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Trends in diet quality among adolescents, adults and older adults: A population-based study☆,☆☆,★

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ABSTRACT

This study aimed to monitor diet quality and associated factors in adolescents, adults and older adults from the city of São Paulo, Brazil. We conducted a cross-sectional population-based study involving 2376 individuals surveyed in 2003, and 1662 individuals in 2008 (Health Survey of São Paulo, ISA-Capital). Participants were of both sexes and aged 12 to 19 years old (adolescents), 20 to 59 years old (adults) and 60 years old or over (older adults). Food intake was assessed using the 24-h dietary recall method while diet quality was determined by the Brazilian Healthy Eating Index (BHEI-R). The prevalence of descriptive variables for 2003 and 2008 was compared adopting a confidence interval of 95%. The means of total BHEI-R score and its components for 2003 and 2008 were compared for each age group. Associations between the BHEI-R and independent variables were evaluated for each survey year using multiple linear regression analysis. Results showed that the mean BHEI-R increased (54.9 vs. 56.4 points) over the five-year period. However, the age group evaluation showed a deterioration in diet quality of adolescents, influenced by a decrease in scores for dark-green and orange vegetables and legumes, total grains, oils and SoFAAS (solid fat, alcohol and added sugar) components. In the 2008 survey, adults had a higher BHEI-R score, by 6.1 points on average, compared to adolescents. Compared to older adults, this difference was 10.7 points. The diet quality remains a concern, especially among adolescents, that had the worst results compared to the other age groups.

1. Introduction

Dietary monitoring is part of the effort toward improving the population's nutritional health. A well-designed health-surveillance program can frame political initiatives by identifying adverse tendencies in the population's eating behavior (Ballard-Barbash, 2001).

Public policies, including raising the minimum wage and income transfer programs and expansion of the family health strategy have contributed to the decline of child malnutrition in Brazil (Monteiro et al., 2010). On the other hand, changes in eating patterns and physical activity have led to a new perspective for the population's health.

Analysis of Household Budget Surveys (HBS) in Brazil (2002/03–2008/09) revealed an insufficient amount of fruits and vegetables and an excess of calories from free sugars and saturated fats in the diet (Levy et al., 2012).

Studies of the Mediterranean population revealed unfavorable trends in diet quality, characterized by higher consumption of total and saturated fat and less consumption of fruits and vegetable in 2005 compared to 2000 (Valdés et al., 2009). Data from the National Health and Nutrition Examination Survey (NHANES) showed that the diet

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quality of Americans is far from optimal and, according to the Healthy Eating Index (HEI), did not improve overall between 2001/02 and 2007/08 (USDA, 2013).

Recently, dietary pattern analysis has emerged as an alternative and complementary approach to examining the relationship between diet and the risk of chronic diseases. Instead of looking at individual nutrients or foods, pattern analysis examines the effects of overall diet. There is a growing interest in using dietary quality indices to evaluate the adherence to a certain dietary pattern or current dietary guidelines (Hu, 2002).

Given all these changes in recent decades, we hypothesized that Brazilian diet quality has deteriorated over the years across all age groups. Therefore, the primary objective of this study was to monitor diet quality and associated factors in adolescents, adults and older adults from the city of São Paulo, Brazil, in 2003 and 2008, using the Brazilian Healthy Eating Index (BHEI-R).

2. Methods

2.1. Study design and population

Data were obtained from two cross-sectional, population-based surveys on health and living conditions in a representative sample of adolescents (12–19 years old), adults (20–59 years old) and older adults (60 years old or over) living in the city of São Paulo (ISA - Capital), one of the most important metropolitan cities in Brazil, conducted in 2003 and 2008.

The two surveys employed a similar sampling process. Sample selection was carried out by two-stage cluster sampling: census tracts and households. For the present study, inclusion criteria were individuals at least 12 years of age who answered the socioeconomic and dietary survey, giving a total of 2376 subjects (814 adolescents, 746 adults and 816 older adults) for the ISA-Capital 2003 and 1662 subjects (560 adolescents, 585 adults and 517 older adults) for the ISA-Capital 2008. Further details on the sampling can be found in another publication (Castro et al., 2009).

The Research Ethics Committee of the School of Public Health, University of São Paulo, approved the study protocol. All participants provided all the data required and signed the informed consent form.

