Dietary patterns are associated with general and central obesity in elderly living in a Brazilian city

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Summary

Objective: dietary pattern evaluation is often used in order to determine wheter a diet is healthy, as well as to predict the onset of diseases. This study aimed to identify dietary patterns, and to examine their associations with general (body mass index) and central (waist circumference and waist-to-hip ratio) obesity in community-living elderly in a Brazilian city.
Methods: this cross-sectional study included 126 elderly subjects aged 60 or older (57.1% females and mean age 74.2 ± 6.46 years). Anthropometric variables, weight, height, waist (WC) and hip (HC) circumferences, were measured. Body mass index (BMI) and waist-to-hip ratio (WHR) were calculated. Answers to a Food Frequency Questionnaire were interpreted by Principal Component Analysis in order to identify dietary patterns.
Results: five dietary patterns were identified and named as prudent (fruit, vegetables and meat), sweets and fats (pastries, sugary foods, fatty foods, whole milk), typical Brazilian (fried eggs, cooked beans, beef, candy, string beans, fried cassava), Mediterranean (fruit, vegetables, olive oil and nuts) and traditional meal (rice and beans). Moderate and high adherences to the Mediterranean pattern were protective factors to general and central obesity (WHR). High adherence to prudent was also protective to central obesity (WC).
Conclusion: adherences to the dietary patterns prudent and Mediterranean were protective factors to general and central obesity in elderly.

Keywords: elderly, dietary pattern, obesity, anthropometry, cross-sectional studies.

Introduction

The elderly population in Brazil has increased rapidly,[1] and by 2025, will rank sixth largest in the world.[2] The number of elders, in relation to the total Brazilian population, grew from 7.3% in 1991, to 8.56% in 2000[3] and to 10.8% in 2010.[4] Mortality and birth rate reductions correspond to factors associated with the elderly population rising.[5] The World Health Organization considers ages 60+ or 65+ years when referring to the older population in developing and developed countries, respectively.

Diet is a changeable factor that can help healthy aging. The analysis of nutrient intake does not result in a clear understanding of its quality. Since a daily diet consists of a diversity of foods and a large concentration of nutrients, the analysis of dietary patterns becomes the best alternative to evaluating healthy behaviors.[6,7]

Diet and nutrition have been studied as factors for promoting and maintaining health throughout life.[8] Dietary patterns have been associated with non-communicable chronic diseases,[9-13] mortality,[14-16] cognitive function,[17] obesity[10,12,18-19] and the protective effect on being overweight.[14,18,20-21]

Unhealthy dietary patterns (sugar, fat, processed foods and refined grains) can be found in overweight younger adults[20,22] as well as in the elderly.[10,19] Moreover, such patterns can be related to measurements above the recom-

mended waist circumference and waist-to-hip ratio in adults and the elderly.[12,23] Several studies have shown that healthy food (fruit, vegetable, low fat meat and fiber rich products) may promote a protective effect against general [body mass index, (BMI)][18,20,24] and central [waist-to-hip ratio (WHR) and waist circumference (WC)] obesity.[14,18,21,24]

Although it seems obvious that unhealthy dietary patterns may be associated with obesity, this issue may be debatable. In fact, other studies have identified no positive relationship between obesity and unhealthy dietary patterns in both elderly[14] and younger adults.[25] Examining children and adults, previous study showed the association between healthy food intake (fruit and vegetables) and obesity reduction (adiposity/overweight) is not clear.[26] Thus, the current study attempts to characterize the dietary patterns, and verify their association with health-related variables in the elderly population of a Brazilian city.

Methods

Subjects

The study was conducted in Botucatu, which is a city with 130,201 inhabitants[27] and is located (22°53'09" south latitude, 48°26'42" west longitude) in the state of Sao Paulo, Brazil. Data were collected at the participants' houses from May to November 2008. The sample consisted of 126 individuals older than ≥ 60 years. Inclusion criteria were pre-defined as follows: residing in a community (city of Botucatu, SP, Brazil),[3] 60 years and agreeing to participate in the study. The sample (base sample) was sourced from a database obtained in a previous study conducted in Botucatu City.[28] From the base sample of 365 elderly, 185 subjects were randomly selected to be part of a database of the current study. The initial contact was made by telephone, followed by a household interview, anthropometric measurements and a dietary record. Fifty-nine subjects were excluded due to several reasons (refusal to participate in the study, 34; unanswered phone, 13; death, 3; use of vitamins, 3; absence of records of their primary health, 3; hospitalization, 2; absence, 1), with 126 subjects remaining. All procedures were in accordance with the Helsinki Declaration for human rights, and the study was approved by the Research Ethics Committee of the Botucatu School of Medicine (UNESP). All patients or their legal guardians signed a Free-Consent form.

Anthropometric measures

Weight and height were measured according to Lohman (1988).[29] Subjects were weighted dressed in light clothing and barefoot in a digital scale (Toledo®), with 150 kg capacity and 0.1 kg accuracy. Height was recorded using a portable stadiometer (Sanny®) with the subjects standing erect without shoes and with the feet together. For bedridden elderly persons, the weight and height were estimated by the Chumlea formula.[30-31]

Body mass index (BMI) was calculated by dividing the weight by height squared (kilograms/meters^2) of the subjects. The classification of nutrition status by BMI was performed according to cutoff points established by the Pan American Health Organization[32] [low weight (≤ 23 kg/m^2), normal weight for height (23 < BMI < 28 kg/m^2) and overweight (≥ 28 kg/m^2 overweight and obese ≥ 30 kg/m^2)].

