

Healthy eating index of elderly: description and association with energy, macronutrients and micronutrients intake

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SUMMARY. The purpose of this study was to define the Healthy Eating Index (HEI) of the elderly of Southern Brazil and its association with energy, macronutrients and micronutrients intake. A cross-sectional study was conducted with 186 elderly aged 60 and older of the Geriatric Service of São Lucas Hospital, Porto Alegre, Brazil. Dietary data were collected by two 24-hour recalls, and diet quality was assessed by HEI adapted to the Brazilian population. The HEI total score was divided into three categories: inadequate diet (below 51 points), diet needs improvement (between 51 and 80 points), and healthy diet (over 80 points). The results showed that the mean HEI score was 58.8 ± 10.5 points (ranging from 31.4 to 79.8). Most elderly (74.2%) showed a diet that needed modification and no elderly individual had a healthy diet. The quality of the diet was associated with greater intake of carbohydrates, and lower intake of total lipids, saturated fatty acids, cholesterol, and sodium. Consumption of vitamins C and D and calcium was shown to be positively correlated with the quality of the diet. Less than 1.1% of the elderly consumed a varied diet. The findings suggest that the diet of the majority of the elderly needs improvement, reinforcing the importance of care in relation to adequate nutrition in this population, and can help in guiding the activities and programs of nutritional education and public policies that stimulate increasingly healthy eating.

Key words: Nutrition assessment, nutritional status, nutrition policy, aged, Healthy Eating Index.

RESUMO. Índice de alimentação saudável de idosos: descrição e associação com ingestão de energia, macronutrientes e micronutrientes. O objetivo deste estudo foi descrever o Índice de Alimentação Saudável (IAS) de idosos do Sul do Brasil e sua associação com a ingestão de energia, macronutrientes e micronutrientes. Foi realizado um estudo transversal com 186 idosos com 60 anos ou mais, do Serviço de Geriatria do Hospital São Lucas, Porto Alegre, Brasil. Os dados relativos ao consumo alimentar foram coletados através de dois recordatórios de 24 horas, e a qualidade da dieta foi avaliada pelo IAS, adaptado à população brasileira e o escore total foi dividido em três categorias: dieta inadequada (abaixo de 51 pontos), dieta necessitando de adequação (entre 51 e 80 pontos), e dieta saudável (mais de 80 pontos). Os resultados mostraram que a média do IAS foi $58,8 \pm 10,5$ pontos (variando de 31,4 a 79,8 pontos). A maioria dos idosos (74,2%) apresentou uma dieta que necessitava de modificação e nenhum idoso tinha uma dieta saudável. A qualidade da dieta foi associada com maior ingestão de carboidrato e baixa ingestão de gordura total, gordura saturada, colesterol e sódio. O consumo de vitaminas C e D e cálcio mostrou-se positivamente correlacionado com a qualidade da dieta. Menos de 1,1% dos idosos consumia uma dieta variada. Os resultados sugerem que a dieta da maioria dos idosos necessita de adequação, reforçando a importância dos cuidados em relação à nutrição adequada desta população e podem auxiliar na orientação de atividades e programas de educação nutricional e políticas públicas que estimulem a prática de uma alimentação mais saudável.

Palavras-chave: Avaliação nutricional, estado nutricional, recomendações nutricionais, idoso. Índice de Alimentação Saudável.

INTRODUCTION

The Brazilian population, as in other countries around the world, is aging at an unprecedented rate (1). Accordingly, greater importance is given to integral health in the aging process, and nutrition plays an important role in healthy living and in the prevention and treatment of diseases. This is especially important for the elderly, for whom

an adequate nutrition is crucial in maintaining not just good health but also functionality (2).

Distortions in the diet of the elderly reveal the importance of the application of a tool to evaluate food consumption as a whole and also with regard to each of the components (3). Accordingly, the indices of diet quality are instruments that can be used to determine the eating habits of the elderly (2,3).

However, few studies have evaluated patterns of die-

tary intake in the elderly population (4). Better knowledge of the usual diet of the elderly is essential for the implementation of preventive initiatives in primary healthcare assistance and for the proposal of more effective dietary interventions.

Since the past century, various guidelines have been proposed (5), and many indices have been developed for evaluating the diet of individuals in relation to dietary recommendations (6,7). The Healthy Eating Index (HEI) (8) was developed to assess and evaluate the quality of the diet of the population and was considered by the American Dietetic Association as an appropriate instrument for this purpose. Some authors have adapted the HEI for different populations, such as Fisberg et al. (3,9), who applied the HEI to the Brazilian population, with the necessary modifications. The objective of this study was to define the HEI of the elderly of Southern Brazil, and its association with energy, macronutrients and micronutrients intake.

