http://dx.doi.org/10.1590/1678-98652016000200001

Social and demographic inequalities in diet quality in a population-based study

Desigualdades sociais e demográficas na qualidade da dieta em estudo de base populacional

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ABSTRACT

Objective

To evaluate sociodemographic inequalities in the diet quality of the urban population of the city of *Campinas*, *São Paulo*, Brazil.

Methods

A population-based, cross-sectional study was performed using data from a health survey conducted in the city of *Campinas* in 2008-2009. Diet quality was evaluated using the Brazilian Healthy Eating Index Revised. A total of 3,382 individuals aged 10 years old and older were analyzed.

Results

Brazilian Healthy Eating Index Revised scores increased with age and education level. Women consumed more vegetables, fruits, and milk, and less sodium, meat and eggs, oils, saturated and solid fats, alcohol, and added sugars than men. Scores for whole grains, vegetables, and fruits also increased with age and education level.

Conclusion

These findings point to sociodemographic segments that are more vulnerable to an inappropriate diet and identify the need of strategies to increase the consumption of whole grains, dark green vegetables, fruits, and milk, and decrease the consumption of sodium, solid fats, alcohol, and added sugar.

Keywords: Eating behavior. Food consumption. Health inequalities. Health surveys.

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Support: Conselho Nacional de Desenvolvimento Científico e Tecnológico (Process nº 409747/2006-8); Secretaria Municipal de Saúde de Campinas; Secretaria de Vigilância em Saúde do Ministério da Saúde; Coordenação de Aperfeiçoamento de Pessoal de Nível Superior.

http://dx.doi.org/10.1590/1678-98652016000200001

RESUMO

Objetivo

Avaliar as desigualdades sociodemográficas na qualidade da alimentação da população urbana do município de Campinas, São Paulo.

Métodos

Trata-se de estudo transversal de base populacional que utilizou dados de inquérito de saúde realizado em Campinas entre os anos de 2008 e 2009. A qualidade da alimentação de 3 382 indivíduos com 10 anos de idade ou mais foi avaliada pelo Índice de Qualidade da Dieta Revisado. Foram estimadas as médias do Índice de Qualidade da Dieta Revisado global e de cada componente segundo as variáveis independentes.

Resultados

O escore total do Índice de Qualidade da Dieta Revisado aumentou com o crescimento da idade e do nível de escolaridade. As mulheres consumiram mais vegetais, frutas e leite, e ingeriram menos sódio, carnes e ovos, óleos, gorduras saturada e sólida, álcool e açúcar de adição, quando comparadas aos homens. Com o avanço da idade e da escolaridade observou-se pontuações mais elevadas de cereais integrais, vegetais e frutas.

Conclusão

Os achados apontam os segmentos sociodemográficos mais vulneráveis à alimentação inadequada e identificam a necessidade de estratégias para aumentar o consumo de cereais integrais, vegetais verdes escuros e alaranjados, frutas e leite, e diminuir o consumo de sódio e de gorduras sólidas, álcool e açúcar de adição.

Palavras-chave: *Comportamento alimentar. Consumo de Alimentos. Desigualdades em Saúde. Inquéritos epidemiológicos.*

INTRODUCTION

An unhealthy diet is one of the four main behavioral risk factors related to the epidemic of Non-Communicable Chronic Diseases (NCD)[1]. In Brazil NCD accounted for 70% of the total mortality in 2012[2]. Facing these diseases is a public health priority, recognized by the definition of a national action plan that aims, among others, to reduce average salt intake and increase fruit and vegetable intakes[1].

In the context of NCD prevention, healthy eating promotion represents a fundamental necessary strategy involving actions that cover different life stages[3]. A review study has shown that over 90% of type 2 diabetes, 80% of heart disease, and 70% of stroke and colon cancer cases could be prevented by a healthy diet combined with other healthy behaviors, such as not smoking, not abusing alcohol, as well as being physically active and maintaining a normal body weight[4].

