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Adherence to the food guide for the Brazilian population

ABSTRACT

OBJECTIVE: To analyze adherence to the Food Guide for the Brazilian Population.

METHODS: Sample composed of participants in the Health Survey for Sao Paulo (n = 1,661) who completed two non-consecutive 24-hour recalls. A bivariate mixed model was created for the ratio of energy from a food group and total energy intake. The estimated ratio was used to calculate the percentage of individuals with intake above or below the recommendation.

RESULTS: At least 80.0% of the individuals consume below the recommendation for milk and dairy; fruit and fresh juice; and cereals, tubers and roots; about 60.0% for vegetables; 30.0% for beans; and 8.0% for meat and eggs. Adolescents had the greatest inadequacy for vegetables (90.0%), and the highest income group had the lowest inadequacy for oils, fat and seeds (57.0%).

CONCLUSIONS: The intake of food groups related to increased risk of chronic diseases were found to be inadequate.

DESCRIPTORS: Food Consumption. Food Guide. Nutrition Policy. Nutrition Assessment. Diet Surveys.

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INTRODUCTION

The Food Guide for the Brazilian Population (Food Guide) is the first official set of food directives for Brazil. Based on the Brazilian epidemiological situation and on scientific evidence, the Food Guide aims to contribute to guiding eating habits that aim to encourage healthy eating and preventing diet related illnesses.^a

Adherence to the Food Guide recommendations is an important marker of the adequacy of the population's diet. With the exception of a few studies that evaluated consumption of fruit and vegetables and meat,^{3,5} the percentages of the population with intake above or below the recommendations is not known, nor have subgroups at greater risk of deficiencies been identified.

Traditionally, 24 hour food recall (R24h) has been used to monitor the population's diet as it provides details of consumption.⁸ In Brazil, the Sao Paulo Health Survey⁶ has used this method with representative samples of the population of the municipality. However, the distribution of intake based on the application of one or several R24h reflects not only inter-person variation but also intra-person variation, as the individual does not consume the same foods in the same quantities, every day. Consequently, the distribution of intake observed does not represent habitual intake and, from a statistical point of view, leads to errors in the results.^{2,4}

Statistical methods that correct consumption distribution for intra-person variability have been used in estimating usual intake that would be obtained if data had been collected from the same individual on multiple days. The NCI method, developed by the National Cancer Institute, enables distribution of the ratios of two dietary components to be estimated (bivariate distribution).⁹ This modelling is especially useful as Food Guide recommendations are according to total energy consumption.

This study aimed to analyze the adherence of the Brazilian population's diet to the Food Guide.

METHODS

Data used were from a subsample of the food intake module of the 2008 Health Survey in the city of Sao Paulo, (ISA-Capital 2008), a population-based cross-sectional study, the sample of which was collected between 2008 and 2009.^b All ISA-Capital participants were invited to respond to the R24h. A total of 1,661 responded to the R24h, of which 50.0% responded to the second R24h.

Socioeconomic and demographic information were obtained using a structured questionnaire in interviews within the home. Income categories were defined in tertiles of *per capita* income. Food intake was collected using the multiple-pass method.⁷ The R24h were collected randomly on weekdays and at the weekend, in all seasons of the year. The data were entered into the Nutrition Data System for Research software, version 2007 (NCC, University of Minnesota, MN, EUA).

In the classification of groups, soft drinks were included in the group of sugars and sweets.

Usual intake of each group, in servings, was estimated using the NCI method. This is a mixed effects model for predicting probability and quantity consumed. The models are adjusted simultaneously, producing means and percentiles of usual intake for the population studied.¹⁷

Servings were calculated by dividing calories from a specific group in the Food Guide by the quantity of calories defined for each serving, as shown in Table 1. In the intake prediction model, the following co-variables were included: sex, age groups and *per capita* household income.

Daily energy and serving needs vary according to sex, age and level of physical activity, among other aspects. The Food Guide adopted a mean daily intake of 2,000 calories as the reference for the Brazilian population, and food servings were calculated based on this value; the higher the energy consumption of the individual, the higher the number of recommended servings. Thus, the calorie share of each group in relation to total calories was the same for all individuals. For example, given an intake of 2,000 kcal, one serving (190 kcal per serving; $190/2,000 = 0.095$) of meat and eggs is recommended, i.e., 9.5% of total calories should come from this group. Table 1 shows the food groups of the Food Guide, the recommended intake values for 2,000 kcal and the calorie share of each group.