2.2. Data collection

A structured questionnaire collecting demographic (sex, age and race), socioeconomic (head of household education and household income per capita), family (family household members), anthropometric (body weight and height) and lifestyle characteristics (smoking habits, alcohol consumption and leisure-time physical activity) was applied by trained interviewers at the participants' homes during the periods March to December 2003 and September 2008 to March 2009. All data are shown in Table 1.

The nutritional status was assessed by body mass index (BMI = weight/stature^2) (CDC, 2012; WHO, 1998; Lipschitz, 1994) and the leisure-time physical activity (active/not active) was defined as the practice of physical activity for at least 30 min per day, five days a week at moderate intensity, or at least 20 min a day three days a week in vigorous intensity, using the International Physical Activity Questionnaire (IPAQ), long version.

Food intake was measured by one 24-h dietary recall, considering all seasons of the year and days of the week, contributing to daily variation in dietary intake. Data were collected using the multiple-pass method,

Table 1
Weighted percentage distribution of studied population according to sociodemographic, anthropometric and lifestyle characteristics. ISA 2003 and 2008. São Paulo, SP, 2003–08.

	ISA 2003		ISA 2008	
Variables	n	%[a] (CI 95%)	n	%[a] (CI 95%)
Sex				
Male	1163	44.92 (42.21–47.62)	722	46.90 (44.36–49.44)
Female	1213	55.08 (52.38–57.79)	940	53.10 (50.56–55.64)
Age group (years)				
12 a 19[b]	814	19.84 (17.66–22.01)	560	15.14 (12.93–17.34)
20 a 59	746	68.42 (66.19–70.65)	585	71.00 (68.00–74.01)
60 or older	816	11.74 (10.22–13.27)	517	13.86 (11.62–16.10)
Race[c]				
White	1509	61.22 (57.30–65.15)	963	58.46 (52.72–64.20)
Non white	856	38.78 (34.85–42.70)	697	41.54 (35.80–47.28)
House head's education[c]				
Up to 4 years[b]	1033	39.27 (35.44–43.09)	595	22.65 (18.82–26.48)
5–8 years	481	23.65 (20.71–26.60)	407	22.10 (16.86–27.36)
9–11 years[b]	426	20.55 (17.67–23.44)	418	35.44 (29.81–41.07)
12 years or more	405	16.53 (12.96–20.09)	216	19.81 (13.94–25.66)
Nutritional status[c]				
Underweight	187	5.48 (04.24–6.72)	96	4.05 (03.20–04.91)
Normal weight	1224	58.57 (55.47–61.66)	899	54.02 (50.67–57.36)
Overweight	670	35.95 (33.03–38.88)	590	41.93 (38.74–45.12)
Leisure-time physical activity[c,d]				
Active[b]	177	07.03 (05.21–08.85)	253	14.41 (11.81–17.00)
Not active[b]	2018	92.97 (91.15–94.79)	1407	85.59 (83.00–88.19)
Smoking habits[c]				
Never smoked	1641	67.53 (64.86–70.21)	1155	64.17 (60.45–67.87)
Former smoker	363	14.21 (11.71–16.70)	274	16.04 (13.21–18.86)
Smoker	334	18.26 (15.76–20.76)	232	19.79 (16.44–23.14)
Alcoholic beverage consumption[c]				
No	1341	50.43 (46.78–54.07)	962	47.89 (44.69–51.08)
Yes	1024	49.57 (45.93–53.22)	699	52.11 (48.92–55.31)

n - number of individuals in the unweighted sample.
CI 95% - Confidence Interval 95%.
[a] Prevalence in the weighted sample.
[b] Intervals do not overlap, so we have (at least) 95% confidence that the true values are not equal.
[c] Exclusion of individuals with ignored information.
[d] Active individual with a physical activity practice of at least 30 min of low or moderate intensity physical activity daily, five or more days of the week, or practice of at least 20 min of vigorous intensity physical activity daily, 3 or more days of the week.

