Healthy Eating Index: Assessment of the Diet Quality of a Brazilian Elderly Population

Nutrition and Metabolic Insights
Volume 11: 1–7

DOI: 10.1177/1178638818818845

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ABSTRACT

BACKGROUND: The food consumption assessment is necessary to monitor elderly's nutritional status because it allows detecting nutrition deficits and guiding the elaboration of effective conducts.

OBJECTIVE: The objective of this study is to assess the global quality of the elderly's diet in Viçosa—MG, Brazil.

METHODS: This is a population-based cross-sectional study, involving noninstitutionalized elderly. Diet quality was assessed through the Brazilian Healthy Eating Index-Revised (BHEI-R) validated to the Brazilian population.

RESULTS: The study comprised 620 elderly individuals. The mean total BHEI-R score was 64.28. The worse consumption scores concerned the components Whole grains, Milk and derivatives, Sodium, Total fruit, and Whole fruit. Approximately 82% scored zero (0%) for Whole grains and 67% for Sodium. Men presented significantly lower scores than women, who have presented maximal score in the same items. Women's scores were not only significantly higher for Total fruit, Whole fruit, Milk and derivatives, but also significantly lower for Saturated fat.

DISCUSSION: Most elderly need to improve their diet quality. Strategies heading toward the improvement of diet quality must be priority in policies to health promotion toward the healthy and active aging.

KEYWORDS: diet, food, and nutrition, food consumption, aged, nutritional epidemiology

RECEIVED: November 1, 2018. **ACCEPTED:** November 12, 2018.

TYPE: Original Research

FUNDING: The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior—Brasil (CAPES)—Finance Code 001 and by the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) (579255/2008-5).

DECLARATION OF CONFLICTING INTERESTS: The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Introduction

Population aging has become a reality in most societies, especially in developed countries. Developing countries, such as Brazil, will double their elderly population 4 times faster than some European countries.[1] This growth has increased the demand for health services, primarily because the elderly present with a large number of chronic noncommunicable diseases (CNCDs) that require continuous follow-up.[2]

Many factors are related to changes in the eating habits of the elderly, namely, physiological functional decline,[3] low schooling level, retirement, widowhood, or an empty nest. Such factors are often followed by losses regarding social roles and incomes, which favor isolation and solitude, as well as lack of interest in preparing meals and in food intake.[4] In addition, the use of medications and the presence of CNCDs may also change the amount, quality, and bioavailability of the consumed food.[5] Accordingly, these factors become challenges for the adoption of healthy eating habits by the elderly.[2]

Food intake by elderly individuals has changed over the past several years, mostly due to the consumption of more calories derived from fat (primarily of animal origin), sugar, and industrialized food, as well as to the low consumption of fruits and vegetables.[6] These changes often happen in adulthood, and they may lead to excessive body weight, which is one of the most important factors explaining the increased number of CNCDs. Thus, food consumption assessment is necessary to monitor the nutritional status of elderly individuals as it enables detection of nutritional deficits and guidance for development of effective measures to improve nutrition and health among the elderly.[7] This assessment can be performed by identifying the elderly's dietary patterns (defined as assessment of food consumption based on indices or multivariate statistical analyzes), the applications of which in Brazil are scarce and very incipient, especially in this population.

Different dietary indices were developed to investigate the relationship between food consumption and mortality caused by CNCDs. These indices are based on many diet components, which can be food groups, isolated food, and nutrients.[8–11] One of these indices is the Healthy Eating Index (HEI-1995), which was developed by Kennedy et al[8] to measure the global dietary quality. The Brazilian Healthy Eating Index-Revised (BHEI-R), which was validated for the Brazilian population,[10,11] is based

on the 2006 Eating Guide for the Brazilian Population[12] and on the HEI-2005. This index evaluates the combination of foods consumed and reduces the effects of day-to-day variability in the amount of food consumed, thereby improving the accuracy of the overall diet quality evaluation. This approach enables a more direct indication of the need for nutritional interventions, thereby representing a useful tool in the analysis of food consumption.

However, in Brazil, studies examining food consumption and diet quality among the elderly are scarce. Among the published studies, including national surveys, the results point to an inadequate intake of whole grains, vegetables, fruits, milk and dairy products, meat and eggs, sugars and sweets,[2,13,14] consumption of sodium and total cereals,[13,14] nutritional deficiencies in feeding mainly among women and individuals more than 80 years,[15] and a high prevalence of inadequate intake of vitamins E, D, and A; calcium; magnesium; and pyridoxine in all regions studied.[3] Therefore, nutrition and eating in the elderly are areas still underexplored in the scope of research in nutritional epidemiology in the country. Considering the growth of the elderly population in Brazil, as well as the relevance of assessing and monitoring eating patterns in this group, the aim of this study was to assess the quality of the diet of an elderly population in Viçosa—MG, Brazil.

