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Inadequate nutrient intake among the Brazilian elderly: National Dietary Survey 2008-2009

ABSTRACT

OBJECTIVE: To estimate the prevalence of inadequate nutrient intake in the Brazilian elderly.

METHODS: This study was based on data from the National Dietary Survey, part of the Household Budget Survey 2008-2009. All individuals aged 60 and over, totaling 4,322 individuals, were included. Individual food intake was obtained from food records from two non-consecutive days. The habitual intake for each nutrient was estimated by the National Cancer Institute method, in which sex and region were included as covariates. The prevalence of inadequate nutrient intake was estimated stratified by sex and region using the EAR method to define cut-off points.

RESULTS: A high prevalence of inadequate intake (> 50%) of vitamins E, D and A, calcium, magnesium and pyridoxine was observed for both sexes. In all regions, 100% inadequate vitamin E intake was observed. Vitamin D showed almost 100% inadequate intake except in the North region. The prevalence of inadequate vitamin A intake was higher than 70% in the North, Northeast, and Midwest regions. Among the minerals evaluated, calcium and magnesium showed the highest prevalence of inadequate intake (> 80%) in all regions.

CONCLUSIONS: The present study found a high prevalence of inadequate intake of nutrients recognized as being protective against chronic diseases among the Brazilian elderly.

DESCRIPTORS: Aged. Elderly Nutrition. Nutritional Status. Nutrition Policy. Nutrition Assessment. Diet Surveys.

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Received: 12/1/2012

Approved: 7/18/2012

INTRODUCTION

The elderly population is one of the age groups at higher risk of malnutrition and nutritional deficiencies due to declining physical and cognitive function and which impair the consumption and metabolizing of nutrients.^{1,4} Thus, dietary and nutritional surveillance have been proven as essential to characterizing dietary practices and their determinants in this population, with the aim of preventing nutritional disorders and related diseases.^a

The calculation of the prevalence of inadequate intake has been a strategy used in international health and nutrition surveys to identify individuals at risk of nutritional deficiencies.^{15-17,23} Therefore, the Ministry of Health's National Dietary and Nutritional Policy, in partnership with IBGE (*Instituto Brasileiro de Geografia e Estatística* — Brazilian Institute of Geography and Statistics) carried out the first INA (National Dietary Survey) as part of the 2008-2009 Household Budget Survey.^b In this survey, a diagnosis of the Brazilian dietary and nutritional situation was carried out using calculations of prevalence of inadequate micronutrient intake.

This article aims to estimate the prevalence of inadequate nutrient intake among the Brazilian elderly.

METHODS

Data from the National Dietary Survey, corresponding to one module of the 2008-2009 Household Budget Survey were analyzed.^b

The Household Budget Survey used a two-stage cluster sampling design.^b In the first stage census primary sampling units were selected for the sample, with probability proportional to the number of residences in each tract. The primary sampling units were randomly selected, with probability proportional to the number of residences based on the 2000 Demographic Census. In the second stage, the sample units were permanent private residences, selected using simple random sampling without replacement, from within each primary sampling unit. All of the strata in the study were evaluated throughout the 12 months of the survey.

An amount of 68,373 households were selected. A subsample for the INA was calculated at 25% of the households in the Household Budget Survey 2008-2009 sample and was organized so that one in every four residences in each primary sampling unit was selected. In the data collection stage 16,764 residences (24.5%) were sampled. There were 38,340 residents aged ten and over, in 13,569 households, who responded to the

research, with a non-response rate of 19%. A total of 34,032 individuals completed the data on food and/or drink intake (11% non-response rate). In this analysis, only those aged 60 or over are included, giving a sample of 4,322 individuals, of both sexes.

Data on individual food intake were obtained through food records completed by residents aged 60 and over on two non-consecutive days according to Institute of Medicine recommendations,⁹ with the aim of estimating usual intake and calculating the prevalence of inadequate nutrient intake. Guidance was given on how to record portion sizes, times and places of meals (at home or away from home) and detailed description of all food and drink consumed, including the cooking methods and ingredients. In addition to collecting information on food and drink consumed, the food record included a question on sugar and/or sweetener consumption.

In the households, interviewers entered the data on food consumption into a program specially developed by the IBGE^b which included food and drinks taken from 5,686 records contained in the Household Budget Survey 2002-2003 database of household food and drink acquisition. This program has approximately 1,500 items of food and drink, 16 options of cooking methods and 106 types of portions and measurements, as well as items which were compulsory such as the place and time of consumption. Food and drink consumed by the individuals who were not included in the survey were included by the interviewer. At the end of the survey, 1,120 items of food and drink were reported.

