Evaluation of food intake markers in the Brazilian surveillance system for chronic diseases – VIGITEL (2007-2009)

Avaliação dos marcadores de consumo alimentar do VIGITEL (2007-2009)

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Abstract

Objective: To evaluate markers of food intake of the telephone-based risk factor surveillance system for chronic diseases (VIGITEL) and the trend of these markers. **Methods:** A total of 135,249 subjects from 27 Brazilian cities interviewed in the 2007 – 2009 surveys were evaluated. Eating habits were evaluated based on the frequency of intake of fruit, vegetables, beans, whole and skim milk, regular and diet/light soft drinks and visible fat in meat and poultry. These items were used to create a diet quality score and to identify dietary patterns in a cluster analysis. **Results:** Time trends indicated statistically significant increase in the frequency of intake of beans, whole milk and regular soft drinks and decline in vegetables and skim milk. There was an increase in the frequency of individuals who reported consuming beans daily, from 11 to 13%. Beans are considered as a protective factor and the prevalence of usual intake is still low. Over the past three years, less than 15% of the studied population reported eating the Brazilian recommended number of 3 servings of fruits and 3 servings of vegetables per day. As to the vegetable intake, a decrease from 5 to 3% was reported. The consumption of regular soft drinks had the highest increase, ranging from 60 to 67%. The assessed items showed a weak correlation and did not represent a sole healthy eating construct. **Conclusion:** The diet quality of the Brazilians has gotten worst and eating markers that are associated with high risk of chronic diseases should be better qualified.

Keywords: food habits; feeding behavior; data collection; Brazil.

Resumo

Objetivo: Avaliar as questões marcadoras de consumo alimentar do Sistema Vigilância de Fatores de Risco e Proteção para Doenças Crônicas por Inquérito Telefônico e sua evolução temporal. **Métodos:** Foram avaliados 135.249 indivíduos de 27 cidades brasileiras, entrevistados nos anos de 2007 – 2009. Os marcadores de consumo alimentar foram descritos a partir da frequência de consumo de frutas, hortaliças, feijão, leite integral e desnatado, refrigerante normal e *diet*/*light,* e consumo de gordura aparente das carnes e a pele do frango. Avaliou-se a evolução temporal desses marcadores e, adicionalmente, testou-se a elaboração de um escore de alimentação saudável e a identificação de padrões alimentares por meio da análise de *cluster*. **Resultados:** Observou-se aumento estatisticamente significativo nas frequências de consumo de feijão, leite integral e refrigerante normal e diminuição no consumo de leite desnatado. Mesmo com aumento de 11 para 13% de indivíduos que referiram consumir feijão diariamente, esses percentuais são baixos; assim como o consumo recomendado de 3 porções de frutas e 3 porções de hortaliças por dia, que foi referido por menos de 15% da população em todos os anos, com queda de 5 para 3% para as hortaliças. O refrigerante não *diet* foi o item com maior aumento no consumo, passando de 60 para 67%. Os itens avaliados apresentaram fraca correlação e não configuram um constructo único de alimentação saudável. **Conclusão:** A qualidade da dieta dos brasileiros tem piorado e é necessária melhor qualificação dos marcadores alimentares considerados de risco para doenças crônicas não-transmissíveis.

Palavras-chave: hábitos alimentares, comportamento alimentar, coleta de dados; Brasil.

Introduction

Chronic Non-Communicable Diseases (CNCD) contribute with a lot of obits in the country, and many risk factors are associated with such diseases[1,2]. Among these factors, inadequate eating habits, physical inactivity, smoking and obesity are important to determine CNCD[2].

The insufficient intake of fruit and vegetables and the high intake of sugar and saturated fat are habits related to the risk factors of CNCD. These habits are included in the Dietary Guidelines for the Brazilian Population[3] established by the Ministry of Health in 2006, and in the Telephone-based Surveillance of Risk and Protective Factors for Chronic Diseases (VIGITEL)[4].

In the first VIGITEL survey, in 2006, 7% of the participants reported the adequate intake of fruit and vegetables according to the Brazilian Guidelines; less than 50% of the interviewees reported the regular consumption of these foods[5]. In this study, we analyzed the consumption of foods from 2007 to 2009, from the seven intake-related questions (beans, fruits, vegetables, whole milk, skim milk, regular soft drinks, diet or light soft drinks and consumption of saturated fat), we evaluated the ability to identify food intake patterns. Therefore, we applied some techniques that are commonly used to assess eating dietary patterns, summarized by Hu[6] in two general formats. The first one consists of indexes created from guidelines, like the Index of Food Quality (IFQ)[7,8]; and the second is comprised of statistical procedures to analyze the covariation structure of different variables (usually foods or food groups) in order to show a restricted number of eating patterns in the assessed group[6,9]. These strategies of analysis have been widely known as *a priori* and *a posteriori*, even though these terms are not properly used, once the former does not concern knowledge based only on theory (*a priori)*, and the latter consists of exploratory analyses, and not on experimental knowledge (*a posteriori)*.