Brazilian studies have pointed out some differences in the dietary patterns of different demographic and social subgroups of the population. As age increases, the participation of fruits, vegetables, skim milk, and whole wheat bread in the diet is likely to increase, while the intake of sugary drinks, snacks, and sandwich cookies tends to decrease[5]. High sodium intake and inadequate calcium and vitamin A, C, and E intakes affect all demographic segments above 10 years of age. In addition the sodium intake of over 70% of the urban population exceeds the tolerable upper intake level[6-8]. A study with adolescents demonstrates higher consumption of candy, processed meat, and cookies in girls, and milk and soft drinks in boys[9]. Adult women eat more fruits and vegetables and less soft drinks and fatty meats than men[10]. Higher education levels and income lead to both a higher intake of healthy foods, such as fruits, vegetables, and milk, and a higher intake of unhealthy foods, such as soft drinks, pre-packaged meals, cookies, and processed meats[9-11].

Evaluation and monitoring of dietary intake are essential tasks to guide public policies that can detain the incidence of diseases related

to unhealthy eating and to direct appropriate actions to vulnerable groups. The Brazilian Healthy Eating Index - Revised (BHEI-R)[12] is an adapted tool of the Healthy Eating Index - 2005 (HEI-2005)[13] that permits the diagnosis and monitoring of the overall quality of the diet according to nutritional recommendations. The BHEI-R is represented by a set of component-based foods, nutrients, and cooking ingredients with proven health implications, such as whole grains, unsaturated fats, fruits, and sodium[14]. The BHEI-R was considered a valid and reliable instrument to asses and monitor the diet quality of the Brazilian population[15].

Recognizing the importance of food quality in health promotion and disease prevention, the need to identify the dietary patterns in population subgroups from different country regions, and in view of the diversity of food habits, the objective of this study was to evaluate the sociodemographic inequalities in the quality of the diet of the urban population from the city of *Campinas* (SP), Brazil.

METHODS

This is a cross-sectional, population-based study based on data from the *Inquérito de Saúde de Campinas* (ISACamp, Health Survey of *Campinas*), which collected information from non-institutionalized individuals living in the urban area of the city of *Campinas* between February 2008 and April 2009.

The survey sample was determined by probabilistic sampling procedures via two-stage clustering. In the first stage, 50 census sectors were drawn with probability proportional to size (number of households). Considering the time elapsed since the Population Census of 2000, the addresses of the selected sectors were updated. The second stage involved a random selection of households.

The population was divided into three age groups, constituting the age domains: adolescents (10-19 years), adults (20-59 years) and older adults (60 and over). Independent samples of 1,000 people in each domain were selected considering the maximum variability to the frequency of events studied (p=0.50), 95% confidence interval, sampling error between 4 and 5 percentage points, and a design effect of 2. To achieve the desired sample size considering 20% of non-response, 2,150, 700, and 3,900 households were drawn for interviews with adolescents, adults and older adults, respectively. Thereby, the 2,150 households sampled for interviews with adolescents would guarantee the minimum number of people in this age group. The calculation of the number of households was based on the people/household ratio for each age domain.

The sample is representative of the population of *Campinas* regarding its demographic and socioeconomic characteristics, and its design was based on the age domains for which the minimum numbers were drawn. Further details on the sample design are found in Alves[16].

Information was collected in the household through a questionnaire structured in 14 thematic blocks, tested in a pilot study, and administered by trained and supervised interviewers. The thematic group on food habits included the 24-Hour Dietary Recall (24HR) in which respondents reported all foods and beverages consumed the day before the interview. The 24HR was conducted on different days of the week and months of the year[17].