To control the quality of data of dietary consumption, partial analysis was carried out during data collection, such as verifying the frequency of the response, mean number of items consumed on the first and second day of food recording, codifying items which were not recorded and inspecting items included by the interviewer.

Details on the pre-test, training, validation of the data collection instrument and data input are published by the IBGE.^b

On analyzing the consistency of the data, 29 individuals who only completed a food record for one day were excluded. In addition, where quantity was not reported and/or considered improbable, these were entered using a *hot deck* procedure, which enables a matrix of similarities to be created, formed by variables correlated with the variable: quantity consumed, these variables being gender, age group, region and portion size reported. This occurred in less than 1% of the food items reported.

^a Ministério da Saúde, Secretaria de Atenção à Saúde, Departamento de Atenção Básica. Indicadores de vigilância alimentar e nutricional: Brasil 2006. Brasília (DF); 2009.

^b Instituto Brasileiro de Geografia e Estatística. Pesquisa de Orçamentos Familiares 2008-2009: análise do consumo alimentar pessoal no Brasil. Rio de Janeiro: IBGE; 2011.

In order to convert the reported food items into values for micronutrients, tables of nutritional composition^c and portion sizes,^d specially created to analyze food and dishes cited in the 2008-2009 Household Budget Survey, were used. The nutritional composition tables were drawn up based on the Nutrition Data System for Research (NDS-R), version 2008 program,¹⁷ as well as the Brazilian Table of Food Composition (TACO).^e Data on nutrient intake represents only nutrients gleaned from food and/or drink and does not include supplements and/or medication.

Usual intake of each nutrient was estimated using the method developed by researchers at the National Cancer Institute.²⁴ The National Cancer Institute method is a mixed model with two parts. In the first part, the probability of consumption is estimated using logistic regression with random effects (probability model); in the second, using the data transformed for normality, the quantity consumed is estimated using linear regression with random effects (quantity model). Due to the fact that the nutrients are consumed almost daily, probability, in this study, is assumed to be equal to 1 for each nutrient, thus dispensing with the use of the probability model. In the quantity model gender (male; female) and region (North, Northeast, Southeast, South and Midwest) were used as co-variables. The means and percentiles of intake were estimated for each gender. The National Cancer Institute method was used with DISTRIB and MIXTRAN macros developed for SAS (Statistical Analysis System) version 9.1 software.

The rates of prevalence of inadequate micronutrient intake were estimated according to gender and age group (51-70 years old; > 70 years old), using the EAR (Estimated Average Requirement) method as cut off points, according to the Institute of Medicine proposal for the population of the United States and Canada.^{7,9-12} The prevalence of inadequate micronutrient intake was calculated as the percentage of individuals with intake below the EAR value, i.e., with intake lower than the mean estimated requirement for the micronutrient for each gender and age group. Sodium intake was compared with the UL (Tolerable Upper Intake Level), which allowed the percentage of the population at risk of adverse health effects to be estimated.

The analyses were stratified by gender and region. Confidence interval of 95% were calculated for the means and prevalence of inadequacy based on the standard error values estimated using the Balanced Repeated Replication (BRR) technique used in the

National Cancer Institute method. These intervals were used to compare prevalence of inadequate intake according to gender and region.

This study was approved by the Ethics Committee of the *Faculdade de Saúde Pública, Universidade de São Paulo* (Protocol n° 2258/2011).

RESULTS

High rates of prevalence of inadequate vitamin E, vitamin D, calcium and magnesium intake were observed in elderly people of both sexes (Tables 1 and 2). For these micronutrients, the rates of prevalence of inadequate intake were around or above 80%. Inadequate intake of thiamine, pyridoxine, and vitamin C in both sexes also stood out, with values between 37% and 57%, as did vitamin A, with percentages between 68% in women and 83% in men.

Prevalence rates of inadequate intake lower than 15% were observed for phosphorus, selenium, iron and niacin for males (Table 1), and for only iron and niacin in females (Table 2). The prevalence rates of inadequate magnesium, vitamin A, riboflavin and zinc intake were higher for men, whereas inadequate phosphorus, niacin, iron and copper intake was more prevalent among women. For the other micronutrients, no significant differences were observed between sexes.

Figure 1 shows prevalence rates of inadequate vitamin intake by region. Throughout the country, vitamins E, D and A had the highest rates of inadequate intake. Irrespective of region, vitamin E was the only nutrient to show 100% inadequate intake for both sexes. Vitamin D had rates close to 100% in all regions except the North, where the rate was significantly lower (89% in men and 92% in women). For vitamin A, higher rates of inadequate intake were observed in the North (93% in men and 91% in women), Northeast (89% in men and 76% in women) and Midwest (86% in men and 78% in women), with a significant difference between men and women only in the Northeast. Other vitamins with high prevalence rates of inadequate intake in the North, Northeast and Midwest were pyridoxine (49% to 60% in men and 56% to 65% in women), thiamine (47% to 53% in men and 50% to 61% in women) and vitamin C (40% to 60% in men and 37% to 43% in women), with no significant difference between the sexes.

