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Dietary pattern of non-frail very old people and relationship with underweight, muscle mass and strength and gait speed test

Ann Kristine Jansen[1]
Giselle Geane Gonçalves Rosa[2]
José Divino Lopes Filho[1]
Maria Isabel Coelho da Cruz[3]
Edgar Nunes de Moraes[4]
Rodrigo Ribeiro dos Santos[4]

Abstract

Objectives: To identify the dietary pattern of non-frail very old people and to evaluate the association of this pattern with body composition, strength, and gait speed. *Methods:* Cross-sectional study with a sample of 96 old people aged 80 or over, non-frail. Food consumption was analyzed using three non-consecutive food records. Muscle mass was assessed using arm muscular area. Muscle strength was measured by grip strength. Cluster analysis was used to distinguish dietary patterns. Bivariate analysis and multivariate Poisson Regression were performed, exploring the relationship between dietary patterns and specific independent variables. *Results:* Two dietary patterns were identified, labeled healthy and traditional. The prevalence of underweight among the old people of the traditional pattern was 10% (95%CI 1.01-1.20) higher than among the old people of the healthy pattern and this prevalence was practically maintained (PR 1.09; 95%CI 1.00-1.18) in the model adjusted by functionality. Regarding the classification of the arm muscular area, the old people of the traditional pattern presented 15% (95%CI 1.00-1.32) more prevalence of low muscle mass, when compared with the old people of the healthy pattern. This prevalence in the functionality-adjusted model was no longer statistically significant. No association was found between dietary pattern and strength and gait speed. *Conclusions:* The findings showed that old people who adhere to healthy dietary patterns have a lower risk of underweight and that low muscle mass is probably more associated with functionality than with dietary patterns.

Keywords: Feeding Behavior. Elderly Nutrition. Healthy Aging. Body Composition.

[1] Universidade Federal de Minas Gerais, Escola de Enfermagem, Departamento de Nutrição. Belo Horizonte, MG, Brasil.

[2] Instituto Mário Penna, Hospital Luxemburgo, Nutrição Clínica. Belo Horizonte, MG, Brasil.

[3] Secretaria Municipal de Saúde. Santana do Riacho, MG, Brasil.

[4] Universidade Federal de Minas Gerais, Faculdade de Medicina, Departamento de Clínica Médica. Belo Horizonte, MG, Brasil.

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Correspondence
Ann Kristine Jansen
akj@ufmg.br /annkjansen@gmail.com

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INTRODUCTION

The Brazilian population ages at a much higher rate than that observed in countries that have already undergone the demographic transition process such as France, Sweden, the United Kingdom, etc. A significant increase in the old aged 80 and over is visible[1]. Advanced age is the main risk factor associated with the development of chronic diseases and loss of autonomy and independence[1]. However, the quality of life and health of the old people is quite heterogeneous, which indicates an opportunity for preventive strategies, not only to live longer, but to live better[1,2]. Studies on the aging process list mechanisms by which healthy lifestyle habits such as moderate to vigorous physical exercise, healthy eating, regular consumption of meals, adequate fluid intake and absence of smoking can contribute to the maintenance of functional capacity and healthy aging[1,2].

In this context, nutrition, recognized for its impact on general morbidity and mortality and the extension of life expectancy, has been the subject of extensive scientific research[2,3]. High intake of fruits, vegetables, fish and seafood, whole grains and nuts associated with low consumption of beef or processed meats and sugary drinks is associated with lower risk of chronic non-communicable diseases (NCDs) and healthy aging[2,4].

Many studies assess the relationship between food and health by analyzing the consumption of nutrients and isolated foods[4]. However, dietary intake is very complex. Nutrients and foods interact with each other with synergistic and antagonistic effects and addressing dietary patterns can better reflect the diet of daily life[3]. Thus, studying the dietary pattern of populations at the expense of the isolated study of nutrients has been recommended[3].

