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Eating patterns and nutrient intake for older people: analysis with different methodological approaches

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Abstract *This study aims to analyse the eating patterns and nutrient intake in different eating patterns of elderly persons. This is a cross-sectional study with elderly people from Botucatu, São Paulo state, Brazil. The mean daily nutrient intake of individuals with high adherence to the eating patterns identified by factor analysis was analysed, comparing the intake by analysis of variance. Individuals with high adherence to the Healthy eating pattern had the highest mean intake of retinol, vitamin A and vitamin E. Individuals with high adherence to the eating pattern Snacks and weekend meal presented lower means of vitamin B12, vitamin C, phosphorus, and retinol intake and the highest means of iron, manganese and magnesium intake. Individuals with high adherence to Fruits had the lowest mean fibre intake. Individuals with high adherence to Light and whole foods had the highest means of vitamin C intake. Individuals with high adherence to Soft diet showed lower protein intake and increased added sugar intake. Individuals with high adherence to the Traditional eating pattern presented high means of nutrient intake. In general, a better characterization of the eating behaviour of elderly people who adhere to each of these eating patterns was possible.*

Key words *Eating patterns, Micronutrients, Macronutrients, Food, Elderly*

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Introduction

With ageing, changes in nutritional status become more frequent due to factors that limit food consumption and nutrient utilization. These include physiological and oral cavity changes, economic and psychosocial factors, restriction of mobility and institutionalization[1]. In addition to these factors, the nutritional transition due to changes in eating patterns and a sedentary lifestyle has been shown to have a major impact on the health and nutritional status of the elderly[2].

In nutritional epidemiology, eating patterns are identified through statistical techniques of the reduction and/or aggregation of components. Pattern identification methods, such as exploratory methods, are based on empirical food data, which are aggregated on the basis of statistical analysis, with subsequent evaluation[3]. Principal component analysis (PCA) is one of the most commonly used statistical methods to empirically derive eating patterns[3]. The patterns derived from the exploratory method do not necessarily represent patterns of ideal diets[4,5]. However, the specificity of this method offers the advantage of reflecting the real behaviour of a population group, providing useful information for the elaboration of nutritional guidelines[6]. Eating patterns may be a consequence of cultural, ethnic, and many environmental factors, including food availability, food purchasing and preparation, and numerous product advertisements[5].

From a public health perspective, researchers stress the importance of evaluating food consumption through the use of various approaches to nutrient, food and food group analysis[5,7]. However, there is a shortage of studies in the literature that evaluate the diet using both approaches. Often, either eating patterns[8-11] or specific dietary components are analysed[12-16].

To date, few studies have used statistical methods to empirically identify eating patterns in elderly groups[17-19]. In Brazil, a statistical analysis of the eating patterns and their components in the elderly population has not yet been published.

To increase the knowledge regarding the eating behaviour of the elderly, a group vulnerable to changes in nutritional status, this study proposes an unprecedented way to analyse eating patterns and nutrient intake by two different methodological approaches.

Methods

This is a cross-sectional epidemiological study, with a sample of 172 individuals aged 60 years or older residing in an urban area and enrolled in the basic health network of the city of Botucatu, SP, Brazil. Data from 172 individuals were randomly selected by stratified sampling among the 16 basic health units (BHUs) and family health strategies (FHS) in the city. Data were collected from March to June 2011, and participants answered a validated quantitative food frequency questionnaire (FFQ) for this population, which contained 71 food items[20].

The 172 individuals were a subsample of a sample of 355 individuals enrolled in primary care. This subsample is representative of the larger sample with regard to sociodemographic aspects, as demonstrated by the proportionality of the data of this study and those presented in Ferreira et al.[21]. Thus, it is possible that this subsample represents the population enrolled in the basic health network, considering the similarity in the sociodemographic profiles.

This study was approved by the Research Ethics Committee of the School of Medicine of Botucatu/Sao Paulo State University (UNESP) through protocol number 3560/2010.

The identification of eating patterns was performed in a previous study[21] using an exploratory factor analysis technique (PCA) with varimax rotation for food items. Individual consumption scores were calculated and divided into tertiles: low adherence, moderate adherence and high adherence to the eating pattern analysed[21].