As to the second approach, cluster analysis (in groups)[10,11] and factorial analysis, or principal components analysis[12-14], have been more frequently reported in literature. The main difference among them is that the cluster analysis gathers individuals, while the factorial analysis gathers variables. The former is adequate for three situations: to explore eating patterns when it is suspected that the sample is not homogeneous; when there are no statistical properties necessary for the factorial analysis; or when the intention is to keep all the proposed food items in the instrument. Thus, the method aims at assigning individuals to different subgroups (the clusters). Food intake of individuals in the same cluster is expected to be reasonably homogeneous, showing more differences among clusters[15-17].

This article aims to assess food intake markers of the VIGITEL system and its temporal evolution.

Methods

Study population and design

This study used data from VIGITEL, conducted in 2007, 2008 and 2009. This survey is a probability sampling of adults (≥18 years) who own a telephone line in 26 Brazilian state capitals and the Federal District. The sampling process was based on the draw of 5,000 households per city, followed by the selection of one inhabitant per household. At least 2,000 interviews were conducted in each city. More details on sampling procedures may be found in Moura et al.[18].

Individuals aged between 20 and 65 years were included in this study, and the women who were pregnant at the time of the survey were excluded. Due to some changes in the questions related to eating habits, the year 2006 was not included in the analyses.

From 2007 to 2009, 162,971 individuals were interviewed for VIGITEL. After the exclusion of 26,430 individuals who were not in the analyzed age group and 1,292 pregnant women, 135,249 adults were assessed.

Description of the variables

The assessed sociodemographic variables were: age group, schooling and gender. Data regarding reported weight and height were used to calculate the Body Mass Index (BMI) – body mass (kg) divided by height in squared meters (m^2). Nutritional status was assessed according to the guidelines by the World Health Organizations[19], that is, excess weight: BMI≥25 kg/m^2 and obesity: BMI≥30 kg/m^2.

Concerning food intake, the survey included a question about the consumption of beans: "On how many days of the week do you usually eat beans?"; the responses were: never/almost never, once or twice a week, three or four times a week, five or six times a week, or every day of the week.

The questionnaire had three questions on the weekly frequency of fruit, salad, raw salad and cooked vegetables intake. Possible responses were: never/almost never, once or twice a week, three or four times a week, five or six times a week, or every day of the week. Another question enabled the analysis of the frequency of fruit intake on a regular day, with the following possible responses: once, twice a day, or three or more times a day. Individuals who reported eating fruits at least once or twice a week, but did not respond as to the frequency of fruit intake on a regular day were classified in the low intake category (once a day). Both questions were matched in order to estimate the daily frequency of fruit intake. The frequency of salad, raw salad and cooked vegetables intake on a regular day was assessed from the following characteristics: for lunch (considered as once a day), for dinner (considered as once a day), for lunch and for dinner (considered as twice a day). Individuals who reported eating salad, raw salad and cooked vegetables at least once or twice a week, but did not respond as to the frequency of salad, raw salad and cooked vegetables consumption on a regular day were classified in the low intake category (once a day). The daily

consumption of vegetables was estimated by the daily intake of salad, raw salad and cooked vegetables.

The consumption of soft drinks (or artificial juice drinks, such as Tampico) was analyzed from the weekly intake frequency (six possible responses, varying from never to every day of the week); type (regular, diet/light, or both) and number of consumed glasses/cans (possible responses ranging from 1 to 6 or more). For those who could not estimate the amount of consumed soft drinks, the average established number was one glass.

The intake of saturated fat was assessed with two questions related to meat consumption: "when you eat red meat, do you usually: remove the visible fat, eat the meat and the fat, or do not eat meat with a lot of fat", and "when you eat chicken, do you usually: remove the skin, eat the skin or do not eat pieces of chicken with skin". The answers were dichotomized into: consumption of visible fat in the meat or not, and the consumption of the chicken skin or not, respectively.

Two questions regarding milk consumption also showed the usual consumption of saturated fat: weekly frequency of milk consumption (ranging from never to every day of the week) and type of milk (whole, skim or both). From these variables, the daily consumption of whole milk was estimated, including those who consumed both types of milk, as well as the daily consumption of skim milk.