With regards to minerals, calcium was that which showed the highest rates of inadequate intake in all

^c Instituto Brasileiro de Geografia e Estatística. Pesquisa de Orçamentos Familiares 2008-2009: tabela de composição nutricional dos alimentos consumidos no Brasil. Rio de Janeiro: IBGE; 2011.

^d Instituto Brasileiro de Geografia e Estatística. Pesquisa de Orçamentos Familiares 2008-2009: tabela de medidas referidas para os alimentos consumidos no Brasil. Rio de Janeiro: IBGE; 2011.

^e Tabela Brasileira de Composição de Alimentos (TACO). Núcleo de Estudos em Pesquisas em Alimentação - NEPA. Universidade de Campinas. 2. ed. Campinas (SP); 2006.

Table 1. Mean percentiles and prevalence of inadequate intake of vitamins and minerals in elderly males. Brazil, 2008-2009.

Micronutrientes	Nutritional recommendation ^a	Mean (95%CI)	Intake percentiles					Prevalence of inadequate intake (%) (95%CI)
			10	25	50	75	90	
Magnesium (mg)	350.0	250.9 (244.4;255.7)	144.1	183.8	237.9	303.8	373.9	86.1 (84.6;88.5)
Phosphorus (mg)	580.0	984.1 (954.3;999.2)	568.5	720.1	929.5	1,188.1	1,468.5	11.1 (10.3;12.4)
Vitamin A (mcg) ^b	625.0	409.9 (394.4;428.7)	150.9	224.2	344.4	521.4	746.6	83.3 (81.6;85.4)
Thiamine (mg)	1.0	1.1 (1.1;1.2)	0.6	0.8	1.1	1.3	1.7	44.1 (42.1;45.5)
Riboflavin (mg)	1.1	1.6 (1.5;1.6)	0.9	1.2	1.5	1.9	2.4	21.5 (18.5;26.9)
Niacin (mg) ^c	12.0	26.5 (25.4;27.2)	15.0	19.3	25.1	32.2	39.8	3.6 (3.3;4.3)
Vitamin D (mcg)	10.0	3.1 (2.9;3.3)	1.2	1.7	2.6	4.0	5.7	98.8 (98.3;99.2)
Vitamin E (mcg) ^d	12.0	4.3 (4.1;4.4)	2.5	3.1	4.0	5.2	6.4	99.9 (99.9;100.0)
Vitamin C (mg)	75.0	117.9 (108.2;137.0)	19.0	38.0	77.8	150.6	260.9	49.0 (39.3;53.4)
Iron (mg)	6.0	11.2 (10.9;11.6)	6.2	8.1	10.7	13.8	17.0	8.8 (7.4;10.2)
Calcium (mg) ^e	800	499.9 (447.8;552.0)	231.4	323.8	455.2	626.2	823.5	88.8 (86.5;91.0)
	1,000	501.7 (446.3;557.0)	231.2	322.5	453.4	628.6	832.4	97.6 (95.4;99.7)
Pyridoxine (mg)	1.4	1.5 (1.4;1.5)	0.8	1.1	1.4	1.8	2.2	50.5 (45.6;53.3)
Zinc (mg)	9.4	11.1 (10.8;11.4)	6.3	8.0	10.5	13.5	16.8	39.1 (35.9;42.2)
Copper (mg)	0.7	1.1 (1.0;1.2)	0.6	0.8	1.0	1.4	1.8	21.0 (16.8;24.6)
Sodium (mg)	2,300 ^f	3,232.0 (3,145.0;3,304.0)	1,960.0	2,457.0	3,111.0	3,875.0	4,660.0	-

^a according to Estimated Average Requirement values (EAR), Institute of Medicine (2000)

^b retinol activity equivalents

^c niacin equivalents

^d total alpha-tocopherol

^e EAR values according to age group (60-70 years old and 71 and over respectively)

^f upper tolerable limit intake (UL)

Table 2. Mean, percentiles and prevalence of inadequate intake of vitamins and minerals of elderly females. Brazil, 2008-2009.