Waist (WC) and hip (HC) circumferences were measured using a non-elastic tape. WC was measured with the subject standing up, at the end of normal expiration, by using the tape at a point midway between the inferior margin of the lowest rib and the iliac crest, whereas HC was recorded at maximum posterior extension of the hip[29]. The waist-to-hip ratio (WHR) was calculated by dividing WC by HC. Waist circumference was considered high when its values were above 88 cm for women and 102 cm for men.[33] WHR was considered elevated when its values were above 0.85 for women and 1 for men.[33] All measurements were performed by the same investigator (1st author of this study), with the same tape, stadiometer and scale.

Dietary intakes

The evaluation of the estimated daily intake was performed by using a food frequency questionnaire (FFQ)[34] with adaptation (inclusion of cooked sweet potatoes, chicory, pepper, lime, mango, beets, green beans, poached eggs and nuts). Besides daily intake, the FFQ was used to evaluate the individuals' frequency of consumption (from 0-10 times a day, week, month or year).[35]

Statistical analysis

The dietary intake information obtained by FFQ was analyzed and interpreted for identification of the dietary patterns by exploratory factor analysis (Principal Component Analysis, PCA). In this method, data are summarized, and correlated variables are grouped.

Some food items were excluded from the analysis because they displayed low intake frequency. One hundred and twenty-one food items were included in the PCA.

Kaiser-Mayer-Olkin (KMO) measurement and Barlett's Test of Spherecity (BTS) were applied to evaluate PCA applicability. In order to obtain the dietary patterns, varimax rotation was used, and based on the correlation

matrix. The number of factors was determined by taking into account loading values greater than or equal to 0.3, and the percentage of explained variation. Food items with negative loadings were excluded from each pattern.

Cronbach's α coefficient was obtained for each factor by evaluating the consistency and the characteristics of each food and the effect of its exclusion on the final coefficient value.

The scores of individual intake were obtained from the dietary patterns and categorized into tertiles, i.e. the 1st as low, the 2nd as moderate and 3rd as high adherence to the pattern.

The variables BMI [(presence (BMI ≥ 28 kg/m²) or absence (BMI ≤ 28 kg/m²) of overweight)] and WC [presence (≥ 88cm, women; ≥ 102cm, men) or absence (<88cm, women; <102cm, men) of increased values] were categorized dichotomously. For the waist-hip ratio, the elevated values were considered when they were above 0.85 for women and 1 for men.

Logistic regression models were fitted by considering general or central obesity as an outcome and the variables of interest (low, moderate and high adherence to dietary patterns) as an explanatory control for age and sex.

All analyses were performed by software SAS (Statistical Analysis System, Cary, North Caroline) and SPSS (Statistical Package for Social Sciences, Armonk, New York) for Windows, versions 9.2 and 19.0, respectively.

Results

One hundred and twenty-six elderly individuals were evaluated. Of these, 72 (57.1%) were females aged 65 to 95 years (74.2 ± 6.46). By using the Kaiser-Mayer-Olkin (KMO) coefficient and the Barlett Test of Sphericity (BTS), appropriate conditions were verified for application of Principal Component Analysis (PCA) and patterns (factors) were extracted. By factor analysis, it was possible to identify 5 dietary patterns in this population, which explained 21.11% of the total variance of food intake. In our study, the pattern labeled as prudent presented the highest variance percentage (5.64%), followed by sweets and fats (4.48%), typical Brazilian pattern (4.05%), Mediterranean (3.72%) and traditional meal (3.22%).

Table 1 shows the anthropometrics characteristics of 126 elderly. Table 2 shows the factor loading (obtained after varimax rotation) of each food item composing the dietary factor (pattern) found. The items with factor loading higher than 0.3 were maintained in order to compose the dietary pattern. Cronbach's α coefficient was analyzed for each factor (pattern). Variability of food intake by individual in that pattern was considered high when the Cronbach's α coefficient value was higher than 0.6. On the other hand, variability was considered low when that coefficient value was lower than 0.6.

TABLE 1 Anthropometric characteristics of participants

	All	Men	Women
Number of subjects[2]	126	54	72
Age (y)[1]	74.1 (6.6)	73.4 (6.3)	74.7 (6.8)
BMI (kg/m²) [1]	27.2 (4.7)	26.3 (4.2)	28 (5)
Overweight (BMI 28 – 30 kg/m²)[2]	20 (15.9)	8 (14.8)	12 (16.7)
Obese (BMI ≥ 30 kg/m²)[2]	29 (23)	9 (16.7)	20 (27.8)
WC (cm)[1]	94 (12.4)	97.4 (11.4)	91.5 (12.6)
HC (cm)[1]	104.8 (10.6)	101.1 (6.7)	107.6 (11.9)
WHR1	0.9 (0.09)	0.96 (0.08)	0.85 (0.06)

BMI, body mass index; WC, waist circumference; HC, hip circumference; WHR, waist to hip ratio.
[1] data are mean (± standard deviation).
[2] data are number (%).