To obtain the percentage of individuals with calorie share for the groups above or below the recommended level, it was necessary to know the distribution of calorie share for each group in the population. This calculation meant knowing the usual intake of servings of groups and of energy. In order to obtain this, the bivariate model with the ratio of the two components was used: the numerator is the quantity of energy coming from the food group in the food Guide and

^a Ministério da Saúde, Secretaria de Atenção à Saúde, Coordenação-Geral da Política de Alimentação e Nutrição. Guia alimentar para a população brasileira: promovendo a alimentação saudável. Brasília (DF); 2006. (Série A. Normas e Manuais Técnicos).

^b Fisberg RM, Marchioni DML, organizadoras. Manual de avaliação do consumo alimentar em estudos populacionais: a experiência do inquérito de saúde em São Paulo (ISA). São Paulo: Grupo de Avaliação de Consumo Alimentar da P/USP; 2012 [cited 2012 Feb]. Available from www.gac-usp.com.br

Table 1. Mean recommended calories, number of servings per day and mean energy value of servings, according to groups in the Food Guide for the Brazilian Population.

Food Group	Mean recommended calories (kcal)	Daily serving (n)	Mean energy value per serving (kcal)	Calorie share (%) ^a
Grains, roots and tubers	900	6	150	45.0
Beans	55	1	55	2.8
Fruit and natural fruit juices	210	3	70	10.5
Vegetables and legumes	45	3	15	2.3
Milk and dairy products	360	3	120	18.0
Meat and eggs	190	1	190	9.5
Oil, fat and oily seeds ^b	73	1	73	3.7
Sugars and sweets ^b	110	1	110	5.5

Source: Brazilian Ministry of Health: Food Guide for the Brazilian Population, 2006.

^a Ratio "kcal group /kcal total".

^b Recommendation that consumption not exceed the values indicated in the Food Guide.

the denominator is total energy intake, using a model proposed by Freedman et al¹⁰ (2010).

First, the models estimating usual intake of each group (numerator) and estimating energy (denominator) were executed separately. The denominator did not use the probability model as this is an item consumed everyday by all individuals (probability of consumption = 1 for each individual).¹⁷ At this stage, parameters were estimated (intra- and inter-person variance, lamda of the Box-Cox transformation, regression intercept and correlation between probability and quantity consumed, among others), which were then used in a mixed effect bivariate model, the dependent variables of which were the calories from one of the Food Guide groups and the total energy consumed. The final stage consisted of Monte Carlo simulation using the parameters estimated based on the bivariate model. This simulation generated usual intake for each group from the Food Guide for a large number of pseudo-individuals (100 pseudo-individuals for each individual in the sample). The ratio of components, which corresponded to the calorie share of the group in the diet, was calculated for each pseudo-individual, and the distribution percentiles were then estimated.⁹ These analyses were conducted using the statistical SAS (SAS Corp, v. 9.2) package and are included in the macros available on the internet.^c

The percentage of individuals with intake below or above the recommended levels for each group corresponded to the percentage of individuals with calorie share above or below the recommendations. The analyses were stratified by sex, age group and tertiles of *per capita* household income. The confidence intervals (95%CI) were calculated based on standard error estimated using the Balanced Repeated Replications (BRR) technique, with Fay's correction of 0.30.¹

This study was approved by the Research Ethics Committee of the *Faculdade de Saúde Pública, Universidade de São Paulo* (Process no. 053/10, 16/4/2010). Participants signed a consent form. Those under 18 obtained permission from parents or guardians to participate.

RESULTS

Table 2 shows the means, the percentiles of usual serving intake and the percentage of individuals with usual intake below recommended levels in the following groups from the Food Guide: grains, roots and tubers; beans; fruit and natural fruit juices; vegetables and legumes; milk and dairy products; meat and eggs. It was observed that fewer than 80.0% of the population had intake below the recommended levels for the following groups: milk and dairy products; fruit and natural fruit juices and grains, roots and tubers; 30.0% of the population consumed less than the recommended level of beans and vegetables and legumes, and around 8.0% for meat and eggs.

It was in the fruit and natural fruit juices and vegetables and legumes groups that the highest percentages of individuals with intake below the recommendation were found for adolescents and for males. The group with the highest inadequate intake for females was that of beans, and the figures were higher for individuals in the highest income tertile. For the group of milk and dairy products, all of the strata had the same level of inadequacy; almost 100.0% of individuals consumed less than the recommended serving. For the group of eggs and meat, around 90.0% of the population consumed the recommended level, with the mean intake being almost two servings per day.