that employs five sequential passes in the interview to facilitate the accurate recall of dietary intake (Conway et al., 2004), and critically reviewed to identify any failures relating to descriptions of foods or preparations consumed and their apportioning and quantification, in accordance with Pinheiro et al. (2000) and Fisberg and Villar (2002). The nutritive values of foods and ingredients were checked. Total energy intake was also analyzed, and none of the 24HRs were excluded. Thus, the 24HR data was controlled for errors that might have occurred in estimating nutrient intake. Data were analyzed using the Nutrition Data System for Research (NDSR database, version 2007, NCC, University of Minnesota, Minneapolis). The primary source of nutritional food values was the US Department of Agriculture (USDA) nutritional composition table, and this was extended with information provided by food manufacturers, the scientific literature and the Brazilian Table of Food Composition (TACO) (NEPA-UNICAMP, 2011). A concordance rate between 80 and 120% for energy and macronutrients content was required to accept a food selection from local composition table (Fisberg and Marchioni, 2012). When regional foods did not have an exact equivalent or similar food available in the NDS-R database, one or more foods combined were inserted as a recipe that represents the same nutritional value as the original version (Kovalskys et al., 2015).

Overall diet quality was assessed using the revised version of the Healthy Eating Index 2005 for the Brazilian population (BHEI-R) by Previdelli et al. (2011) and evaluated according to the psychometric properties of Andrade et al. (2013). This index evaluates a combination of different types of foods, nutrients and other components of the diet regarding the daily intake recommendations and/or health outcomes.

The BHEI-R components were based on Dietary Guidelines for Brazilians Population (Ministério da Saúde, 2005) and expressed in terms of food density (1000 kcal/g). BHEI-R comprises 12 components, nine of which are food groups, two of which are nutrients, and the last of which represents the sum of the energy value contributed by solid fats, alcohol, and added sugar (the SoFAAS component). The maximum number of total points was assigned for intakes at the standard level: 5 points (total grains, whole grains, dark-green and orange vegetables and legumes, total vegetables, total fruit and whole fruit), 10 points (milk and dairy products, meat and beans, oils, saturated fat and sodium) and 20 points for SoFAAS. Thus, the final score of the BHEI-R ranged from zero to 100 points. Higher values of score indicates greater adherence to dietary guidelines.

For most components, higher intakes result in higher scores. It should be noted, however, that for three components: saturated fat, sodium and SoFAAS, lower intake levels result in higher scores.

2.3. Statistical analysis

The prevalence of descriptive variables for ISA 2003 and 2008 were compared using a confidence interval of 95% (95% CI).

Total BHEI-R mean and components scores from 2003 and 2008 were compared using the Wald test or one-way analysis of variance for each age group.

The relationship between the BHEI-R (continuous variable) and the associated factors was assessed by multiple linear regression analysis (stepwise forward selection), given that the BHEI-R had a normal distribution. Data modeling was performed for the two survey years (2003 and 2008). The dependent variable was overall diet quality (BHEI-R) whereas independent variables were age group (adolescent, adult or older adults), smoking habits (smoker, former smoker or non-smoker), head of household education (years), gender (male or female), nutritional status (overweight or not overweight), household income per capita, alcohol consumption (yes or no), ethnicity (white or non-white) and the energy intake (kcal) to adjust for potentially confounding effects. Interactions among the variables included in the final model were also investigated, but no significant values were found. A residual analysis was performed to test for homoscedasticity of errors in regression, and no bias was found.

All analyses were performed using the "survey" module of the STATA software package (version 12, Stata Corporation, College Station, TX, USA) and a significance level of 5%.

3. Results

The two representative samples from the city of São Paulo were similar for most variables, according to descriptive analysis (Table 1). The mean of schooling years of the family head was 7.3 years (SE = 0.41; 95% CI 6.51–8.13) in 2003 and 8.4 years (SE = 0.21; 95% CI 7.95–8.79) in 2008. The mean energy intake was 1864.15 kcal (SE = 26.94; 95% CI 1810.20–1918.10) in 2003 and 1949.58 kcal (SE = 42.00; 95% CI 1865.77–2033.40) in 2008.

Over the five-year period studied, diet quality remains worrying (BHEI-R = 54.99 vs. 56.42, $p < 0.005$) with an increase in scores for total and whole fruit, milk and dairy products, saturated fat and sodium and a decline in scores for total grains, oils and SoFAAS components (comprising total calories derived from solid fats, alcohol and added sugar) (Table 2).