Micronutrients	Nutritional recommendation ^a	Mean (95%CI)	Intake percentiles					Prevalence of inadequate intake (%) (95%CI)
			10	25	50	75	90	
Magnesium (mg)	25.0	209.0 (206.8;213.0)	116.1	150.8	197.7	254.4	316.2	78.3 (76.9;79.2)
Phosphorus (mg)	580.0	851.2 (834.3;878.7)	481.4	617.4	802.7	1,030.0	1,281.1	20.5 (18.4;21.4)
Vitamin A (mcg) ^b	500.0	443.7 (414.9;465.5)	162.8	243.8	374.2	563.2	806.8	67.9 (65.5;72.2)
Thiamine (mg)	0.9	1.0 (0.9;1.0)	0.5	0.7	0.9	1.2	1.5	46.9 (44.1;48.6)
Riboflavin (mg)	1.1	1.4 (1.4;1.5)	0.8	1.0	1.3	1.7	2.1	16.6 (14.8;18.2)
Niacin (mg) ^c	11.0	22.1 (21.7;22.9)	12.1	15.8	20.9	27.0	33.7	6.6 (5.4;7.7)
Vitamin D (mcg)	10.0	2.9 (2.8;3.1)	1.1	1.6	2.5	3.7	5.4	99.0 (98.5;99.4)
Vitamin E (mcg) ^d	12.0	3.6 (3.5;3.8)	1.9	2.6	3.4	4.4	5.6	100.0 (100.0;100.0)
Vitamin C (mg)	60.0	127.0 (117.2;140.3)	20.5	41.5	84.5	161.8	280.2	37.3 (31.0;41.0)
Iron (mg)	5.0	9.0 (8.8;9.0)	4.7	6.3	8.5	11.1	13.9	12.8 (10.4;13.6)

Continue

Tabela 2. Continuation

Micronutrients	Nutritional recommendation ^a	Mean (95%CI)	Intake percentiles					Prevalence of inadequate intake (%) (95%CI)
			10	25	50	75	90	
Cálcio (mg)	1,000	476.6 (429.4;523.9)	217.5	305.2	433.6	599.9	789.8	96.5 (94.9;98.0)
Pyridoxine (mg)	1.4	1.3 (1.2;1.4)	0.7	0.9	1.2	1.6	1.9	57.2 (52.1;60.5)
Zinc (mg)	6.8	9.0 (8.8;9.1)	4.9	6.4	8.4	10.9	13.7	30.5 (28.6;32.3)
Copper (mg)	0.7	0.9 (0.9;1.0)	0.5	0.6	0.8	1.1	1.5	35.6 (31.8;38.4)
Sodium (mg)	2,300 ^e	(2,630.0;2,714.0)	1,557.0	1,996.0	2,568.0	3,237.0	3,939.0	-

^a according to Estimated Average Requirement values (EAR), Institute of Medicine (2000)

^b retinol activity equivalents

^c niacin equivalents

^d total alpha-tocopherol

^e upper tolerable limit intake (UL)

