Trends and association of BMI between sociodemographic and living conditions variables in the Brazilian elderly: 2002/03-2008/09

Vladimir Schuindt da Silva [1]
Israel Souza [2]
Diego Augusto Santos Silva [3]
Aline Rodrigues Barbosa [3]
Maria de Jesus Mendes da Fonseca [4]

[1] Instituto Federal Catarinense. R. Cruz e Souza 100, Centro. 89580-000 Fraiburgo SC Brasil. vladimirschuindt@ hotmail.com
[2] Instituto Federal de Educação, Ciência e Tecnologia do Rio de Janeiro. Rio de Janeiro RJ Brasil.
[3] Departamento de Educação Física, Universidade Federal de Santa Catarina. Florianópolis SC Brasil.
[4] Departamento de Epidemiologia e Métodos Quantitativos em Saúde, Escola Nacional de Saúde Pública, Fundação Oswaldo Cruz. Rio de Janeiro RJ Brasil.

Abstract *This study aimed to describe BMI's short-term trends and analyze the association between the Body Mass Index (BMI) and the sociodemographic variables and variables of family perception of the sufficiency and type of food consumed by Brazilian elderly of both sexes. The authors used data from the Household Budget Surveys (HBS) collected by the Brazilian Institute of Geography and Statistics (IBGE) in 2002/03 and 2008/09. The prevalence of overweight and obesity increased, whereas normal and low weight decreased. Multinomial regression models were used for 2008/09 to analyze the association between BMI and sociodemographic variables and variables of family perception of the sufficiency and type of food intake. Income and age were more associated with BMI. We suggest that health and nutrition prevention and monitoring measures be implemented through public policies, considering multifactorial overweight in the Brazilian elderly.*
Key words *Nutritional status, Elderly, Epidemiological surveys, Body Mass Index*

Introduction

Population ageing causes changes in the nutritional and epidemiological profile worldwide, with a predominance of non-transmissible diseases[1], which can lead the elderly to a quicker loss of autonomy and quality of life. Metabolic, physiological, psychological and biochemical changes are the most common events and directly affect the nutritional status[2].

The nutritional status is the physiological state of an individual, which results from the relationship between nutrient intake and the body's need and ability to digest, absorb and use these nutrients[3], and its analysis in the elderly, by means of epidemiological studies, can be performed by anthropometry, which is a simple-use harmless method that is easy to interpret and has less cultural restrictions.

The anthropometric body mass and height variables favor the evaluation of the nutrition and health process[4], with frequent use of the body mass index (BMI) to evaluate the nutritional status[5].

High prevalence of underweight and overweight / obesity in elderly of both sexes were recorded in high and middle-income countries[6-8]. In Brazil, national surveys from 1977 to 2013[9-13] show that there was an increased prevalence of overweight associated with sociodemographic conditions.

Overweight is related to increased chronic noncommunicable diseases (CNCD), which are the main causes of disease and mortality burden in Brazil, with 72.4% of total deaths[14], and more than half of these deaths are food-related[15]. One of the main factors related to the ageing process, which can even contribute to healthy ageing, is food consumption[2].

Food consumption can be estimated through subjective assessment of living conditions, family perception of sufficiency and type of food consumed[11,12], surveyed in each household interviewed in the Family Budget Surveys (POFs) of 2002/2003 and 2008/2009.

Family perception of the adequacy and type of food consumed is part of the "access"[3] to food realm, from the wide range of food and nutritional security (FNS)[16]. In addition, they are generally used to analyze the subjective poverty through specific methods to identify monetary poverty[17,18]. Thus, it can contribute to identify groups at risk of inadequate consumption and help to better understand the current panorama of the nutritional status of the elderly population aged 60 years or older in the country.

The subjective assessment of living conditions are based on World Bank (WB) studies on this specific area[19], and, in Brazil, they were initially used by the Brazilian Institute of Geography and Statistics (IBGE) from the Living Standards Survey (PPV/1996)[20] in agreement with the WB, and incorporated into the topic from the POF 2002/03[11], with the construction of questions and "POF 6" questionnaires based on the "Living Standards Measurement Study" (LSMS) methodology carried out by the WB in different countries of the world[21].