For nutrient consumption calculation, the food composition data provided by the study "Inquérito de Saúde do Município de São Paulo (Health Survey of the Municipality of Sao Paulo; ISA- Capital)" of the University of São Paulo (USP) were used. All FFQ data were converted to nutrient intake using information on the portion size proportional to 100 grams of each nutrient, and these data were represented as the mean and standard deviation (SD). The following nutrients were evaluated: carbohydrate, protein, total fat, saturated fat, total fibre, added sugar, alcohol, vitamin D, vitamin C, retinol, vitamin A, folate, vitamin E, vitamin B12, calcium, phosphorus, magnesium, iron, sodium, potassium, selenium, copper, and manganese.

The total energy value (TEV) was calculated for each individual according to the following formula: TEV = ((4 kcal x protein (in grams) + (4 kcal x carbohydrate (in grams) + (9 kcal x total

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fat (in grams) + (7 kcal x alcohol (in grams)).

Comparisons of nutrient intake means, according to sex, were made regarding the high adherence to each of the patterns (identified as the highest tertile of adherence scores to each pattern identified in a previous study) using analysis of variance (ANOVA), followed by the energy-adjusted Tukey multiple comparison test (TEV) in cases of symmetrically distributed data. When the distribution was asymmetric, a generalized linear model with a gamma distribution was used, followed by the multiple Wald comparison, which was also adjusted by energy (TEV).

All analyses were performed using the SAS program, version 9.3. The level of significance was 5%.

Results and discussion

The sample consisted of 172 individuals aged sixty years or older, of whom 80 (46.51%) were male and 92 were female. The age ranged from 60 to 92 years, the mean age was 69.51 years (standard deviation = 7.90 years). This population lived with a mean *per capita* family income of 1.89 minimum wages. The majority of the individuals were white (86.55%) and had studied up to elementary school (40.12%).

The 6 eating patterns identified in the factor analysis[21] and that consistently reproduced the different eating characteristics of the elderly in the city of Botucatu were:

1. *Healthy:* Raw vegetables, vegetables, broccoli/cauliflower/cabbage, cooked vegetables, carrot, extra virgin olive oil, tomato, lettuce, fish, oats.
2. *Snacks and weekend meal*: Sausages, yellow cheeses, pizza/pancake, baked snacks, bacon/jerky beef, burger/nuggets/meatballs, fried snacks, butter, soda, French bread, pasta with meat, mayonnaise salad, desserts/sweets, potato/fried cassava.
3. *Fruits*: Avocado, guava, papaya, apple/pear, melon/watermelon, orange/bergamot/pineapple, banana.
4. *Light and whole foods*: Skimmed/semi-skimmed milk, whole wheat bread, natural juice without sugar, oats, extra virgin olive oil.
5. *Soft diet*: Baked potato/cassava, soup, French bread, whole milk, carrot, cooked corn meal.
6. *Traditional:* White rice, bean, lettuce, tomato.

A previous study presented the distribution of adherence to these eating patterns according to sociodemographic characteristics[21]. However, although the identification of these global patterns translates, in practical terms, the main foods that characterize the diet of these groups, it is not an evaluation method that can be used to describe the composition of nutrients in each eating pattern. For a complete evaluation of dietary intake, the present study proposes to quantitatively analyse the nutrients consumed by individuals with high adherence to each of the identified patterns, thereby expanding the understanding of the possible nutritional advantages or risks for the elderly when adhering to each of these patterns, as shown in Tables 1 and 2.

The means and pattern deviations of the intake of macro and micronutrients, respectively, of men and women with high adherence to each of the eating patterns are presented in Tables 1 and 2.

As shown in Tables 1 and 2, the high adherence to the *Healthy* pattern differed significantly from all other patterns because of the higher consumption of retinol in both sexes and vitamin A in males. In females, this pattern also presented the highest mean of vitamin A, not differing significantly from the *Fruits* and *Light and whole foods* patterns.