The dietary patterns most related to longevity are those of low energy density and high density of nutrients and bioactive substances, with emphasis on the dietary patterns of the Mediterranean and Okinawa[3,5,6]. A healthy dietary pattern is related to successful aging not only by preventing NCDs, but also by reducing functional decline, mainly through maintaining physical function and proper body composition[5,7,8]. The association between the adequacy of a healthy dietary pattern with the increase in years free of disability in old people[9] has also been demonstrated, that is, it promoted the compression of morbidity, one of the main objectives of the approach of old people.

Changes in body composition in old people are characterized by a redistribution and increase in fat mass and a concomitant decrease in lean mass and bone density, independent of changes in body weight and body mass index (BMI)[10]. The reduction in lean mass occurs even in physically active old people, but to a lesser extent when compared to sedentary ones[11]. A study comparing the amount of muscle mass assessed by dual energy X-ray absorptiometry (DXA) of young people at the peak age of muscle mass (18 and 34 years old) and old people over 80 years found an annual loss of muscle mass of 3.3 and 2.3% in men and women, respectively[12]. Between 60 and 79 years the loss was 0.5 and 0.3 kg and from 80 to 94 years of age 1.7 and 0.7 kg in men and women, respectively[12].

Although changes in body composition occur regardless of changes in BMI[10], old people are more susceptible to underweight than young people and this underweight is usually related to low muscle mass and not to low fat mass, as in adults[13], which suggests the use of BMI cutoff points different from those of adults[14]. A recent review study evaluating the relationship between dietary pattern and the effects of nutrients and bioactive components of the diet on muscle aging, found that the Mediterranean food pattern shows highly consistent and positive associations with muscle health[7].

Most studies that relate diet to longevity, quality of life and muscle health have an emphasis on Mediterranean diet or similar dietary patterns. Thus, it is necessary to understand the binomial diet and longevity with quality, in regions of food and cultural reality far from the Mediterranean. The existence of few studies in gerontological nutrition research with long-lived old people[7,15] is also noteworthy and even fewer studies with populations that survived until that age with preserved functionality[15].

In this sense, considering the hypothesis that long-lived old people with a healthy dietary pattern preserve more body and muscle mass, muscle strength and physical performance, the objective of this study was to identify the dietary pattern of non-frail old people and assess the association of this pattern with body composition, muscle strength and gait speed test.

METHODS

This is a retrospective cross-sectional study, with a convenience sample composed of all the old people assisted in a multiprofessional outpatient clinic for the long-lived old people in a public reference center for old people health in a capital and a rural municipality both in the southeast region of Brazil. This outpatient clinic serves old people aged 80 and over, independent for basic and instrumental activities of daily living and at risk of frailty, functional independents who have sarcopenic syndrome or frailty phenotype. Centenarians are eligible for outpatient care regardless of their functionality because they are considered models of healthy aging[16].

The inclusion criteria were old people aged 80 or over, of both sexes, non-institutionalized, with a classification of functionality, according to the Visual Frailty Scale[16] in robust old people or at risk of frailty. This scale is based on dependence or independence for basic, instrumental or advanced activities of daily living and on the presence of risk factors for functional decline, diseases and comorbidities. The exclusion criteria were frail old people, classified by the same scale[16], institutionalized and under the age of 80 years.

The research included the care provided during the period from May 2015 (beginning of the outpatient service) to October 2018. During this period, a total of 101 old people were served, five old people who were fragile were excluded from this research. Of these, two were residents of a long-term institution. The research project was approved by the Research Ethics Committee of the Federal University of Minas Gerais (CAAE: 80295616.1.0000.5149).

All data were collected from multidisciplinary medical records of geriatric and nutrition consultations. Data were collected that characterize the population studied, including demographics such as sex and age and socioeconomic data such as education in years, place of residence and number of people in the household. Health data were also collected, including information on the presence of systemic arterial hypertension (SAH) or diabetes, the presence of edentulism, the presence of smoking and the use of alcohol.

Food intake was analyzed using food records for three non-consecutive days, one being a weekend day. Each participant received a form and guidelines for filling out the records prior to the nutritional consultation, which can be noted by the old person or someone in his/her community. They were instructed on how to fill in, in a detailed manner, on the intake of the food consumed with their respective quantities, whether in homemade measure, unit, volume or kilogram, the meal time and the possible “nibbles” carried out throughout the day. Additional information regarding the intake of oil, fats, salt, industrialized seasoning and water was also collected.