This study aims to analyze the association between BMI and sufficiency and type of food consumed in the Brazilian population of elderly aged 60 years and over from 2002/03 to 2008/09.

Methods

Sampling

This study used public domain secondary data from 2002/03 and 2008/09 POFs, both with national coverage and comparable methodologies, conducted by IBGE in two periods: from June 2002 to July 2003 and from May 2008 to May 2009[11,12].

In the survey carried out in 2002/03, 48,470 households were studied, and in the 2008/09 survey, 55,970 households were studied. On both occasions, we used a complex sample plan by clusters, with draws of the census tracts in the first stage and households in the second. For the draw of census tracts, the research previously carried out the grouping of census tracts in the country, aiming to obtain strata of households with geographic and socioeconomic homogeneity. In this cluster, we considered the location of sectors and the socioeconomic level of the resident families in order to establish 443 household strata in 2002/03 and 550 in 2008/09. Households were drawn by simple random sampling in each sector, without replacement. Interviews to households drawn within each stratum were evenly distributed throughout the four quarters of study duration to reproduce the seasonal variation of income and food purchases in each stratum. Further details regarding the sampling process of the two surveys (2002/03 and 2008/09) are provided in specific publications [11,12].

Target population and sample

The target population of this study was the elderly aged 60 years and older, of both sexes, living in the five Brazilian regions of the country. The total sample was 19,189 (POF 2002/03) and 27,891 (POF 2008/09), however, considering the expanded sample, was 15,581,735 and 19,633,067 individuals, by 2002/03 and 2008/09 POFs, respectively, after the exclusion of incomplete data from the elderly (2.5%).

Study variables

The dependent variable analyzed was the classification of nutritional status based on BMI [BMI = body mass (kg)/height (m^2)]. The cut-off values adopted to assess nutritional status were proposed by WHO: low weight (BMI ≤ 18.5 kg/m^2); adequate weight (18.5 <BMI <25 kg/m^2); overweight (25 ≤ BMI <30 kg/m^2) and obesity (BMI ≥ 30.00 kg/m^2)[22].

Body mass and height were measured using a portable electronic scale for adults (mark not specified by the IBGE), with a sensitivity of at least 100 g, maximum capacity of 150 kg, and KaWe PERSON-CHECK® portable adult stadiometer (KaWe, Germany) with a precision of 0.1 cm and extension of up to 200 cm, respectively, as per recommendations of the Research Agent Manuals[11,12].

The independent variables of the study were:

Living conditions: family perception of sufficiency (usually insufficient, sometimes insufficient, always sufficient) and type (always as desired, not always as desired, rarely as desired) of food consumed.

The potential confounding variables of the study were:

Demographic characteristics: age group (60-64, 65-69, 70-74, 75-79, and 80 years and over - for simple and continuous analysis in multiple analysis), gender (male, female), self-reported skin color/ethnicity (white, black and brown - yellow and indigenous were suppressed due to low percentage of Brazilian elderly self-classified in these categories);

Socioeconomic characteristics: large regions (north, northeast, southeast, south and midwest), schooling (0-5, 6-9, 10-12, and 13 years or more of schooling - for simple and continuous analysis in multiple analysis), low monthly family income (percentile ≤ 25); middle (25 <percentile <75); high (percentile ≥ 75), from the equivalent amounts in Federal Minimum Wages (SM)

for the 2002/03 and 2008/09 periods, of R$ 200 and R$ 415, respectively. All the 2002/2003 POF income was inflated, based on the accumulated variation of the Broad National Consumer Price Index of 39.37%, in order to represent values compatible with those obtained in the 2008/09 survey.

Data review

Comparisons between the prevalence surveys of the categories of variables in the nutritional status classification were performed using the Pearson Chi-square test to verify significant differences in the period studied.