The high adherence to the *Healthy* pattern was also characterized by a greater intake of several nutrients. In this pattern, higher means were observed in both sexes for magnesium, iron, copper and manganese; in men, higher means of vitamin E, protein and selenium were observed, and in women the highest means were observed for vitamin B12.

Some of these results are expected because elements such as magnesium, iron, copper, manganese, vitamin E, vitamin A, protein and selenium are present in the foods that characterize the *Healthy* pattern.

For example, protein is present in both animal foods, such as fish, and foods of plant origin. Vitamin E and the aforementioned minerals are abundant in foods of plant origin. However, the higher means of retinol and vitamin B12 intake by individuals with high adherence to this pattern allow us to infer that it can supply larger amounts of important nutrients, such as those that are exclusive to foods of animal origin.

Considering that 10 to 30% of the elderly population may have impaired absorption of vitamin B12[22] due to intrinsic factor deficiency, inflammatory bowel disease, surgery and medi-

Table 1. Means and standard deviations of nutrients in elderly men with high adherence to eating patterns. Botucatu (SP), Brazil, 2011.

Nutrient	Healthy Pattern Mean (SD)	Snacks and Weekend Meal Pattern Mean (SD)	Fruits Pattern Mean (SD)	Light and Whole Foods Pattern Mean (SD)	Soft Diet Pattern Mean (SD)	Traditional Pattern Mean (SD)	P-value
Total fat (g)*	99.64^{a} (19.08)	94.16^{a} (18.95)	99.08^{a} (19.07)	96.400^{a} (19.07)	93.405^{a} (18.98)	100.495^{a} (18.96)	0.0020
Saturated fat (g)*	32.15^{ab} (7.68)	29.71^{b} (7.62)	34.50^{a} (7.67)	34.88^{a} (7.67)	31.71^{ab} (7.64)	34.52^{a} (7.63)	0.0040
Carbohydrate (g)*	310.86^{b} (47.78)	324.37^{b} (47.44)	317.56^{b} (47.76)	327.12^{ab} (47.77)	346.07^{a} (47.54)	329.44^{ab} (47.48)	0.194
Protein (g)*	95.74^{a} (17.98)	83.91^{b} (17.86)	89.16^{ab} (17.97)	85.59^{ab} (17.98)	81.23^{b} (17.89)	81.20^{b} (17.87)	< 0.0001
Total fibre (g) *	34.69^{a} (7.44)	31.45^{a} (7.39)	27.24^{b} (7.44)	34.12^{a} (7.44)	30.01^{b} (7.40)	31.95^{a} (7.39)	0.0210
Vitamin D (µg) *	3.76^{a} (1.87)	3.66^{a} (1.86)	3.68^{a} (1.87)	4.15^{a} (1.87)	4.15^{a} (1.87)	3.92^{a} (1.86)	0.9810