^c Applied Research Cancer Control and Population Sciences. Usual dietary intake. Bethesda (MD): National Cancer Institute; s.d [cited 2012 Feb]. Available from: <http://riskfactor.cancer.gov/diet/usualintakes>

Table 2. Mean and percentiles of intake of servings and the proportion of the population with usual intake below the recommendation for each group from the Food Guide. Sao Paulo, SP, Southeastern Brazil, 2008. (N = 1,661)

Food Group	Characteristics of the population	n	Mean	95%CI	Percentiles of intake					% below	95%CI
					10	25	50	75	90		
Grains, roots and tubers and derivatives	Male	722	4.83	4.21;5.39	2.90	3.60	4.60	5.80	7.00	91	85;97
	Female	939	3.95 ^b	3.70;4.12	2.30	2.90	3.70	4.70	5.80	84	82;86
	Adolescent	561	5.24	5.00;5.41	3.10	3.90	4.90	6.20	7.50	89	85;93
	Adult	583	4.37	3.91;4.69	2.50	3.20	4.10	5.20	6.30	88	84;92
	Older adult	517	3.63 ^b	3.43;3.81	2.10	2.70	3.40	4.40	5.40	80	72;88
	1 st t. income ^a	554	4.49	3.81;4.99	2.50	3.20	4.10	5.30	6.50	83	73;92
	2 nd t. income	554	4.60	4.21;4.99	2.70	3.40	4.40	5.60	6.90	83	81;85
	3 rd t. income	553	4.13	3.51;4.69	2.30	3.00	3.90	4.90	6.10	95	91;99
	Beans	Male	722	1.72	1.63;1.77	0.50	0.92	1.53	2.29	3.09	30
Female		939	1.15 ^b	1.04;1.26	0.34	0.63	1.04	1.54	2.10	35	31;39
Adolescent		561	1.62	1.56;1.68	0.46	0.84	1.43	2.17	3.02	34	32;36
Adult		583	1.41	1.27;1.55	0.40	0.74	1.24	1.89	2.64	32	29;35
Older adult		517	1.14 ^b	1.09;1.19	0.32	0.59	1.00	1.52	2.11	31	26;37
1 st t. income ^a		554	1.45	1.41;1.49	0.42	0.75	1.27	1.93	2.70	29	24;33
2 nd t. income		554	1.44	1.33;1.54	0.40	0.74	1.26	1.92	2.69	32	28;35
3 rd t. income		553	1.37	1.23;1.51	0.40	0.71	1.19	1.82	2.55	35	33;38
Fruit and natural fruit juices		Male	722	1.01	0.97;1.05	0.20	0.41	0.82	1.41	2.07	98
	Female	939	0.87	0.71;1.03	0.16	0.35	0.70	1.21	1.82	96	93;98
	Adolescent	561	0.95	0.88;1.03	0.19	0.39	0.77	1.33	1.97	98	97;99
	Adult	583	0.95	0.81;0.99	0.17	0.36	0.72	1.25	1.86	97	95;99
	Older adult	517	1.11	0.96;1.25	0.22	0.46	0.90	1.55	2.26	89	75;100
	1 st t. income ^a	554	0.94	0.89;0.98	0.18	0.38	0.76	1.31	1.94	96	94;98
	2 nd t. income	554	0.99	0.93;1.04	0.19	0.40	0.80	1.37	2.05	96	94;98
	3 rd t. income	553	0.91	0.85;0.98	0.17	0.37	0.74	1.28	1.89	97	95;99
	Vegetables and legumes	Male	722	2.19	1.92;2.48	0.86	1.42	2.10	2.85	3.60	76
Female		939	1.87	1.63;2.11	0.74	1.20	1.79	2.43	3.08	62	51;72
Adolescent		561	1.81	1.66;1.95	0.70	1.16	1.73	2.35	2.97	90	83;98
Adult		583	2.06	1.81;2.32	0.80	1.31	1.96	2.68	3.39	68	57;81
Older adult		517	2.09	1.88;2.29	0.81	1.33	1.98	2.71	3.44	44 ^b	33;55
1 st t. income ^a		554	1.94	1.73;2.17	0.76	1.25	1.86	2.52	3.17	67	57;77
2 nd t. income		554	1.80	1.49;2.11	0.71	1.16	1.73	2.34	2.95	77	64;92
3 rd t. income		553	2.25	2.05;2.45	0.87	1.45	2.17	2.92	3.70	62	53;72
Milk and dairy products		Male	722	0.96	0.75;1.04	0.22	0.49	0.86	1.24	1.60	100
	Female	939	0.93	0.86;1.02	0.22	0.50	0.89	1.27	1.65	98	97;100
	Adolescent	561	1.13	1.03;1.23	0.28	0.63	1.10	1.56	1.98	99	98;100
	Adult	583	0.88 ^b	0.77;0.98	0.22	0.48	0.85	1.21	1.54	100	99;100
	Older adult	517	0.88	0.73;1.04	0.22	0.49	0.85	1.22	1.57	97	94;100
	1 st t. income ^a	554	0.94	0.83;1.05	0.23	0.51	0.90	1.29	1.67	99	97;100
	2 nd t. income	554	0.87	0.79;0.96	0.21	0.48	0.83	1.20	1.55	99	99;100
	3 rd t. income	553	0.94	0.82;1.06	0.23	0.52	0.90	1.29	1.66	99	98;100
	Meat and eggs	Male	722	2.18	1.96;2.45	1.24	1.68	2.16	2.66	3.16	6
Female		939	1.51 ^b	1.45;1.57	0.84	1.14	1.48	1.85	2.21	9	4;13
Adolescent		561	1.95	1.79;2.11	1.03	1.41	1.87	2.41	2.95	11	7;16
Adult		583	1.88	1.71;2.05	1.00	1.36	1.81	2.33	2.86	7	3;11
Older adult		517	1.46 ^b	1.37;1.54	0.76	1.05	1.39	1.80	2.22	8	2;14
1 st t. income ^a		554	1.72	1.67;1.77	0.89	1.23	1.64	2.12	2.63	8	3;13
2 nd t. income		554	1.86	1.66;2.05	0.97	1.33	1.78	2.30	2.84	7	3;11
3 rd t. income		553	1.89	1.72;2.07	0.99	1.37	1.82	2.35	2.89	7	3;12