Multinomial regression models (reference category was the eutrophic classification of nutritional status) were obtained by stepwise forward Wald, non-automatic, starting with the variables "year + type of food consumed + sufficiency of food consumed", and at each stage the other variables were added one by one, adopting the following order: skin color/ethnicity; age group; schooling; income; region. The association was quantified by the odds ratio and the respective 95% confidence intervals in the period from 2002/03 to 2008/09. All variables with p value < 0.05 in any of the nutritional status classifications were maintained in the final multinomial analysis model. The significance of variables and models was evaluated. The existence of confounders was considered when the unadjusted estimate of probability differed from the adjusted estimate, promoting a change in the status of the association, but did not show results different from those found for the final models (data not shown). In addition, we evaluated the increment in the explanation of the model due to the entry of each variable with the use of Nagelkerke Pseudo R^2. Such a test is an approximation of the coefficient of determination of linear regression. In the multinomial regression, however, no coefficient can accurately explain the variation in the statistical model by including or removing a predictor as proposed by the coefficient of determination. Thus, in this study, we evaluated how much each predictor affects the dependent variable when included in the regression model[23].

All the analytical procedures of this study were performed with the Statistical Package for the Social Sciences (SPSS) 20.0™ [24] and expansion factors of the 2002/03 and 2008/09 IBGE's POFs were used in the analyses to enable extrapolation of results for the total number of Brazilian households and their metropolitan areas.

Results

Of the 35,214,802 elderly individuals aged 60 years or older studied (considering sample expansion), most were female (55.3%). The prevalence of low weight, overweight and obesity was 5.2%, 33.2% and 14.0% for 2002/2003, and 3.2%, 37.4% and 18.2% for 2008/2009, respectively. The comparison between the surveys, according to socioeconomic variables and variables of family perception about the sufficiency and type of food consumed showed that the prevalence of low weight decreased and overweight and obesity increased in men (Table 1) and women (Table 2).

For males, the highest increases in the prevalence of overweight were observed in browns aged from 65 to 69 years, with 13 years of schooling or more, low and middle income, of the North Region, with sufficiency and type of food consumed reported as "sometimes insufficient" and "not always as desired", respectively. As for obesity, they were found in blacks, in the last age range, with 6 to 9 years of schooling, middle-income level, of the Southern Region, with sufficiency and type of food consumed reported as "not usually sufficient" and "not always as desired", respectively. However, there was a reduced prevalence of overweight in blacks with 6 to 12 years of schooling.

As for women, the largest increases in the prevalence of overweight were observed in whites aged from 70 to 74 years, with 10-12 years of schooling, high income level, of the North Region, with sufficiency and type of food consumed reported "sometimes insufficient" and "always as desired/not always as desired", respectively. Moreover, for obesity, they were found in blacks aged from 65 to 69 years, with 6 to 9 years of schooling, high-income, of the Midwest Region, with sufficiency and type of food consumed reported as "always sufficient" and "not always as desired", respectively. However, reduced overweight prevalence was observed in black elderly women with 6 to 9 years of schooling.

In Table 3, the first model showed that the elderly who reported sufficiency of food consumed as "always sufficient" were 30% more likely to

be overweight and 44% to be obese than those of adequate weight, and among the elderly, the magnitude was about 15% for the two categories of BMI. However, in relation to the type of food consumed, the elderly who reported "not always as desired" (men) and "rarely as desired" (women) were more likely to be underweight.

After adjusting for skin color/ethnicity, age group, schooling, income and region, between the variables of family perception about sufficiency and type of food consumed and the categories of BMI analyzed, the other associations remained in the direction and magnitude close to the model 1 (Table 3). Thus, it is observed that variables used in the analysis were not identified as confounding factors.

The input of each variable was significant, with all variables remaining in the final model and with increasing explanatory power at each step of the stepwise forward Wald method, by the Nagelkerke Pseudo R^2 values, highlighting the largest increments in the inclusion of age group [model 3; 5.7% (men) and 2.9% (women)] and income [model 5; 7.5% (men) and 4.0% (women)] variables.

Discussion

The results of this study evidenced an increased prevalence of overweight and obesity and decreased underweight among Brazilian elderly people aged 60 years or over, of both sexes, in the period from 2002/03 to 2008/09, reinforcing the nutritional transition in Brazil. In addition, overweight and obesity were more likely to be found among the elderly who reported that food consumed was always sufficient, and low weight were more likely to be found among those who reported that food type consumed was "not always as desired" (men) and "rarely as desired" (women). Moreover, age group and income were the variables that contributed the most to explain associations between BMI and sociodemographic variables and variables of sufficiency and type of food consumed.