TABLE 2 Foods and factor loading for the five dietary patterns identified

Foods	Pattern 1	Pattern 2	Pattern 3	Pattern 4	Pattern 5
Cooked rice	- 0.206	0.142	0.287	- 0.029	0.367
Sweet biscuits	0.134	0.385	0.082	- 0.135	0.113
French fries	- 0.055	0.323	0.223	- 0.180	- 0.066
Boiled potato	0.424	- 0.113	0.116	0.060	0.163
Boiled cassava	0.488	- 0.166	0.193	- 0.443	- 0.098
Fried cassava	0.148	0.127	0.329	- 0.245	- 0.067
Baked sweet potatoes	- 0.010	0.400	0.040	- 0.011	0.135
Sugar	- 0.180	0.420	0.214	- 0.278	0.165
Ice cream	0.051	0.337	0.126	0.175	0.025
Cooked beans	- 0.350	0.025	0.384	0.028	0.330
Chard	0.372	- 0.217	0.201	0.448	0.204
Watercress	0.423	0.161	- 0.031	0.049	0.035
Chicory	0.458	- 0.106	0.137	- 0.338	0.057
Escarole	0.425	- 0.274	0.104	- 0.262	0.174
Broccoli	0.706	- 0.299	0.247	0.152	0.025
Cauliflower	0.506	- 0.036	0.216	0.356	0.085
Spinach	0.415	0.218	- 0.225	- 0.020	0.142
Courgette	0.663	- 0.199	0.074	- 0.303	0.108
Eggplant	0.695	- 0.228	- 0.030	- 0.121	- 0.081
Chayote	0.556	- 0.184	0.274	- 0.201	- 0.074
Pepper	0.230	0.002	0.296	0.335	0.105
Tomatoes	0.315	0.171	0.136	0.328	0.030
String beans	0.609	- 0.233	0.335	- 0.050	0.109

(continue)

TABLE 2 Foods and factor loading for the five dietary patterns identified (continuation)

Foods	Pattern 1	Pattern 2	Pattern 3	Pattern 4	Pattern 5
Beets	0.491	- 0.320	0.284	0.139	- 0.178
Carrots	0.545	- 0.039	0.107	0.124	0.047
Pineapple	0.517	- 0.098	0.098	- 0.329	- 0.045
Avocado	0.197	- 0.002	0.042	0.366	0.124
Banana	0.050	0.064	0.241	0.374	- 0.133
Guava	0.308	0.314	- 0.288	0.050	- 0.006
Orange	0.307	0.036	0.165	0.252	0.020
Lime	0.102	0.313	0.120	0.242	0.250
Apple	0.319	0.020	0.125	- 0.094	- 0.033
Papaya	0.437	- 0.044	0.140	0.134	0.030
Mango	0.378	0.040	- 0.046	- 0.271	- 0.507
Watermelon	0.537	- 0.088	0.102	- 0.394	- 0.122
Strawberry	0.466	- 0.038	0.181	- 0.199	- 0.174
Peach	0.353	0.234	- 0.106	0.107	- 0.423
Whole milk	- 0.035	0.355	0.168	- 0.098	0.147
Prato cheese	0.086	0.151	0.093	0.328	- 0.375
Parmesan cheese	0.300	0.153	- 0.280	0.375	- 0.009
Mozzarella cheese	0.106	0.235	0.125	0.388	- 0.289
Milk cream	0.240	0.317	- 0.092	- 0.031	- 0.166
Olive oil	0.287	0.064	0.014	0.443	- 0.032
Fried eggs	- 0.141	0.189	0.422	- 0.090	- 0.045
Boiled eggs	0.051	0.303	0.150	- 0.035	0.103
Poached eggs	0.228	0.362	- 0.177	- 0.106	0.067
Fish	0.421	0.036	- 0.283	0.171	0.268
Salt cake	0.215	0.442	- 0.206	- 0.196	0.005
Pizza	0.147	0.533	0.126	0.153	- 0.112
Beef	0.152	- 0.187	0.359	0.020	0.096
Pork	- 0.066	0.367	0.173	- 0.244	- 0.087
Poultry	0.306	- 0.159	- 0.082	- 0.201	0.209
Homemade sweets	0.143	0.537	- 0.120	0.071	- 0.024
Industrialized sweets	- 0.072	0.325	0.293	- 0.236	0.120
Sweet milk	- 0.034	0.416	0.182	0.017	0.036
Candy	- 0.093	0.298	0.358	- 0.046	0.151
Sweets in syrup	0.248	0.490	- 0.145	- 0.122	- 0.132
Nuts	0.153	- 0.108	- 0.190	0.320	0.003
Cronbach's α	0.768	0.518	0.348	0.57	0.821

Table 3 shows the five patterns identified. Dietary pattern 1 was mainly loaded with fruit, vegetables and low fat meat and was labeled as prudent. Pattern 2 was mainly rich in foods with high energy, such as, sweets, pork, and french fries and was named the sweets and fats. Pattern 3 contained legumes, meat, vegetables, fried eggs and fried carbohydrates (cassava, in this case), which are foods usually used in the preparation of Brazilian people's meals, and was called the typical Brazilian pattern. Pattern 4 was rich in fruits, vegetables, monounsaturated fats (olive oil, avocado and nuts), low amounts of foods from animal sources, and was designated the Mediterranean. Pattern 5 contained cooked rice and beans, which represented the basis of Brazilian meals, and was labeled the traditional meal.