The dependent variable was the BHEI-R. The BHEI-R consists of 12 components, eight are food-based (total fruits; whole fruits; total vegetables and legumes; dark green and orange vegetables and legumes; total grains; whole grains; milk and dairy products; meat, eggs and legumes) and four are based on nutrients and cooking ingredients (sodium; saturated fats; oils; *Gordura Sólida, Alcool e Açúcar de Adição* [Gord_AA, Calories from Solid Fat, Alcohol and Added Sugar] which assesses the percentage energy from saturated and trans fats, alcohol and added sugar)[12].

http://dx.doi.org/10.1590/1678-98652016000200001

Depending on the component scores can range from zero (minimum) to 5, 10, or 20 (maximum) as assigned (Chart 1). The minimum score is represented by zero consumption of components 1-9 or consumption above the recommendations for components 10 through 12, while the maximum score for each component is established when it reaches or exceeds the recommended intake. Intakes between the minimum and maximum standards are scored proportionately. The Total BHEI-R is the sum of the scores of the components and can reach up to 100 points.

The Brazilian Healthy Eating Index Revised was calculated based on information obtained by the 24HR recall. During the field work, the content of the recalls was thoroughly checked by a dietician to identify and correct any administration mistakes. The 24HR were quantified to convert household measures of the food preparations into grams or milliliters. For this purpose, information available from household measurement tables[18,19], food labels, and customer services were used.

The dietary food intake information was calculated by the software Nutrition Data System for Research version 2007 (NCC Food and Nutrient Database, Minneapolis Minnesota, United States). Data consistency analysis consisted of verifying the 24HRs that had a total energy value below 800 kcal or above 3,500 kcal.

Like the Healthy Eating Index - 2005, the BHEI-R uses energy from legumes to complete the total score component of meat and eggs if the consumption of these foods is inadequate. When the score of meat and eggs is met and there is still energy remaining from the legumes, the surplus is transferred to the total vegetables and dark green and orange vegetable components, respectively. For these reasons, the legumes were excluded from the BHEI-R calculation in this study.

The sociodemographic variables analyzed in this study were gender, age, and education level of the household head (years of formal education).

The means of total BHEI-R and of each component were estimated and the differences between the means of sociodemographic subgroups were obtained by linear regression at a level of 5% significance for associations with the variables analyzed. The mean values of total BHEI-R were adjusted for sex and/or age, as well as total energy in the diet (kcal). The mean BHEI-R component scores were adjusted by kcal. The relative percentage of the maximum score for each BHEI-R component was calculated to present the results in a picture format.

Chart 1. Scoring criteria of Brazilian Healthy Eating Index Revised (BHEI-R) components.

BHEI-R components	Scoring range	Standard for minimum score of zero	Standard for maximum score
1. Total fruit*	0 to 5	No consumption	1.0 serving/1,000 kcal
2. Whole fruit	0 to 5	No consumption	0.5 serving/1,000 kcal
3. Total vegetables	0 to 5	No consumption	1.0 serving/1,000 kcal
4. Dark green and orange vegetables	0 to 5	No consumption	0.5 serving/1,000 kcal
5. Total grains	0 to 5	No consumption	2.0 servings/1,000 kcal
6. Whole grains	0 to 5	No consumption	1.0 serving/1,000 kcal
7. Milk and dairy products	0 to 10	No consumption	1.5 serving/1,000 kcal
8. Meat and eggs#	0 to 10	No consumption	1.0 serving/1,000 kcal
9. Oils**	0 to 10	No consumption	0.5 serving/1,000 kcal
10. Saturated fat	0 to 10	≥15% of TEV	≤7% of TEV
11. Sodium	0 to 10	≥2.0 g/1,000 kcal	≤0.75 g/1,000 kcal
12. Gord_AA	0 to 20	≥35% of TEV	≤10% of TEV
BHEI-R Total	0 to 100		

Note: *Represent the consumption of fruits as natural juice; **Include nuts and fish; #Legumes were excluded from this component. Source: Previdelli *et al.*[12].

TEV: Total Energy Value; Gord_AA: *Gordura Sólida, Alcool e Açúcar de Adição.*

The interviews were entered into the database using EpiData 3.1 (EpiData Association, Odense, Denmark) and statistical analyses were made in the *svy* module of Stata 11.0 (Stata Corporation, College Station, Texas, United States), which allows the analysis of data from a complex sample.