The information contained in the records was checked and doubts clarified by nutritionists at the clinic during the nutrition consultation. To improve the reliability of this check, contributing to the recall of the information recorded, it was requested to fill out the record in the days before the nutritional consultation.

For the identification of the dietary patterns of the old people, the homemade measures of the food included in the food records were first converted into grams using tables of homemade measures or food labels when not found in the reference tables. Subsequently, foods were grouped into 19 food groups: whole fruit and vitamin; fruit in juice; vegetables; beef; pork; chicken and poultry; fish; eggs; sausages; legumes; milk and dairy products; whole grains; non-whole grains; roots and tubers; nuts and seeds; sweets and sugar; soft drink and artificial juice; alcoholic beverage; and oils and fats. Then, the average amount of food from each food group consumed in the 3 registered days was calculated.

For anthropometric assessment, performed by previously trained nutritionists, height and body mass measurements were taken on a digital scale with a stadiometer (PL 200 LED, Filizola®, São Paulo, SP, Brazil), in addition to the arm circumference measurement with the inelastic tape measure and tricipital skinfold measurements, bicipital skinfold, subscapular skinfold and supra iliac skinfold using an skinfold caliper (Model 68902, Lange®, Santa Cruz, California, USA). Such anthropometric measurements followed the techniques recommended by the World Health Organization (WHO)[17]. The body mass index (BMI) was calculated by dividing body mass in kilograms by height in meters squared and classified as follows: underweight (<22 kg/m²), normal weight (22-27 kg/m²) and overweight (>27 kg/m²)[14].

The muscle mass information was obtained by calculating the arm muscular area (AMA), from the arm circumference and the tricipital skinfold[18], according to the following formula: AMA (cm²) = {[Arm circumference in cm - (tricipital skinfold in cm x 3.14)]² / 12.56} - [10.0 cm² (for men) or 6.5 cm2 (for women)]. AMA was classified into percentiles, considering values from the 15th percentile as normal muscle mass[19], with ≥36.65 cm² for men and ≥27.97 cm² for women[18].

A manual hydraulic dynamometer (BL5001, Jamar®, Lafayete, Indiana, USA) was used to measure muscle strength. Three standardized measurements of maximum handgrip strength of the right hand and left hand were performed. The measurements on each side (kg) were noted and the one with the highest value was used, as recommended by the literature and references that supported the European consensus on sarcopenia[20]. Gait speed was assessed by the 4-meter gait speed test. The test was applied three times and the average of the three speeds in seconds was considered[20].

Physical activity was considered as any body movement produced by skeletal muscle that requires energy expenditure, such as housework and gardening, among others, whereas physical exercise was considered as any exercise performed in a planned and structured way with the objective of maintaining or achieving good physical and health status, such as walking, cycling, weight training, among others[21]. The information was obtained through an open question: do you perform physical activity (yes/no), do you perform physical exercise (yes/no).

To identify dietary patterns, cluster analysis was carried out, a posteriori cluster analysis. First, the food quantity variables were converted into a z-score. The similarity measure used was the Euclidean metric. For the formation of clusters, the K-means non-hierarchical grouping method was applied. Finally, a number of clusters was determined, opting for a number of groups that would ensure the greatest intra-group homogeneity and heterogeneity between groups. To interpret the results of the cluster analysis, the means of the z-scores obtained were used, with negative values representing a lower intake than the general average and positive values representing a higher intake than the general average.

The Kolmogorov-Smirnov test was conducted to verify the normality of continuous variables. For comparisons between groups, Student's t test was used for continuous normal variables, Mann-Whitney U test for non-normal variables and Pearson's chi-square test or Fisher's exact test for categorical variables. The results were expressed as mean and standard deviation, median and 25th and 75th percentiles or absolute frequency and percentage.