TABLE 3 Food items of the five factors identified

Dietary pattern	Foods
Dietary pattern 1 Prudent Variance explained: 5.64%	Broccoli, eggplant, courgette, string beans, chayote, carrots, watermelon, pineapple, cauliflower, beets, boiled cassava, strawberry, chicory, papaya, escarole, boiled potato, watercress, fish, spinach, mango, chard, peach, apple, orange, poultry
Dietary pattern 2 Sweets and fats Variance explained: 4.48%	Homemade sweets, pizza, sweets in syrup, salt cake, sugar, sweet milk, baked sweet potatoes, sweet biscuits, pork, whole milk, ice cream, industrialized sweets, french fries, milk cream, guava, lime, poached eggs, boiled eggs
Dietary pattern 3 Typical Brazilian pattern Variance Explained: 4.05%	Fried eggs, cooked beans, beef, candy, string beans, fried cassava
Dietary pattern 4 Mediterranean Variance explained: 3.72%	Chard, olive oil, mozzarella cheese, parmesan cheese, banana, avocado, cauliflower, pepper, tomatoes, prato cheese, nuts
Dietary pattern 5 Traditional meal Variance explained: 3.22%	Cooked rice, cooked beans

Associations between dietary pattern adherence *versus* general and central obesity are showed in Table 4. The adherence to Mediterranean and prudent patterns were protective factors for obesity. In detail, moderated adherence to Mediterranean was a protective factor to general obesity (values above the recommended BMI) (OR 0.243, 95% CI 0.093-0.635). High adherence to the same pattern was a protective factor to central obesity (values above the recommended for WHR) (OR 0.027, 95% CI 0.109-0.706). High adherence to prudent was a protective factor for central obesity (values above the recommended WC) (OR 0.160, 95% CI 0.031-0.835).

TABLE 4 Dietary patterns and overweight (BMI), WHR and WC association in 126 elderly

Variables	Adherence to patterns	BMI		WHR		WC	
		p-value	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)
Pattern 1	High	0.22	0.626 (0.250-1.567)	0.36	1.015 (0.402-2.561)	0.01	0.160 (0.031-0.835)
Prudent	Moderate	0.47	1.051 (0.433-2.554)	0.05	2.158 (0.870-5.356)	0.03	1.390 (0.455-4.241)
	Low	–	1.0	–	1.0	–	1.0
Pattern 2	High	0.77	0.679 (0.265-1.735)	0.28	0.595 (0.227-1.557)	0.09	0.249 (0.061-1.025)
Sweets and fats	Moderate	0.39	0.585 (0.233-1.473)	0.76	0.869 (0.348-2.172)	0.75	0.596 (0.190-1.872)
	Low	–	1.0	–	1.0	–	1.0
Pattern 3	High	0.57	0.497 (0.202-1.226)	0.77	1.026 (0.414-2.544)	0.20	1.451 (0.429-4.907)
Typical Brazilian	Moderate	0.15	0.386 (0.151-0.991)	0.51	1.318 (0.522-3.328)	0.18	0.558 (0.145-2.153)
	Low	–	1.0	–	1.0	–	1.0
Pattern 4	High	0.33	0.332 (0.133-0.830)	0.02	0.027 (0.109-0.706)	0.29	0.357 (0.104-1.222)
Mediterranean	Moderate	0.04	0.243 (0.093-0.635)	0.94	0.513 (0.207-1.269)	0.48	0.402 (0.114-1.419)
	Low	–	1.0	–	1.0	–	1.0
Pattern 5	High	0.94	0.860 (0.346-2.139)	0.10	0.586 (0.229-1.494)	0.98	0.995 (0.297-3.341)
Traditional meal	Moderate	0.68	0.785 (0.313-1.969)	0.18	1.316 (0.530-3.269)	0.98	1.009 (0.300-3.391)
	Low	–	1.0	–	1.0	–	1.0

BMI, body mass index; WHR, waist to hip ratio; WC, waist circumference.
Odds ratio adjusted for age and sex.

Discussion

The current study conducted in community-living elderly identified five dietary patterns named as prudent, sweets and fats, typical Brazilian pattern, Mediterranean and traditional meal. Our results showed that moderate and high adherences to the Mediterranean pattern are protective factors to general (BMI) and central obesity (WHR), respectively; whereas high adherence to prudent may have a beneficial effect on central obesity (WC). To our knowledge, this is the first time that dietary patterns and their effects on general and central obesity in Brazilian elderly have been evaluated.

The 5 patterns found represented 21.11% of the total variance. This value was similar (21%) to that found in a previous study conducted on Italians elderly, which identified 4 dietary patterns.[10] The FFQ currently applied[34] has been used in previous studies.[36-38] The good reproducibility for associations currently observed by applying FFQ and PCA was also identified by another author.[39] In fact, FFQ can be applied in epidemiological studies, since it is able to associate the frequency of intake of certain dietary factors with variables of interest.[34,40]

The named Mediterranean pattern included health foods from a plant source, olive oil, avocados and nuts, although also comprised some kind of cheeses with high fat amount (mozzarella, parmesan and prato cheese). Since it contains foods that are rich in monounsaturated fatty acids, it is considered to be a cardioprotective diet.[16,41-42] The inverse association between adherence to the Mediterranean diet and cardiovascular disease has been shown in a study that examined event occurrences (myocardial infarction, stroke, or death from cardiovascular causes) in the 4.8 years of follow-up in a population aged 55-80 years,[43] and by meta-analysis that evaluated mortality risk.[44] This diet pattern also has been associated with lower general mortality in Europe.[16,45-46]

Our results showed that moderate and high adherences to Mediterranean pattern are protective factors to general (BMI) and central obesity (WHR), respectively. Previous study identified the Mediterranean pattern and WHR as factors independently associated with the ischemic stroke occurrence in elderly and other adults.[47] Spanish researchers found an inverse association between obesity (BMI and WC) and a healthy life style, including adherence to the Mediterranean diet[48] by the elderly. Examining adults, prospective studies also have shown that adherence to the Mediterranean diet was negatively associated with WC[49] and with weight gain (≥ 5 kg).[50] On the other hand, some studies found no protective effect of the Mediterranean diet on weight gain in adults and elderly.[51-53]