Assessment of healthy eating scores

A healthy eating score with the following variables was established: beans, fruits, raw salad, cooked vegetables, milk and soft drinks, in four levels of weekly frequency, as described in Chart 1. The score was calculated from the sum of the punctuation of the items, ranging from 0 to 24 points.

The internal consistency of the score was assessed by the correlation of the items and with the Cronbach's α coefficient, which was 0.24. Food intake patterns were also assessed by the cluster analysis, with the following variables: intake of fruits, vegetables, whole and skim milk, regular and diet/light soft drinks, consumption of meat and chicken fat. For the consumption of fruits and vegetables, daily frequency was dichotomized into less than three times a day and three or more times a day, according to the Dietary Guidelines for the Brazilian Population[3]. The consumption of soft drinks was assessed as to daily frequency (glasses/day).

Statistical analysis

Descriptive data analysis was conducted by the calculation of the distribution of variables frequency and their respective 95% confidence intervals; concerning continuous variables, the calculation consisted of the mean and the standard error, according to year of monitoring.

Chart 1. Components and scoring of the healthy eating index
Quadro 1. *Descrição da pontuação utilizada para cálculo do escore de alimentação saudável*

	0	1	2	3	4
Beans	Never/almost never	1–2x /week	3–4x/week	5–6x/week	Every day
Fruits	Never/almost never	1–2x/week	3–4x/week	Every day or 5–6x/ week and 1–2x/day	Every day or 5–6x/week e ≥3x/day
Raw salad	Never/almost never	1–2x/week	3–4x/week	Every day or 5–6x/ week and 1x/day	Every day or 5–6x/week e 2x/day
Cooked vegetables	Never/almost never	1–2x/week	3–4x/week	Every day or 5–6x/ week and 1x/day	Every day or 5–6x/week e 2x/day
Milk	Never/almost never	1–2x/week	3–4x/week	5–6x/week	Every day
Soft drinks	Every day	5–6x/week	3–4x/week	1–2x/week	Never/almos never or *diet/light*

Simple linear regression models were used to assess temporal variation of the continuous variables in the years of monitoring. The chi-square test was used to assess the temporal variation of the distribution of frequencies per year of monitoring. Weighted analyses were conducted using the Statistical Analysis System (SAS), version 9.1.

For the cluster analysis, the 16.0 version of the SPSS k-means procedure was used, which consists of a non-hierarchical cluster technique that classifies individuals in a pre-defined number of clusters by the Euclidean distance, in a way to minimize the distances between observations inside a cluster in relation to the distances between clusters. This requires the previous definition of a number of clusters to be used in the analysis[16,20].

The analysis was performed separately for each year of monitoring, with two hypothetical clusters: a healthy cluster and an unhealthy cluster. In this analysis, F-statistics values identify the food items that contribute the most with the solution of clusters. Variables with high F values present a larger separation between clusters.

Ethical aspects

VIGITEL was approved by the National Committee of Ethics in Research with Human Beings, of the Ministry of Health. Because it was a telephone survey, the verbal consent was obtained instead of the informed consent form.

Results

According to the year of monitoring, there was no difference related to sociodemographic characteristics (age, gender and schooling). The prevalence of excess weight showed statistically significant increase over the years (Table 1).

There was statistically significant increase in the frequencies of bean, whole milk and regular soft drink intake; meanwhile, the consumption of vegetables and skim milk decreased throughout the years (Table 1). The recommended consumption of three servings of fruit and three servings of vegetables per day was reported by less than 15% of the population in all analyzed years, with a decrease from 5 to 3% for vegetables.

The average healthy eating index score did not change throughout the years (12.2 in 2006, 12.4 in 2007 and 12.4 in 2008). Correlation values between score items ranged from -0.05 to 0.17.

Due to the low internal consistency of the score (Cronbach's α=0.24), it was not considered a good marker of healthy eating. If the beans were removed, they would be the only item that could increase Cronbach's α coefficient to 0.29 (data not shown).

The cluster analysis identified the same patterns in the three evaluated years: cluster I, characterized by the intake of vegetables, fruits, diet/light soft drinks and skim milk, and cluster II, comprised of whole milk, regular soft drinks, visible fat of the meat and chicken skin; however, some items such as fruits and milk did not properly discriminate both patterns. According to the F values obtained by the ANOVA table, the variable which presented the largest separation among clusters were the regular soft drinks. In 2007, 90.7% of the individuals were part of cluster I; in 2008, this percentage decreased to 86.4% and, in 2009, it was 87.5% (Table 2).