Poisson regression was also performed with robust variance, exploring the relationship between dietary patterns and specific independent variables (BMI, BMI classification, AMA, handgrip strength and gait speed). For this purpose, all independent variables that had $p < 0.20$ in the bivariate analysis were included in the model, using the backward method. Those with greater significance (higher p-value) were removed one by one from the model, the procedure being repeated until all the variables present in the model had statistical significance (p<0,05). To verify the adjustment of the final model, the Hosmer & Lemeshow test was performed and for effect measurement, the prevalence ratio (PR) was used with a 95% confidence interval (95% CI). In model 2, the procedure was the same, however, the variables were adjusted for functionality. Statistical analyzes were performed using SPSS software version 17 (SPSS Inc, Chicago, IL, USA), with the exception of Poisson regression analysis, subsequently performed using Stata software version 14 (Stata Corp, College Station, TX, USA). The level of statistical significance was set at $p < 0.05$.

RESULTS

Ninety-six old people participated in this study, with a mean age of 87.45±1.34 years and a higher proportion of males (53.1%). Two clusters were identified for the dietary pattern. The average intake of the food groups was described in z-score and the first cluster represented by 11.5% of the sample (n=11), was labeled "healthy pattern". The second cluster, represented by 88.5% of the sample (n=85), was labeled "traditional pattern" (Figure 1). Assessing daily food intake, a significant difference is observed between dietary patterns (Table 1).

The characteristics of the old people, according to the dietary pattern are shown in Table 2. Most of the studied old people are robust. The old people with a healthy dietary pattern studied longer. There is a high prevalence of hypertension and edentulism among the old people in both groups. Although the practice of physical exercise was not very frequent, the practice of physical activity was high. In the preparation and seasoning of the food it is observed that the healthy dietary pattern used more olive oil and less animal fat.

When comparing anthropometric measurements between the old people of the two dietary patterns, it was observed that underweight was present only among the old people of the traditional pattern, although there was no statistical difference in the BMI classification between the groups. Regarding the AMA classification, it was observed that the old people of the healthy pattern presented, in the great majority, an adequate AMA in comparison to the old people of the traditional pattern (Table 3).

The multivariate Poisson Regression model, without adjustment (model 1) showed that the prevalence of underweight among the old people of the traditional pattern was 10% higher than among the old people of the healthy pattern and this prevalence was practically maintained in the model adjusted by functionality. Regarding the AMA classification, the old people of the traditional pattern have a 15% higher prevalence of low muscle mass, when compared to the old people of the healthy pattern. This prevalence in the model adjusted for functionality is no longer statistically significant (Table 4).