Also found in other studies,[8,14,21] the prudent dietary pattern has been associated with the reduction of all-cause mortality[54] and hypertension.[12,55] In the current study,

high adherence to this dietary pattern was a protective factor for central obesity (WC). Similar results were identified in the elderly[56-58] and adults.[56,59-60]

The sweets and fats pattern has been found in several researches.[8,16,61] It represents a concerning dietary pattern since it contains foods that are associated with the high prevalence of chronic diseases.[8] In fact, elderly people tend to show a high percentage of non-communicable chronic diseases, such as hypertension, cardiovascular diseases and diabetes.[62-64] However, it is important to note that other factors are associated with chronic diseases, such as genetic ones. Absence of the association between obesity and this dietary pattern was currently found. Conversely, the dietary pattern containing sweets and fats was associated with a high BMI in the elderly and adults,[59,61,65] elevated WC in adults[59,61] and high mortality in elderly men.[16]

Another dietary pattern, typical Brazilian, represents the standard Brazilian meal which contains a type of meat, a legume (beans, in this case), a fried carbohydrate (cassava), a vegetable, and fried eggs. Examining results from the Family Budget Study (children, adults and elderly individuals), a study found that the typical Brazilian pattern contains foods that were noteworthy in the dietary representation from all Brazilian regions.[66] The absence of the association with this dietary pattern and obesity was evident in our study. To the best of our knowledge, no studies have addressed this issue. Therefore, comparisons cannot be made.

The traditional meal pattern is incorporated into the population's habits from the North to the South of Brazil and in all age ranges.[66] The comparison of this pattern with international studies is not actually feasible since this combination of rice and beans is typically Brazilian. We did not identify the association of this dietary pattern with obesity in the elderly. Some national studies performed in adult populations showed that this pattern was inversely associated with WC[61] and was associated with lower risk factors for weight gain.[61,67-68]

It is important to emphasize that the metabolic syndrome is a frequent condition among elderly[69-71] and that central obesity is a risk factor for this disorder.[72] In the present study, we showed central obesity may have been protected by high adherence to the Mediterranean and prudent patterns, and general obesity may have been protected by moderated adherence to the Mediterranean dietary pattern. Recent systematic review identified evidences of adherence to the Mediterranean diet and protective effects in adults and elderly subjects with metabolic syndrome.[73] Thus, the adherence to those dietary patterns may contribute to diminishing the metabolic syndrome prevalence.

It is worth mentioning that the current population cannot be considered representative of the whole Brazilian community-living elderly, since they came from a Brazilian small city. Other limiting factors should also be mentioned, such as the sample size, study design (cross-sectional) and method for identifying the dietary patterns, which is not defined as a gold standard.

Although longitudinal studies with larger numbers of elderly are needed, health programs, including the formulation of policies for dietary education and health care, should be adopted to prevent obesity in older people.

Conclusion

In summary, our study identified that moderate and high adherences to the Mediterranean pattern are protective factors to general (BMI) and central obesity (WHR), whereas high adherence to the prudent pattern is a protective factor to central obesity (WC) in the elderly.

In spite of the limitations discussed, the outcomes of this study contribute to the literature by furthering the knowledge of the relationship between dietary patterns and obesity in the elderly. Longitudinal studies using a larger sample size are needed to test the hypothesis of the possible obesity protecting effect of the Mediterranean and prudent dietary patterns on community-living elders.

Author's contributions

PLM performed the data collection. JEC and PLM worked on data analysis and interpretation, and statistical analysis. PJFVB, PLM, JEC and ALAF wrote the final version of the manuscript. All authors evaluated the results, contributed with their comments, and approved the final version of the manuscript before submission for publication.

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Resumo

Padrões alimentares associados com obesidade geral e central em idosos residentes em uma cidade brasileira.

Objetivo: a avaliação do padrão alimentar é muitas vezes usada para determinar se uma dieta é saudável, bem como para predizer o aparecimento de doenças. Este estudo teve como objetivo identificar padrões alimentares e analisar as suas associações com obesidade geral (índice de massa corporal) e central (circunferência da cintura e relação cintura-quadril) em idosos residentes em comunidade em uma cidade brasileira.
Métodos: este estudo transversal incluiu 126 idosos com 60 anos ou mais de idade (57,1% do sexo feminino e média de idade 74,2 ± 6,46 anos). As variáveis antropométricas [peso, altura, circunferências da cintura (CC) e do quadril (CQ)] foram mensuradas. Foram calculados o índice de massa corporal (IMC) e relação cintura-quadril (RCQ). As respostas a um questionário de frequência alimentar foram interpretadas por Análise de Componentes Principais, a fim de identificar os padrões alimentares.
Resultados: cinco padrões alimentares foram identificados e nomeados como prudente (frutas, legumes e carne), doces e gorduras (alimentos de pastelaria, doces, alimentos gordurosos, leite integral), padrão tipicamente brasileiro (ovos fritos, feijão cozido, carne, caramelo, vagens, mandioca frita), Mediterrâneo (frutas, legumes, azeite de oliva e nozes) e tradicional (arroz e feijão). Adesões moderada e alta ao padrão Mediterrâneo foram fatores de proteção para obesidade geral e central (RCQ). Alta adesão ao padrão prudente também foi protetor contra a obesidade central (CC).
Conclusão: adesões aos padrões alimentares prudente e Mediterrâneo foram fatores de proteção para obesidade geral e central em idosos.

