women at 25, 50 and 70 to 79 years of age, compared with those who maintained a healthy weight[9]. A meta-analysis with data from two cohorts conducted on older adults in Spain detected a higher risk of frailty among obese individuals, higher scores in the fatigue criteria, low levels of physical activity and low handgrip strength[13].

Excess visceral adipose tissue and ectopic fat deposits (liver, pancreas, heart, musculoskeletal system, and bone marrow) increase the production of inflammatory cytokines and reduce the production of adiponectin, a protein that has an anti-inflammatory, antidiabetic and antiatherogenic role[14]. In old age, the activation of the innate immune system triggers a low-grade chronic inflammatory process called inflammaging, which accelerates the development of chronic diseases and loss of muscle mass[14,15].

There are several anthropometric indicators considered practical, inexpensive and that show good reliability in the assessment of body composition, such as body mass index (BMI), waist circumference (WC) and waist-to-hip ratio (WHR) that are widely used, in addition to others like the waist-to-height ratio (WHtR) and the conicity index (C index), which are rarely used in clinical practice and in population studies. Since it adjusts for height, WHtR is better than WC at detecting cardiovascular diseases, diabetes, arterial hypertension and dyslipidemia in men and women[16]. The C index comes from measurements of weight, height and WC, and is based on changes in body design – from the shape of a cylinder to a double cone (two cones with a common base) – due to the concentration of fat in the abdomen[17]. With aging, the redistribution of adipose tissue and its accumulation in the abdominal region affect the ability of these indicators to classify older adults with excess adiposity[6,15]. BMI does not assess the distribution of body fat, especially that deposited in the visceral region, which makes it less accurate for detecting increased cardiometabolic risk than the other indicators mentioned[18,19].

The Frailty Profile of Elderly Brazilians (FIBRA Study) is a multicenter, population-based survey that was developed in 2008-2009 in 17 cities located in all five geographic regions of Brazil, selected by criteria of convenience. It aimed to characterize frailty profiles in adults aged 65 years old and over, considering a profusion of instruments and variables. One of the consequences of this research was a follow-up study, in 2016-2017, involving older adults from the initial study who were still alive and residing in Campinas/SP and Ermelino Matarazzo/SP. In the follow-up survey, the sociodemographic, anthropometric, frailty phenotype and mental status variables collected in the initial survey were repeated.

The literature provides accumulated evidence on the nutritional status of older adult populations and associated factors. In contrast, there are few national studies that analyze changes in body composition and associations with adverse health outcomes, particularly in a sample with a considerable portion of adults aged 80 years old and over.

The aim of this study was to characterize changes in anthropometric indicators in older adults and to investigate whether being overweight is associated with lower gait speed, based on measurements taken at an interval of nine years.

METHODS

This is a multicenter, populational cohort study conducted using data from the FIBRA Study. Data collection originally took place in 2008-2009, in cities chosen for convenience in the five Brazilian geographic regions, which were gathered in poles coordinated by four public universities, including the State University of Campinas and its survey of seven cities. In each one, a representative sample of the urban population of older adults aged 65 years and over[20] was selected. In 2016-2017, Campinas/SP and Ermelino Matarazzo, a district of the city of São Paulo, conducted a cohort study involving older adult who had participated in the initial study and who still resided there, and the data obtained were analyzed in this research.

In 2008-2009 (baseline), 90 urban census sectors were randomly selected in Campinas and 62 in Ermelino Matarazzo. All households in the selected sectors were visited to identify the presence of older adults who met the inclusion criteria: 65 years of age or older, agreeing to participate in the research, residing in the household, and presenting sufficient independence and autonomy, and sensory, psychomotor, language, and comprehension abilities. The study excluded older adults who were bedridden, those with terminal disease or neoplasia (except for the skin), severe sensory or cognitive problems, aphasia or neurological diseases with signs of aggravation[20].

Recruited from households and flow points, the older adults were invited to attend public places, in easily accessible areas, for a data collection session. Recruitment at flow points, places of confluence for older adults located in the selected census sectors, was the except and was used when households were difficult to access. Recruitment was carried out until the quotas of men and women by age group (65 to 69, 70 to 74, 75 to 79 and ≥80 years old) were completed in proportions compatible with the census distribution of the same in the selected sectors, having anticipated possible losses or refusals[20].

In 2016-2017, a follow-up study was conducted involving the older adult participants at baseline. The addresses registered in the Campinas and Ermelino Matarazzo databases served as a basis for locating these older adults. Recruitment and data collection were carried out at home by graduate students in gerontology and undergraduate students in medicine, organized in pairs. Up to three attempts were made to find each older adult.