MATERIALS AND METHODS

A cross-sectional study was conducted in the outpatient clinic of the Geriatric Service of São Lucas Hospital of Pontifical Catholic University of Rio Grande do Sul (PUCRS), in the period of November 2009 to November 2010. In a convenience sample, elderly individuals 60 years and older were invited to participate, and those with cognitive decline, restricted mobility and severe hearing loss, which compromised nutritional assessment, were excluded. A sample size of 200 elderly was calculated as adequate, on the basis of a pilot study. The final sample comprised 186 elderly because 14 did not complete the data. An alpha error of 5% and power of 80% were considered. The procedures were approved by the Research Ethics Committee of PUCRS and all participants signed an informed consent form.

Two 24-hour dietary recall data (R24h) were collected with a minimum interval of two weeks, one regarding the intake of a weekend day and the other one of a weekday. The nutritional values and the chemical composition of diet were calculated using Dietwin®2008, which was fed data from the Brazilian Table of Food Composition (TACO) version 2 and food labels. The averages of the data of the two recalls were then calculated. Total energy intake (TEI), total carbohydrates, proteins, lipids, monounsaturated

(MUFA), polyunsaturated (PUFA), saturated (SFA) fatty acids and cholesterol were selected for the analysis. The micronutrients examined were those that, as noted in other studies, evaluated diet quality of the elderly (8,10,11). Vitamin D was included, despite no other publication mentioned it, because of its importance in clinical practice and the high prevalence of deficiency among Brazilian people (12,13). The socio-demographic data were obtained using a structured questionnaire.

The HEI adapted to the Brazilian population (3,9) was used to evaluate the dietary quality. The index consists of a score of 10 equally weighted components, each with a minimum score of zero and a maximum of 10, with intermediate values calculated proportionally, and resulting in a total score range of 10 to 100. The first five HEI components measure compliance of the consumption of grains, fruits, vegetables, meat and eggs, dairy products and pulses with the recommended number of servings, according to sex and age, of the Food Guide Pyramid, also adapted for the Brazilian population (6). The next three components measure compliance with recommended intake (11) of total fat, cholesterol and sodium; and the final component, the dietary variety was measured considering the minimum of 5 and a maximum of 15 different foods consumed in a day (Table 1).

TABLE 1. Components of Healthy Eating Index - number of servings, amount of total fat, cholesterol, sodium, and different foods consumed per day for a total energy intake of 1600 kcal

Components of Healthy Eating Index	Criteria for score
Grains, breads, tubers and roots	5 servings
Vegetables	4 servings
Fruits	3 servings
Milk and dairy products	3 servings
Meat and eggs	1 serving
Pulses	1 serving
Total fat	30%-45% of total energy intake
Cholesterol	300-450 mg
Sodium	2,400-4,800 mg
Variety of diet	5-15 different types of foods a day

Source: (3,6,9,11)

The total score was categorized as: inadequate diet (below 51 points), diet needs improvement (between 51 and 80 points), and healthy diet (over 80 points) (9,12).

Data were analyzed using the Statistical Package for Social Sciences (SPSS) version 17.0. Measures of central tendency, dispersion and proportion were used in the descriptive analysis of data. Mean HEI scores were compared using Student's t test, and the Pearson coefficient was calculated to determine the correlation between HEI and percentage of macronutrients of TEI and micronutrients. Level of statistical significance was set at $P < 0.05$.

TABLE 2. Distribution of elderly according to sociodemographic characteristics (n=186).

Characteristic	Frequency N (%)
Sex	
Male	34 (18.3)
Female	152 (81.7)
Age range (years)	
60-70	54 (29.0)
71-80	98 (52.7)
81-93	34 (18.3)
Marital status	
Married	63 (33.9)
Single	14 (7.5)
Separated/divorced	27 (14.5)
Widowed	82 (44.1)
Race	
White	152 (81.7)
Black	20 (10.8)
Yellow	1 (0.5)
Brown	13 (7.0)
Schooling	
Completed primary education	114 (61.3)
Did not complete primary education	49 (26.3)
No schooling	23 (12.4)
Retired	
Yes	145 (78.0)
No	41 (22.0)
Personal income (MS)*	
Up to 1	72 (38.7)
> 1 to 3	95 (51.1)
> 3	19 (10.2)
TOTAL	186 (100)

*MS=Minimum salary (US\$ 320/month).