Methods

This is a cross-sectional study with a population basis that was conducted between June and December 2009.[16]

Target population and sample

The study's target population consisted of seniors aged more than 60 years who were not institutionalized and were residents in rural and urban areas of Viçosa, which corresponded to 7980 elderly in 2008 (the study period) according to the Brazilian Institute of Geography and Statistics (IBGE).[17] Identification of this population was done by census during the National Campaign of Immunization of the Elderly in 2008, which covered more than 90.0% of the city's elderly population. Aiming for the identification of the nonparticipants in the vaccination campaign, the campaign's database was merged with other databases: database of Viçosa, Federal University employees both active and retired, and databases of registers of the municipality's health services. After combination of these databases, 7980 people aged 60 and above were identified and this number formed the basis for the calculation of the sample.

The sample size was calculated considering a confidence level of 95%, estimated prevalence of 50% for different outcomes of interest to the larger project, 4% tolerated error, and 20% increase to cover losses, resulting in a sample size of 670 participants. From this initial study sample size, there were a total of 50 losses due to subject refusal to participate (3.6%), death (1.3%), addresses that could not be located in the city (1.2%), or individuals who had moved to other locations that were either difficult to find or in other municipalities (1.2%), in addition to missing data from the usual food record (0.15%). Those participants excluded were no different from the included ones regarding sex and age range.[18] Thus, excluding losses, the final sample was of 620 elderly, representing a response rate of 93.0%. The selection of the individuals was made by simple random sampling[19] from the database of records obtained, as described above.

Data collection

Initially, the contact was made by phone or home visit to inform the research objectives, invite the elder to participate, and schedule the interview that was conducted by 5 trained interviewers in the elder's home. Three visitation attempts were made to locate the elder before he or she was excluded from the sample.

A semistructured questionnaire concerning the sociodemographic and food intake conditions was applied during the interview. Food intake data were collected through the application of the usual food record. The content of the record was revised before data were entered into the *Epi-info* software, version 6.04.

The study was conducted according to the directives established in the Declaration of Helsinki, and all procedures involving humans were approved by the Research Ethics Committee of the Federal University of Viçosa, Brazil (027/2008). All persons provided their informed consent prior to their inclusion in the study.

Measurement of dietary intake

Food intake data were obtained by a usual food record. To this end, the elderly or their caregivers described the foods consumed and their respective home measures taken. Based on the food groups of the Food Guide for the Brazilian Population of 2006, foods were classified and preparations containing more than one food group were broken down into their ingredients and classified into their respective food groups. For preparations that did not have salt and/or oil, the percentage was standardized for each type of preparation. All sugars added to food during processing, preparation, or consumption were considered as added sugars. The amount of added sugar present in each food was standardized according to the methodology described by Fernandes.[20] The estimation of the food consumption and the macronutrients and micronutrients value of the foods consumed were done with the aid of DietPro version 5i software. Subsequently, the ingested portions of each food group were calculated according to the Food Guide for the Brazilian Population 2006.[12]

Assessing diet quality

According to information found in the record, diet quality was assessed through BHEI-R.[10] This index was based on

Table 1. Scoring criteria of components of the Brazilian Healthy Eating Index-Revised.

COMPONENTS	CRITERIA FOR MINIMUM SCORE	CRITERIA FOR MAXIMUM SCORE	
		PORTIONS (KCAL)	SCORE (POINTS)
1. Total fruit[a]	0 point	1.0 portion/1000	5
2. Whole fruit[b]	0 point	0.5 portion/1000	5
3. Total vegetables[c]	0 point	1.0 portion/1000	5
4. Dark green and orange vegetables and legumes[c]	0 point	0.5 portion/1000	5
5. Total grains	0 point	2.0 portion/1000	5
6. Whole grains	0 point	1.0 portion/1000	5
7. Milk and derivatives[d]	0 point	1.5 portion/1000	10
8. Meat, eggs, and legumes	0 point	1.0 portion/1000	10
9 Oils[e]	0 point	0.5 portion/1000	10
10. Saturated fat	⩾15% of TEV 0 point	⩽7% do TEV	10
11. Sodium	⩾2.0g/1000 Kcal 0 point	⩽0.75 g/1000	10
12. SoFAAS	⩾35% of TEV 0 point	⩽10% of TEV	20