For both time points of the study, body weight, height, and waist (WC) and hip (HC) circumference were measured. Weight was measured with a portable electronic scale, with the older adult standing erect on the equipment platform, facing the scale, with their eyes fixed forward, feet parallel and barefoot, while wearing light-weight clothes. For height, a portable stadiometer was used and the older adults stood upright, with their backs to the scale, barefoot and feet together, with their heads positioned in the Frankfurt Plane. WC was verified at the midpoint between the lower edge of the last rib and the iliac crest, with the individual standing and the waist region naked. HC was measured in the area with the greatest volume of the buttocks, with the older adult standing and wearing clothes below the buttocks[21,22].

The following anthropometric indicators were calculated:

- Body Mass Index (BMI): [weight (kg)/height (m^2)].
- Waist-to-height ratio (WHtR): [waist circumference (cm)/height (cm)].
- Waist-to-hip ratio (WHR): [waist circumference (cm)/hip circumference (cm)].
- Conicity Index (C Index):

$$\frac{\text{waist circumference (m)}}{0.109\sqrt{\dfrac{\text{body weight (kg)}}{\text{height (m)}}}}$$

The anthropometric variables and indicators were presented according to sex and age group at baseline (65-69, 70-74 and 75 years old or over) and at follow-up (72-79, 80-84 and 85 years old or over).

The usual gait speed (GS) was evaluated by the time in seconds it took the older adult to walk a distance of 4 meters on a flat floor. Three attempts were made, allowing the use of a walking stick or walker. The average travel time was calculated. The cut-off point ≤0.8 m/s was used to identify older adults who presented slow gait[23]. Next, a dichotomous variable was created that reflects stability or change in GS from baseline to follow-up, composed of: older adults with higher GS (>0.8m/s) at baseline and follow-up or who began to present higher GS at follow-up; lower GS (≤0.8m/s) at the two time periods or who began to present lower GS at follow-up.

Being overweight was identified from the anthropometric variables and respective cut-off points:

- WC: ≥96.0 cm for men and ≥88.7 cm for women[24].
- WHtR: ≥0.58 for both sexes[24].
- BMI: ≥27 kg/m^2 [21].
- WHR: >1.0 for men and >0.85 for women[25].
- C index: ≥1.25 for men and ≥1.18 for women[26].

The cut-off points used for WC, WHtR and BMI were defined for older adults, while cut-off points for WHR were defined for adults and for the C index were defined for adults aged 30 to 74 years.

Data analysis used descriptive statistics (mean, standard deviation, median and interquartile distance) for the variables considered at baseline and at follow-up, according to sex. To assess the differences between the measurements studied during the period, the normality of the distribution of variables was initially verified using the Shapiro-Wilk statistical test. Thus, the appropriate statistical tests were used – Student's t test for paired samples, and the non-parametric Wilcoxon test – considering a significance level lower than 5%. The percentage changes in measurements and anthropometric indicators in older adults were also calculated between baseline and follow-up for both sexes.

Next, the incidences (%) of lower GS according to being overweight at baseline were estimated, and the associations were verified using Pearson's chi-square test ($p<0.05$). Logistic regression adjusted for sex and age was used to obtain the odds ratios (OR) and respective 95% confidence intervals (95%CI) of slow gait, and associations with being overweight were determined by the Wald test, $p<0.05$.

The FIBRA Study projects were approved by the Ethics Committees of the Campinas State University (report 1,332,651, CAAE 49987615.3.0000.5404) and the University of São Paulo (report 2,952,507, CAAE 92684517.5.3001.5390). All participants signed a term of free, informed consent.

RESULTS

At baseline, 1,284 older adults composed the sample, 900 in Campinas and 384 in Ermelino Matarazzo. At follow-up, only 549 older adult participants remained, 192 were deceased and 543 could not be located. Regarding the baseline samples, the losses (older adults not located or who refused to participate) represented 41.9% in Campinas and 43.2% in Ermelino Matarazzo.

Among the 549 older adults interviewed at baseline and at follow-up, 12 were excluded due to the lack of complete data on anthropometric measurements in both periods. Thus, data from 537 older adults were analyzed in this study (Figure 1).

Data were analyzed from 537 older adults whose weight, height, WC and HC were measured in 2008-2009 and 2016-2017. Women represented 70.0% of the sample evaluated in both survey time periods, and the mean age was 72.2 years (±5.2) at baseline and 80.7 years (±4.8) at follow-up. Mean GS was 0.43 m/s (±0.49) for the group of older adults at baseline, and 0.81 m/s (±0.39) at follow-up.

For men, weight and height were normally distributed ($p>0.05$). All other variables for both men and women did not show normal distribution. Between baseline and follow-up, among men, decreases in the average weight and height, in the median BMI, and an increase in the median C index were observed (Table 1).

For women, decreases in the median weight, height and BMI, and increases in the median WC, HC, WHtR, WHR and C index were observed (Table 2).