^a Tertiles of *per capita* household income.^b Categories with lower mean and statistically significant prevalence.

Table 3. Mean and percentiles of distribution of intake of servings and the proportion of the population with usual consumption above the recommended level for each group in the Food Guide. Sao Paulo, SP, Southeastern Brazil, 2008. (N = 1,661)

Food groups	Characteristics of the population	n	Mean	95%CI	Percentiles of intake					% above	95%CI
					10	25	50	75	90		
Oils, fat and oily seeds	Male	722	1.49	1.39;1.59	0.31	0.66	1.26	2.05	2.98	60	55;64
	Female	939	1.28 ^b	1.21;1.37	0.27	0.57	1.08	1.77	2.54	66	63;70
	Adolescent	561	1.72	1.56;1.88	0.36	0.77	1.47	2.38	3.38	66	61;72
	Adult	583	1.35	1.24;1.46	0.28	0.60	1.15	1.85	2.65	62	57;67
	Older adult	517	1.19 ^b	1.06;1.32	0.25	0.53	1.01	1.64	2.35	67	64;73
	1 st t. income ^a	554	1.44	1.29;1.59	0.29	0.63	1.21	1.99	2.86	68	64;71
	2 nd t. income	554	1.53	1.43;1.63	0.31	0.68	1.30	2.10	3.01	68	64;72
	3 rd t. income	553	1.22 ^b	1.7;1.28	0.25	0.54	1.04	1.69	2.42	57 ^b	52;62
	Sugars and sweets	Male	722	1.67	1.53;1.81	0.61	0.95	1.45	2.14	3.01	76
Female		939	1.42 ^b	1.33;1.48	0.50	0.78	1.21	1.81	2.54	82	68;97
Adolescent		561	2.49	2.21;2.77	1.03	1.55	2.28	3.18	4.21	93	85;100
Adult		583	1.43	1.31;1.55	0.55	0.85	1.28	1.83	2.41	78	69;88
Older adult		517	1.01 ^b	0.91;1.12	0.37	0.59	0.90	1.31	1.74	71	51;98
1 st t. income ^a		554	1.46	1.32;1.61	0.50	0.78	1.23	1.88	2.71	78	68;88
2 nd t. income		554	1.48	1.35;1.61	0.52	0.82	1.27	1.89	2.67	78	68;87
3 rd t. income		553	1.62	1.58;1.65	0.59	0.92	1.41	2.07	2.86	82	69;95

^a Tertiles of *per capita* household income.

^b Categories with lower mean and statistically significant prevalence.

Table 3 shows the mean, the percentiles of usual serving intake and the percentages of individuals with usual intake above the recommended level for the following groups: oil, fat and oily seeds; sugars and sweets. More than half of the population consumed above the recommended level of sweets and sugars and oil, fat and oily seeds. There was no difference between the strata with regards intake of sugar and sweets above the recommended level; individuals in the highest incomes had the smallest percentage of consuming more than the recommended amount of oil, fat and oily seeds (57.0%). However, mean consumption of both groups was higher among males and in adolescents.