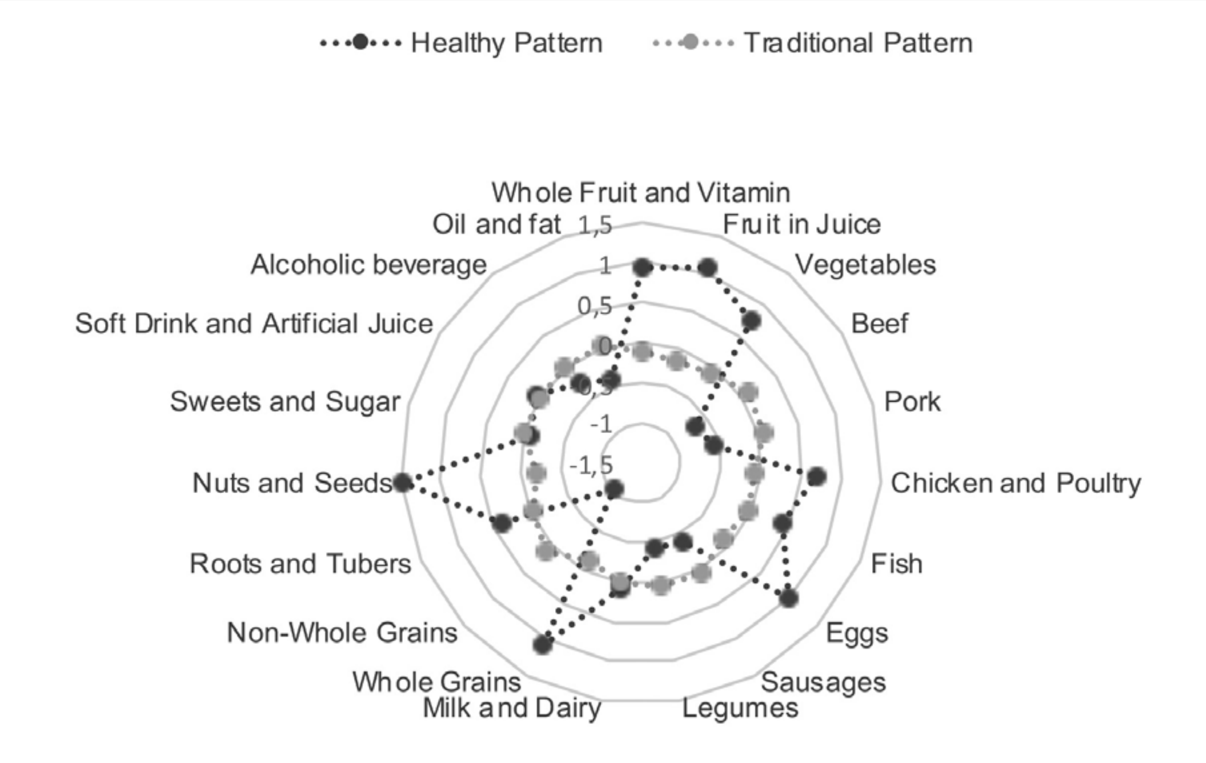

Figure 1. Graphical representation of the dietary pattern of long-lived non-frail old people, obtained through cluster analysis using the non-hierarchical method. Z-score data. Belo Horizonte/MG, May 2015 to October 2018.

Table 1. Dietary pattern of long-lived non-frail old people, through cluster analysis using the non-hierarchical method, data presented in z-score. Belo Horizonte/MG, May 2015 to October 2018.

Food or food groups	Cluster 1 Healthy pattern n=11	Cluster 2 Traditional pattern n=85	*p* value
Whole Fruit and Vitamin	0.933592588	-0.120817864	<0.001
Fruit in Juice	1.078302866	-0.139545077	0.002
Vegetables	0.747760712	-0.096769033	0.036
Beef	-0.694703353	0.089902787	0.004
Pork	-0.561386833	0.072650061	0.024
Chicken and Poultry	0.685183159	-0.088670762	0.022
Fish	0.406038672	-0.052546181	0.036
Eggs	0.994994113	-0.128763944	0.002
Sausages	-0.375576813	0.048604058	0.031
Legumes	-0.420312838	0.054393426	0.238
Milk and Dairy	0.096470833	-0.012484461	0.800
Whole Grains	1.087293382	-0.140708555	0.001
Non-Whole Grains	-1.041004795	0.134718268	<0.001
Roots and Tubers	0.396968313	-0.05137237	0.111
Nuts and Seeds	1.473293922	-0.190661566	<0.001
Sweets and Sugar	-0.065813114	0.008516991	0.457
Soft Drink and Artificial Juice	0.042751829	-0.00553259	0.591
Alcoholic beverage	-0.243315969	0.031487949	0.291
Oil and fat	-0.384606804	0.049772645	0.019

P values derived from Mann-Whitney's U test for continuous data without normal distribution.

Table 2. Sociodemographic, health and food preparation characteristics, according to the Dietary Pattern, of long-lived non-frail old people. Belo Horizonte/MG. May 2015 to October 2018.

Characteristics	Dietary Pattern: Healthy n=11	Dietary Pattern: Traditional n=85	*p* value
Age[a]	87.6 ± 7.3	87.4 ± 5.96	0.919
Sex[b]			0.588
Male	5 (45.4)	46 (54.1)	
Female	6 (54.5)	39 (45.9)	
Place of housing[b]			0.158
Urban	9 (81.8)	52 (61.2)	
Rural	2 (18.2)	33 (38.8)	
Years of study[c]	4.0 (3.0 – 8.0)	1.0 (0.0 – 4.0)	0.004
No. of people in household[c]	2.0 (1.0 – 2.0)	2.0 (2.0-3.0)	0.078
Functionality[b]			0.160
Robust	10 (90.9)	61 (71.8)	
At risk of becoming frail	1 (9.1)	24 (28.2)	