The study design was approved by the Research Ethics Committee of the *Universidade Estadual de Campinas* in addendum to the Opinion nº 079/2007.

RESULTS

From the total of 3,405 interviews, 23 were excluded due to non-completion of the 24HR. Thus, 3,382 subjects were evaluated, with a mean age of 14.1 years (95% Confidence Interval-95%CI=13.8-14.4) for adolescents, 37.4 years (95%CI=36.6-38.3) for adults, and 70.0 years (95%CI=69.3-70.6) for older adults.

Analyses of total BHEI-R revealed gradual increase in diet quality scores with advancing age and education level of the household head (Table 1).

The Brazilian Healthy Eating Index Revised components with the worst scores were whole grains, sodium, dark green and orange vegetables, total fruit, whole fruit, and milk and dairy products, as well as the one that assesses the energy percentage from Gord_AA. The best scores were found in the groups total grains, meat and eggs, and oils (Figure 1).

Women had higher scores than men for total vegetables, dark green and orange vegetables, total fruit, whole fruit, dairy products, and sodium components, while for meat and eggs, oils, saturated fats, and Gord_AA the opposite happened (Table 2).

With increasing age, there was a gradient of score improvement for whole grains, total vegetables, dark green and orange vegetables, total fruit, whole fruit, oils, Gord_AA, and worsening scores for sodium. Compared with adolescents, adults had lower scores for dairy products and higher scores for meats and eggs (Table 2).

Table 1. Crude and adjusted mean total Brazilian Healthy Eating Index Revised (BHEI-R) by social and demographic variables. Health Survey of *Campinas* (SP), Brazil, 2008.

Variables	n	Overall mean	95%CI	*p*-value*	Adjusted mean**	95%CI	*p*-value*
Gender							
Male#	1,521	48.9	47.4-50.4		50.5	46.9-54.1	
Female	1,861	51.4	48.9-53.9	0.000	49.6	46.7-56.0	0.094
Total	3,382	52.7	51.9-53.5				
Age group (in years)							
10 to 19#	924	48.6	47.5-49.7		52.4	49.1-55.7	
20 to 29	303	49.6	47.2-52.1	0.141	53.7	49.1-58.3	0.047
30 to 39	231	52.8	49.8-55.8	0.000	56.5	51.4-61.6	0.000
40 to 49	220	54.5	51.5-57.5	0.000	57.6	52.4-62.7	0.000
50 to 59	195	55.4	52.3-58.5	0.000	58.6	53.4-63.9	0.000
60 to 69	812	57.5	55.1-59.9	0.000	60.2	55.6-64.9	0.000
70 to 79	498	58.5	56.1-60.9	0.000	61.0	56.4-65.6	0.000
80 or +	199	60.3	57.1-63.5	0.000	62.5	57.1-67.9	0.000
Education of the household head (years)							
0 to 7#	1,655	51.9	51.1-52.7		51.4	48.3-54.5	
8 to 11	942	52.5	50.5-54.6	0.305	53.2	48.7-57.6	0.013
12 or +	763	54.3	51.7-56.9	0.008	54.4	49.7-59.0	0.000

Note: *Value of $p<0.05$; **Adjusted for gender and/or age and diet calories; #Category used as reference.

http://dx.doi.org/10.1590/1678-98652016000200001

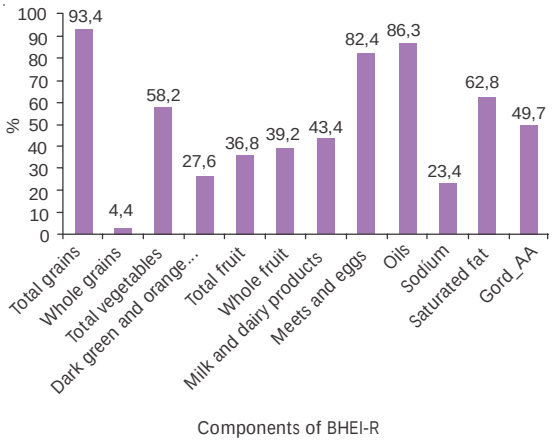

Figure 1. Percentage of the mean score of each component of Brazilian Healthy Eating Index Revised (BHEI-R) in regards to its maximum value. Health Survey of *Campinas* (SP), Brazil, 2008.