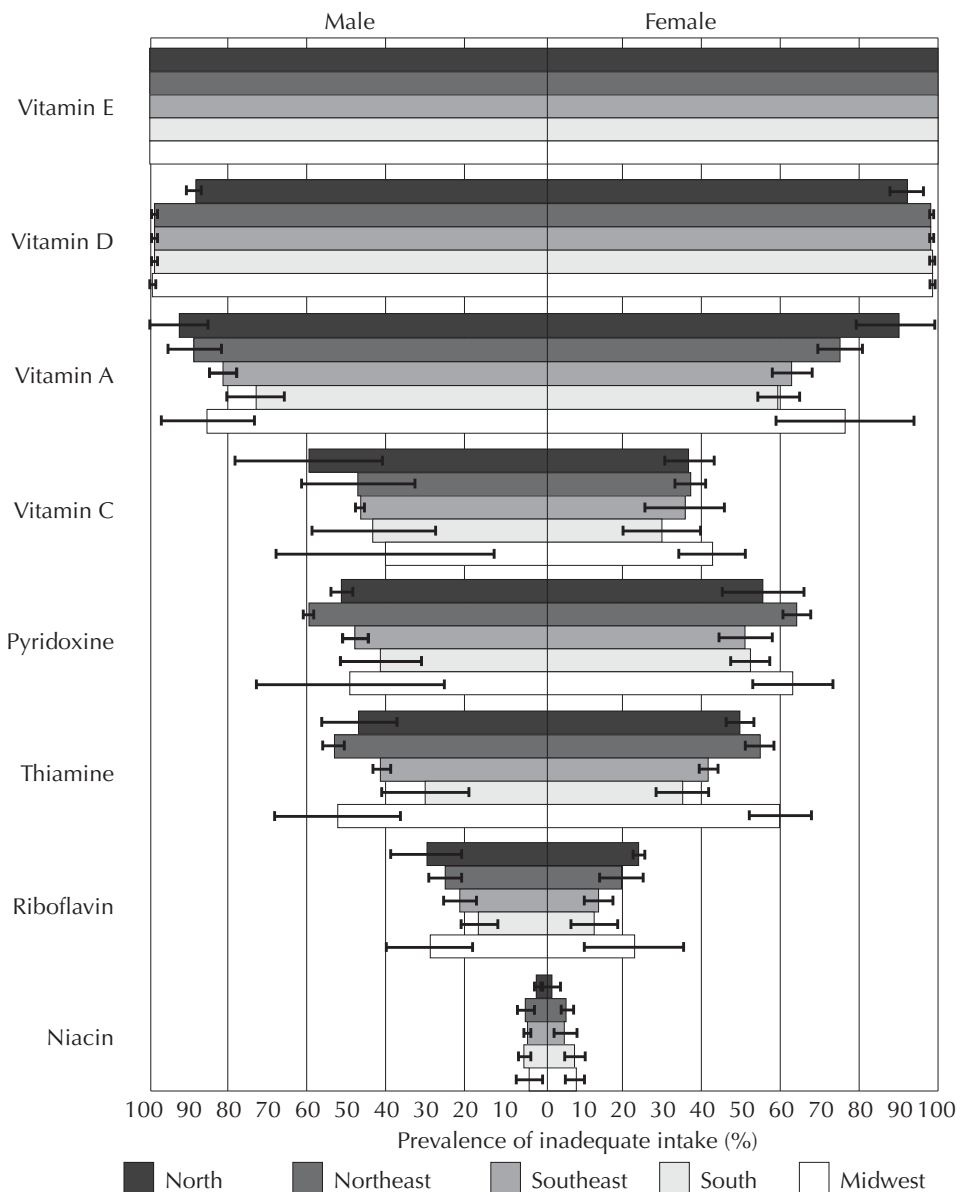


Figure 1. Prevalence of inadequate intake of vitamins in the elderly by sex and region. Brazil, 2008-2009.

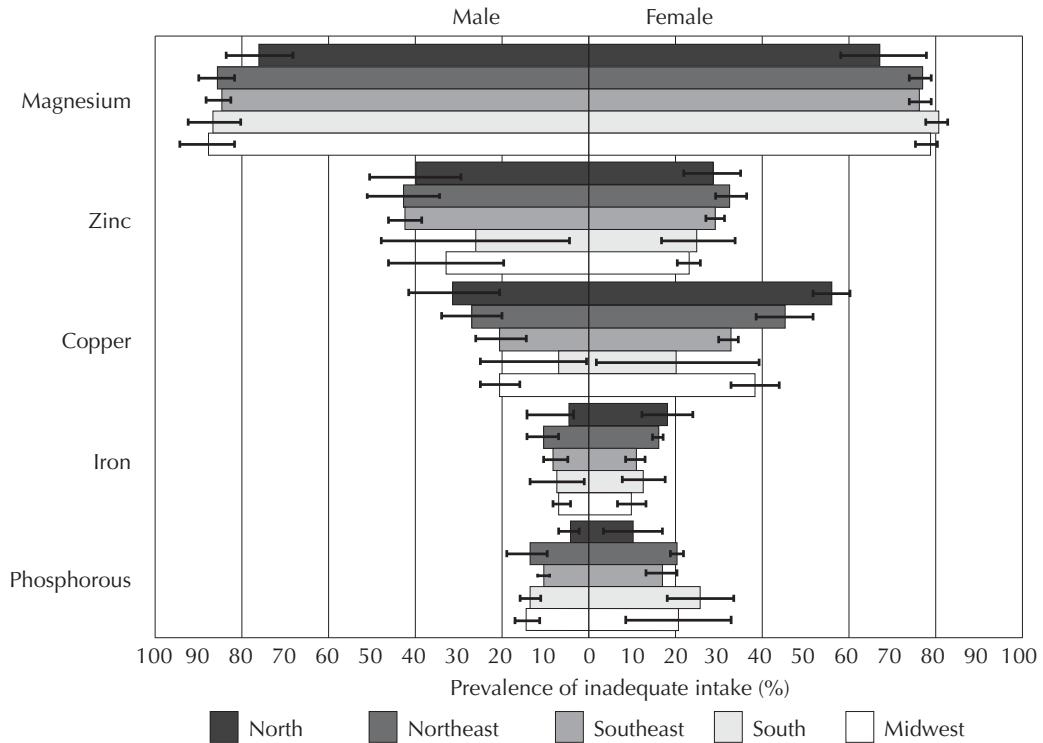


Figure 2. Prevalence of inadequate intake of minerals in the elderly by sex and region. Brazil, 2008-2009.