Vitamin C (mg) *	223.83^{a} (139.84)	172.14^{a} (138.86)	163.28^{a} (139.79)	248.41^{a} (139.82)	194.53^{a} (139.16)	190.46^{a} (138.99)	0.3670
Retinol (µg*)	1794.79^{a} (738.71)	1002.53^{b} (733.55)	1205.29^{b} (738.46)	1379.73^{ab} (738.64)	1186.01^{b} (735.12)	1307.79^{b} (734.23)	0.0090
Vitamin A (µg)***	3557.28^{a} (2393.89)	1713.67^{b} (1168.04)	2465.99^{b} (1651.44)	2260.55^{b} (1389.45)	2073.8^{b} (1268.60)	2358.92^{b} (1615.94)	< 0.0001
Folate (µg) *	576.36^{a} (92.24)	542.51^{ab} (91.60)	484.44^{c} (92.21)	546.67^{ab} (92.23)	517.45^{abc} (91.79)	532.19^{abc} (91.68)	0.0070
Vitamin E (mg) *	13.14^{a} (2.66)	11.21^{b} (2.64)	10.74^{b} (2.66)	11.35^{b} (2.66)	10.74^{b} (2.64)	11.63^{b} (2.64)	0.0060
Vitamin B12 (µg) **	56.92^{a} (110.17)	30.47^{ab} (49.04)	41.00^{ab} (71.37)	43.05^{ab} (79.29)	33.45^{ab} (54.55)	22.64^{b} (37.92)	0.1130
Calcium (mg) *	928.88^{ab} (302.31)	816.07^{b} (300.20)	941.07^{ab} (302.21)	1072.06^{a} (302.28)	899.70^{ab} (300.84)	900.90^{ab} (300.48)	0.1630
Phosphorus (mg) *	1451.60^{a} (215.56)	1307.80^{b} (214.05)	1394.83^{ab} (215.48)	1440.15^{a} (215.54)	1307.21^{b} (214.51)	1314.30^{ab} (214.25)	< 0.0001
Magnesium (mg) *	420.12^{a} (52.12)	388.97^{ab} (51.76)	351,98^{b} (52.10)	383.26^{bc} (52.12)	362.47^{bc} (51.87)	370.61^{bc} (51.80)	< 0.0001
Iron (mg) *	16.79^{a} (3.02)	15.75^{a} (3.00)	14.91^{b} (3.02)	14.69^{b} (3.02)	14.86^{b} (3.01)	15.73^{ab} (3.01)	0.0004
Sodium (mg) *	4112.95^{a} (944.26)	3705.65^{a} (937.67)	3887.98^{a} (943.94)	3679.13^{a} (944.18)	3641.76^{a} (939.67)	3820.56^{a} (938.53)	0.0050
Potassium (mg) *	3674.44^{a} (667.55)	3191.42^{b} (662.89)	3067.56^{b} (667.32)	3709.82^{a} (667.49)	3344.94^{ab} (664.31)	3283.91^{ab} (663.50)	0.0130
Selenium (µg) *	129.64^{a} (23.83)	119.08^{b} (23.67)	127.49^{a} (23.82)	117.38^{b} (23.83)	118.29^{b} (23.72)	114.33^{b} (23.68)	< 0.0001
Copper (mg) *	1.64^{a} (0.24)	1.49^{ab} (0.23)	1.45^{b} (0.24)	1.50^{ab} (0.24)	1.47^{b} (0.23)	1.58^{ab} (0.23)	0.0003
Manganese (mg) *	5.28^{a} (1.16)	5.06^{ab} (1.15)	4.53^{b} (1.16)	4.54^{ab} (1.16)	4.79^{ab} (1.15)	4.91^{ab} (1.15)	0.0220
Added sugar (g) *	49.29^{b} (59.48)	64.40^{ab} (59.07)	87.90^{a} (59.46)	64.80^{ab} (59.48)	96.48^{a} (59.19)	78.44^{ab} (59.12)	0.1050
Alcohol (g) *	6.26^{a} (27.59)	12.34^{a} (27.40)	6.91^{a} (27.59)	6.93^{a} (27.59)	2.45^{a} (27.46)	2.85^{a} (27.43)	0.5630