Note: Gord-AA: *Gordura Sólida, Alcool e Açúcar de Adição.*

Segments with higher education levels had a higher mean score for whole grains, total vegetables, dark green and orange vegetables, total fruit, whole fruit, and dairy products, but lower mean for saturated fat. Regarding the reference category, the stratum with 12 or more years of formal education had significantly lower scores for total grains, oils, and Gord_AA, and higher scores for sodium (Table 2).

DISCUSSION

In the present study, diet quality did not differ by gender after adjusting for energy. North American studies have found higher diet quality among women[20,21]. In Brazil studies that evaluated diet quality using the HEI or BHEI-R have found worse eating habits in adolescents[22,23] and adult females[24]. The fact that females have better diet quality could be the result of several factors, such as increased attention to health and signs of disease, increased concern with body image, the role of being the family caregiver and generally having the responsibility of selecting and preparing meals, as well as the lower consumption of food away from home[25,26]; women also have more careful attitude towards their health than men[27,28].

The increase in diet quality scores with advancing age has also been observed by other authors[20,21]. A North American study found a difference of 9.6 points in the HEI-2005 score among individuals aged between 20 and 39 years and 60 years or more[20], similar to the 11.3 points found in the present study. The positive influence of age on food quality may result from the occurrence of chronic diseases and comorbidities that increase greatly throughout life[25]. The impact of disease on health status tends to increase the number of visits to health services and better expose patients to health care guidelines, which encourages and pushes the individual to adhere to a treatment where healthy eating is a fundamental component[29]. The association between aging and better diet quality can also result from effects of the birth cohort. The eating habits of today's older adults was formed at a time when meals were often prepared at home, where there was not a wide availability of pre-packaged meals, nor a high variety of restaurants and diners with a delivery service, in addition to the industry's appeal with advertisement so people incorporate the idea of convenience and time saving when preparing their food. Nowadays, exposure to poor food quality happens quite early in life. The National Demographic and Health Research (2006-2007) detected a high percentage of children aged 6-59 months who were already eating cookies (46.3%), soft drinks (22.1%), and sweets (21.4%) on a daily basis[30]. Therefore, the best current quality attributed to the diet of older adults can partly stem from a difference in generation.

Individuals with the highest education levels also had the highest Brazilian Healthy Eating Index Revised scores. Ervin[20] and Hiza *et al.*[21] reported higher overall diet quality scores in adults with college degrees. Even if still inadequate, individuals with higher education levels ate more fruits, vegetables, milk, and whole grains, leading to better diet quality. However, this segment also presented greater intake of saturated fats. BHBS 2008-2009 data has shown that household purchases of fruits and vegetables increase with

Table 2. Mean score of each Brazilian Healthy Eating Index Revised (BHEI-R) component according to sex, age group, and education level of the household head. Health Survey of *Campinas* (SP), Brazil, 2008.