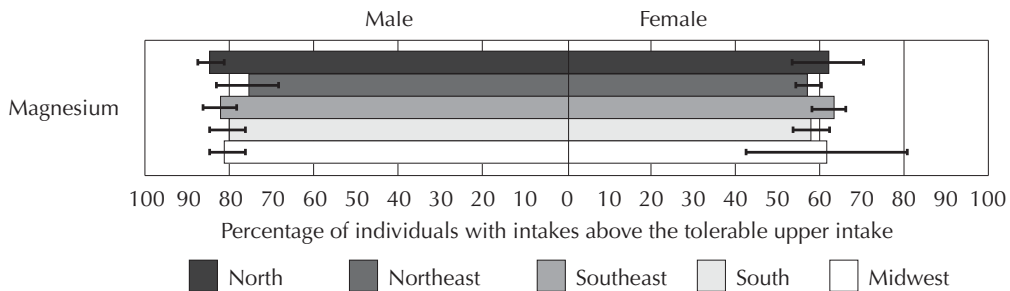


Figure 3. Percentage of elderly with habitual intake of sodium above the tolerable upper intake by gender and region. Brazil, 2008-2009.

regions, for both men (84% to 98%) and women (94% to 98%). In the five regions of the study, no significant differences between the sexes were observed in the prevalence rates of inadequate calcium intake. Significant differences were only observed between women in the North and Southeast (North: 98%, 95%CI 97.0;100.0 and Southeast: 94%, 95%CI 93.0;96.0). Magnesium was the mineral with the second highest prevalence rate of inadequate intake (77% to 88% in men and 69% to 82% in women), with significant differences apparent between men and women in the Northeast (men: 86%, 95%CI 82.3;90.3; women: 79%, 95%CI 76.5;80.6) and Southeast (men: 85%, 95%CI 83.0;87.9; women: 78%, 95%CI 76.1;79.0), and between women in the South (82%, 95%CI 80.0;84.0)

and Southeast (78%, 95%CI 76.0;79.0) (Figure 2). Other minerals with high rates of inadequate intake were zinc among men in all of the regions (26% to 42%) and copper in women in the North (56%), Northeast (45%), Midwest (38%) and Southeast (32%). No significant differences were observed in prevalence rates of inadequate intake of zinc according to region. Inadequate copper intake in women was higher in the Northeast (45%, 95%CI 39.0;52.0) compared with the Southeast (32%, 95%CI 30.0;34.0).

With regard to sodium, 80% of the elderly males and 61% of the elderly females in the study showed usual intake above the tolerable intake level. Figure 3 shows these percentages according to region. The highest percentages of excessive sodium intake were observed in the North

(64% for women and 83% for men), Southeast (65% for women and 82% for men) and the Midwest (61% for women and 80% for men), although there were no significant differences between the regions.

DISCUSSION

This study found high percentages of inadequate intake of vitamins E, D and A, thiamine and pyridoxine and the minerals calcium, magnesium, zinc and copper, as well as high percentages of excessive sodium intake. With the exception of vitamin D, calcium and copper, these nutrients were also those which had high rates of inadequate intake in the North American elderly population assessed in the NHANES 2001-2002¹⁵ health and nutrition survey.

Compared with Americans aged over 50, the Brazilian elderly showed higher prevalence rates of inadequate intake, especially of vitamin A, pyridoxine, thiamine and copper. In the Brazilian elderly, the highest rate of inadequate vitamin A intake was 83% in males and of the highest rates of inadequate pyridoxine, thiamine and copper intake were 57%, 47% and 36% respectively, in females. For the Americans, the prevalence of inadequate vitamin A intake in males was 55%, and 49%, 12% and 14% for pyridoxine, thiamine and copper respectively, in females.

As the EAR values for vitamin D and calcium have only recently been established by the Institute of Medicine Nutrition Committee,^{13,21} there is still no published data on rates of inadequate intake of these nutrients in the elderly in other countries. However, based on the data from 2005-2006 NHANES,¹⁶ it is believed that the rates of inadequate vitamin D and calcium intake are also high in the North American population, if we take into consideration that fewer than 6% of Americans aged 50 and over have an higher than recommended intake of vitamin D, this figure being 24% for calcium.

In the analysis by region, it was verified that the North had the lowest percentages of inadequate vitamin D intake for both sexes, whereas the Southeast was where the lowest rates of inadequate magnesium and copper intake for females were found. These results suggest that consumption of foods with high levels of micronutrients by the elderly varies significantly between the different regions of the country. For example, the lower rates of inadequate vitamin D intake in the North may be explained by greater regular consumption of fish, the rate being twice as high as in the North East and more than seven times higher than consumption in the other regions.^b

