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Diversity of eating patterns and obesity in older adults—A new challenge

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ABSTRACT

The increase in the variety of food choices influences the eating patterns of older adults, which is in turn increases the occurrence of obesity. This study aimed at identifying eating patterns and their association with obesity in a representative sample of older adults living in an urban area and registered in the basic health unit in the city of Botucatu, São Paulo, Brazil. This is a cross-sectional study and data collection took place from March to June of 2011 through the application of a validated food frequency questionnaire for older adults, a socio-demographic survey and an anthropometric evaluation. Eating patterns were identified through principal component analysis. Scores of individual consumption were divided in tertiles, characterizing as low, moderate or high adherence of the individuals to each pattern. Logistic regression models were fitted for the outcomes "general obesity" and "abdominal obesity" and the tertiles of consumption adjusting by socio-demographic variables. Six eating patterns were identified: Healthy foods, Snacks and weekend meals, Fruits, Light and whole foods, Mild diet and Traditional diet. It was found that the adherence to healthy foods is protective against obesity as well as adherence of snacks and weekend meals are risk of obesity. Eating patterns and their recognized influence on obesity comprise an issue that deserves continuous attention in order to evaluate collectively the eating profile, and develop specific nutritional guidelines for older adults.

Keywords: Eating Patterns; General Obesity; Older Adults

1. INTRODUCTION

In Brazil, the most recent research regarding the nutritional state of the population showed that, between 1974 and 2009, the prevalence of older individuals of below average weight decreased, whereas the number of older individuals who are overweight or obese has increased steadily [1]. The rise in the number of obese older adults may be associated with changes in nutrition in this age group at a time when an increased consumption of foods with high energy density and a reduction in the ingestion of foods rich in fiber, and nutrients are becoming more prevalent in society [2].

The importance of eating behaviors as a risk factor for overweight and obesity is already well known [3,4]. The relationship between eating and nutritional status in the context of aging is frequently associated with nutritional problems [5] and boredom with eating [6,7], since physiological, economic and psychosocial factors may limit the consumption of food [7-9]. Nevertheless, it may be assumed that the older population, in addition to being vulnerable, is also a heterogeneous group in terms of many different aspects, including eating [9]. Due to the increase in the variety of food choices offered by the food industry and commerce, diversity in eating patterns is emerging in the same population group.

In terms of epidemiology, the use of empirical analyses of derivative standards may reflect the true eating behaviors of a population and allow for improved planning and effective proposals to promote healthy eating habits [10]. Therefore, from the hypothesis that the eating habits of older adults are diversifying and exerting a strong influence on the increased prevalence of obesity, this study aimed at identifying eating patterns of the older

people and investigating their association with obesity.

2. METHODOLOGY

2.1. Study Population and Data Collection

The present study was carried out in the city of Botucatu, São Paulo, Brazil, which was chosen, in part, due to the development of a growing number of studies on population aging and to its high prevalence of older adults (13.35%) [11], higher than the mean in the state (11.6%) and in the country (10.8%) [12]. It is an epidemiological cross-sectional study, with a representative sample of individuals aged 60 years or older, living in the urban area and registered in the basic health unit of the municipality.

A validated food frequency questionnaire (FFQ) with 71 food items was provided to the participants [13]. The sample size was calculated by considering five times the number of items present in the FFQ, according to the formula: if $k > 15 \geq n = 5 \times k$ where k = number of items of the FFQ [14], yielding a total of 355 individuals, who were stratified among the sixteen basic health units in the municipality. For the association study between general obesity and the identified dietary patterns, we performed a posteriori sample size calculation.

Data collection took place at households and at the basic health units from March to June of 2011. Also it was applied a sociodemographic and lifestyle identification questionnaire and anthropometric evaluation was made. The weight it was measured using a calibrated portable digital electronic scale (TANITA® TM), portable stadiometer (ALTUREXATA®TM) for height. The waist circumference measurement was performed using inelastic tape with 1 mm precision. Failing to perform the measurement of height (older adults stooped posture), these values were estimated from the measurement of the knee based on the validated techniques [15], and waist circumference according to the techniques recommended by the World Health Organization [16].