Palavras-chave: idoso, padrão alimentar, obesidade, antropometria, estudos transversais.

References

1. Campos MTFS, Monteiro JBR, Ornelas APRC. Factors that affect the aged people food intake and nutrition. Rev Nutr. 2000;13:157-65.
2. Organização Mundial de Saúde (OMS). Envelhecimento ativo: uma política de saúde. Brasília (DF): Organização Pan-Americana de Saúde; 2005.
3. Instituto Brasileiro de Geografia e Estatística. IBGE. Available from: http://www.ibge.gov.br/home/estatistica/populacao/perfilidoso/tabela1_1.shtm
4. Instituto Brasileiro de Geografia e Estatística. IBGE. Available from: http://www.censo2010.ibge.gov.br/resultados_do_censo2010.php.
5. Lebrão ML. O envelhecimento no Brasil: aspectos da transição demográfica e epidemiológica. Saúde Coletiva. 2007;4:135-40.
6. Randall E, Marshall JR, Brasure J, Graham S. Dietary patterns and colon cancer in western New York. Nutr Cancer. 1992;18:265-76.
7. Okubo H, Sasaki S, Horiguchi H, Oguma E, Miyamoto K, Hosoi Y, et al. Dietary patterns associated with bone mineral density in premenopausal Japanese farmwomen. Am J Clin Nutr. 2006;83:1185-92.
8. Marchioni DML, Latorre MRDO, Eluf-Neto J, Wünsch-Filho V, Fisberg RM. Identification of dietary patterns using factor analysis in an epidemiological study in São Paulo. São Paulo Med J. 2005;123:124-7.
9. Sieri S, Krogh V, Pala V, Muti P, Micheli A, Evangelista A, et al. Dietary patterns and risk of breast cancer in the ORDET Cohort. Cancer Epidemiol Biomarkers Prev. 2004;13:567-72.
10. Pala V, Sieri S, Masala G, Palli D, Panico S, Vineis P, et al. Associations between dietary pattern and lifestyle, anthropometry and other health indicators in the elderly participants of the EPIC-Italy cohort. Nutr Metab Cardiovasc. 2006;16:186-201.
11. Sant M, Allemani C, Sieri S, Krogh V, Menard S, Tagliabue E, et al. Salad vegetables dietary pattern protects against HER-2-positive breast cancer: a prospective Italian study. Int J Cancer. 2007;121:911-4.
12. Lee SA, Cai H, Yang G, Xu WH, Zheng W, Li H, et al. Dietary patterns and blood pressure among middle-aged and elderly Chinese men in Shanghai. Br J Nutr. 2010;104:265-75.
13. Olinto MTA, Gigante DP, Horta B, Silveira V, Oliveira I, Willett W. Major dietary patterns and cardiovascular risk factors among young Brazilian adults. Eur J Nutr. 2012;51:281-91.
14. Bamia C, Orfanos P, Ferrari P, Overvad K, Hundborg HH, Tjønneland A, et al. Dietary patterns among older Europeans: the EPIC-Elderly study. Br J Nutr. 2005;94:100-13.
15. Masala G, Ceroti M, Pala V, Krogh V, Vineis P, Sacerdote C, et al. A dietary pattern rich in olive oil and raw vegetables is associated with lower mortality in Italian elderly subjects. Br J Nutr. 2007;98:406-15.
16. Hamer M, McNaughton SA, Bates CJ, Mishra GD. Dietary patterns, assessed from a weighed food record, and survival among elderly participants from the United Kingdom. Eur J Clin Nutr. 2010;64:853-61.
17. Wang Z, Dong B, Zeng G, Li J, Wang W, Wang B, et al. Is there an association between mild cognitive impairment and dietary pattern in Chinese elderly? Results from a cross-sectional population study. BMC Public Health. 2010;10:595.
18. Newby PK, Muller D, Hallfrisch J, Qiao N, Andres R, Tucker KL. Dietary patterns and changes in body mass index and waist circumference in adults. Am J Clin Nutr. 2003;77:1417-25.
19. Polychronopoulos E, Pounis G, Bountziouka V, Zeimbekis A, Tsiligianni I, Qira B-E, et al. Dietary meat fats and burden of cardiovascular disease risk factors, in the elderly: a report from the MEDIS study. Lipids Health Dis. 2010;9:30.
20. Maskarinec G, Novotny R, Tasaki K. Dietary patterns are associated with body mass index in multiethnic women. J Nutr. 2000;130:3068-72.
21. Cai H, Zheng W, Xiang YB, Xu WH, Yang G, Li H, et al. Dietary patterns and their correlates among middle-aged and elderly Chinese men: a report from the Shanghai Men's Health Study. Br J Nutr. 2007;98:1006-13.
22. Quatromani PA, Copenhafer DL, D'Agostino RB, Millen BE. Dietary patterns predict the development of overweight in women: the Framingham Nutrition Studies. J Am Diet Assoc. 2002;102:1239-46.
23. Lee JE, Kim J-H, Son SJ, Ahn Y, Lee J, Park C, et al. Dietary pattern classifications with nutrient intake and health-risk factors in Korean men. Nutrition. 2011;27:26-33.
24. Fogelholm M, Anderssen S, Gunnarsdottir I, Lahti-Koski M. Dietary macronutrients and food consumption as determinants of long-term weight change in adult populations: a systematic literature review. Food Nutr Res. 2012;56.
25. Carrera PM, Gao X, Tucker KL. A study of dietary patterns in the Mexican-American population and their association with obesity. J Am Diet Assoc. 2007;107:1735-42.
26. Ledoux TA, Hingle MD, Baranowski T. Relationship of fruit and vegetable intake with adipositu: a systematic review. Obes Rev. 2011;12:143-50.
27. Instituto Brasileiro de Geografia e Estatística-IBGE, Diretoria de Pesquisas – DPE. Coordenação de População e Indicadores Sociais – COPIS. Estimativa da população residente com data de referência 1º de julho de 2012. Available from: http://www.ibge.gov.br/cidadesat/link.php?codmun=350750.
28. Jóia LC, Ruiz T, Donalisio MR. Life satisfaction among elderly population in the city of Botucatu, Southern Brazil. Rev Saúde Pública. 2007;41:131-8.
29. Lohman TG, Roche AF, Martorell R. Anthropometric standardization reference manual. Champaign: Human Kinetics; 1988. p.44-45.