to be continued

Continuation of Table 2

Characteristics	Dietary Pattern		p value
	Healthy n=11	Traditional n=85	
Use of alcoholic beverage[b]	3 (27.3)	17 (20.0)	0.452
Smoking[b] (n=73)	0 (0.0)	12 (18.8)	0.179
Edentulism[b] (n=35)	2 (50.0)	21 (67.7)	0.725
Presence of comorbidities[b]			
Diabetes *mellitus*	3 (27.3)	11 (12.9)	0.199
Systemic arterial hypertension	7 (63.6)	57 (67.1)	0.533
Practice of physical exercise[b]			0.411
Yes	1 (9.1)	15 (17.6)	
Practice of physical activity[b]			0.281
Yes	10 (90.9)	66 (77.6)	
Food preparation and seasoning			
Olive oil[b]	9 (81.8)	28 (32.9)	0.003
Animal fat[b]	1 (9.1)	35 (41.2)	0.035
Salt (g/day)[c]	5.2 (3.7-18.1)	7.1 (5.1-11.1)	0.536
Industrialized seasoning[b]	4 (44.4)	33 (39.8)	0.526

[a] mean ± standard deviation; [b] number (%); [c] median (25th and 75th percentiles); P-values derived from Student's t-test for normally distributed continuous data, Chi-square test for categorical data and Mann-Whitney U test for continuous data without normal distribution.

Table 3. Comparison of anthropometric measurements, muscle strength and gait speed test between the dietary patterns of long-lived non-frail old people. Belo Horizonte/MG, May 2015 to October 2018.

Characteristics	N	General	Dietary Pattern		P value
			Healthy	Traditional	
Body Mass (kg)[a]	93	61,0 ± 13,3	67,4 ± 15,8	60,2 ± 12,8	0,089
Body Mass Index (kg/m²)[a]	92	25,4 ± 4,4	27,6 ± 5,0	25,1 ± 4,3	0,081
BMI classification[b]	92				
Underweight		18 (19,6)	0 (0,0)	18 (22,2)	0,076
Normal weight		41 (44,6)	6 (54,5)	35 (43,2)	
Overweight		33 (35,9)	5 (45,5)	28 (36,6)	
Low AMA[b]	95	36 (37,9)	1 (9,1)	35 (41,7)	0,033
Skinfolds sum (mm)[a]	87	57,4 ± 20,7	61,8 ± 11,8	56,9 ± 21,4	0,305
Handgrip strength (kg)[b]	73	26 (8,3)	29,8 (13,1)	25,6 (7,5)	0,402
Gait speed (m/s)[b]	67	1,0 (0,3)	1,1 (0,3)	1,0 (0,3)	0,300

[a] mean ± standard deviation; [b] number (%); AMA = muscular area of the arm; m/s = meter per second; P-values derived from Student's t-test for normally distributed continuous data and Chi-square test for categorical data.

Table 4. Poisson Regression Analysis with robust variance for the traditional dietary pattern and anthropometric variables adjusted or not by functionality among long-lived non-frail old people. Belo Horizonte / MG, May 2015 to October 2018.

Anthropometric variables	PR	95%CI	*P* value
Model 1 (without adjustment)			
Underweight			
No	1.0	-	
Yes	1.1	1.01-1.20	**0.026**
Arm Muscular Area			
Proper	1.0	-	
Low	1.15	1.00 -1.32	**0.044**
Model 2 (Adjusted by functionality)			
Underweight			
No	1.0	-	
Yes	1.09	1.00 -1.18	**0.039**
Arm Muscular Area			
Proper	1.0	-	
Low	1.14	0.99 -1.31	0.067

PR: Prevalence ratio; CI: Confidence interval. Model adjustment: Goodness off it=1.00.

DISCUSSION

This study evaluated the dietary pattern of long-lived non-frail old people and the association of this pattern with body composition, muscle strength and gait speed test. Two distinct dietary patterns have been identified and called healthy and traditional. The healthy pattern was characterized by a higher intake of fruits and vegetables, white meat, fish, eggs, whole grains, nuts and oilseeds and olive oil and a lower intake of beef or processed meat, refined cereal and oils and animal fats. Such dietary characteristics are associated with health and longevity and prevention of NCDs[4,5], in this way called healthy. The old people of this dietary pattern studied longer. Despite the fact that long-lived old people usually have less education than younger people[15,22], the positive association between dietary pattern and education is commonly evidenced[23], confirming that a higher level of education has an important influence on the choice of healthier foods.