RESULTS

The mean age of the sample was 74.3 ± 7.1 years (range 60-93 years) and other sociodemographic data are described in Table 2.

The mean overall HEI score of the total sample was 58.8 ± 10.5 and ranged from 31.4 to 79.8 points. No participant showed a healthy diet, while 74.2% of them had a diet that needed improvement and 25.8% an inadequate diet.

The largest percentages of elderly meeting dietary recommendation (Table 3) were for cholesterol (68.3%) and sodium (62.9%). According to these results, the same components produced the highest mean scores, i.e., 8.91 and 8.96, respectively.

The lowest mean scores were found for meats and eggs (3.55), fruits (3.82) and in the pulse group (3.90). The highest percentages of inadequate intake were also observed in these components, with meats and eggs (47.8%) and pulses (39.8%) being higher than fruits (21%).

There was no significant association between the amount of TEI and the quality of diet. An inadequate diet was associated with a lower carbohydrate intake ($P=0.024$) and higher lipid intake ($P=0.033$). A decrease in the intake of SFA ($P=0.010$), cholesterol ($P=0.002$), and sodium ($P=0.011$) improved diet quality. (Table 4)

The statistical association between HEI and intake levels of macronutrients and micronutrients was equally confirmed by the correlation coefficient presented in Table 5. A weak direct association was observed with carbohydrates ($P=0.001$), vitamin C ($P=0.047$), vitamin D ($P=0.025$) and calcium ($P=0.004$); there was a moderate inverse association with SFA ($P < 0.001$), and cholesterol ($P < 0.001$), and weak inverse association with total fat ($P < 0.001$), MUFA ($P=0.011$) and sodium ($P=0.002$). TEI, percentage of protein of TEI, PUFA, vitamins A, B and E, iron, magnesium and zinc did not demonstrate a correlation with HEI.

DISCUSSION

Before the main analysis it is important to highlight that the higher percentage of women in the sample reflects the national phenomenon of feminization of aging observed in the Brazilian age pyramid (1).

TABLE 3. Median, mean, standard deviation and confidence interval of scores of each component of the Healthy Eating Index of elderly, and percentage of observations with minimum and maximum score (n=186).

	Score		95% CI	Score 0	Score 10
	Median	Mean±SD		%	%
Grains, breads, tubers and roots	6.00	6.04±2.54	5.67-6.40	5.4	6.5
Vegetables	3.75	4.29±2.36	3.95-4.64	3.2	2.2
Fruits	3.33	3.82±2.96	3.39-4.25	21.0	6.5
Milk and dairy products	5.00	4.78±2.80	4.38-5.19	15.6	4.8
Meats and eggs	5.00	3.55±3.83	2.99-4.10	47.8	18.8
Pulses	5	3,90±3,64	3.37-4.42	39.8	17.7
Total fat	9.73	8.64±1.90	8.37-8.92	0.5	47.8
Cholesterol	10.00	8.91±1.99	8.63-9.20	0.5	68.3
Sodium	10.00	8.96±1.96	8.67-9.24	0.5	62.9
Variety of diet	5.99	5.93±2.04	5.63-6.22	2.7	1.1

SD: standard deviation CI: confidence interval.

TABLE 4. Mean and standard deviation of energy intake, percentage of macronutrients of total energy intake and micronutrients in relation to categories of Healthy Eating Index of elderly (n=186).