Discussion

The results in this study show that a low percentage of individuals analyzed in VIGITEL met the Dietary Guidelines for the Brazilian Population regarding the intake of fruit, vegetables and beans. We observed four types of evolution: negative (for vegetables, skim milk and diet soft drinks), positive (for beans, whole milk and regular soft drinks), unstable (for fruit) and with no changes regarding the action of removing the fat from the meat or chicken skin.

In relation to the intake of fruit and vegetables, our findings are similar to those

Table 1. Socio-demographic characteristics, nutritional status and frequency of consumption of beans, vegetables and other food intake markers, according to survey year

Tabela 1*. Características sócio-demográficas, estado nutricional e frequência de consumo de feijão, frutas e hortaliças e outros marcadores da alimentação, no segundo ano de monitoramento*

	2007 (n=45,408)		2008 (n=44,932)		2009 (n=44,909)		
	Mean	SE	Mean	SE	Mean	SE	p value
Age (years)	37.3	0.1	37.3	0.2	37.2	0.2	0.80
Schooling (years)	9.4	0.1	9.3	0.1	9.3	0.1	0.59
	%	95%CI	%	95%CI	%	95%CI	
Female	53.0	51.9–54.1	52.8	51.5–54.0	52.6	51.2–54.1	0.92
Excess weight (BMI≥25 kg/m^2)	43.9	42.8–45.0	45.3	44.1–46.5	47.4	45.8–48.9	0.001
Obesity (BMI≥ 30kg/m^2)	13.3	12.6–14.0	13.5	12.8–14.3	14.2	13.3–15.1	0.25
Beans ≥1x/day	11.4	10.8–12.0	12.8	12.2–13.4	13.2	12.2–14.1	<0.0001
Fruit ≥3x/day	8.7	8.2–9.3	7.8	7.3–8.4	8.0	7.5–8.6	0.06
Vegetables ≥3x/day	5.1	4.6–5.6	3.7	3.3–4.1	3.4	3.0–3.8	<0.0001
Consumption (Yes/No)							
Whole milk	54.2	53.2–55.3	57.4	56.2–58.6	58.6	57.3–59.9	<0.0001
Skim milk	16.3	15.6–17.0	15.4	14.7–16.1	15.0	14.2–15.7	0.02
Diet soft drink	11.4	10.8–12.1	10.8	10.2–11.4	10.5	9.8–11.2	0.13
Regular soft drink	60.7	59.7–61.7	65.3	64.2–66.3	67.2	66.1–68.4	<0.0001
Fat in the meat	26.4	25.4–27.4	26.5	25.5–27.6	26.6	25.3–27.8	0.99
Chicken skin	17.6	16.7–18.5	17.5	16.3–18.7	17.4	16.3–18.5	0.98

Frequency (%); 95% confidence interval (95%CI); SE – mean and standard error
Frequências (%); intervalo de 95% de confiança (IC95%); SE – médias e erro-padrão

Table 2. Food items grouping identified by cluster analysis, F statistic, and percentage (%) of individuals in each cluster

Tabela 2*. Agrupamento de itens alimentares identificados por análise de cluster, estatística F, número (n) e percentual (%) de indivíduos aderidos a cada cluster*

Foods	2007			2008			2009		
	Cluster I	Cluster II	F	Cluster I	Cluster II	F	Cluster I	Cluster II	F
Vegetables (≥3x day)	0.04	0.03	27	0.04	0.02	25	0.03	0.02	16
Fruit (≥3x day)	0.10	0.09	11	0.09	0.05	104	0.10	0.05	95
Diet/light soft drink (glasses/day)	0.17	0.00	322	0.15	0.00	462	0.14	0.00	411
Skim milk (glasses/day)	0.20	0.08	330	0.20	0.07	543	0.19	0.07	483
Whole milk (glasses/day)	0.43	0.48	52	0.45	0.51	71	0.45	0.50	49
Regular soft drink (glasses/day)	0.47	3.80	85,986	0.38	2.90	85,117	0.40	3.03	87,525
Visible fat in the meat (yes/no)	0.21	0.42	919	0.19	0.42	1475	0.20	0.39	995
Chicken skin (yes/no)	0.14	0.25	399	0.13	0.26	616	0.11	0.24	426
n (%) of individuals in each cluster	37,961 (90.5)	3,975 (9.5)		36,114 (86.4)	5,676 (13.6)		36,631 (87.5)	5,252 (12.5)	

demonstrated by the Household Budget Survey (Pesquisa de Orçamentos Familiares – POF) carried out by the Brazilian Institute of Geography and Statistics (IBGE) from 1970 to 2003. The presence of fruit, salads and vegetables in the diet remained relatively constant (from 3 to 4%) and below the recommendation of consuming 9 to 12% of the total calories from this food group. The low intake of fruit and vegetables has also been observed in the United States[21], and some analyses show that even though healthy eating costs more than industrialized products, it is possible to choose healthy items at a lower cost[22]. Thus, it is not only the costs that determine the eating

choices. De Bem Lignani et al.[23] also identified that the higher purchasing power of the population addressed by Brazilian income transfer programs (Bolsa Família) increased the intake of unhealthy foods.