Abbreviations: SoFAAS: calories from solid fats, alcoholic beverages, and added sugars; TEV: total energy value.
[a]Includes fruit and natural fruit juices.
[b]Excludes fruit juices.
[c]Includes legumes only after the maximum score of meat, eggs, and legumes has been achieved.
[d]Includes milk and dairy products and soy milk.
[e]Includes mono- and polyunsaturated fats, oils from oleaginous vegetables and fish oils.
Adapted from Previdelli et al.[10]

recommendations from the Food Guide for the Brazilian Population 2006,[12] the Healthy Eating Index 2005 (HEI-2005),[9] the recommendations of the World Health Organization (WHO), the Institute of Medicine, and the guidelines of the Brazilian Society of Cardiology (BSC). BHEI-R was validated for the Brazilian population by Andrade and colleagues, which demonstrated that the index shows good reliability and reproducibility and is valid to be used as an instrument to evaluate and monitor the quality of the Brazilian diet.

This index is the sum of 12 components, which refer to food groups: (1) Total fruit (includes fruit and natural fruit juices); (2) Whole fruit (excludes fruit juices); (3) Total vegetables (includes all vegetables; legumes are counted as vegetables only after the meat and beans standard is met); (4) Dark green and orange vegetables, and legumes (includes only dark green and orange vegetables, and legumes; legumes are counted as vegetables only after the meat and beans standard is met); (5) Total grains (includes grains, roots, and tubers); (6) Whole grains (includes only foods containing whole grains); (7) Milk and derivatives (includes all milk products); (8) Meat, eggs, and legumes (includes all types of beef, pork, sheep, game, poultry, fish, eggs, seeds, and soy products); (9) Oils (includes mono and polyunsaturated fats, oils from oleaginous vegetables, and fish oils), 2 based on nutrient intake; (10) Saturated fat; (11) Sodium; and (12) the energetic value derived from the ingestion of alcohol, added sugars, and solid fats (sum of saturated and trans fats) (SoFAAS)[10] (Table 1).

The component "Meat, eggs, and legumes" presented an estimated score based on the sum of energy values of the groups "Meat and eggs" and "Legumes." The calorie value of "Legumes" was added to the "Meat, eggs, and vegetables" component until the portion limit was reached (1 portion = 190 Kcal = 10 points). In cases of excess calories, the caloric value from the "Legumes" was computed in the groups "Dark green and orange vegetables and vegetables" and "Total vegetables" simultaneously, according to the methodology of Previdelli et al. Such inclusion is explained by the relevance of legumes, especially beans, in Brazilians' eating habits.[10] Because of this, the BHEI-R computes the portions of this group different from the American proposal, to incorporate local dietary customs into the calculation.

The score of each component was calculated by estimating the number of consumed portions per 1000 Kcal of each food group, per mg/1000 Kcal of sodium, and the portion of total energy consumption per nutrient for saturated and solid fats, sugar, and alcoholic beverages ('SoFAAS'). The maximum value for BHEI-R is 100 points. The maximum component scores (5, 10, or 20 points, depending on the analyzed component) were attributed when the consumption was equal to or greater than the recommended portion. Absence of consumption received a minimum score (0). Intermediate consumption

Table 2. Descriptive statistics of the scores (total and per components) and frequency of minimum and maximum scores for the BHEI-R, Viçosa, Brazil, 2009.

COMPONENTS	MEDIAN (IQR)	MINIMUM SCORE (%)[a]	MAXIMUM SCORE (%)[b]
Total fruit	3.58 (0.00–5.00)	31.60	38.20
Whole fruit	5.00 (0.00–5.00)	37.60	51.60
Total vegetables	5.00 (5.00–5.00)	0.80	87.90
Dark green and orange vegetables and legumes	5.00 (5.00–5.00)	1.90	92.40
Total grains	5.00 (4.60–5.00)	28.70	71.30
Whole grains	0.00 (0.00–0.00)	82.30	6.80
Milk and dairy	3.98 (0.03–8.09)	24.50	14.20
Meat, eggs, and legumes	10.00 (10.00–10.00)	15.80	84.20
Oils	10.00 (7.95–10.00)	35.30	64.70
Saturated fat	10.00 (8.66–10.00)	2.40	51.10
Sodium	0.00 (0.00–1.40)	67.10	0.20
SoFAAS	11.62 (5.49–17.69)	10.30	16.60
Total BHEI-R	64.29 (56.94–72.92)	—	—