The literature indicates that factors associated with overweight and obesity are different between genders, data similar to that observed in this study[6-8,22,26].

Health problems related to overweight and obesity in Brazil are due in part to the increased income of the population associated to the consumption of foods with inconsistent frequency, low quality and high-energy content, besides the

Table 1. Prevalence of low weight (LW), overweight (OW) and obesity (O), by sociodemographic variables and variable of family perception on the sufficiency and type of food consumed by the elderly (men). Brazil, 2002/03-2008/09. *

Variables	2002/03 (A)			2008/09 (B)			Variation (B-A)**		
	LW	OW	O	LW	OW	O	LW	OW	O
	%	%	%	%	%	%	%	%	%
Skin color/ethnicity									
White	4.8	35.6	10.4	2.3	41.5	15.1	-2.5	5.9	4.7
Black	7.1	36.5	6.6	3.2	30.8	12.5	-3.9	-5.7	5.9
Brown	4.5	29.6	6.7	3.0	35.8	11.0	-1.5	6.2	4.3
Age group (years)									
60 to 64	2.2	38.8	10.0	2.5	41.7	15.3	0.3	2.9	5.3
65 to 69	3.8	30.5	11.3	1.9	40.4	12.4	-1.9	9.9	1.1
70 to 74	4.1	36.5	8.3	3.3	39.0	12.9	-0.8	2.5	4.6
75 to 79	7.8	27.6	7.7	3.1	33.2	14.1	-4.7	5.6	6.4
≥ 80	12.8	27.1	2.7	2.9	30.2	9.7	-9.9	3.1	7.0
Schooling (years)									
0 to 5	5.4	32.3	8.1	3.1	36.9	12.4	-2.3	4.6	4.3
6 to 9	2.8	40.9	6.8	1.0	37.0	16.3	-1.8	-3.9	9.5
10 to 12	1.2	42.5	16.0	1.9	39.5	18.6	0.7	-3.0	2.6
≥ 13	2.3	39.5	14.7	1.0	50.2	11.0	-1.3	10.7	-3.7
Income									
Low	7.4	24.0	6.6	3.6	30.2	9.4	-3.8	6.2	2.8
Middle	5.3	31.5	7.4	2.7	37.7	13.5	-2.6	6.2	6.1
High	2.8	42.2	12.4	1.9	44.7	15.4	-0.9	2.5	3.0
Region									
North	5.6	30.4	7.8	2.1	38.1	9.6	-3.5	7.7	1.8
Northeast	5.8	27.7	5.9	3.9	33.9	9.9	-1.9	6.2	4.0
Southeast	4.4	36.2	10.1	2.3	39.4	14.4	-2.1	3.2	4.3
South	4.5	37.1	10.9	1.4	44.1	16.8	-3.1	7.0	5.9
Midwest	4.1	35.5	8.9	3.2	37.2	14.1	-0.9	1.7	5.2
Sufficiency of Food Consumed									
Usually insufficient	6.4	30.9	6.1	3.7	30.3	12.4	-2.7	-0.6	6.3
Sometimes insufficient	6.3	28.8	7.0	3.6	38.2	9.1	-2.7	9.4	2.1
Always sufficient	3.7	37.1	10.6	2.2	39.5	14.8	-1.5	2.4	4.2
Type of Food Consumed									
Always as desired	3.3	39.0	12.8	2.0	41.4	14.3	-1.3	2.4	1.5
Not always as desired	5.6	31.8	7.6	3.0	37.5	13.1	-2.6	5.7	5.5
Rarely as desired	4.9	30.5	6.4	3.1	32.5	10.8	-1.8	2.0	4.4

* The appropriate weight was the reference category in the analysis. ** p < 0.001 to evaluate the variation of nutritional status categories among the surveys, that all differences were significant; Pearson's Chi-square test.

automation of daily activities and the low rates of physical activity practice[27,28]. However, low weight should be a focus of continuous interest of the public health bodies, even showing a decrease in the period investigated, since studies showed that lower quality of life and higher mortality from all causes were associated with this condition of nutritional status[29-31].