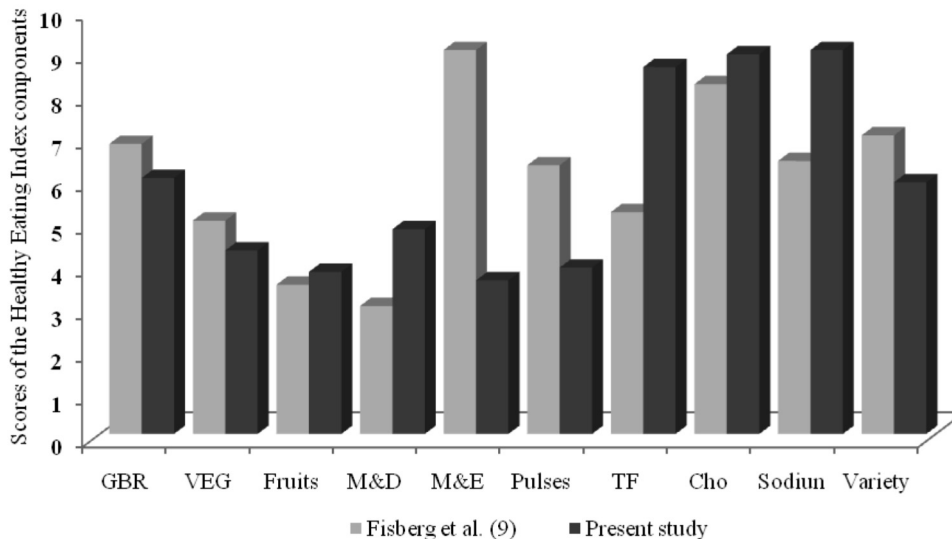
Nutrients	Total (Mean±SD)	Classification of diet according to HEI		P*
		Inadequate diet	Diet needs improvement	
		(n=48)	(n=138)	
TEI (kcal)	1454.4±452.4	1533.5±594.6	1426.8±390.0	0.251
Macronutrients (% of TEI)				
Carbohydrates	55.2±8.1	52.4±10.7	56.2±6.8	0.024
Protein	17.1±3.5	17.6±4.7	16.9±3.1	0.357
Lipids	27.2±6.5	29.3±8.3	26.5±5.6	0.033
MUFA	7.2±2.8	8.0±3.6	6.9±2.4	0.054
PUFA	3.6±1.6	3.5±1.5	3.6±1.7	0.774
SFA	9.4±3.1	10.6±3.9	9.0±2.7	0.010
Cholesterol (mg)	194.6±141.7	275.0±225.3	166.6±81.6	0.002
Micronutrients				
Vitamin A–Retinol (µg)	470.0±1850.8	921.3±3571.0	313.0±394.4	0.245
Vitamin B1–Thiamine (mg)	0.8±0.9	0.7±0.4	0.8±1.0	0.492
Vitamin B2–Riboflavin (mg)	1.2±0.6	1.3±0.8	1.2±0.6	0.403
Vitamin B6–Pyridoxin (mg)	0.7±0.3	0.7±0.3	0.7±0.3	0.588
Vitamin B9–Folate (µg)	73.5±63.1	74.7±63.7	73.1±63.1	0.876
Vitamin C–Ascorbic acid (mg)	91.7±87.1	82.5±1414.1	94.9±75.8	0.396
Vitamin D–Cholecalciferol (µg)	3.0±2.1	2.9±2.5	3.1±1.9	0.633
Vitamin E–Tocopherol (mg)	4.1±3.4	4.7±3.8	3.9±3.3	0.203
Calcium (mg)	638.6±305.0	582.5±343.5	658.1±289.8	0.140
Iron (mg)	8.0±14.1	7.8±3.8	8.1±16.3	0.894
Magnesium (mg)	247.0±127.3	255.8±186.0	244.1±100.1	0.677
Sodium (mg)	1667.3±860.2	1993.5±1085.2	1553.9±738.2	0.011
Zinc (mg)	7.4±3.8	8.3±5.3	7.1±3.2	0.138

SD: standard deviation HEI: Healthy Eating Index TEI: total energy intake, MUFA: monounsaturated fatty acids PUFA: polyunsaturated fatty acids SFA: Saturated fatty acids. *P= calculated by Student t test.

TABLE 5. Correlation coefficient between Healthy Eating Index and percentage of macronutrients of total energy intake and micronutrients of diet of elderly (n=186).

Nutrients	Healthy Eating Index	
	r*	P
Percentage carbohydrates of TEI	0.248	0.001
Percentage total fats of TEI	-0.273	<0.001
Percentage saturated fatty acids of TEI	-0.441	<0.001
Percentage monounsaturated fatty acids of TEI	-0.187	0.011
Cholesterol	-0.305	<0.001
Vitamin C—ascorbic acid	0.146	0.047
Vitamin D—cholecalciferol	0.165	0.025
Calcium	0.209	0.004
Sodium	-0.229	0.002

TEI: total energy intake.*Pearson linear correlation.



GBR: Grains, breads, roots and tubers; VEG: Vegetables; M&D: Milk and dairy products; M&E: Meats and eggs; TF: Total fat; Cho: Cholesterol; Variety: variety of foods.

FIGURE 1. Comparison of the scores of the Healthy Eating Index components between our study (n=186 elderly) and that of Fisberg et al. (9) (n=3,454 individuals, 20 years and older).