BHEI-R Components	Total	*Gender*		
	Overall mean	Male (1)	Female (2)	*p*-value* (2)-(1)
Total grains	4.67	4.97	7.90	0.083
Whole grains	0.22	0.22	0.27	0.065
Total vegetables	2.90	3.06	3.33	0.005
Dark green and orange vegetables	1.38	1.17	1.48	0.005
Total fruit	1.84	1.51	2.00	0.000
Whole fruit	1.96	1.37	1.91	0.000
Milk and dairy products	4.34	2.96	3.76	0.000
Meats and eggs	8.24	8.47	8.09	0.003
Oils	8.63	9.95	9.55	0.046
Sodium	2.34	0.37	0.94	0.000
Saturated fat	6.28	8.41	7.87	0.000
Gord_AA	9.94	14.90	14.17	0.015
	Age group (in years)			
	10 to 19 (1)	20 to 59 (2)	60 or + (3)	*p*-value* (2)-(1)	*p*-value* (3)-(1)
Total grains	4.96	4.82	4.84	0.002	0.000
Whole grains	0.16	0.30	0.43	0.000	0.000
Total vegetables	2.97	3.57	3.80	0.000	0.000
Dark green and orange vegetables	1.11	1.76	1.98	0.000	0.000
Total fruit	1.91	2.28	3.01	0.008	0.000
Whole fruit	1.74	2.18	3.10	0.004	0.000
Milk and dairy products	4.85	4.16	4.92	0.000	0.701
Meats and eggs	7.58	7.92	7.47	0.002	0.434
Oils	8.73	9.32	9.21	0.000	0.004
Sodium	1.82	1.36	1.36	0.001	0.000
Saturated fat	7.20	7.44	7.49	0.249	0.145
Gord_AA	11.55	13.27	15.23	0.000	0.000
	Education of the household head (in years)			
	0 to 7 (1)	8 to 11 (2)	12 or + (3)	*p*-value* (2)-(1)	*p*-value* (3)-(1)
Total grains	4.89	4.88	4.69	0.895	0.002
Whole grains	0.19	0.28	0.58	0.011	0.000
Total vegetables	3.13	3.86	4.12	0.000	0.000
Dark green and orange vegetables	1.38	1.88	2.26	0.000	0.000
Total fruit	2.11	2.43	3.04	0.015	0.000
Whole fruit	2.09	2.42	2.89	0.019	0.001
Milk and dairy products	3.79	4.34	5.71	0.018	0.000
Meats and eggs	7.92	7.82	7.55	0.535	0.076
Oils	9.37	9.41	8.77	0.820	0.020
Sodium	1.18	1.37	1.87	0.159	0.003
Saturated fat	7.93	7.23	6.63	0.006	0.000
Gord_AA	14.12	13.33	12.76	0.076	0.005

Note: *Value of $p<0.05$. Adjusted mean by diet calories. (1) Category used as reference; (2)-(1) Category 2 in relation to 1; (3)-(1) Category 3 in relation to 1.

Gord-AA: *Gordura Sólida, Alcool e Açúcar de Adição.*

income *per capita*, along with soft drinks, pre-packaged meals, condiments, and animal fats[11]. These results reveal social inequality in eating habits, analyzed both by income usage as a marker for socioeconomic level and access to purchases, as well as by education level, which is an indicator of acquired knowledge that would facilitate adherence to a healthier lifestyle.

http://dx.doi.org/10.1590/1678-98652016000200001

The growth of the Brazilian economy allowed the socially excluded segments to purchase processed products, whereas before, only groups with high socioeconomic levels were able to purchase them. In European countries, the highest socioeconomic segment, defined by education level, income, and occupation, eats more fruits and vegetables, whole grains, lean meats, fish, and dairy products with low fat content, while the stratum with the lowest socioeconomic status eats more fatty meats, refined grains, and fats[31]. Researchers estimated that the adoption of an aggressive political scenario regarding food legislation could prevent 29,920 deaths annually from cardiovascular disease with the intake of 500 g of fruits and vegetables (7,420), elimination of *trans* fats (4,700), reduction in salt intake by 3 g (6,600), and a 3% reduction in saturated fats in the total energy (11,200)[32].

The Brazilian Healthy Eating Index Revised components with significant inequalities between sociodemographic strata were analyzed, especially whole grains, vegetables, fruits, and milk and dairy products.