Some authors argue that variables analyzed on a subjective basis on living conditions can be used to show individuals' real perception of ac-

cess to food[32,33] and, in association with other information contained in the 2002/03 and 2008/09 POFs, provide a set of information that enriches the understanding of health problems in the Brazilian elderly population.

Thus, this study found that elderly who reported "usually insufficient" and "sometimes insufficient" consumption of food were more likely to be underweight, perhaps due to the difficulty of access to food because of issues related to social exclusion, indicating that the problem of low

Table 2. Prevalence of low weight (LW), overweight (OW) and obesity (O), by sociodemographic variables and variable of family perception on the sufficiency and type of food consumed by the elderly (women). Brazil, 2002/03-2008/09. *

Variables	2002/03 (A)			2008/09 (B)			Variation (B-A)**		
	LW	OW	O	LW	OW	O	LW	OW	O
	%	%	%	%	%	%	%	%	%
Skin color/ethnicity									
White	4.7	32.0	19.7	3.2	36.8	23.0	-1.5	4.8	3.3
Black	5.2	37.5	15.5	3.5	34.3	21.1	-1.7	-3.2	5.6
Brown	7.4	33.5	15.7	4.5	36.8	20.9	-2.9	3.3	5.2
Age group (years)									
60 to 64	3.8	34.5	22.8	2.1	38.4	24.8	-1.7	3.9	2.0
65 to 69	4.7	36.6	16.3	3.2	37.2	22.7	-1.5	0.6	6.4
70 to 74	5.9	32.8	17.3	4.5	37.0	22.2	-1.4	4.2	4.9
75 to 79	6.4	31.7	14.1	4.2	35.5	22.6	-2.2	3.8	8.5
≥ 80	9.4	24.7	15.6	6.5	32.2	14.7	-2.9	7.5	-0.9
Schooling (years)									
0 to 5	6.0	32.6	18.2	3.9	36.1	22.1	-2.1	3.5	3.9
6 to 9	2.5	45.2	21.1	1.8	34.4	28.6	-0.7	-10.8	7.5
10 to 12	2.1	29.9	16.2	3.3	38.6	22.2	1.2	8.7	6.0
≥ 13	1.5	32.6	14.9	2.2	40.0	19.4	0.7	7.4	4.5
Income									
Low	9.0	28.8	15.9	5.6	32.2	19.8	-3.4	3.4	3.9
Middle	5.6	34.9	17.4	3.9	37.9	21.8	-1.7	3.0	4.4
High	7.3	32.0	14.6	3.6	37.5	20.5	-3.7	5.5	5.9
Region									
North	7.3	32.0	14.6	3.6	37.5	20.5	-3.7	5.5	5.9
Northeast	7.8	32.2	15.7	4.7	35.6	19.3	-3.1	3.4	3.6
Southeast	4.2	31.8	19.0	3.3	37.2	22.3	-0.9	5.4	3.3
South	4.1	36.4	22.1	2.7	36.9	27.1	-1.4	0.5	5.0
Midwest	8.6	37.1	14.1	4.7	34.2	20.9	-3.9	-2.9	6.8
Sufficiency of Food Consumed									
Usually insufficient	6.6	34.2	16.9	4.8	30.5	21.1	-1.8	-3.7	4.2
Sometimes insufficient	7.0	30.8	19.2	4.3	37.2	20.1	-2.7	6.4	0.9
Always sufficient	4.4	33.9	17.8	3.4	37.1	22.9	-1.0	3.2	5.1
Type of Food Consumed									
Always as desired	4.5	32.7	18.8	3.5	36.8	22.2	-1.0	4.1	3.4
Not always as desired	5.6	33.1	17.8	3.8	37.2	22.2	-1.8	4.1	4.4
Rarely as desired	7.2	32.7	17.9	3.5	32.9	21.3	-3.7	0.2	3.4

* The appropriate weight was the reference category in the analysis. ** p < 0.001 to evaluate the variation of nutritional status categories among the surveys, that all differences were significant; Pearson's Chi-square test.

weight would still be socioeconomic in Brazil[34]. However, it is known that moderate food insecurity can be associated with overweight and obesity[16], and it is not ruled out that elderly who reported "always sufficient" food consumption and that food type was "always as desired" or "not always a desired", which were more likely to be overweight and obese, could be food insecure.