2.2. Ethical Approval

The study was approved by the Committee of Ethics in Research of the Botucatu Medical School—São Paulo State University (UNESP).

2.3. Data Analysis

Obesity was evaluated as either "general obesity" or "abdominal obesity". In order to define general obesity, the authors used the Body Mass Index (BMI), with obesity defined as ≥30 kg/m^2; for abdominal obesity, a waist Circumference (WC) ≥88 cm for women and ≥102 cm for men were used as the defining criteria. Both criteria are in agreement with recommendations from the World Health Organization [16]. Other variables analyzed were: consumption of alcoholic beverages, gender, education, marital status and physical activity. The criteria established by VIGITEL 2010 were used for the categorization of physical activity [17].

The information regarding food consumption obtained from the Food Frequency Questionnaire (FFQ) was analyzed and interpreted for the identification of eating patterns, using the technique of exploratory factor analysis (principal component analysis—PCA). The applicability of the factor analysis was confirmed by the PCA method with varimax rotation, through Kaiser-Meyer-Olkin (KMO) and Bartlett's tests of sphericity. Six factors were extracted considering only the items with a factor load greater than 0.3. Eating patterns were determined according to the nutritional and functional characteristics of the food items for each factor.

Following the factor analysis, consumption scores were calculated in order to obtain participants' adherence, which were divided into tertiles classified as low (1st tertile), moderate (2nd tertile) and high (3rd tertile) compliance. Logistic regression models were fitted considering "general" and "abdominal" obesity as response variables and adherence to the eating patterns (low, moderate and high) as explanatory variables adjusted for possible confounding effects. All analyses were performed using the SAS (Statistical Analysis System) program for Windows (v. 9.2). For all tests, a significance level of 5% (or the corresponding *p*-value) was considered.

3. RESULTS AND DISCUSSION

The study sample consisted of 163 male (45.9%) and 192 female individuals (54.1%), which is close to the Brazil 2010 census results, in which 42.7% were men and 57.3% were women [18], indicating that this is a representative sample of the city's population.

Age varied between 60 and 92 years, with a mean of 69.54 years old (standard deviation = 7.73 years old); this population has a mean *per capita* family income of 1.76 minimum wages (approximately 500 US dollars). The prevalence of general obesity was 15.95% in men and 30.20% in women, while the prevalence of abdominal obesity was much higher: 42.94% in men and 74.47% in women.

The patterns identified through factor analysis were:

1) Healthy foods: raw endive/chicory; beetroot/chayote/zucchini; broccoli/cauliflower/cabbage; cooked endive/kale; carrots; extra virgin olive oil; tomatoes; lettuce; fish; oats.

2) Snacks and weekend meals: processed meat; mozzarella/cheddar cheese; pizza/pancakes; baked snacks; bacon/jerky; hamburger/chicken nuggets/meatballs; fried snacks; regular butter; regular soda; bread rolls; pasta with meat; cooked potatoes with mayonnaise; desserts/

candies; fried potatoes/manioc.

3) Fruits: avocado; guava; papaya; apple/pears; melon/watermelon; oranges/tangerines/pineapples; bananas.

4) Light and whole food: low-fat/non-fat milk; whole wheat bread; natural juice without added sugar; oats; extra virgin olive oil.

5) Mild diet: cooked potatoes/manioc; soup; bread rolls; whole milk; carrots; polenta.

6) Traditional diet: white rice; beans; lettuce; tomatoes.

Until now, there have been few studies that have specifically included older adults and that have used statistical models to identify eating patterns empirically [19-21]. In Brazil, these statistical analyses have not still included samples confined to older adults.

The knowledge of specific eating behaviors of older adults is essential, since they comprise a group that is highly vulnerable to nutritional problems, one in which repercussions is much more severe than in other stages of life [9].

Through the habits identified, it was possible to observe the existence of different consumption conditions occurring in the eating culture of this population. Contrary to what was observed a few years ago in Brazil, the older population does not seem to be limiting itself to the consumption of a boredom diet, generally characterized by the predominance of traditional food items of Brazilian culture, such as rice and beans. The older adults in this study also showed a preference for other eating patterns which may reflect the local culture (characterized by the consumption of pasta, cooked potatoes with mayonnaise and desserts on the weekends), the Western diet (characterized by a high concentration of carbohydrates and fat), special diets (characterized by a consumption of healthier food items, such as diet/light foods), and diets consumed by individuals of a more advanced age (characterized by a consumption of mild diet, with cooked and easily digested food items).