However, it is noteworthy that the majority of the studied population had a dietary pattern with a high intake of beef, processed meat, refined cereals and animal fat, associated with a lower intake of fruits, vegetables, white meat, fish, eggs, nuts and oilseeds. According to the 2017-2018[24] Household Budget Survey, in Brazil, the old people in general, as well as in the Southeast region, the site of that research, have a high intake of rice and beans, beef, poultry and pork, moderate consumption of fruits and a reduced intake of vegetables, fish and eggs. Thus, due to the characteristics of this cluster being very similar to the traditional dietary pattern of the population, it was labeled a traditional pattern.

From a dietary point of view, the key ingredients for healthy aging are fruits, vegetables, whole grains, legumes and fish[2,3]. The Global Burden Disease[25] study, conducted in 195 countries from 1990-2017, showed that an unsatisfactory diet is responsible for a higher number of deaths than tobacco use and that improving the diet can prevent one in five deaths worldwide, regardless of gender, age and socioeconomic status. It was also demonstrated that the dietary factors that most contribute to the increase in mortality and the burden of survival with disabilities are, in this order of importance: high sodium intake, low intake of whole grains, fruits, nuts and seeds, vegetables and omega 3 fatty acids, the first three factors accounting for more than 50% of deaths and 66% of the survival with disabilities burden attributable to diet[25].

The intake of table salt in both dietary standards was above the WHO recommendations, which is 5 grams daily[26], despite being below the national average in the old people, which is 9.01 grams per day[27]. It is suggested that due to the high prevalence of hypertension in the old people in this study, there is a greater awareness of the risk of high salt intake and changes in blood pressure. On the other hand, almost half of the studied population uses industrialized spices, despite the amount and frequency of this intake not being available, this suggests that sodium consumption undoubtedly exceeds the maximum recommendation of 2,000 mg per day[26], even in the old people of the healthy pattern. Changes in sensory perception, with decreased ability to perceive taste with age[28], in addition to dietary culture, could explain the higher salt intake, despite the fact that most old people are hypertensive.

As for whole grains, although the old people of the healthy standard stood out, with a higher intake, this was below the recommended for the reduction of NCDs and mortality, which is 100 to 150 grams per day[23,25]. The average daily intake of whole grains in Brazil is only 13.6 grams, consumption positively associated with the socioeconomic level[23]. In addition to access to food, culture, habit and food preferences hinder the introduction of new foods, especially among old people, and may also be related to the perception of taste[28], or even the ability to chew, reduced in the old people studied due to the high presence of edentulism, with half or more of the population presenting this problem.

Fruit intake was higher in the old people with a healthy pattern, a habit that contributes to reducing the risk of NCDs and mortality[25]. Fruits are widely available in Brazil and in the studied rural area, however intake is positively associated with socioeconomic status[23]. Ingestion of 200 to 300 grams per day is recommended[23,25], however in Brazil and among the old people of the traditional pattern this intake was well below the recommended. Recent study on food intake in Latin American countries found fruit consumption in Brazil of 70.5 grams per day, being slightly higher in the age group from 50 years old (104.6 grams per day)[23].

However, it is known that healthy aging is not only related to a good dietary pattern, but to a healthy lifestyle[1,2]. It is observed that, in the present study, the prevalence of overweight is lower than the Brazilian average among the old people[28], the vast majority practice physical exercises, smoking is very low and the consumption of alcoholic beverages is not high. Still, it is necessary to remember that the old people studied are long-lived and not fragile individuals, therefore, even the traditional diet has somehow protected them until the moment of functional loss and fragility, similar to that found by Gu et al.[15], when studying the dietary pattern of healthy super old people (individuals ≥85 years old), found a higher probability of being super old, more associated with a western diet than with a healthy diet. However, it cannot be ignored that the sample studied is at risk for health problems and frailty, due to advanced age[2]. Even though they are not frail, they are vulnerable in terms of health. Thus, the traditional diet eaten by a large part of the old people, can contribute to an increase in NCDs and functional decline[4,8].