The first objective of this study was to describe the HEI in the target population, and the results suggest that the elderly evaluated did not have a healthy diet. There are very few studies that have evaluated HEI in samples composed exclusively of elderly. Studies in the North American population (2,4,7,8,14), with similar methodology, revealed scores between 61.9 and 67.6, which were higher than our findings (58.8). Studies carried out in the Brazilian population (9,15,16) obtained scores that ranged from 56.9 to 66.6; how-

ever, two of them (9,15) evaluated adults in general, and Louzada et al. (16) used another methodology.

When participants were categorized, our results showed that most individuals (74.2%) had a diet needing improvement, proving to be within the range (67.0 to 80.9%) of previous studies (2,4,8,9,14).

In the present study, none of the elderly was classified as having a diet that could be considered healthy, which has not been reported in any previous studies. This finding, along with the fact that 25.8% of participants had a diet considered poor, higher than that found in the literature (8.0 to 21.6%), doubly suggests that the diet of the elderly is not adequate (2,4,8,9,14).

Figure 1 illustrates the comparison between the scores of the HEI components of this study with the results of Fisberg et al. (9), whose methodology served as the basis for our survey. However, it

should be noted that only 13% of their sample consisted of elderly individuals, which may hamper the comparison of results. In addition, methodological differences with other studies allowed only some components of HEI to be reliably compared.

(Insert Figure 1)

In the comparison with the study of Fisberg et al. (9), individuals in our sample showed lower scores (6.0 vs. 6.8) in relation to the consumption of grains, bread, tubers and roots, but the mean score of that

group was close to that of the majority of other studies (2,14,15). Increased intake of cereals and whole grain breads is recommended, but is not an easy task, because these foods are not usually present in the diet of Brazilians. Surveys have demonstrated a 40.5% decrease in the consumption of rice in Brazil, between 2003 and 2009 (17). In addition to that, the high prevalence of poor oral health among the elderly, reducing chewing efficiency, can cause restrictions in fibrous food consumption (18).

In relation to vegetables, it was found that the frequency of regular intake of these foods increased with age in adults living in Brazilian capitals (19). However, in the present study, the score of vegetables (4.3) was lower than that observed in other works (2,7,9,14). Only 2.2% of the elderly consumed the recommended amount of vegetables. Part of this could be explained by the fact that more than half of our sample comprised elderly with income between one and three times minimum salary and that there is a positive association between frequency of vegetable consumption per capita with income level (17).

The consumption of fruits showed inadequacy in our study as well as that by Fisberg et al. (9), with low scores, 3.8 and 3.5, respectively, and this result is not surprising because surveys indicate a low intake of fruits by the Brazilian population, less than half that recommended by the Food Guide for the Brazilian Population (17,19). Loss of appetite, difficulty in food acquisition and preparation, movement, chewing, swallowing, and diseases such as depression and dementia are also associated with low consumption of fruits and vegetables in the elderly (18).

The dairy group score showed a greater adequacy in intake than that found by Fisberg et al. (9), though still low as observed by other authors (2,7,14), and according to the behavior of the Brazilian elderly, that shows an unsatisfactory consumption of dairy products (17). Low consumption of these foods among the elderly may be related to the fact that some elderly people have lactose intolerance, which is very common in the aging process (18).

The score of meat and eggs (3.6) among the elderly evaluated was much lower than that observed by Fisberg et al. (9.0) (9). Perhaps these findings can be explained by the fact that the sample analyzed by those authors consisted of younger individuals (mean age 41.3 vs. 74.3 years) and included 66.3% actively wor-

king persons as opposed to 78.0% retired persons in our sample. Conversely, less consumption of meat can be related to oral and dental problems, common among elderly, as well as to the lower purchasing power of this population due to retirement (18). The consumption of eggs has diminished considerably in Brazil, probably due to the fact that their consumption has been replaced by the purchase of industrialized foods, consequently decreasing the use of eggs in homemade preparations (19).

As regards to pulses, national data show a reduction of 26.4% in the consumption of beans during the period 2003-2009, with people showing increased interest in industrialized and less healthy foods (17,19). Surveys have reported that the regular consumption of beans has decreased (17,19), which may explain the lower scores between our elderly and individuals analyzed by Fisberg et al. (3.9 vs. 6.3) (9).

The elderly evaluated had a greater adequacy in intake of total fat, cholesterol, and sodium than those of other studies previously reported (2,17,9,14,15,16), and this better performance may be explained by the fact that the elderly, in general, have multiple diseases and chronic treatments. In this case, they could have received nutritional guidance or could represent the possibility of reverse causality, where with aging, developing diseases are responsible for dietary behavior modification.