Abbreviations: IQR, interquartile ranges; SoFAAS, Calories from solid fats, alcoholic beverages, and added sugars; Total BHEI-R, Total Brazilian Healthy Eating Index-Revised
[a]Minimum score: 0.
[b]Maximum score: 5, 10, and 20.

values were calculated proportionally to the quantity consumed. Scores of components, such as Saturated fat, Sodium, and SoFAAS, go in the opposite direction, that is, the greater the consumption is, the lower the score is. This relationship is justified by the fact that they are moderation components; thus, their excessive intake must be avoided.[9,10] Scores for intermediate intake values, in the interval between the minimal and maximal score criteria, are proportionally attributed (Table 1).

Values closer to the maximal score indicate better dietary quality in the total scoring, whereas low scores indicate less adherence to recommendations. As the index was developed to reflect different dietary aspects, there is no established cutoff point for classifying the diet as "adequate" or "inadequate" if the total score is considered; thus, the score of each component must be individually assessed.[9,21]

Statistical analysis

Relative frequencies, means, and standard deviations were estimated to describe the sample. The means, medians, and interquartile intervals of the total BHEI-R and of each component were also assessed, as well as the rate of minimal and maximal scores of the components. Distribution normality of BHEI-R values between the categories of variables of interest was assessed through the *Shapiro-Wilk* test. The *Student t test* or the *Mann-Whitney* test was used to compare the total BHEI-R distribution and the distribution of components according to sex and age group. *Pearson's chi-square* test was used to compare the percentage of maximal score of components per sex. All analyses were conducted using STATA software (Stata Corp., College Station, TX, USA) version 13.0, at a significance level $\alpha = 0.05$.

Results

We studied 620 elderly with a mean age of 70.8 (SD = 8.07) years old, and most of them were between 60 and 74 years old (69.8%) and were women (53.2%). More than 15% were reported to be illiterate and approximately 64% only attended the first years of elementary school.

Their mean score on the BHEI-R was 64.28 (SD = 11.19), with minimal and maximal scores of 21.95 and 90.56 points, respectively. Components presenting the worse scores were "Whole grains," "Milk and derivatives," "Sodium," "Total fruit," and "Whole fruit." In addition, 82.0% and 67.0% scored 0 in "Whole grains" and "Sodium," respectively (Table 2).

The total BHEI-R score showed that 75% scored less than 72.92 and that men presented a global score of 62.55 (a value significantly lower than the women's global score of 65.80). Women presented mean scores and maximal score percentages significantly higher than men for "Total fruit," "Whole fruit," "Whole grains," "Milk and derivatives"; as well as significantly lower than men for "Saturated fat" (Table 3).

Elderly in the age group 60 to 74 presented mean scores significantly higher for the components "Oils" and "Dark green

Table 3. Median and interquartile ranges of the components of the Brazilian Healthy Eating Index-Revised according to sex and age of the elderly. Viçosa, Brazil, 2009.

MEDIAN (IQR)	SEX (N)		AGE (N)	
	MALES (290)	FEMALES (330)	60–74Y (433)	75+Y (187)
Total fruit	3.05 (0.00–5.00)[a]	4.01 (0.00–5.00)[a]	3.79 (0.00–5.00)	3.37 (0.00–5.00)
Whole fruit	3.43 (0.00–5.00)[a]	5.00 (0.00–5.00)[a]	5.00 (0.00–5.00)	4.65 (0.00–5.00)
Total vegetables	5.00 (5.00–5.00)	5.00 (5.00–5.00)	5.00 (5.00–5.00)	5.00 (5.00–5.00)
Dark green and orange vegetables and legumes	5.00 (5.00–5.00)	5.00 (5.00–5.00)	5.00 (5.00–5.00)[a]	5.00 (5.00–5.00)[a]
Total grains	5.00 (4.79–5.00)	5.00 (4.45–5.00)	5.00 (4.50–5.00)	5.00 (5.00–5.00)
Whole grains	0.00 (0.00–0.00)[a]	0.00 (0.00–0.00)[a]	0.00 (0.00–0.00)	0.00 (0.00–0.00)
Milk and dairy	2.78 (0.00–6.48)[a]	4.95 (2.16–8.72)[a]	3.93 (0.00–7.69)	4.41 (0.04–8.85)
Meat, eggs, and legumes	10.00 (10.00–10.00)	10.00 (10.00–10.00)	10.00 (10.00–10.00)	10.00 (10.00–10.00)
Oils	10.00 (7.73–10.00)	10.00 (8.05–10.00)	10.00 (8.69–10.00)[a]	10.00 (6.98–10.00)[a]
Saturated fat	10.00 (8.93–10.00)[a]	9.77 (8.40–10.00)[a]	10.00 (8.69–10.00)	9.79 (8.43–10.00)
Sodium	0.00 (0.00–0.71)	0.00 (0.00–1.66)	0.00 (0.00–1.49)	0.00 (0.00–1.34)
SoFAAS	11.20 (5.22–17.09)	11.80 (5.69–18.38)	11.92 (5.48–17.40)	11.15 (5.49–18.00)