DISCUSSION

Usual intake of servings of food groups recommended by the Food Guide were estimated and insufficient intake of the following were found: fruit and natural fruit juices, grains, roots and tubers and derivatives and milk and dairy products. A high percentage of individuals consuming above the recommended levels of oil, fat and oily seeds and sugars and sweets was also observed.

In general, inadequacies in each group from the Food Guide were comparable between all sub-populations studied, indicating that the population is systematically exposed to the risk of an inadequate diet.

Although sex, age group and income influenced mean intake of some groups from the Food Guide, the same was not true when the percentage of inadequacy was assessed. For example, women consumed smaller quantities of meat and eggs than men, but their percentiles of inadequacy did not differ statistically. This is because, although males have higher mean consumption of this food groups, they also have higher mean energy intake. Similarly, mean total consumption of meat and eggs is lower for women, meaning that the calorie share is similar between the sexes. The same occurs in other groups, with higher intake of sugars and sweets, oil, fat and oily seeds, beans and grains, roots, tubers and derivatives.

High intake of oil, fat and oily seeds and sugars and sweets, together with low intake of fruit and natural fruit juices and vegetables and legumes, and added to lower energy expenditure due to reduced physical activity,¹⁴ may explain the growing trend in the population for being overweight and obese, and associated chronic diseases. According to the World Health Organization Global Health Risks report,¹⁹ being overweight and obese is the third most significant risk factor for mortality, accounting for 6.7% and 8.4% of deaths in developing and developed countries, respectively. In Brazil, cardiovascular disease is responsible for 65.0% of deaths in adults aged between 30 and 69 years, and the cause of 14.0% of hospitalization in this age group (1,150,000 hospitalizations/year) and of 40.0% of cases of early retirement.^d

^d Ministério da Saúde. Atenção Primária em Saúde: hipertensão e diabetes. In: Relatório de atividades do Fórum Global sobre Prevenção e Controle de Enfermidades Não-Transmissíveis; 2003; Rio de Janeiro, Brasil.

Almost all of the population studied met the recommendation for meat and egg intake; however, mean consumption was almost double the recommendation. For this group, there is no established maximum intake, but moderation is advised in its consumption, especially of meat with high saturated fat content. Recent studies indicate a consistent relationship between high consumption of red and processed meat and increased risk of chronic diseases such as colon and rectal cancer and cardiovascular disease,^{11,15,18} leading the Food Guide to consider including a recommendation restricting intake of at least some types of meat.

As regards inadequate intake, the worst situation was observed in the milk and dairy products group, for which practically the whole population failed to meet the recommendation. This food group represents the most important sources of calcium in the diet, resulting in deficiencies of this nutrient.^e Although calcium is important at all stages of life, special attentions should be paid to adolescents. Up to 45.0% of an individual's growth,¹⁶ 37.0% of bone density¹³ and 15.0% to 25.0% of height are determined in this period.¹⁶ Ongoing insufficient intake of milk and dairy products during adolescence can result in increased risk of fractures at later stages of life.¹²

As regards the method used to analyze the data, the distribution of the ratio of the two components can be estimated in two ways:^{9,10} 1) calculating the ratio of the two components and estimating the ratio of distribution, using univariate modelling, for each individual and; 2) estimating usual distribution for each component and, then, estimating ratio using bivariate modelling. When the numerator is the food or nutrient consumed everyday by almost the entire population, the two forms produce similar results. However, when the food in question is one consumed episodically (and so there are excess zeroes in the numerator), the result of the ratio would be zero, irrespective of the quantity of energy consumed. In this case, the appropriate calculation is to estimate distribution of the ratio using bivariate modelling, as described in Freedman et al¹⁰ (2010).

To conclude, most population studied, irrespective of age group, sex and income, did not follow the recommendations in the Food Guide for food groups related to disease prevention: fruit and natural fruit juices; vegetables and legumes and milk and dairy products. The risk of developing disease may be increased, especially considering the simultaneous intake of oil, fat and oily seeds and sugars and sweets above the recommended level.

^eInstituto Brasileiro de Geografia e Estatística. Pesquisa de Orçamentos Familiares 2008-2009: análise do consumo alimentar pessoal no Brasil. Rio de Janeiro; 2011 [cited 2012 Feb]. Available from: http://www.ibge.gov.br/home/xml/pof_2008_2009.shtm

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