The scores for whole grains increased with age and education level. Ervin had similar findings[20]. High intake of whole grains reduces constipation and is associated with lower risk of developing cardiovascular disease, diabetes and diverticulitis[33]. Munter *et al.*[34] reported an inverse association between consumption of whole grains and the risk of type 2 diabetes, and found that the increment of two servings/day decreased the risk of the disease by 21%. Evidence of the health benefits of whole grains is well established in the literature, which indicates the need to disseminate information on the subject for the population and develop actions that encourage consumption and reduce the cost of whole grain products. The Brazilian dietary guidelines advise people to prefer less processed grains, such as whole wheat flour and brown rice, in view of their greater nutrient content[35].

Higher scores for fruits and vegetables were found in women, as well as a gradual increase in scores with increasing age and years of formal education. A researcher who analyzed a sample of National Health and Nutrition Examination Survey (NHANES) 2003-2004 obtained similar results, except for education level, which showed oscillating values in these components[20]. The *Vigilancia de Fatores de Risco e Proteção para Doenças Crônicas por Inqueritos Telefonico* (Vigitel) survey points to higher intake of fruits and vegetables in women and a trend to increase with age and education level[10]. It is estimated that inadequate fruit and vegetable intakes account for 2.8% of all deaths worldwide[36]. Higher intake of fruits and vegetables is one of the goals set by the Brazilian government to stop the spread of chronic diseases, involving actions such as lower prices, and higher production and supply of these foods[37].

The mean values for the milk and dairy component scores were highest in both women and the most educated subgroups, and lowest in adults. Other studies also found a declining milk score in adulthood, higher scores in high school categories, but no differences by gender[20,21]. Milk and dairy products are the main sources of dietary calcium and their intakes are recommended for proper bone metabolism[14]. The target age groups for calcium are the 9-18-year-olds and 70-year-olds and older for males and 9-18-year-olds and 51-year-olds or older for females. In these groups the EAR (Estimated Average Requirements) levels range from 1,000 to 1,100 mg[38]. The reference values for adequate calcium intake have been discussed because of the need for more evidence on the role of this nutrient, not only on bone health, but especially on body weight and cardiovascular health[39]. Data from the Brazilian National Dietary Survey draws attention to the inadequate calcium intake of adolescents[6], adults[7] and older adults[8]. Among adults, the average *per capita* intake of dairy products did not exceed 100 g or mL *per* day[7]. A survey of adult participants of the Framingham Heart Study observed that individuals who consumed yogurt presented

higher diet quality, assessed by the Dietary Guidelines Adherence Index, higher intakes of vitamins and minerals, as well as lower levels of triglycerides, glucose, systolic blood pressure, and insulin[40].

Women and more educated individuals had higher scores for sodium, but they decreased with age. In the study by Ervin[20], mean sodium score decreased with increasing education level, but no difference was detected regarding gender and age. Excessive sodium intake is one of the determinants for the development of arterial hypertension, which according to the World Health Organization (WHO), kills 7.5 million people/year[36]. The WHO recommends a maximum daily salt intake of 5 g (equivalent to 2 g of sodium) for the prevention of cardiovascular diseases. In Brazil household sodium availability adjusted for an intake of 2,000 kcal reaches as much as 4.7 g *per* person *per* day, exceeding more than twice the maximum recommendation for this nutrient[41]. Reducing sodium intake stands out as a priority in the Brazilian health agenda. The Ministry of Health established a cooperation agreement with the *Associação Brasileira das Industrias da Alimentação* (ABIA, Brazilian Association of Food Industry) in 2010 to decrease the sodium content of processed foods. For this purpose, working groups were created to act in the "agreement on the levels of sodium reduction targets in processed food", in "conducting education and information campaigns for the population", and in "developing a guideline for good nutritional practices" (p.289)[42].

The mean score of the composite component Gord_AA increased with age and decreased in the highest education level. Ervin[20] and Hiza *et al.*[21] observed higher scores with age, in women, and in education level extremes. According to a study using data from the Brazilian National Dietary Survey, 66.6% of 1,793 tested foods had high contents of solid fat (saturated and *trans*) and sugar. The mean contribution of these foods to total energy was higher in women (52.0%), adolescents (54.0%), and those with higher education levels (55.0%) and family income (57.0%)[43]. A study using BHBS 2008-2009 data has shown that the participation of meats, milk, cheese, animal fats, soft drinks, and pre-packaged meals in the diet increases with household income, and these foods contain sugar and saturated and *trans* fats[11].