Insufficient micronutrient intake may be a result of the reduced variety of foods which make up the usual diet of the elderly in Brazil. On analyzing food items consumed (data not shown), it was noted that rice, beans and beef were the items which contributed the most to the total calories consumed, followed by cassava flour in the North, couscous in the Northeast, pasta and bread in the South and Southeast and pork in the Midwest. These food items, together, provided around 50% of the total calories consumed. Moreover, insufficient fruit and vegetable intake, which represents around a third of the recommendations proposed in the Food Guide for the Brazilian Population^f (≥ 400 g/day), may also lead to the low levels of micronutrient intake and explain the high rates of inadequate intake found here.^b

The implications of high levels of inadequate intake observed in this study highlight the current demographic and epidemiological profile of the Brazilian population, characterized by the increasing number of adults and the elderly and the high figures of non-communicable diseases associated with ageing.¹⁴ Although elderly brings a higher number of chronic diseases, studies have shown that they are not inevitable consequences of ageing^{19,20} and can be prevented by making healthy lifestyle choices, such as diet. There are an increase number of scientific evidence which indicate the protective role played by nutrients in etiology and the progression of chronic diseases, for example, anti-oxidants (vitamins C and E),^{2,13} those related to bone metabolism (vitamin D, calcium, magnesium and phosphorus)^{5,18} and those involved in cognitive functions (thiamine, riboflavin, niacin and pyridoxine).⁶ High sodium intake in this population is a potential health risk, due to its link with increased blood pressure. According to World Health Organization estimates,²⁵ 17.2% of deaths in developing countries are attributed to high blood pressure, the most important cardiovascular risk factor known.

This study had some methodological characteristics which should be considered. The analysis of inadequate nutrient intakes using the EAR method as a cutoff point estimates the percentage of individuals in the population with intakes below the recommended values for their gender and age group.⁸ Such recommendations are based on the average requirements of the nutrients estimated for the North American and Canadian population and are only appropriate for healthy individuals.⁸ The recommended daily allowance values express the ideal level of intake nutritional status of the nutrient (e.g. blood levels, body stores) remain adequate. Thus, the elderly with a long period of inadequate intake of one or more nutrients may, in the long term, have a reduced body store of these nutrients without, however, displaying any clinical manifestations of deficiency.

^f Ministério da Saúde, Secretaria de Atenção à Saúde, Departamento de Atenção Básica. Guia alimentar para a população brasileira: promovendo a alimentação saudável. Brasília (DF); 2006. (Série A. Normas e Manuais Técnicos).

Another important aspect is the adjustment of nutrient intake for intra-individual variance. The National Cancer Institute method is, at the moment, one of the most commonly used to remove intra-individual variance in nutrients and food items when these are measured by short term methods, such as 24-hour recall or food records.³ In spite of providing more detailed information on dietary consumption than long term methods, the short term ones are incapable of capturing the day-to-day variation and, therefore, require accounting for the intra-individual variance

using statistical techniques, in order to calculate the prevalence of inadequate intake.^{22,24} Thus this study maintained methodological rigor in using statistical techniques suitable for measuring inadequate intake.

Vitamin and mineral intakes among the elderly in Brazil were lower than recommended values. Actions to encourage health eating by facilitating access to food sources of micronutrients, such as whole grains, fruit and vegetables, dairy products and fish for the elderly population may contribute to improve this situation.