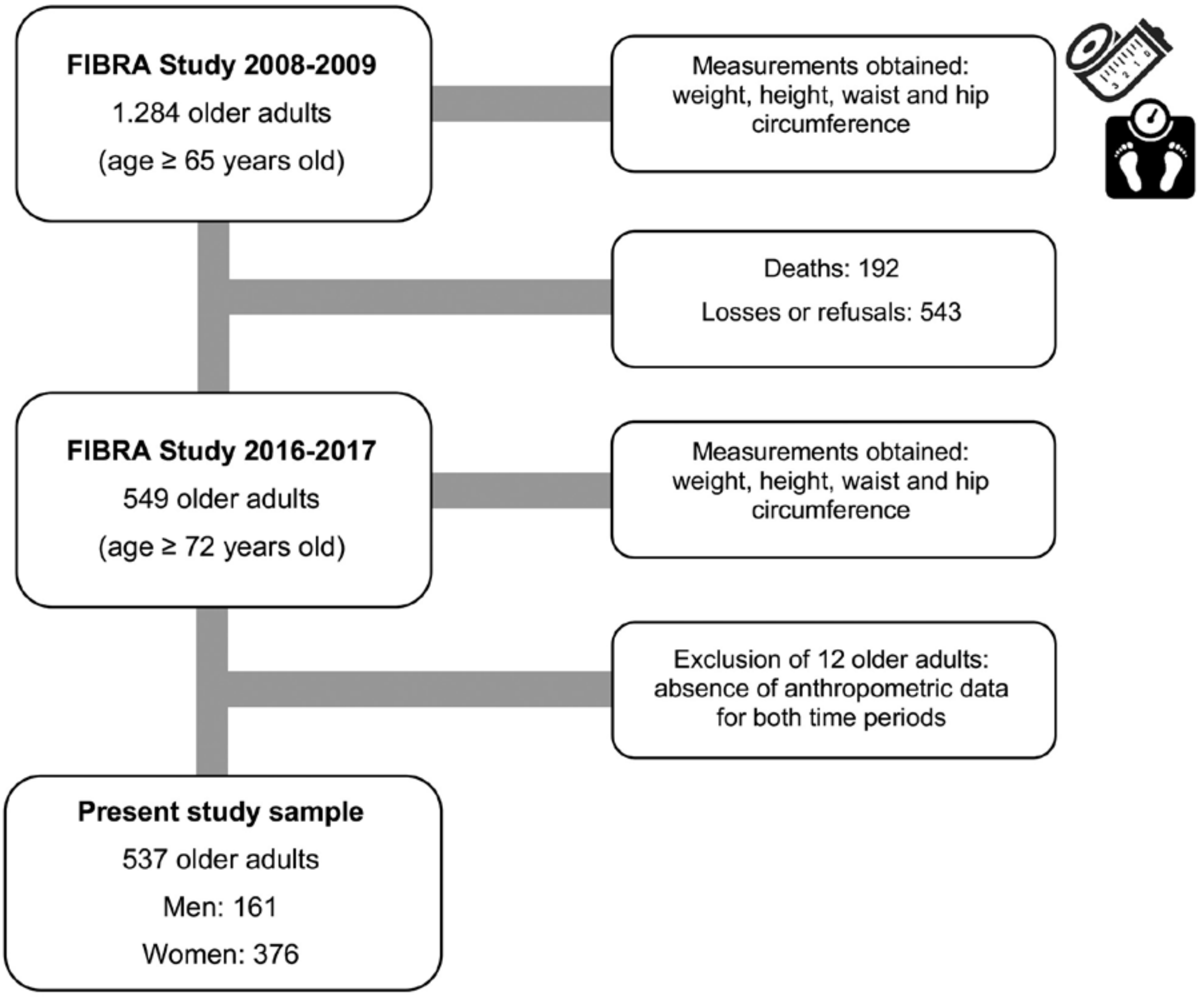

Figure 1. Flowchart of the sample used in this research. FIBRA study, Older adults, Campinas and Ermelino Matarazzo, SP, Brazil.

Table 1. Means and medians of anthropometric variables in older adult males, according to age (n=161). FIBRA Study, Older adults, Campinas and Ermelino Matarazzo, SP, Brazil, 2008-2009 and 2016-2017.

Variables by age group	n (%)	Mean (standard deviation)	Median (interquartile distance)
Weight (kg) – baseline			
65-69	48 (29.8)	77.8 ± 14.2	76.7 (16.4)
70-74	68 (42.3)	73.9 ± 11.2	74.2 (13.5)
≥ 75	45 (27.9)	72.1 ± 10.2	72.7 (11.6)
Total	161	74.6 ± 12.1	75.0 (13.5)
Weight (kg) – follow-up			
72-79	57 (35.4)	74.0 ± 15.2	75.8 (20.1)
80-84	70 (43.5)	72.5 ± 13.2	72.3 (18.9)
≥ 85	34 (21.1)	66.0 ± 8.8	65.1 (10.4)
Total	161	71.7 ± 13.4	71.1 (18.4)