* p-value for the F test (ANOVA). ** p-value for the Wald test (linear model with gamma distribution). *** Equivalents of retinol activity. Letters superscripted to the mean values indicate Tukey's multiple comparison test: a difference between two means is represented by the presence of different letters.

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Table 2. Means and standard deviation of nutrients in elderly women with high adherence to dietary patterns. Botucatu (SP), Brazil, 2011.

Nutrient	Healthy Pattern Mean (SD)	Snacks and Weekend Meal Pattern Mean (SD)	Fruits Pattern Mean (SD)	Light and Whole Foods Pattern Mean (SD)	Soft Diet Pattern Mean (SD)	Traditional Pattern Mean (SD)	P-value
Total fat (g)*	98.74^{a} (21.99)	96.73^{a} (21.62)	99.81^{a} (21.69)	101.21^{a} (21.54)	98.21^{a} (21.56)	101.38^{a} (21.47)	<0.0001
Saturated fat (g)*	33.37^{a} (9.13)	31.43^{a} (8.98)	35.14^{a} (9.01)	33.62^{a} (8.95)	33.28^{a} (8.96)	34.83^{a} (8.96)	<0.0001
Carbohydrate (g)*	319.15^{a} (62.60)	340.31^{a} (61.56)	316.39^{a} (61.75)	322.90^{a} (61.32)	335.11^{a} (61.39)	325.35^{a} (61.40)	<0.0001
Protein (g)*	93.12^{a} (20.05)	90.37^{ab} (19.72)	91.76^{a} (19.78)	87.77^{ab} (19.64)	81.58^{b} (19.66)	93.23^{a} (19.66)	<0.0001
Total fibre (g) *	33.55^{a} (9.47)	32.94^{a} (9.32)	27.19^{b} (9.35)	34.97^{a} (9.28)	27.44^{b} (9.29)	32.46^{a} (9.30)	0.0009
Vitamin D (µg) *	3.94^{b} (2.16)	4.39^{ab} (2.12)	4.42^{ab} (2.13)	4.14^{ab} (2.12)	4.44^{ab} (2.12)	5.00^{a} (2.12)	0.0686
Vitamin C (mg) *	216.17^{b} (146.96)	128.40^{b} (144.52)	217.87^{b} (144.96)	313.02^{a} (143.96)	168.49^{bc} (144.11)	186.18^{bc} (144.13)	<0.0001
Retinol (µg*)	1456.51^{a} (596.17)	890.87^{b} (586.25)	1181.93^{bc} (588.03)	1208.41^{ab} (583.99)	1087.55^{bc} (584.60)	1163.67^{bc} (584.69)	0.0460
Vitamin A (µg)***	4076.05^{a} (3471.76)	2431.71^{b} (1898.52)	2711.27^{ab} (2116.10)	3195.49^{ab} (2023.90)	2607.07^{b} (1830.24)	2869.88^{ab} (2243.96)	< 0.0001
Folate (µg) *	532.50^{ab} (134.80)	535,24^{ab} (132,55)	469.76^{b} (132.96)	538.81^{a} (132.04)	469.82^{b} (132.18)	531.44^{ab} (132.20)	0.0015
Vitamin E (mg) *	11.85^{ab} (2.91)	10,77^{b} (2.86)	10.45^{b} (2.87)	12.29^{a} (2.85)	10.89^{ab} (2.85)	11.17^{ab} (2.85)	0.0536
Vitamin B12 (µg) **	48.91^{a} (73.918)	20.09^{b} (31.79)	40.95^{a} (61.02)	37.10^{a} (52.44)	31.18^{ab} (49.09)	24.80^{ab} (38.07)	0.0348
Calcium (mg) *	970.30^{a} (335.07)	876.86^{a} (329.49)	979.29^{a} (330.49)	953.67^{a} (328.22)	900.24^{a} (328.56)	1026.92^{a} (328.62)	0.1059
Phosphorus (mg) *	1447.01^{a} (278.22)	1370.49^{ab} (273.59)	1417.43^{ab} (274.42)	1355.90^{ab} (272.53)	1296.63^{b} (272.82)	1463.72^{a} (272.86)	<0.0001
Magnesium (mg) *	392.63^{a} (72.46)	394.43^{a} (71.25)	339.37^{c} (71.47)	377.58^{ab} (70.98)	348.62^{bc} (71.05)	381.94^{ab} (71.07)	<0.0001
Iron (mg) *	15.71^{ab} (3.63)	17.01^{a} (3.57)	14.15^{b} (3.58)	14.58^{b} (3.55)	14.04^{b} (3.56)	16.40^{a} (3.56)	<0.0001
Sodium (mg) *	3732.12^{a} (777.31)	3520.81^{ab} (764.38)	3698.55^{a} (766.69)	3272.77^{b} (761.43)	3300.57^{b} (762.22)	3634.38^{ab} (762.34)	<0.0001
Potassium (mg) *	3594.12^{ab} (776.35)	3433.83^{b} (763.43)	3241.13^{b} (765.75)	3873.97^{a} (760.49)	3277.35^{b} (761.28)	3551.74^{ab} (761.40)	0.0002
Selenium (µg) *	124.09^{ab} (22.71)	118.75^{ab} (22.33)	129.43^{a} (22.40)	115.73^{b} (22.24)	113.29^{b} (22.27)	120.39^{ab} (22.27)	< 0.0001
Copper (mg) *	1.57^{a} (0.28)	1.58^{a} (0.27)	1.41^{b} (0.27)	1.54^{ab} (0.27)	1.44^{ab} (0.27)	1.58^{a} (0.27)	<0.0001
Manganese (mg) *	4.74^{ab} (1.19)	5.16^{a} (1.17)	4.06^{bc} (1.18)	4.36^{bc} (1.17)	4.24^{bc} (1.17)	4.68^{ab} (1.17)	<0.0001
Added sugar (g) *	71.76^{b} (63.28)	88.94ab (62.22)	87.45^{ab} (62.41)	65.08^{b} (61.8)	105.27^{a} (62.05)	76.60^{ab} (62.06)	0.0030
Alcohol (g) *	7.55 (0.72)	-0.381 (1.34)	8.52 (0.73)	5.28 (0.62)	5.69 (0.63)	0.54 (1.17)	0.4856