This study did not analyze the characteristics of the eating habits of the elderly for more accurate inferences about food intake. However, it can be speculated that overweight elderly people who eat food as desired may opt for food rich in simple carbohydrates and fats, consequently adopting a monotonous diet, and evidencing depletion of essential nutrients for health maintenance and disease control[35]. Evidence regarding the inadequate diet of the Brazilian elderly for vitamins A, C, D, E, thiamine, pyridoxine, calcium, magnesium, zinc and copper minerals and customary

Table 3. Association between body mass index (kg/m2) and sociodemographic variables and variable of family perception on the sufficiency and type of food consumed by the elderly of both sexes. Brazil, 2008/09.*

	Men			Women		
Variables	Low Weight OR (CI95%)**	Overweight OR (CI95%)**	Obesity OR (CI95%)**	Low Weight OR (CI95%)**	Overweight OR (CI95%)**	Obesity OR (CI95%)**
Model 1 = Sufficiency of Food Consumed + Type of Food Consumed + Year						
SANS	1	1	1	1	1	1
SAAV	0.95 (0.94-0.96)	1.08 (1.07-1.08)	0.87 (0.87-0.88)	1.06 (1.05-1.07)	1.06 (1.06-1.06)	1.08 (1.08-1.09)
SASS	0.68 (0.68-0.69)	1.30 (1.30-1.31)	1.44 (1.43-1.45)	0.74 (0.74-0.75)	1.14 (1.13-1.14)	1.15 (1.15 -1.16)
TASe	1	1	1	1	1	1
TANe	1.15 (1.12-1.15)	0.82 (0.82-0.82)	0.82 (0.81-0.82)	1.03 (1.03-1.04)	0.98 (0.97-0.98)	1.03 (1.03-1.04)
TARa	0.89 (0.88-0.90)	0.71 (0.71-0.71)	0.66 (0.66-0.66)	1.08 (1.07-1.09)	1.05 (1.05-1.05)	0.99 (0.99-1.00)
Model 2 = Model 1 + Skin color-ethnicity						
SANS	1	1	1	1	1	1
SAAV	0.94 (0.94-0.95)	1.07 (1.06-1.07)	0.86 (0.86-0.87)	1.05 (1.05-1.06)	1.05 (1.05-1.06)	1.07 (1.07-1.08)
SASS	0.67 (0.66-0.67)	1.23 (1.22-1.23)	1.35 (1.34-1.36)	0.78 (0.78-0.79)	1.14 (1.13-1.14)	1.11 (1.11-1.12)
TASe	1	1	1	1	1	1
TANe	1.13 (1.12-1.14)	0.83 (0.83-0.84)	0.85 (0.84-0.85)	1.00 (1.00-1.01)	1.06 (1.05-1.06)	1.04 (1.03-1.04)
TARa	0.93 (0.92-0.94)	0.73 (0.73-0.73)	0.69 (0.69-0.70)	1.02 (1.01-1.03)	0.97 (0.96-0.97)	1.01 (1.00-1.01)
Model 3 = Model 2 + Age group						
SANS	1	1	1	1	1	1
SAAV	0.96 (0.95-0.97)	1.06 (1.05-1.06)	0.85 (0.85-0.86)	1.05 (1.04-1.05)	1.06 (1.05-1.06)	1.08 (1.07-1.08)
SASS	0.68 (0.68-0.69)	1.21 (1.20-1.22)	1.33 (1.32-1.34)	0.77 (0.76-0.77)	1.16 (1.14-1.15)	1.13 (1.13-1.14)
TASe	1	1	1	1	1	1
TANe	1.22 (1.21-1.23)	0.82 (0.82-0.82)	0.83 (0.83-0.83)	1.02 (1.01-1.03)	1.05 (1.04-1.05)	1.02 (1.02-1.03)
TARa	0.98 (0.97-0.99)	0.71 (0.71-0.72)	0.67 (0.66-0.67)	1.01 (1.00-1.02)	0.97 (0.96-0.97)	1.01 (1.00-1.02)
Model 4 = Model 3 + Schooling						
SANS	1	1	1	1	1	1