30. Chumlea WC, Guo S, Roche AF, Steinbaugh ML. Prediction of body weight for the nonambulatory elderly from anthropometry. J Am Diet Assoc. 1988;88:565-8.
31. Chumlea WC, Guo S. Equations for predicting stature in white and black elderly individuals. J Gerontol. 1992;47:M197-203.
32. Organización Panamericana de la Salud. Guía clínica para atención primaria a las personas mayores. Washington (DC): OPAS; 2003.
33. WHO. World Health Organization. Obesity: preventing and managing the global epidemic: report of a WHO Consultation on Obesity. Geneva; 1997.
34. Fisberg RM, Colucci ACA, Morimoto JM, Marchioni DML. Food frequency questionnaire for adults from a population-based study. Rev Saúde Pública. 2008;42:550-4.
35. Fisberg RM, Marchioni DML, Colucci ACA. Assessment of food consumption and nutrient intake in clinical practice. Arq Bras Endocrinol Metab. 2009;53:617-24.
36. Boz C, Santos JS, Mendes KG. Descrição do índice de massa corporal e do padrão do consumo alimentar das integrantes de uma universidade da terceira idade no interior do Rio Grande do Sul. Rev Bras Ciênc Envelhec Hum. 2010;7:229-43.
37. Teixeira JA, Baggio ML, Fisberg RM, Marchioni DML. Calibration of the dietary data obtained from the Brazilian center of the Natural History of HPV Infection in Men study: the HIM Study. Cad Saúde Pública. 2010;26:2323-33.
38. Teixeira JA, Baggio ML, Giuliano AR, Fisberg RM, Marchioni DML. Performance of the quantitative food frequency questionnaire used in the Brazilian center of the prospective study "Natural History of HPV Infection in Men: the HIM Study". J Am Diet Assoc. 2011;111:1045-51.
39. Hu FB, Rimm E, Smith-Warner SA, Feskanich D, Stampfer MJ, Ascherio A, et al. Reproducibility and validity of dietary patterns assessed with a food-frequency questionnaire. Am J Clin Nutr. 1999;69:243-9.
40. Willett WC. Nutritional epidemiology. 2nd ed. New York: Oxford University Press; 1998.
41. Costa RP, Silva CC, Pimentel IC. Terapia nutricional nas doenças cardiovasculares. In: Silva SMCS, Mura JDP, editores. Tratado de alimentação, nutrição e dietoterapia. São Paulo: Roca; 2007. p.671-92.
42. Tyrovolas S, Panagiotakos DB. The role of Mediterranean type of diet on the development of cancer and cardiovascular disease, in the elderly: a systematic review. Maturitas. 2010;65:122-30.
43. Estruch R, Ros E, Salas-Salvadó J, Covas M-I, Corella D, Arós F, et al. Primary prevention of cardiovascular disease with a mediterranean diet. N Eng J Med 2013;368:1279-90.
44. Sofi F, Cesari F, Abbate R, Gensini GF, Casini A. Adherence to Mediterranean diet and health status: meta-analysis. Br Med J. 2008;337:a1344.
45. Knoops KTB, Groot LCPGM, Kromhout D, Perrin AE, Moreiras-Varela O, Menotti A, et al. Mediterranean diet, lifestyle factors, and 10-year mortality in elderly European men and women: the HALE Project. JAMA. 2004;292:1433-9.
46. Tognon G, Rothenberg E, Eiben G, Sundh V, Winkvist A, Lissner L. Does the Mediterranean diet predict longevity in the elderly? A Swedish perspective. Age. 2011;33:439-50.
47. Yau WY, Hankey GJ. Which dietary and lifestyle behaviours may be important in the aetiology (and prevention) of stroke? J Clin Neurosci. 2011;18:76-80.
48. Bulló M, Garcia-Aloy M, Martínez-González MA, Corella D, Fernández-Ballart JD, Fiol M, et al. Association between a healthy lifestyle and general obesity and abdominal obesity in an elderly population at high cardiovascular risk. Prev Med. 2011;53:155-61.
49. Kesse-Guyot E, Ahluwalia N, Lassale C, Hercberg S, Fezeu L, Lairon D. Adherence to Mediterranean diet reduces the risk of metabolic syndrome: a 6-year prospective study. Nutr Metab Cardiovasc Dis. 2013:23:677-83.
50. Beunza J-J, Toledo E, Hu FB, Bes-Rastrollo M, Serrano-Martínez M, Sánchez-Villegas A, et al. Adherence to the Mediterranean diet, long-term weight change, and incident overweight or obesity: the Seguimiento Universidad de Navarra (SUN) cohort. Am J Clin Nutr. 2010;92:1484-93.
51. Trichopoulou A, Naska A, Orfanos P, Trichopoulos D. Mediterranean diet in relation to body mass index and waist-to-hip ratio: the Greek European Prospective Investigation into Cancer and Nutrition Study. Am J Clin Nutr. 2005;82:935-40.