to be continued

Continuation of Table 1

Variables by age group	n (%)	Mean (standard deviation)	Median (interquartile distance)
p value (difference: baseline – follow-up)			**<0.001**[a]
Height (cm) – baseline			
65-69	48	168.1 ± 6.9	168.0 (11.5)
70-74	68	167.3 ± 6.0	167.5 (9.5)
≥ 75	45	165.9 ± 5.2	166.0 (7.0)
Total	161	167.1 ± 6.1	167.0 (9.0)
Height (cm) – follow-up			
72-79	57	167.8 ± 7.1	168.0 (10.0)
80-84	70	165.5 ± 6.3	165.7 (9.0)
≥ 85	34	166.2 ± 6.0	166.5 (7.0)
Total	161	166.5 ± 6.6	166.0 (8.0)
p value (difference: baseline – follow-up)			**0.038**[a]
Waist circumference (cm) – baseline			
65-69	48	96.6 ± 12.8	96.0 (16.7)
70-74	68	95.9 ± 9.9	95.5 (11.7)
≥ 75	45	93.7 ± 11.3	94.0 (15.0)
Total	161	95.5 ± 11.2	95.0 (16.0)
Waist circumference (cm) – follow-up			
72-79	57	97.3 ± 12.3	97.0 (14.0)
80-84	70	96.0 ± 13.3	94.5 (19.0)
≥ 85	34	92.3 ± 8.0	94.0 (11.0)
Total	161	95.7 ± 12.1	96.0 (15.5)
p value (difference: baseline – follow-up)			0.402[b]
Hip circumference (cm) – baseline			
65-69	48	98.1 ± 9.5	98.5 (12.2)
70-74	68	98.5 ± 7.6	97.5 (9.7)
≥ 75	45	97.4 ± 8.0	98.0 (11.0)
Total	161	98.1 ± 8.3	98.0 (10.5)
Hip circumference (cm) – follow-up			
72-79	57	99.4 ± 10.0	99.0 (13.0)
80-84	70	99.3 ± 7.9	98.0 (9.0)
≥ 85	34	97.3 ± 5.7	98.5 (8.0)
Total	161	98.9 ± 8.3	98.0 (9.0)
p value (difference: baseline to follow-up)			0.121[b]
Body mass index (kg/m^2) – baseline			
65-69	48	27.5 ± 4.9	27.2 (5.8)
70-74	68	26.4 ± 3.7	26.2 (5.4)
≥ 75	45	26.2 ± 3.7	26.0 (4.4)
Total	161	26.7 ± 4.1	26.3 (5.4)
Body mass index (kg/m^2) – follow-up			
72-79	57	26.2 ± 5.2	25.8 (6.2)
80-84	70	26.4 ± 4.4	25.9 (6.7)
≥ 85	34	23.9 ± 3.4	23.6 (4.3)
Total	161	25.8 ± 4.6	25.2 (6.2)

to be continued

Continuation of Table 1

Variables by age group	n (%)	Mean (standard deviation)	Median (interquartile distance)
p value (difference: baseline – follow-up)			**<0.001**[b]
Waist-to-height ratio – baseline			
65-69	48	0.57 ± 0.08	0.57 (0.10)
70-74	68	0.57 ± 0.06	0.57 (0.09)
≥ 75	45	0.56 ± 0.07	0.55 (0.10)
Total	161	0.57 ± 0.07	0.57 (0.09)
Waist-to-height ratio – follow-up			
72-79	57	0.58 ± 0.08	0.57 (0.09)
80-84	70	0.58 ± 0.08	0.57 (0.10)
≥ 85	34	0.56 ± 0.05	0.55 (0.07)
Total	161	0.57 ± 0.07	0.57 (0.09)
p value (difference: baseline – follow-up)			0.180[b]
Waist-to-hip ratio – baseline			
65-69	48	0.98 ± 0.07	1.00 (0.11)
70-74	68	0.97 ± 0.06	0.97 (0.09)
≥ 75	45	0.96 ± 0.08	0.96 (0.11)
Total	161	0.97 ± 0.07	0.98 (0.10)
Waist-to-hip ratio – follow-up			
72-79	57	0.98 ± 0.06	0.98 (0.07)
80-84	70	0.96 ± 0.08	0.97 (0.09)
≥ 85	34	0.95 ± 0.06	0.95 (0.07)
Total	161	0.96 ± 0.07	0.97 (0.08)
p value (difference: baseline – follow-up)			0.349[b]
Conicity index – baseline			
65-69	48	1.30 ± 0.07	1.31 (0.10)
70-74	68	1.33 ± 0.06	1.32 (0.07)
≥ 75	45	1.30 ± 0.10	1.30 (0.13)
Total	161	1.31 ± 0.08	1.32 (0.10)
Conicity index – follow-up			
72-79	57	1.35 ± 0.09	1.35 (0.09)
80-84	70	1.33 ± 0.10	1.34 (0.11)
≥ 85	34	1.35 ± 0.07	1.35 (0.08)
Total	161	1.34 ± 0.09	1.35 (0.10)
p value (difference: baseline – follow-up)			**<0.001**[b]

[a] p-value, paired T test; [b] p-value, paired Wilcoxon test.