SAAV	0.96 (0.95-0.97)	1.06 (1.05-1.06)	0.83 (0.82-0.83)	1.04 (1.04-1.05)	1.06 (1.06-1.07)	1.08 (1.07-1.08)
SASS	0.69 (0.68-0.70)	1.19 (1.19-1.20)	1.29 (1.28-1.30)	0.77 (0.76-0.77)	1.16 (1.15-1.16)	1.15 (1.14-1.15)
TASe	1	1	1	1	1	1
TANe	1.16 (1.15-1.17)	0.84 (0.83-0.84)	0.85 (0.84-0.85)	0.96 (0.96-0.97)	1.05 (1.05-1.06)	1.02 (1.02-1.02)
TARa	0.91 (0.90-0.92)	0.73 (0.72-0.73)	0.66 (0.66-0.67)	0.97 (0.96-0.98)	0.98 (0.97-0.98)	1.00 (0.99-1.00)
Model 5 = Model 4 + Income						
SANS	1	1	1	1	1	1
SAAV	0.97 (0.96-0.98)	1.03 (1.03-1.04)	0.81 (0.81-0.82)	1.07 (1.06-1.07)	1.05 (1.05-1.05)	1.06 (1.06-1.07)
SASS	0.72 (0.71-0.72)	1.10 (1.09-1.10)	1.19 (1.18-1.20)	0.85 (0.84-0.86)	1.12 (1.12-1.12)	1.10 (1.09-1.10)
TASe	1	1	1	1	1	1
TANe	1.15 (1.14-1.15)	0.88 (0.87-0.88)	0.88 (0.88-0.89)	0.90 (0.90-0.91)	1.06 (1.06-1.06)	1.05 (1.04-1.05)
TARa	0.89 (0.88-0.89)	0.82 (0.81-0.82)	0.74 (0.73-0.74)	0.87 (0.87-0.88)	1.01 (1.01-1.01)	1.06 (1.05-1.06)
Model 6 = Model 5 + Region						
SANS	1	1	1	1	1	1
SAAV	0.97 (0.96-0.98)	1.03 (1.03-1.04)	0.82 (0.81-0.82)	1.06 (1.05-1.07)	1.05 (1.04-1.05)	1.07 (1.06-1.07)
SASS	0.72 (0.71-0.73)	1.08 (1.07-1.08)	1.16 (1.15-1.17)	0.85 (0.85-0.86)	1.10 (1.10-1.11)	1.07 (1.06-1.07)
TASe	1	1	1	1	1	1
TANe	1.14 (1.13-1.15)	0.88 (0.88-0.89)	0.89 (0.89-0.90)	0.90 (0.89-0.90)	1.07 (1.06-1.07)	1.06 (1.05-1.06)
TARa	0.88 (0.87-0.89)	0.82 (0.82-0.83)	0.75 (0.74-0.75)	0.87 (0.86-0.88)	1.01 (1.01-1.02)	1.06 (1.06-1.07)

* The appropriate weight was the reference category in the analysis. OR: odds ratio; CI95%: 95% confidence interval. ** adjusted by the multinomial logistic regression method for all variables in the table with p < 0.001 for all items. SANS: Usually insufficient; SAAV: Sometimes insufficient; SASS: Always sufficient; TASe: Always as desired; TANe: Not always as desired; TARa: Rarely as desired.

excessive sodium intake for both sexes reinforce these speculations[36].

Younger adults with higher income were more likely to be overweight and obese in this study, although for both sexes, blacks with 6-12 years of schooling showed a slight reduced prevalence of overweight. A possible explanation for this effect would be the adoption of daily habits that they had in adulthood, such as work-related stress, since people retire on average three years after the minimum age in Brazil[37]. Thus, these elderly may have commitments with work schedules and daily tasks that prevent greater health care. However, a natural loss of muscle mass occurs with age, which may also reflect reduced overweight and obesity[38].