It was observed that the high compliance with Standard 1—Healthy foods had an inverse and significant relationship to general obesity, constituting a protective factor. In other words, individuals showing high compliance with this standard decreased their chance of developing general obesity by 63.3% (**Table 1**).

Table 1. Association between eating patterns and general obesity in older adults, according to the variables of interest (adjusted model*), Botucatu, São Paulo, Brazil, 2011.

Variables	Categories	Estimate	Standard error	*p*-value	OR (IC 95%)**
	High compliance	**−0.6071**	**0.2134**	**0.0044**	**0.367 (0.179 - 0.752)**
1-Healthy foods	Moderate compliance	0.2112	0.1932	0.2742	0.831 (0.434 - 1.592)
	Low compliance	0.0	-	-	1.0
	High compliance	−0.00364	0.2165	0.9866	1.104 (0.514 - 2.370)
2-Snacks and weekend meals	Moderate compliance	0.1059	0.1964	0.5897	1.231(0.612 - 2.478)
	Low compliance	0.0	-	-	1.0
	High compliance	0.3048	0.2048	0.1367	1.334 (0.660 - 2.698)
3-Fruits	Moderate compliance	−0.3211	0.2133	0.1323	0.714 (0.343 - 1.484)
	Low compliance	0.0	-	-	1.0
	High compliance	0.1981	0.2018	0.3263	1.485 (0.728 - 3.029)
4-Light and whole foods	Moderate compliance	−0.00053	0.2050	0.9979	1.218 (0.591 - 2.510)
	Low compliance	0.0	-	-	1.0
	High compliance	−0.0904	0.2069	0.6621	0.795 (0.393 - 1.610)
5-Mild diet	Moderate compliance	−0.0480	0.1987	0.8090	0.830 (0.422 - 1.634)
	Low compliance	0.0	-	-	1.0
	High compliance	−0.3991	0.2113	0.0589	0.625 (0.307 - 1.270)
6-Traditional diet	Moderate compliance	0.3275	0.1931	0.0899	1.292 (0.676 - 2.467)
	Low compliance	0.0	-	-	1.0
Age	**-**	**−0.0591**	**0.0236**	**0.0122**	**0.943 (0.900 - 0.987)**
Marital Status	**Partner**	**0.3910**	**0.1667**	**0.0190**	**2.186 (1.137 - 4.202)**
	No partner	0.0	-	-	1.0
Alcohol consumption	Consumption	0.2046	0.1678	0.2225	1.506 (0.780 - 2.906)
	No consumption	0.0	-	-	1.0

*Logistic model with adjustment for gender, *per capita* family income, education and physical activity; obtained from full model, keeping all variables of interest. **OR = Adjusted odds ratio.

Regarding abdominal obesity, it was observed that individuals who comply moderately with Standard 1—Healthy foods decrease their risk of developing abdominal obesity by 41.2%. On the other hand, moderate compliance with Standard 2—Snacks and weekend meals increased 2.21 times the chance of developing abdominal obesity (**Table 2**).

These results agree with the recommendations, since Standard 1—Healthy foods has a high concentration of protective elements for weight gain, while Standard 2—Snacks and weekend meals has a high concentration of fat and simple carbohydrates which, if ingested excessively, can influence the development of obesity. Similar eating patterns and results have been found in other studies [22,23]. A standard termed "Healthy", described by Americans in the *Baltimore Longitudinal Study of Aging*, was associated with lower gains in body mass index and waist circumference [22]. A standard termed "Meat and French Fries", identified in Puerto Rican adults and older adults, was associated with higher measures of waist circumference [23]. This similarity between studies shows the consistency of the empirical methods used to identify eating patterns.

The other identified eating patterns did not show a significant association with obesity.