Finally, less than 1.1% of the elderly ate a varied diet, with a score of 5.9 for this component, not in line with data in literature, showing considerably higher values both in the Brazilian and North American population (2,9,14,15). It could be considered that elderly nutrition shows a pattern and systematization different from that of younger people. These individuals have very entrenched eating habits, where they are not receptive to new foods, resulting in general in a diet poor in variety (21).

It is important to highlight that Brazil is a country with continental dimensions and many differences between regions with regard to food consumption, which is evident in the analysis of the data from the latest Family Budget Research, conducted by the Brazilian Institute of Geography and Statistics (IBGE) (17), and that can explain differences between our results and those obtained in the study of Fisberg et al. (9) conducted on a population of a distinct region.

To respond to the second aim of this study, we exa-

mined the association between HEI, food energy and macronutrients. TEI was not associated with HEI, indicating that the greater consumption of a certain amount of energy, by itself, does not improve HEI (8). However, the index was related to the intake of carbohydrates, total fat, SFA, cholesterol and sodium. A healthier diet associated with an increase in carbohydrate intake has not been demonstrated in similar study (22) and may initially suggest an inappropriate result, however, it is important to note that the Dietary Reference Intake (DRI) (11) mentions that carbohydrates should match 45 to 65% of TEI. Therefore, it seems that the percentage (56%) of carbohydrates consumed by the elderly with a better index, more closely approximated the average recommended intake, i.e. 55%. Research carried out in Brazil showed that over the past 30 years, there was a decrease in the relative participation of complex carbohydrates in food composition, approaching the recommended lower limits, with fats offsetting the lower carbohydrate levels, a change considered detrimental to health and conducive to the risk of chronic diseases (19).

The quality of diet related to a decrease in the quantity of SFA, cholesterol, and sodium is mentioned in the literature (2,22) and this relationship found here is important because it shows that the diet of the elderly evaluated has positive characteristics that confirm the recommendations related to these foods established in the main guidelines as preventing chronic diseases (11,19).

The analysis of diet quality in relation to vitamins and minerals, the ultimate goal of this study, was not among the objectives of the majority of the studies on HEI (2,4,7,12,16). Kennedy et al. (8), however, conducted this analysis and obtained a positive correlation for some of these nutrients. In our study, this correlation was not observed for the majority of the micronutrients studied, except for vitamin C, vitamin D and calcium. This finding is relevant because it indicates that the index based on the Brazilian Food Guide Pyramid was able to reflect the adequacy of these important nutrients to elderly health: vitamin C, in the resistance to infections and with antioxidant action, and vitamin D and calcium, in bone metabolism among other functions (18).

There are some limitations in this study that should be noted. First, our sample consisted of elderly in an outpatient clinic of a geriatric service, with particular

characteristics, and therefore, the results should not be extrapolated to the general population. The other limitations refer to the collection, handling and analysis of the dietary inquiries. R24h, despite being a much utilized instrument in epidemiological studies, has limitations, mainly when used to study the elderly. In the analysis of the data, there are difficulties inherent to the correct identification of foods, as well as the quantification of recipes and preparations and also limitations in the programs for the chemical analysis of foods in the diet, based on available sources, which are sometimes limited or incomplete in terms of nutrients, particularly micronutrients. To overcome these limitations, researchers have excluded from the sample elderly with cognitive decline, as well as obtaining two R24h. Finally, only one nutritionist evaluated all the dietary recalls, with respect to the foods, quantity, mode of preparation, and count of variety, in attempt to standardize the information that was entered in program for calculating diet.

CONCLUSION

The results suggest that the diet of the majority of the elderly evaluated needs improvement, mainly with regard to the consumption of meat, eggs, fruits, pulses, vegetables and dairy products. The quality of the diet was associated with greater intake of carbohydrates and lower intake of lipids, SFA, cholesterol and sodium. Consumption of vitamin C, vitamin D and calcium was shown to be positively correlated with the quality of the diet. Less than 1.1% of the elderly consumed a varied diet. HEI provided indications for the need of the elderly to modify the quality of their diets in these respects, aiming to make their eating habits comply more with nutritional recommendations and dietary guidelines.

The information obtained in the investigation of HEI of the elderly reinforces the importance of care in relation to the adequate nutrition of this population and can help in guiding the activities and programs of nutritional education, and public policies that stimulate increasingly healthy eating.

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