Unprocessed or minimally processed foods are valued by the 2014 Dietary Guidelines for the Brazilian Population (DGBP)[35] as the basis of a healthy diet and are contemplated in the components fruits, vegetables, grains, milk, and meat and eggs, which integrate the BHEI-R. However, some components include foods like cookies, ice cream, cakes, and milk drinks, identified as ultra-processed foods by DGBP; these foods affect the score of the BHEI-R and partly integrate the components saturated fats, Gord_AA, and sodium.

This study has some limitations. One refers to the administration of a single 24HR, which does not represent the usual intake of an individual due to food intake variability. However, the ISACamp 2008 collected 24HR in a population-based sample and in different days of the week and months of the year, allowing for a proper estimate of the average intake of the target population[44]. Also, the possibility of reverse causality as this is a cross-sectional study prevents the interpretation of the results as cause and effect, meaning that it is not possible to verify if the changes in education level would change eating habits. The best diet quality observed in older adults can be due, in part, to a survival bias (individuals with a healthy diet present greater survival rates), to the presence of chronic diseases, as well as to the generation cohort. Related to the BHEI-R, the use of energy from the legumes both in the meat and eggs and in the vegetables components constitutes another limitation. Considering that Brazilians have greater legume intake than North Americans, this method masks the real intake values of the components cited

http://dx.doi.org/10.1590/1678-98652016000200001

above. Furthermore, the composition and use of bean and meat proteins are not equivalent.

In addition the study data do not come from a specific nutrition survey, which reduces the detailing of the questions about diet, but on the other hand, it expands health dimensions that can be assessed with the diet.

Among the strengths of the study, the evaluation of diet quality in different life stages with a population-based sample can be highlighted.

This paper presents population-level information on the diet quality of adolescents, adults, and older adults from the city of *Campinas*, evaluated by a set of dietary components. The pattern of global food intake and specific components was identified according to the socio-demographic stratum of the population, bringing subsidies for the design of policies to promote healthy eating, prevention, and control of NCDs.

CONCLUSION

A distinct dietary intake pattern was observed among the study sociodemographic subgroups. The score of the BHEI-R was low for the whole population, but the adolescents, young adults, and the individuals with less education were shown to be more vulnerable to poor diet quality.

The components with the worst scores, indicating inappropriate intake, were whole grains, sodium, dark green and orange vegetables, total fruit, whole fruit, milk and Gord_AA. Women scored higher for vegetables, fruits, milk, and sodium, and lower for meat and eggs, oils, saturated fats, and Gord_AA. Adults and older adults had better scores for whole grains, vegetables, oils and Gord_AA than adolescents. Adults had lower score for milk and dairy products than adolescents. The segments with higher education levels presented higher scores for whole grains, fruits, vegetables, milk, and sodium, as well as lower scores for saturated fats.

The results of this study reveal the need to promote strategies for a healthier diet directed to stimulate the intake of fruits, vegetables, and whole grains, as well as to reduce the intake of sodium in the study population. Adults must be oriented to include more milk and dairy products in their diet, and individuals with higher education levels need orientation to decrease saturated fat intake.

ACKNOWLEDGEMENTS

The study was sponsored by the *Conselho Nacional de Desenvolvimento Científico e Tecnológico* and the *Coordenação de Aperfeiçoamento de Pessoal de Nível Superior*.

COLABORATORS

D ASSUMPÇÃO analyzed and interpreted the data and wrote the article. SMA DOMENE and RM FISBERG analyzed and interpreted the data and collaborated in the discussion of the manuscript. MBA BARROS drafted the article, supervised the study and outlined the article.

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Received: February 2, 2015
Final version: September 28, 2015
Approved: October 19, 2015