The effect of income could be related to the fact that elderly people with high income, while with higher access conditions to health services, healthy food purchase and levels of physical activity during leisure in paid environments[39], do not show a healthy weight status, perhaps due to the high consumption of ultra-high-calorie processed food, sugar-added beverages and insufficient physical activity in their daily routine[40]. While data from the National Food Survey (INA) have pointed to older people as the only group to include more fruits and vegetables among the most prevalent food, it is known that the prevalence of oil, fat and other ingredients used in food preparation may have been underestimated, as these items were not reported in isolation when they were part of a dish[41].

In Brazil, in the end, those with low-income levels face both malnutrition and overweight and obesity[42]. A meta-analysis, including 32 studies, with 197,940 elderly people aged 65 years and over pointed to the greatest increase in mortality risk to those with $20 \leq$ BMI <20.9 kg/m^2 [43]. Thus, government actions underway in the country are increasingly important to minimize acute malnutrition, allowing access to better nutrition by the most vulnerable subpopulations[28].

This study has some limitations, such as the non-use of cutoff values adopted by the Food and Nutrition Surveillance System (SISVAN) to classify the nutritional status of the elderly in the Country[2], which were tested but did not show results different than those found in this study. Therefore, we chose the WHO cutoff values[22], for further comparisons with data available in the literature.

POFs were not designed with the sole objective of studying determinants of nutritional status and we should consider the lack of a broader

set of covariables that could better describe the pattern of this outcome, such as lifestyle, physical activity practice and the very preventive health care, which influence weight status[44,45]. However, we highlight the relevance of this study, which analyzed the association of BMI and sociodemographic variables and variables of living conditions, sufficiency and type of food consumed, using anthropometric variables measured, in a national sample of Brazilian elderly people aged 60 years or over, with scarce literature's information on the subject.

It is important to note that there is no consensus among researchers as to how much subjective information correlates with the reality of individuals[46] and that such information expresses the respondent's perception as indicated by the families as the most appropriate respondent. Thus, same situation of living conditions may be considered extremely favorable to a particular person or family group, as opposed to others, with different histories, desires, aspirations or culture, who see them as unfavorable[11,12].

The selected variables of family perception about the adequacy and type of food consumed are insufficient to fully comprehend the problem of FNS[16]. Nonetheless, debates on the subject have become increasingly intense and broad in recent years and the demands regarding the production of knowledge that has the potential to contribute to this field of interest are increasing[47]. However, it helps to understand the quality of life of the Brazilian population, which was historically based on objective living conditions concepts, such as per capita income, private consumption or household's infrastructure[46,48].

The sectional design does not allow establishing the cause-effect relationship between the studied variables, since exposure and outcome information were obtained at the same time. The information provided refers to changes in the population over time, not in the individual. The possible underestimating biases are the exclusion of institutionalized individuals and survival. In addition, we should take into account that multinomial regression, with OR measure of effect may overestimate findings.

We can conclude that the prevalence of overweight and obesity increased and of low weight decreased in the Brazilian elderly population in the interval of approximately six to seven years. Overweight and obesity were, in general, higher in black and brown elderly in practically all categories of age groups, schooling and income analyzed, and living in Brazilian regions with dif-

ferent levels of economic development and less favorable sufficiency and type of food consumed conditions reported. Age and income highly contributed to explain associations between the BMI and the sociodemographic variables and variables of sufficiency and the type of food consumed.

Finally, strategic public health actions are suggested, with a focus on health promotion and prevention, and aimed at the Brazilian elderly population, with a view to interrupting and/or reversing the trend of the epidemic outbreak of overweight in the country, mainly due to its condition as a risk factor for several health problems.

Collaborations

VS da Silva and MJM da Fonseca participated in the design and planning of the study and elaboration of the draft. I Souza, DAS Silva and AR Barbosa participated in data review and interpretation and critical review of content. All authors approved the final version of the manuscript.

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