Concerning the consumption of beans, POF identified a 30% reduction in the household availability of this item in the same period. However, although our data show that the percentage of individuals who consume the adequate amount of beans increased throughout the years, this percentage remained low.

Milk consumption is recommended as a good source of riboflavin and the main source of calcium in the diet. Nowadays, recommendations addressed to the adult population related to milk consumption are restricted to low fat sources in order to reduce the intake of saturated fat[3]. Our data meet the recommendations, once they showed opposite trends for the consumption of whole milk and skim milk in the period, with increasing values for the former and decreasing values for the latter. Another marker of saturated fat intake is the consumption of visible fat of meat and chicken. Even though these markers did not present statistically significant changes between surveys, about 70% of the participants reported removing the fat of the meat and the chicken skin.

The intake of regular soft drinks, which is a marker of unhealthy eating habits, increased through the years, just as reported in data from POF. In 30 years, the household availability of soft drinks increased 400%[24].

The food items analyzed did not allow to establish a global indicator of healthy eating. Methods to assess food intake, such as the construction of indexes and scores, have been proposed to analyze the general quality of the diet and, although most of these methods are able to predict health-related outcomes, the associations have low magnitude[25]. Besides, the choice of the variables, cut off values, and the exact method to calculate a score are the main difficulties to develop such instrument[25]. In this study, a healthy eating score was established including the following variables: beans, fruits, raw salad, cooked vegetables, milk and soft drinks. The internal consistency of this score was low, with Cronbach's α coefficient of 0.24, like that obtained in the healthy eating score evaluation used in the United States, the Healthy Eating Index (HEI) – 2005[7]; in this case, Cronbach's α coefficient was 0.43, which is higher than the value found in this study, but it is still a moderate consistency value among the items.

Cluster analysis was also unsatisfactory. This method was chosen due to the possibility to produce mutually exclusive clusters and to identify a healthy pattern. This procedure is also justified by the heterogeneity of the sample and by the initial intention of keeping all the food items that were proposed, as well as having the advantage to classify individuals in only one pattern[15]. Despite the fact that this method led to the identification of a cluster comprised of foods considered healthy or frequently consumed by individuals who are more concerned about their health, and of another cluster comprised by items that are considered unhealthy, there were high percentages (around 90%) of adherence to cluster I, which is closer to healthy eating habits, in all investigated years. This clearly does not represent the eating habits of the Brazilian population[24]. Besides, the mean consumption of the food items did not significantly vary between the identified clusters. This may be explained by the low percentage of individuals who consume in accordance with the Ministry of Health guidelines related to fruits and vegetables[25]. However, the employed procedures did not lead to a sole healthy eating construct, indicating that the seven questions in VIGITEL should be reviewed as to the constructs that will be assessed and their real ability to measure healthy eating habits. It is acceptable that if the quality of the diet is a multidimensional construct, we could not recover a global measure

from the assessed items. Thus, those items represent different consumption dimensions considered adequate by the guidelines discussed for HEI 2005-US[4,7].

It is worth to emphasize that the three analyzed years may not be sufficient to detect great changes regarding the consumption of the assessed items. Besides, the changes observed in this short period may reflect alterations in price, distribution or access to the products.

Among the analyzed items, the regular soft drinks represented the largest separation between clusters, which demonstrates that this item is the one that discriminates food intake the most. Thus, this item is essential to investigate food intake of populations.

Monteiro et al.[26] demonstrated good reproducibility and adequate validation for most of the questions in the eating analysis of VIGITEL; thus, the non recovery of a sole healthy eating construct is not a result of information bias.

Factors that could explain the difficulty of questions present in VIGITEL to define healthy eating habits included: 1) the absence of questions regarding the intake of unhealthy foods in Brazil, like crackers – which increased 400% in 30 years[24], according to data from POF –, pastry and fast food; 2) the low percentage of individuals who presented inadequate consumption of healthy items, such as fruits and vegetables; 3) the complexity and the multidimensionality of this construct.

The inclusion of new variables in the eating analysis of VIGITEL and the identification of items that do not characterize health consumption may contribute with the construction of eating patterns that discriminate more and identify individuals with eating habits considered risky for chronic non-communicable diseases.

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