Table 2. Means and medians of anthropometric variables in older adult females, according to age (n=376). FIBRA Study, Older adults, Campinas and Ermelino Matarazzo, SP, Brazil, 2008-2009 and 2016-2017.

Variables by age group	n (%)	Mean (standard deviation)	Median (interquartile distance)
Weight (kg) – baseline			
65-69	143 (38.0)	67.6 ± 11.0	66.1 (13.4)
70-74	117 (31.1)	66.4 ± 12.2	65.1 (15.1)
≥ 75	116 (30.9)	63.5 ± 12.2	62.1 (15.7)
Total	376	65.9 ± 11.9	64.4 (14.9)
Weight (kg) – follow-up			
72-79	164 (43.6)	66.7 ± 11.0	66.9 (12.9)
80-84	135 (35.9)	64.0 ± 14.1	61.7 (17.3)
≥ 85	77 (20.5)	58.5 ± 10.0	57.5 (13.6)
Total	376	64.1 ± 12.4	62.5 (15.4)
p value (difference: baseline – follow-up)			**<0.001[a]**
Height (cm) – baseline			
65-69	143	155.1 ± 6.8	155.0 (10.0)
70-74	117	154.0 ± 6.1	154.0 (8.0)
≥ 75	116	152.6 ± 6.7	153.0 (7.7)
Total	376	154.0 ± 6.6	154.0 (8.0)
Height (cm) – follow-up			
72-79	164	153.8 ± 6.5	154.0 (9.0)
80-84	135	152.5 ± 6.5	153.0 (9.0)
≥ 85	77	149.7 ± 7.7	151.0 (8.0)
Total	376	152.5 ± 6.9	153.0 (9.0)
p value (difference: baseline – follow-up)			**<0.001[a]**
Waist circumference (cm) – baseline			
65-69	143	90.4 ± 11.1	90.0 (13.5)
70-74	117	89.9 ± 11.3	89.0 14.5)
≥ 75	116	87.9 ± 12.9	88.5 (16.2)
Total	376	89.5 ± 11.7	90.0 (14.5)
Waist circumference (cm) – follow-up			
72-79	164	94.7 ± 11.4	93.2 (14.0)
80-84	135	93.7 ± 15.0	93.0 (19.0)
≥ 85	77	88.5 ± 11.4	90.0 (18.0)
Total	376	93.1 ± 13.0	93.0 (16.7)
p value (difference: baseline – follow-up)			**<0.001[a]**
Hip circumference (cm) – baseline			
65-69	143	101.9 ± 9.3	100.0 (12.0)
70-74	117	102.0 ± 9.7	101.0 (11.5)
≥ 75	116	101.1 ± 9.7	100.7 (11.4)
Total	376	101.7 ± 9.5	100.4 (11.0)
Hip circumference (cm) – follow-up			
72-79	164	103.9 ± 11.7	103.0 (13.5)
80-84	135	103.4 ± 12.3	101.5 (15.0)
≥ 85	77	98.1 ± 9.2	98.0 (13.0)
Total	376	102.5 ± 11.7	102.0 (13.7)