Some limitations of this study, which are common to most studies regarding food consumption, must be considered. The first one refers to the cross-sectional design, which does not allow for the establishment of a causal relationship between risk factors and health outcomes. However, since the purpose was to describe eating behaviors in order to guide immediate actions of health promotion, the priority was not to determine whether the relationship between food consumption and negative health outcomes is indeed casual.

The influence of reverse causality in studies of obesity is broadly recognized [24,25], since individuals may either overestimate or underestimate the consumption of certain food items. On the other hand, in this study the results of associations between eating patterns and obesity assumed the expected direction, and the control of covariates was performed, increasing the probability

Table 2. Association between eating patterns and abdominal obesity in older adults, according to the variables of interest (adjusted model[*]), Botucatu, São Paulo, Brazil, 2011.

Variables	Categories	Estimate	Standard error	p-value	OR (IC 95%)[**]
1-Healthy foods	High compliance	0.2062	0.1781	0.2469	1.045 (0.570 - 1.914)
	Moderate compliance	**−0.3686**	**0.1746**	**0.0348**	**0.588 (0.325 - 1.064)**
	Low compliance	0.0	-	-	1.0
2-Snacks and weekend meals	High compliance	−0.0935	0.1824	0.6082	1.293 (0.677 - 2.469)
	Moderate compliance	**0.4436**	**0.1808**	**0.0141**	**2.212 (1.164 - 4.203)**
	Low compliance	0.0	-	-	1.0
3-Fruits	High compliance	0.0981	0.1818	0.5895	1.455 (0.779 - 2.716)
	Moderate compliance	0.1788	0.1793	0.3187	1.577 (0.852 - 2.920)
	Low compliance	0.0	-	-	1.0
4-Light and whole foods	High compliance	0.1306	0.1818	0.4726	1.045 (0.562 - 1.943)
	Moderate compliance	−0.2172	0.1838	0.2373	0.738 (0.394 - 1.382)
	Low compliance	0.0	-	-	1.0
5-Mild diet	High compliance	0.1292	0.1805	0.4740	1.047 (0.565 - 1.939)
	Moderate compliance	−0.2130	0.1761	0.2265	0.743 (0.407 - 1.357)
	Low compliance	0.0	-	-	1.0
6-Traditional diet	High compliance	−0.2674	0.1755	0.1276	0.593 (0.325 - 1.081)
	Moderate compliance	0.0115	0.1763	0.9478	0.783 (0.428 - 1.433)
	Low compliance	0.0	-	-	1.0
Age	-	−0.0120	0.0190	0.5279	0.988 (0.952 - 1.026)
Marital status	Partner	0.1793	0.1447	0.2152	1.431 (0.812 - 2.524)
	No partner	0.0	-	-	1.0
Alcohol consumption	Consumption	0.1373	0.1464	0.3482	1.316 (0.741 - 2.336)
	No consumption	0.0	-	-	1.0

[*]Logistic model with adjustment for gender, *per capita* family income, education and physical activity; obtained from full model, keeping all variables of interest. [**]OR = Adjusted odds ratio.

that the associations found are valid.

In order to reduce the bias of memory, the assistance of caregivers was permitted to answer the questionnaires, and the questions from the Food Frequency Questionnaire (FFQ) referred only to frequency of consumption, and did not include the portions consumed. Furthermore, the apparent effect of report errors in the FFQ is frequently discussed, since people are inclined to overestimate, for instance, their consumption of vegetables [25]. However, a study observed that eating patterns extracted from the FFQ are comparable to those obtained from the 24 h recall (the instrument which is considered to be the standard) [26].

Since the eating patterns are derived empirically, it is possible that other combinations of food items exist. Nevertheless, in the present study, the authors chose the best factor solution and verified the quality of interpretation of the eating standards using statistical criteria, defining which factor solution was closer to the combination of food items observed among the sample individuals.

4. CONCLUSIONS

The authors concluded that there was a diversity of eating patterns within a population of older adults, and this current eating behavior was found to be a factor independently associated with obesity.

The results obtained support the premise that the eating standards and their recognized influence on obesity are issues that deserve continuing attention in order to evaluate collectively the eating profile of the older population and orientate efforts for the development of specific nutritional guidelines for the older population.

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