52. Rossi M, Negri E, Bosetti C, Dal Maso L, Talamini R, Giacosa A, et al. Mediterranean diet in relation to body mass index and waist-to-hip ratio. Public Health Nutr. 2007;11:214-7.
53. Inelmen EM, Toffanello ED, Enzi G, Sergi G, Coin A, Busetto L, et al. Differences in dietary patterns between older and younger obese and overweight outpatients. J Nutr Health Aging. 2008;12:3-8.
54. Bamia C, Trichopoulos D, Ferrari P, Overvad K, Bjerregaard L, Tjønneland A, et al. Dietary patterns and survival of older Europeans: The EPIC-Elderly Study (European Prospective Investigation into Cancer and Nutrition). Public Health Nutr. 2007;10:590-8.
55. Hsiao PY, Mitchell DC, Coffman DL, Craig Wood G, Hartman TJ, Still C, et al. Dietary patterns and relationship to obesity-related health outcomes and mortality in adults 75 years of age or greater. J Nutr Health Aging. 2013;17:566-72.
56. Panagiotakos DB, Pitsavos C, Skoumas Y, Stefanadis C. The association between food patterns and the metabolic syndrome using principal components analysis: the ATTICA Study. J Am Diet Assoc. 2007;107:979-87.
57. Salas-Salvadó J, Fernández-Ballart J, Ros E, Martínez-González M-A, Fitó M, Estruch R, et al. Effect of a mediterranean diet supplemented with nuts on metabolic syndrome status. One-year results of the PREDIMED Randomized Trial. Arch Intern Med. 2008;168:2449-58.
58. Casas-Agustench P, Bulló M, Ros E, Basora J, Salas-Salvadó J. Cross-sectional association of nut intake with adiposity in a Mediterranean population. Nutr Metab Cardiovasc Dis. 2011;21:518-25.
59. Rezazadeh A, Rashidkhani B. The association of general and central obesity with major dietary patterns in adult women living in Tehran, Iran. ARYA Atheroscler. 2010;6:23-30.
60. Kim J, Jo I. Grains, vegetables, and fish dietary pattern is inversely associated with the risk of metabolic syndrome in South Korean adults. J Am Diet Assoc. 2011;111:1141-9.
61. Cunha DB, Almeida RMVR, Sichieri R, Pereira RA. Association of dietary patterns with BMI and waist circumference in a low-income neighbourhood in Brazil. Br J Nutr. 2010;104:908-13.
62. Ramos LR. Determinant factors for healthy aging among senior citizens in a large city: the Epidoso Project in São Paulo. Cad Saúde Pública. 2003;19:793-8.
63. Lima-Costa MF, Barreto SM, Giatti L. Health status, physical functioning, health services utilization, and expenditures on medicines among Brazilian elderly: a descriptive study using data from the National Household Survey. Cad Saúde Pública. 2003;19:735-43.
64. Nascimento CM, Ribeiro AQ, Cotta RMM, Acurcio FA, Peixoto SV, Priore SE, et al. Factors associated with functional ability in Brazilian elderly. Arch Gerontol Geriatr. 2012;54:89-94.
65. Ledikwe JH, Smiciklas-Wright H, Mitchell DC, Miller CK, Jensen GL. Dietary patterns of rural older adults are associated with weight and nutritional status. J Am Geriatr Soc. 2004;52:589-95.
66. Nascimento S, Barbosa FS, Sichieri R, Pereira RA. Dietary availability patterns of the Brazilian macro-regions. Nutr J. 2011;10:79.
67. Sichieri R. Dietary Patterns and their associations with obesity in the Brazilian city of Rio de Janeiro. Obes Res. 2002;10:42-8.
68. Sichieri R, Castro JFG, Moura AS. Factors associated with dietary patterns in the urban Brazilian population. Cad Saúde Pública. 2003;19:47-53.
69. Ford ES, Giles WH, Dietz WH. Prevalence of the metabolic syndrome among US adults: findings from the third National Health and Nutrition Examination Survey. JAMA. 2002;287:356-9.
70. Chuang SY, Chen CH, Tsai ST, Chou PS. Clinical identification of the metabolic syndrome in Kinmen. Acta Cardiol Sin. 2002;18:16-23.
71. Gu D, Reynolds K, Wu X, Chen J, Duan X, Reynolds RF, et al. Prevalence of the metabolic syndrome and overweight among adults in China. Lancet. 2005;365:1398-405.
72. Ferreira ALA, Correa CR, Freire CMM, Moreira PL, Berchieri-Ronchi CB, Reis RAS, et al. Metabolic syndrome: updated diagnostic criteria and impact of oxidative stress on metabolic syndrome pathogenesis. Rev Bras Clin Med São Paulo. 2011;9:54-61.
73. Esposito K, Kastorini CM, Panagiotakos DB, Giugliano D. Mediterranean diet and metabolic syndrome: an updated systematic review. Rev Endocr Metab Disord. 2013; 14:255-63.