to be continued

Continuation of Table 2

Variables by age group	n (%)	Mean (standard deviation)	Median (interquartile distance)
p value (difference: baseline to follow-up)			**0.036[a]**
Body mass index (kg/m^2) – baseline			
65-69	143	28.1 ± 4.5	27.2 (6.0)
70-74	117	27.9 ± 4.5	27.8 (5.5)
≥ 75	116	27.2 ± 4.8	27.1 (6.8)
Total	376	27.8 ± 4.6	27.3 (5.9)
Body mass index (kg/m^2) – follow-up			
72-79	164	28.3 ± 4.7	27.6 (5.9)
80-84	135	27.5 ± 5.5	27.2 (6.9)
≥ 85	77	26.3 ± 5.3	25.6 (6.4)
Total	376	27.6 ± 5.2	27.1 (6.5)
p value (difference: baseline – follow-up)			0.041[a]
Waist-to-height ratio – baseline			
65-69	143	0.58 ± 0.08	0.58 (0.08)
70-74	117	0.58 ± 0.07	0.58 (0.10)
≥ 75	116	0.58 ± 0.09	0.58 (0.11)
Total	376	0.58 ± 0.08	0.58 (0.10)
Waist-to-height ratio – follow-up			
72-79	164	0.62 ± 0.08	0.60 (0.10)
80-84	135	0.61 ± 0.10	0.62 (0.12)
≥ 85	77	0.59 ± 0.09	0.59 (0.12)
Total	376	0.61 ± 0.09	0.60 (0.11)
p value (difference: baseline – follow-up)			**<0.001[a]**
Waist-to-hip ratio – baseline			
65-69	143	0.89 ± 0.07	0.89 (0.10)
70-74	117	0.88 ± 0.08	0.87 (0.10)
≥ 75	116	0.87 ± 0.08	0.87 (0.10)
Total	376	0.88 ± 0.08	0.88 (0.10)
Waist-to-hip ratio – follow-up			
72-79	164	0.91 ± 0.10	0.91 (0.11)
80-84	135	0.90 ± 0.10	0.90 (0.11)
≥ 85	77	0.90 ± 0.08	0.90 (0.11)
Total	376	0.91 ± 0.10	0.90 (0.11)
p value (difference: baseline – follow-up)			**<0.001[a]**
Conicity index – baseline			
65-69	143	1.26 ± 0.09	1.26 (0.11)
70-74	117	1.26 ± 0.10	1.27 (0.13)
≥ 75	116	1.25 ± 0.11	1.26 (0.13)
Total	376	1.26 ± 0.10	1.26 (0.12)
Conicity index – follow-up			
72-79	164	1.32 ± 0.09	1.32 (0.12)
80-84	135	1.33 ± 0.13	1.32 (0.13)
≥ 85	77	1.30 ± 0.11	1.30 (0.16)
Total	376	1.32 ± 0.11	1.32 (0.14)
p value (difference: baseline – follow-up)			<0.001[a]

[a] p-value, paired Wilcoxon test.

Figure 2 shows the percentage change in anthropometric measurements after nine years, according to sex. Among men, decreases in weight (-3.89%), height (-0.36%) and BMI (-4.18%) were observed. Only the C index showed a positive change (+2.27%). Among women, decreases in weight (-2.95%), height (-0.65%) and BMI (-0.73%) were observed, while the remaining measurements and indicators showed increases: WC (+3.33%), HC (+1.59%), WHtR (+3.45%), WHR (+2.27%) and C index (+4.76%).

There were no significant differences between the sexes in the incidence of gait stability or occurrence of slower gait between baseline and follow-up. In contrast, among adults aged 75 years old and over, the incidence of slower gait was 2.6 times higher compared with those 60 to 69 years old. As determined by the anthropometric measurements WC, BMI, WHtR and WHR, being overweight increased the chances of older adults presenting gait stability or a slower gait after nine years (Table 3).