* p-value for the F test (ANOVA). ** p-value for the Wald test (linear model with gamma distribution). *** Equivalents of retinol activity. Letters superscripted to the mean values indicate Tukey's multiple comparison test: a difference between two means is represented by the presence of different letters.

cation (especially antibiotics, which destroy the intestinal flora)[23], adherence to the *Healthy* pattern can contribute to a greater amount of this nutrient.

Fisberg et al., when assessing the prevalence of inadequate nutrient intake in the Brazilian elderly population, found a high prevalence of inadequacy in vitamin A intake, with percentages between 68% in women and 83% in men[16].

Considering the key role of vitamin A in the visual cycle, promotion of growth, epithelial cellular differentiation and maintenance, immune system activity and reproduction[24], in addition to the low consumption of vitamin A-rich foods by the Brazilian elderly population[16,25], stimulating adherence to the *Healthy* pattern becomes strategic.

The development of guidelines and government programmes that encourage the consumption of fish, vegetables, oats and extra virgin olive oil, foods typical of this eating pattern, may be a good strategy for the prevention of vitamin A and vitamin B12 deficiencies, as well as ensuring intake of other micronutrients present in these foods.

As shown in Tables 1 and 2, a high adherence to the standard *Snacks and weekend meal* when compared to the *Healthy* and *Light and whole foods* patterns is characterized by lower means of vitamin C and vitamin B12 (in women) and phosphorus and retinol (in men).

This result demonstrates that even though the pattern *Snacks and weekend meal* contains foods of animal origin, it may not be a good source of important nutrients such as vitamin B12 and retinol.

On the other hand, the reduced means of vitamin C in high adherence to the pattern *Snacks and weekend meal* is an expected result because there is no source food of this vitamin found in this eating pattern.

The highest means of nutrients, such as iron (in both sexes) and magnesium and manganese (in females), in a high adherence to the pattern *Snacks and weekend meal* compared to a high adherence to the *Fruits*, *Light and whole foods* and *Soft diet* patterns are notable because this was only possible due to the isolated analysis of nutrients. This result may have occurred due to the consumption of meat and meat products and the presence of foods such as cereals and pasta that characterize this pattern.

The fortification of wheat and corn flours with iron and folic acid is mandatory and was established by Resolution RDC No. 344 of December 13, 2002[26]. Although the supplemented amount of iron in 100 grams of flour was not elevated, this supplementation may also contribute to the higher levels of iron in a high adherence to the pattern *Snacks and weekend meal*.

Data from the Pesquisa de Orçamentos Familiares (Family Budget Survey; POF 2008-2009) show results similar to those found in this study, demonstrating that the mean intake of vitamin C was lower in groups of people who consume soda, pizza, stuffed biscuits and processed meats when compared to the average vitamin C intake of the population[27].

The data from POF (2008-2009) also indicated a higher mean folate intake in groups of people who consumed pizza and salty bread when compared to the mean folate intake of the population, correlating this finding with the probable fortification of flour with folate[27].

Men with a high adherence to the pattern *Snacks and weekend meal* consumed significantly lower amounts of saturated fat when compared to those with a high adherence to *Fruit*, *Light and whole foods* and *Traditional patterns*.