Abbreviations: IQR, interquartile ranges; SoFAAS: calories from solid fats, alcoholic beverages, and added sugars.
[a]Mann-Whitney test, $P < 0.05$.

and orange vegetables and legumes" than those in the age group 75 years or older (Table 3).

Discussion

This study is one of the first to use the BHEI-R as an instrument to assess diet quality in a sample representative of the elderly population in a Brazilian city. The results revealed a scenario that requires changes in food consumption among older adults.

The mean total BHEI-R score found was close to that found in other national[13,22] and international[23] studies. The few prior studies on this subject found that most of the Brazilian elderly need modifications of their diets and only a minority have an adequate diet.[24–26] However, elderly women had a higher mean total BHEI-R score when compared with elderly women assessed in other national[13,22] and international studies.[23,27]

In general, the components showing the worst scores were "Sodium," "Milk and derivatives," "Whole grains," "Total fruit," and "Whole fruit." These results are similar to the findings of other cross-sectional studies involving the elderly in Brazil, which also showed low scores on these components.[13,22,28]

The low "Sodium" score found indicates a high intake of salt by elderly individuals. In Brazil, 80.4% of the elderly population consume high amounts of sodium,[14] even though some studies have pointed out their awareness of the beneficial effects of reducing sodium intake to control hypertension and to reduce the risk of cardiovascular events.[29,30] Although there are public policies prohibiting access to supplemental salt in restaurants, there is still a need for more effective policies.

Because aging causes reductions in sensitivity to primary tastes, elderly individuals often add excessive amounts of sugar and salt to their food, a fact that can increase their sodium and added sugar intake to values above the recommended maximum.[4]

Low scores were also observed for "Milk and derivatives" intake. Such a finding may suggest that elderly individuals tend to reduce or stop consuming milk and its derivatives. This behavior can be attributed to different factors, such as the amount of fat in these foods, and/or to the development of lactose intolerance.[30] Data from the National Research on Family Income (a large national population-based study) from 2008 and 2009, which was performed in larger states, revealed a high prevalence of calcium deficits among the elderly due to milk consumption below the recommended level.[14] Such behavior seems to also happen in smaller cities in Brazil, such as Viçosa. The authors point out a concern that calories not consumed from milk will be replaced by calories from other sources, such as processed grains, sweet beverages, and candies, which can increase the risk of obesity, diabetes *mellitus*, and cardiac diseases.[31]

The consumption of "Whole grains" is related to prevention of cardiovascular diseases, so their consumption must be encouraged.[32] However, more than 80% of the studied sample scored 0 in this component; this shows a diet based on processed grains and on diminished whole grains intake, as well as

a consequent possible reduction in fiber intake, according to the results of a large national population-based study.[14] This behavior can be partially explained by edentulism and using dental prostheses that impair and make mastication less efficient, affecting the intake of such food. Accordingly, many elderly increase their intake of soft processed foods that are poor sources of fiber, vitamins, and minerals, as well as being rich in carbohydrates, because they are more practical and easier to chew.[4,33,34]

The low "Total fruit" and "Whole fruit" scores are similar to those found in other Brazilian studies conducted in larger cities.[13,24] According to the Eating Guide for the Brazilian Population (2014),[35] the basis of eating must be composed of food *in natura* or minimally processed, with a variety of food components, predominantly of vegetal origin,[35] as fruits and vegetables are rich in vitamins, minerals, and fiber, as well as acting to reduce the risks of developing the main chronic diseases.[36] However, Brazilian elderly have shown insufficient fruit and vegetable intake[3,14] and this finding indicates the need for nutritional and dietary interventions to improve the consumption of components presenting the worst scores.