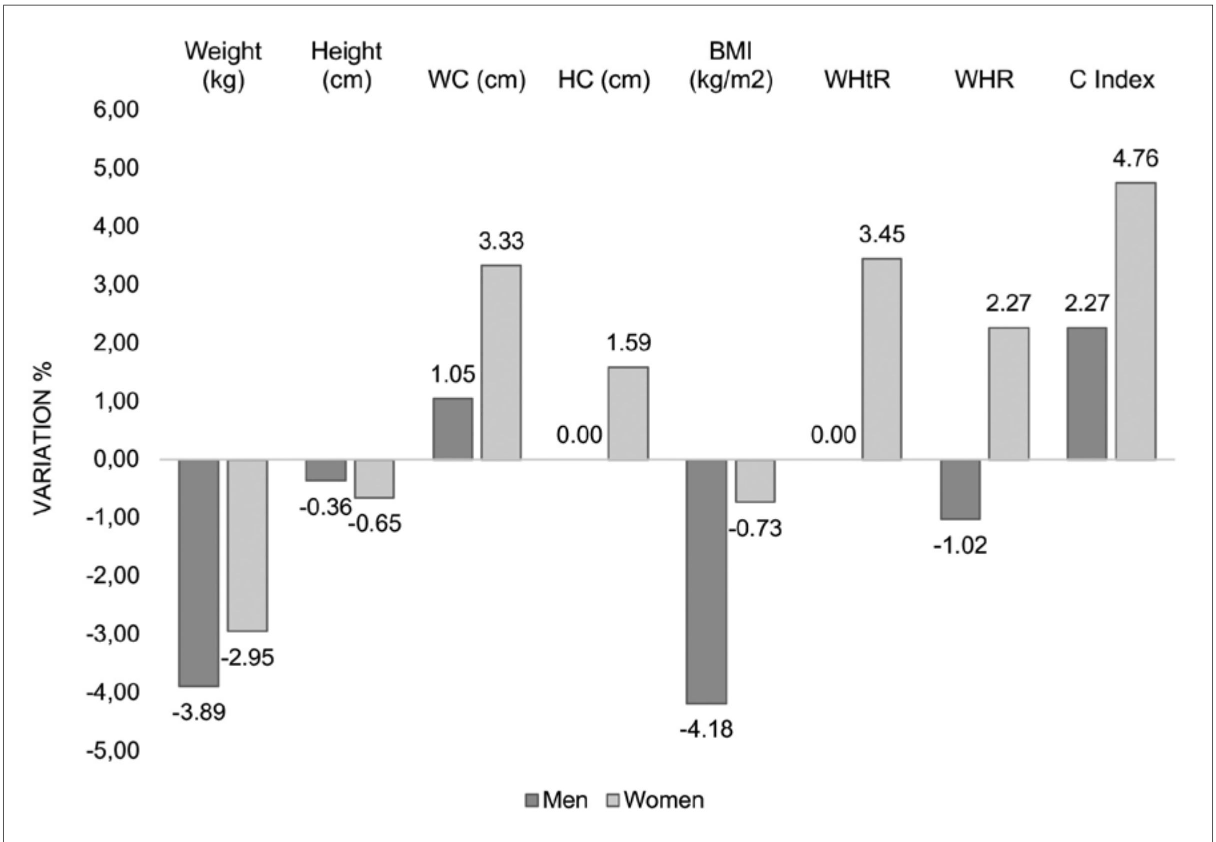

Figure 2. Percentage variation in measurements and anthropometric indicators in older adults, between baseline and follow-up. FIBRA study, Older adults, Campinas and Ermelino Matarazzo, SP, Brazil.

Table 3. Incidence of lower gait speed in older adults, according to sex, age and overweight. FIBRA study, Older adults, Campinas e Ermelino Matarazzo, SP, Brazil, 2008-2009 and 2016-2017.

Variable	Incidence %	Adjusted OR [b] (IC95%)	p value [c]
Sex	p= 0.139 [a]		
Male	77.2	1.00	
Female	82.7	1.51 (0.95 - 2.41)	0.082
Age (in years)	p= 0.004		
60 to 69	77.0	1.00	
70 to 74	77.8	1.09 (0.66 - 1.79)	0.733
≥ 75	89.7	2.66 (1.43 - 4.92)	**0.002**
Waist circumference	p= 0.017		
Not overweight	76.8	1.00	
Overweight	85.0	1.80 (1.14 - 2.83)	**0.011**
Body mass index	p= 0.009		
Underweight	81.2	1.38 (0.62 - 3.08)	0.428
Eutrophy	75.0	1.00	
Overweight	86.1	2.11 (1.31 - 3.39)	**0.002**
Waist-to-height ratio	p= 0.001		
Not overweight	75.6	1.00	
Overweight	86.9	2.08 (1.31 - 3.31)	**0.002**
Waist-to-hip ratio	p= 0.009		
Not overweight	75.8	1.00	
Overweight	84.9	1.87 (1.17 - 2.99)	**0.009**
Conicity index	p= 0.128		
Not overweight	76.1	1.00	
Overweight	82.4	1.60 (0.96 - 2.68)	0.069

[a] p value, Pearson's chi-square test; [b] OR: adjusted odds ratio: sex adjusted for age, age adjusted for sex, and overweight adjusted for sex and age; 95%CI: 95% confidence interval; [c] p value, Wald test.

DISCUSSION

This research assessed changes in the anthropometric profile of the older adults recruited in households and at flow points, during the period between the baseline (2008-2009) and follow-up (2016-2017) surveys of the FIBRA Study. Among the eight measures and indicators selected, men showed alterations in four: decreases in weight, height and BMI, and an increase in C index; while women showed alterations in all of them: decreases in weight, height and BMI, and increases in measurements and indicators of central adiposity – WC, HC, WHtR, WHR and C index. Significant associations were observed between being overweight and gait stability or new cases of slower gait. Being overweight/obese impacts the health and quality of life of older adults, resulting from the increased risks of morbidity and mortality, complications and disabilities, while also impacting health care systems through the increase in costs and demand for health services[4-7,10].

Other studies report the same findings regarding the reduction in weight[5,27,28] and height[27-29] observed in this research. Santanasto et al.[5] analyzed data from the Health, Aging and Body Composition (Health ABC) cohort of Pittsburgh, PA, and Memphis, TN, in the United States, and observed a reduction in body weight in men (81.6 kg at baseline; -1.5 kg/-1.7%)

and women (70.1 kg at baseline; -1.4 kg/-1.8%) after five years. In Norway, a follow-up study, detected decreases in the height of older adults aged between 60 and 69, 70 and 79 and ≥ 80 years at baseline: -1.3 cm, -1.9 cm, -2.4 cm in males and -1.9 cm, -2.3 cm, -2.3 cm in females, 11 years later. Regarding body weight, reductions were observed from the age of 70: -1.3 kg and -2.4 kg in men and -2.4 kg and -5.6 kg in women[27]. In contrast to the results of this study, Almeida et al.[30] observed no significant changes in the weight and height of older adults (≥60 years) included in the SABE Study (Health, Well-being and Aging), between 2000 and 2006, probably due to the younger sample and shorter follow-up time.