The greater risk of underweight, even when adjusted for functionality, presented by the old people of the traditional pattern, may be an indicator of greater vulnerability of these old people, increasing the risk of sarcopenia and frailty[16]. In the old people, adherence to a dietary pattern similar to the traditional pattern in this study was associated with an increased risk for unintentional weight loss, a characteristic that was considered one of the factors for frailty[8].

Low muscle mass was also more present in individuals of the traditional dietary pattern. When analyzing old women during three years of follow-up, Isanejad et al.[30], found that those with greater adherence to the Mediterranean and Baltic Sea diets lost less muscle mass, as assessed by the relative skeletal muscle index and total lean body mass. Also Nikolov et al.[31], observed that adopting a healthy dietary pattern has a positive effect on lean body mass, assessed by the appendicular lean mass ratio on BMI.

However, in the present study, due to the results found in the regression analysis, this low muscle mass found in these old people is probably more related to functionality than to the diet itself. Corroborating these results, Tyrovolas et al.[22], studying old people from Mediterranean islands, observed that those with a higher healthy aging score (better functionality), had a greater chance of high lean mass even after adjusting for demographic, health and adherence to the Mediterranean diet variables. Although the positive relationship between muscle mass and functionality[32] is not unanimous in the literature, as all old people lose muscle mass, regardless of functionality[10], frail old people tend to have lower levels of this tissue[11]. It is noteworthy that the quality and not the quantity of muscle mass has a direct effect on functionality[10,11].

Unlike other studies[8,33,34], the study did not show differences in gait speed and muscle strength between the two dietary patterns, which may be due to the population studied being composed of non-frail old people and independent for activities, a population which tends to present the most preserved muscle strength and best performance in the gait speed test, closely related to healthy aging and longevity[11]. Makizako et al.[32], in a study with 356 old people in the community, observed that frail old people had a higher risk of muscle weakness (OR 2.04, CI 95% 1.06–3.95), compared to non-frail people.

Finally, it is observed that, regarding the dietary pattern, no differences were found between the old people in the rural area and those in the urban area. Regarding the reasons for this similarity, the data in the present study are not conclusive, but we must consider the proximity between the rural and urban areas studied and the possibility of "bilateral influences" in the dietary pattern[35]. That is, the urban old people, mostly from rural areas, bring with them the tradition of this dietary culture, at the same time that the rural old people absorb habits of the urban dietary culture through means of communication and personal interactions.

This study has some positive points that should be highlighted. First, it is that the method of investigation of food intake used was the food record and the old people could count on the help of third parties to fill it in when consuming meals, which limited memory bias. Second, food records for three non-consecutive days were requested to better detect habitual intake and each information entered was checked at the time of the nutritional consultation. To reduce the memory bias in this check, it was requested to fill in the records in the days prior to the consultation. Another positive point was the use of specific food composition tables for the Brazilian population. However, there are also some limitations to be considered. The study design was cross-sectional, which prevents the establishment of causal relationships between the findings, the number of old people in the healthy pattern was reduced, which may have influenced the lack of association between muscle strength and gait speed with the dietary pattern. Finally, the method of assessing muscle mass in the old people using AMA was also a limitation because it is not a reference method in assessing muscle mass.

CONCLUSIONS

This study contributes to new evidence about the dietary pattern of long-lived non-frail old people. The findings showed that old people who adhere to healthy dietary patterns have a lower risk of low weight and that low muscle mass is probably more associated with functionality than with dietary patterns. As there is great interest in studying the healthy aging of populations, more research is needed to assess the dietary pattern of long-lived old people and other Brazilian cities, in addition to the need for a thorough investigation of the association between dietary patterns and muscle mass, muscle strength and gait speed test of this population. However, one cannot fail to consider the complex interaction of genotype, diet, lifestyle and environmental factors and the interaction of the individual with these factors, promoting different responses regarding healthy aging.

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