This result was not expected because this pattern is represented by several fatty foods such as sausage, yellow cheese, pizza/pancake, baked snack, bacon, hamburger, and butter, among others. There may have been an underestimation of the portion sizes of these foods.

It is known that in food consumption assessment studies, several factors may interfere with the quality of information, including gender, age, education level, the individual being concerned with social approval, and the patient's own perception about healthy food[28,29].

Researchers recognize that sub-reporting remains a problem and may be associated with underestimation of portion size[30-32]. Tucker[31] notes that it is important to understand these sources of potential bias because they may lead to false conclusions about the observed associations.

Contrary to expectations, the method of analysis used in this study did not identify a higher intake of nutrients that are markers of an unhealthy diet, such as saturated fat and added sugar, by individuals with a high adherence to the pattern *Snacks and weekend meal*. However, the method proved to be effective in signalling lower means of vitamins and minerals in the high adherence to this pattern when compared to the other patterns.

As shown in Tables 1 and 2, a high adherence to the *Fruits* pattern was shown to have the lowest mean fibre intake for both sexes, differing significantly from most of the patterns (it did not significantly differ only from the pattern *Soft diet*).

Higher means of sodium and selenium were also observed in a high adherence to the pattern *Fruits* compared to a high adherence to the *Light and whole foods* and *Soft diet* patterns, as well as lower means of magnesium, folate, copper, and manganese when compared to a high adherence to the *Healthy* and *Snack and weekend meal* patterns.

In males, the mean saturated fat intake was higher in a high adherence to the *Fruit* pattern than in a high adherence to the *Snacks and weekend meal* pattern.

The isolated analyses of the nutrients for the *Fruit* pattern present unexpected results.

In the present study, it can be inferred that, inherent to this eating behaviour described by the preference for fruits, there is also the consumption of other types of food that can be fatty and caloric.

The high frequency of fruit consumption could also indicate a compensatory behaviour. It is known that individuals who recognize positive and negative effects of food may overestimate or underestimate the consumption of certain foods, so that the individual's responses do not reflect the actual consumption information.

One reason for the smaller fibre means in the high adherence to this pattern when compared to the others may be that these individuals may have reported a high frequency of fruit consumption, but in smaller amounts than expected.

When analysing the portions of fruits consumed (considering a 70 kcal portion of the food pyramid, proposed by Philippi et al.[33]), it was found that individuals of both sexes with high adherence to the *Fruit* pattern consumed an average of only 2.62 (SD = 2.56) and a median of 2.06 servings of fruits per day. On the other hand, individuals with a high adherence to the *Healthy*, *Soft diet*, *Snacks and weekend meal*, *Traditional* and *Light and whole foods* patterns consumed, respectively, means of 2.74 (SD = 1.87), 2.99 (SD = 2.64), 3.08 (SD = 3.11), 3.27 (SD = 2.21) and 5.12 (SD = 2.83) servings of fruit per day.

Although the average number of portions consumed in a high adherence to the *Fruits* pattern was lower than the other patterns, it differed significantly only in relation to the *Light and whole foods* pattern (p = 0.012, by the Kruskal-Wallis test). In the total sample, the mean intake of fruit portions was 2.85 (SD = 2.41), and the median was 2.46 servings per day.

Importantly, when identifying the eating patterns by principal component analysis, the frequency of food intake was considered, not the evaluation of the amount of food consumed.

Other studies have highlighted the insufficient consumption of fruits and vegetables by the Brazilian elderly population[16,34-37].

Fisberg et al. observed that the consumption of fruits and vegetables by the Brazilian elderly population was approximately one-third of the amount recommended by the Food Guide for the Brazilian Population (≥ 400 g/day)[16].

As shown in Tables 1 and 2, a high adherence to the *Light and whole foods* pattern in females in comparison to a high adherence to all other patterns is characterized by higher mean values of vitamin C. Additionally, the high adherence to this pattern is characterized by higher means of retinol and vitamin B12.

A high adherence to the *Soft diet* pattern presents lower means of protein and fibre and higher means of added sugar when compared to the other patterns. These results are expected for a pattern of these types of foods.