REFERENCES

- Brownie S. Why are elderly individuals at risk of nutritional deficiency? *Int J Nurs Pract.* 2006;12(2):110-8. DOI:10.1111/j.1440-172X.2006.00557.x
- Carr AC, Zhu BZ, Frei B. Potential antiatherogenic mechanisms of ascorbate (vitamin C) and α -tocopherol (vitamin E). *Circ Res.* 2000;87(5):349-54. DOI:10.1161/01.RES.87.5.349
- Dodd KW, Guenther PM, Freedman LS, Subar AF, Kipnis V, Midthune D, et al. Statistical methods for estimating usual intake of nutrients and foods: a review of the theory. *J Am Diet Assoc.* 2006;106(10):1640-50. DOI:10.1016/j.jada.2006.07.011
- Gariballa S. Nutrition and older people: special considerations relating to nutrition and ageing. *Clin Med.* 2004;4(5):411-4.
- Gennari C. Calcium and vitamin D nutrition and bone disease of the elderly. *Pub Health Nutr.* 2001;4(2B):547-59.
- Huskisson E, Maggini S, Ruf M. The influence of micronutrients on cognitive function and performance. *J Inter Med Res.* 2007;35(1):1-19. DOI:10.1177/147323000703500101
- Institute of Medicine, Food and Nutrition Board. Dietary reference intakes for calcium, phosphorus, magnesium, vitamin D, and fluoride. Washington (DC): National Academy Press; 1997.
- Institute of Medicine, Food and Nutrition Board. Dietary reference intakes for thiamin, riboflavin, niacin, vitamin B6, folate, vitamin B12, pantothenic acid, Biotin, and choline. Washington (DC): National Academy Press; 1998.
- Institute of Medicine, Food and Nutrition Board. Dietary reference intakes: applications in dietary assessment. Washington (DC): National Academy Press; 2000.
- Institute of Medicine, Food and Nutrition Board. Dietary reference intakes for vitamin C, vitamin E, selenium, and carotenoids. Washington (DC): National Academy Press; 2000.
- Institute of Medicine, Food and Nutrition Board. Dietary reference intakes for vitamin A, vitamin K, arsenic, boron, chromium, copper, iodine, iron, manganese, molybdenum, nickel, silicon, vanadium, and zinc. Washington (DC): National Academy Press; 2001.
- Institute of Medicine, Food and Nutrition Board. Dietary reference intakes for calcium and vitamin D. Washington (DC): National Academy Press; 2010.
- Kaliora AC, Dedoussis GVZ, Schmidt H. Dietary antioxidants in preventing atherogenesis. *Atherosclerosis.* 2006;187(1):1-17. DOI:10.1016/j.atherosclerosis.2005.11.001
- Lebrão ML, Laurenti R. Saúde, bem-estar e envelhecimento: o estudo SABE no Município de São Paulo. *Rev Bras Epidemiol.* 2005;8(2):127-41. DOI:10.1590/S1415-790X2005000200005
- Moshfegh A, Goldman J, Cleveland L. What we eat in America, NHANES 2001-2002: usual nutrient intakes from food compared to dietary reference intakes. Washington (DC): USDA Agricultural Research Service; 2005 [cited 2011 Oct 23]. Available from: <http://www.ars.usda.gov/SP2UserFiles/Place/12355000/pdf/0102/usualintaketables2001-02.pdf>
- Moshfegh A, Goldman J, Cleveland L. What we eat in America, NHANES 2005-2006: usual nutrient intakes from food and water compared to 1997 dietary reference intakes for vitamin D, calcium, phosphorus, and magnesium. Washington (DC): USDA Agricultural Research Service; 2009 [cited 2011 Oct 23]. Available from: http://www.ars.usda.gov/SP2UserFiles/Place/12355000/pdf/0506/usual_nutrient_intake_vitD_ca_phos_mg_2005-06.pdf
- NCC. Nutrition Coordinating Center. Nutrition Data System For Research – NDS-R. Features. [cited 2012 Jan 26]. Available from: <http://www.ncc.umn.edu/products/ndsfeatures.html>
- Palacios C. The role of nutrients in bone health, from A to Z. *Crit Rev Food Sci Nutr.* 2006;46(8):621-8. DOI:10.1080/10408390500466174
- Parahyba MI, Simões CCS. A prevalência de incapacidade funcional em idosos no Brasil. *Cien Saude Coletiva.* 2006;11(4):967-74. DOI:10.1590/S1413-81232006000400018
- Parahyba MI, Veras RP, Melzer D. Incapacidade funcional entre as mulheres idosas no Brasil. *Rev Saude Publica.* 2005;39(3):383-91. DOI:10.1590/S0034-89102005000300008
- Ross AC, Manson JE, Abrams AS, Aloia JF, Brannon PM, Clinton SK, et al. The 2011 Dietary Reference Intakes for calcium and vitamin D: what dietetics

- and practitioners need to now. *J Am Diet Assoc.* 2011;111:524-527.
22. Subar AF, Dodd KW, Guenther PM, Kipnis V, Midthune D, McDowell M, et al. The food propensity questionnaire: concept, development, and validation for use as a covariate in a model to estimate usual food intake. *J Am Diet Assoc.* 2006;106(10):1556-63. DOI:10.1016/j.jada.2006.07.002
23. Tabacchi G, Wijnhoven TMA, Branca F, Román-Viñas B, Ribas-Barba L, Ngo J, et al. How is the adequacy of micronutrient intake assessed across Europe? A systematic literature review. *Br J Nutr.* 2009;101(Suppl 2):S29-36. DOI:10.1017/S0007114509990560
24. Toozé JA, Midthune D, Dodd KW, Freedman LS, Krebs-Smith SM, Subar AF, et al. A new statistical method for estimating the usual intake of episodically consumed foods with application to their distribution. *J Am Diet Assoc.* 2006;106(10):1575-87. DOI:10.1016/j.jada.2006.07.003
25. World Health Organization. Global health risks: mortality and burden of disease attributable to selected major risks. Geneva; 2009.

The authors declare that there are no conflicts of interest.

This manuscript was submitted for publication and underwent a peer review process as any other manuscripts submitted to this publication, and anonymity was guaranteed for authors and reviewers. Editors and reviewers declare no conflicts of interest that may affect the peer-review process.