Based on data from a cohort of Swedish older adults, Gavriilidou et al.[28] observed decreases in height of around 6 cm for men and 8 cm for women, between the ages of 60 to 64 and 85 years or older. The authors also investigated anthropometric classification errors caused by the imprecision of measured height in older adults. To achieve this, they calculated the BMI using the measured height and that estimated by knee height. The results revealed that the use of measured height to calculate the BMI underestimated the prevalence of low weight and overestimated the prevalence of obesity, in both sexes and more intensely in older adults aged ≥80 years, in relation to the estimated measure[28]. A study conducted in an outpatient clinic identified that frail older adults presented greater differences between the measured and estimated height compared with their robust peers, and recommended the use of the estimated measure, particularly for frail older adults[31].

The trajectory of human aging involves changes in body composition that include a decrease in height, loss of muscle and bone tissue, and an increase in and redistribution of adipose tissue[1,2,6]. The progressive decrease in height results from compression of the intervertebral discs, flattening of the vertebrae, changes in body posture, decreased bone mineral density (osteopenia/osteoporosis) and flattening of the plantar arch[1,2,32]. Body weight reduction is observed from the age of 70 and over[6,27] and results from the loss of muscle mass, body water and bone mass[1,2,32]. BMI decreases with advancing age due to loss of muscle mass[27,33]. Results from the English Longitudinal Study of Ageing (ELSA) show an increase in BMI in the early years of old age, followed by a significant decline from the age of 71 onwards[33].

In this study, women showed an increase in the medians of anthropometric measurements that evaluated the distribution of body fat (WC, HC, WHtR and WHR). Over the course of eight years, the ELSA data revealed an increase in waist circumference up to the age of 80 (0.18 cm/year) and a downward trend from that age onwards, for both sexes[33]. In the United States, a five-year prospective study involving older adults aged 70 to 79 years at baseline, identified a reduction in subcutaneous and visceral abdominal fat in women using computed tomography[5]. Adipose tissue increases with advancing age and tends to accumulate in the abdominal region, increasing chronic low-grade inflammation and the risk of cardiometabolic diseases[2,6,15]. After menopause, with the decline in estrogen levels, the fat deposited in the gluteofemoral region is redistributed to the visceral deposit[15]. The findings of this research show that the process of fat mass redistribution in women continued during follow-up, different from that observed in men.

Although there were increases in the medians of the C index in both sexes, it was more intense among women. In a study conducted with older adults assisted by the *Estratégia Saúde da Família* [Family Health Strategy] in Viçosa, MG, the mean value of the C index for women was also higher than for men ($p<0.01$)[34]. In older adults (≥60 years) from Salvador, BA, the accuracy of the C index for classifying visceral obesity was 0.97 and 0.66, respectively for males and females[35]. Proposed by Valdez[17] in the 1990s, as an indicator of central obesity, the C index is considered a good predictor of diabetes mellitus, hypertension and cardiovascular diseases[19].

A cross-sectional study involving Portuguese older adults (≥65 years) observed greater chances of slower gait (≤0.8 m/s) among overweight (OR= 2.42, 95%CI: 1.13-5.18) and obese women (3.97, 95%CI: 1.63-9.67) than among eutrophic women. Among men, these associations were similar, but the OR estimates fell by half (p value for trend = 0.001)[7]. Data from the SABE Colombia survey showed an inverse association between BMI and gait speed in women and older adults in general[8]. The mechanical overload that being overweight/obese exerts on body joints, such as the knees and hips, and the low-grade inflammation triggered by excess adipose mass are indicated in the literature as causes of slower gait[7,8], highlighting the importance of strategies to prevent weight gain.

Appraisal of the results of this research should consider certain limitations. At baseline, the FIBRA Study selected a sample of older adults with no apparent cognitive deficit and with adequate physical and health status to attend the data collection sites, which may have introduced some bias in the selection of individuals who presented better anthropometric and nutritional profiles. In turn, the survival bias that may have influenced the data could be due to the lower risk of premature death among non-obese older adults with a greater reserve of lean mass. Despite these potential limitations, the possibility of evaluating changes in the anthropometric indicators of older adults nine years later is a major strength of this study.

CONCLUSION

The results of this study revealed changes in the anthropometric profile resulting from aging. In both sexes, we observed decreases in body weight, height and BMI. Women showed increases in all the indicators of abdominal obesity, while men only showed an increase in the C index. Being overweight was associated with a greater chance of gait stability and new cases of slower gait, nine years after the first survey of measurements.

This study provides information from a cohort of older adults, a considerable portion of whom were aged 80 years old or over, on changes in various anthropometric indicators and in gait speed. Clinical or public health professionals dedicated to the care of older adults and research will benefit from the results, in order to identify, for example, the most sensitive indicators for discerning excess weight during aging, in order to develop interventions that promote healthy aging.

Edited by: Isac Davidson S. F. Pimenta

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