The high adherence to the *Soft diet* pattern is more prevalent in the female sex and in the elderly, and these characteristics are justified both by economic issues and ease of preparation or by issues related to changes in masticatory capacity due to the use of dental prostheses or even swallowing problems arising from pathologies[21].

The *Traditional* pattern received this name because it reflects the basic diet of the Brazilian population, such as the "rice and beans" combinations and the "lettuce and tomato" salad.

A high adherence to the *Traditional* pattern presents, in general, higher means of nutrient consumption when compared to the others, but it did not differ significantly in relation to most of the patterns. This pattern was highlighted only in females when compared to the *Soft diet* pattern because it presents higher means of protein; when compared to the *Healthy* pattern it presents a higher consumption of vitamin D.

The results of the component analysis of the diet demonstrate that adhering more to the *Traditional* pattern can provide a larger supply of nutrients that are important for the proper nutritional status of the elderly, such as vitamin D and protein. Ferreira et al. (2014) confirmed that there is a fairly homogeneous distribution of this pattern in the population because these foods are the most frequently consumed by most individuals[21].

Recent studies carried out in Brazil show that the intake of vitamins and minerals by the elderly is below the recommended values. These studies found a high prevalence of inadequacy, mainly of vitamins A, E and D and of minerals such as calcium, magnesium and iron[16,38-40].

Strategic planning for qualitative changes in eating may help to satisfactorily provide a greater supply of vitamins and minerals. The new Food Guide for the Brazilian Population[41], for example, calls for more general dietary recommendations, such as "making raw or minimally processed food as a staple food", "limit the consumption of processed foods," and "avoid consuming ultra-processed food", among others.

These general guidelines can help minimize much of the negative impacts of nutritionally poor foods, such as ultra-processed foods, which should be replaced by foods rich in vitamins and minerals such as fruits and vegetables.

Some limitations inherent to food consumption studies should be evaluated and discussed for a better interpretation of the results of this study.

The amount of nutrient intake can be influenced by the total amount of energy consumed[42]. Therefore, in this study, before interpreting the nutrient intake data, a strategy for energy adjustment was used[43-45]. Beaton[46] emphasizes that food intake cannot be estimated without errors, and probably will never be.

The FFQ is a recognized method for characterizing the typical diet, but, like other food surveys, it may underestimate or overestimate the information collected regarding consumption[7,28].

To reduce recall bias, a frequent phenomenon in patients of advanced age, the participation of a companion or caregiver was requested in all interviews. When it was not possible to rely on the participation of a companion in the interview, a larger amount of time was taken for the interview, up to 1 ½ hours when necessary.

In recognizing the difficulties of estimating the typical diet, the present study did not evaluate the individual's typical intake in a precise way, but rather aimed to increase the knowledge regarding the heterogeneous dietary characteristics observed in this group of elderly people in Botucatu.

Despite efforts over the last half century, there is still a need for an international definition of harmonized methods and data collection for assessing the food consumption of this population[45].

Detailing the nutritional components of each food pattern presented expected results, which corroborated the characteristics of each pattern. On the other hand, some unexpected results were also found, which contributes to broaden the discussion about the challenge of evaluating food consumption, with special attention to methodological issues.

Adhering to eating patterns with characteristics similar to the *Healthy*, *Light and whole foods* and *Traditional* patterns can provide greater macronutrient and micronutrient inputs, contributing to the reduction of the inadequate intake of important nutrients for the health of the elderly population. In contrast, adhering to eating patterns similar to the *Snacks and weekend meal* pattern may contribute to a reduced intake of vitamins and minerals.

In this study, it was possible to better characterize food behaviour, broadening the understanding about the possible nutritional benefits and risks for the elderly who adhere to each of these food patterns.

Collaborations

PM Ferreira-Nunes contributed to the conception and execution of the research, analysis and interpretation of the data, writing of the article, and critical review and approval of the final version of the article. SJ Papini participated in the critical review and approval of the final version of the article. JE Corrente contributed to the design of the research, analysis and interpretation of the data, writing of the article, and critical review and approval of the final version of the article.

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