The components with the highest maximal score percentage were "Total grains," "Meat, eggs and legumes," "Total vegetables" and "Dark green and orange vegetables and legumes." These 2 last presented maximal score percentages higher than those found in other studies.[13,23] Consumption of legumes and vegetables is a feature of healthy eating habits of elderly individuals; this may be a result of the impact of chronic illnesses occurring in old age, of comorbidities, and of these individuals' eating habits and preferences.[15]

The component "Meat, eggs, and legumes" presented a high score (9.57 points), indicating the adequate consumption of food in this group. It is worth considering that this result can be attributed to the inclusion of the Legumes group in this component, because beans are often consumed by the Brazilian population,[14] and it could have led to overestimating the intake of this group, because the score would only be 6.67 if the legumes were disregarded.

An intermediate score of calories deriving from solid fat (saturated and trans), alcoholic beverages, and added sugar ("SoFAAS") was found; in addition, there was low saturated and trans fat consumption. Just 2.9% of the elderly reported drinking alcoholic beverages. Accordingly, it is quite likely that most "SoFAAS" calories result from added sugar as there was a high sweetened-coffee intake leading to a mean sugar intake of 30.1 g per person a day. According to Adamska and colleagues,[37] coffee intake tends to increase with age, a fact that can explain the high coffee intake rates and, consequently, of the sugar intake.

All methods of measuring food consumption have limitations.[38,39] Some considerations must be taken into account concerning the use of the usual food record as a consumption assessment instrument. Although it is not a validated instrument, it has been observed that the elderly have a greater facility to report their habitual consumption than their consumption in the last 24 hours. This may happen due to their lower concentration capacity and vulnerability to memory lapses.[40] In addition, meals taken by the elderly tend to often be the same every day due to habit issues, as well as to preparation and food intake difficulties,[15] and possibly because of their income, a fact that minimizes potential bias resulting from the application of the usual food record.

The HEI was developed to assess eating habit patterns, but it presents some limitations, such as the absence of upper score limits for beneficial food components, because the excessive consumption of food/food groups of such components can also be inappropriate, especially in the elderly, most of whom have at least one chronic illness, but also in other population groups that may have high habitual consumption of certain foods. This excess can make it difficult to treat and control these diseases. For example, high bean consumption, a habit of Brazilians, may overestimate their consumption of the "Meat, eggs, and legumes" group, masking a low consumption of meat and eggs. These issues indicate the need for method adaptations in future studies. In addition, even after taking the methodology concerning the use of this index into consideration, it is possible to observe that there is no standardization of food inquires between different studies, along with the adoption of different intake recommendation parameters, facts that impair comparisons.[41]

Conversely, the BHEI-R enables qualitatively assessing consumption because it can help simultaneously analyze many components comprising diets based on energy density, as well as showing which of the food groups, foods, and/or nutrients are adequate or need to be improved in the usual intake. In addition, it also allows for monitoring the diet's fit to the current nutritional recommendations; thus, it is useful for the development of health promotion and nutritional education actions, as well as to plan and monitor nutritional and dietary interventions, and develop nutrition epidemiology studies.

Despite the limitations, this study's results regarding the elderly's food intake based on the HEI showed similarities to national studies conducted in larger cities, as well as to some international studies. The observed results point out that the elderly population needs improvements in their food intake routines, with emphasis being placed on increased ingestion of whole grains, fruits, milk and derivatives, and to reduce consumption of food rich in sodium. Therefore, strategies focused on dietary quality promotion are necessary to improve this scenario and to promote changes in eating behaviors. In parallel, effective implementation of safe eating and nutritional public policies is crucial to favor the compliance with the Human Right to Adequate Eating and with the World Health Organization guidelines, into the political framework for Active Aging. These strategies and public policies must be a priority in actions taken to promote healthy aging in Brazilian countries.

Acknowledgements

The authors thank the team of researchers who collected the data and the Grupo de Estudo sobre Envelhecimento, Nutrição e Saúde (GREENS) of the Department of Nutrition and Health of the Federal University of Viçosa.

Author Contributions

Fernandes DPS worked in study design, analysis and interpretation of data, article writing and critical review of relevant intellectual content and final approval of the version to be published. Ribeiro AQ guided the design, collection and analysis and interpretation of data, and critical review of relevant intellectual content and final approval of the version to be published. Duarte MSL and Pessoa MC collaborated in the analysis and interpretation of data, article writing and critical review of relevant intellectual content; Franceschini SCC collaborated in the relevant critical review of the intellectual content.

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