Age group stratification was carried out to better understand dietary changes. The adolescents revealed deterioration in diet quality influenced by a decrease in scores for dark-green and orange vegetables and legumes (DGOV&L), total grain, oils and SoFAAS components. Milk and dairy products and sodium were the only components that showed improvement in this age group. For adults and older adults, diet quality showed improvement, influenced by an increase in scores for total and whole fruit, as well as saturated fat and sodium. Sodium was the only component that showed improvement across all age groups (Table 2).

In addition to age group, a difference in mean BHEI-R was observed for lifestyle characteristics such as smoking habits. Former smokers had better diet quality, followed by non-smokers, on the 2003 survey, as did non-consumers of alcoholic beverages (Table 3). The BHEI-R showed an inverse correlation with energy intake ($r = -0.207$ in 2003 and $r = -0.260$ in 2008) and with socioeconomic variables such as head of household education ($r = -0.104$ in 2003 and $r = -0.132$ in 2008). On the 2008 survey, the BHEI-R showed a weak positive correlation with per capita income ($r = 0.045$).

The modeling in the multiple linear regression analysis (Table 4) revealed that adults in 2003 were associated with a BHEI-R score that was 2.5 points higher compared to adolescents. This difference was even greater for older adults, whose mean score was 7.2 points higher on the index. On the other hand, smoker status was associated with an index which was lower, on average, by 3 points, regardless of energy intake, age, or head of household education. Comparing 2008, a greater difference was found in index scores for age, with an average increase of 6.1 and 10.7 points among adults and older adults, respectively, compared with adolescents.

4. Discussion

The study population showed increased scores on the BHEI-R but these remain worrying, falling short of scores obtained by other countries with high morbidity and mortality rates due to diseases related to inadequate eating habits, such as the United States (USDA, 2009). This concern is greatest among adolescents, who had the worst diet quality compared with the other age groups, a gap that has been widening.

Among the groups assessed, only the adolescent group showed a decline in scores on BHEI-R components. Despite a decline in scores for total grains and oils, scores remained close to expected values. The score for SoFAAS components, already relatively low (7.8) in 2003, became even lower (5.4), given the maximum score for this component is 20 points.

The points attributed to SoFAAS components are for the energy value derived from solid fat, saturated and trans fats, alcohol and

Table 2
Comparison of means of components and BHEI-R final score of population studied according to age group in 2003 and 2008. ISA 2003 and 2008. São Paulo, SP, 2003–08.

Component (maximum score)	Total population		Adolescents		Adults		Older adults	
	2003 (n = 2376) Mean[a] (SE)	2008 (n = 1662) Mean[a] (SE)	2003 (n = 814) Mean[a] (SE)	2008 (n = 560) Mean[a] (SE)	2003 (n = 746) Mean[a] (SE)	2008 (n = 585) Mean[a] (SE)	2003 (n = 816) Mean[a] (SE)	2008 (n = 517) Mean[a] (SE)
Total fruit (5)	1.63 (0.09)	1.94 (0.08)*	1.44 (0.11)	1.36 (0.08)	1.53 (0.09)	1.88 (0.11)*	2.51 (0.10)	2.88 (0.14)*
Whole fruit (5)	1.33 (0.08)	1.92 (0.09)*	1.06 (0.10)	1.22 (0.08)	1.21 (0.09)	1.86 (0.12)*	2.45 (0.11)	3.01 (0.14)*
Total vegetable (5)	4.16 (0.05)	4.17 (0.06)	3.82 (0.06)	3.59 (0.12)	4.24 (0.07)	4.25 (0.07)	4.32 (0.06)	4.34 (0.07)
DGOV&L[b] (5)	3.64 (0.07)	3.61 (0.09)	3.22 (0.08)	2.86 (0.11)*	3.72 (0.10)	3.73 (0.11)	3.90 (0.05)	3.79 (0.11)
Total grains (5)	4.62 (0.03)	4.52 (0.04)*	4.73 (0.03)	4.55 (0.04)*	4.59 (0.37)	4.50 (0.05)	4.59 (0.04)	4.59 (0.04)
Whole grains (5)	0.38 (0.03)	0.41 (0.04)	0.32 (0.04)	0.29 (0.04)	0.38 (0.04)	0.39 (0.05)	0.49 (0.05)	0.62 (0.07)
Milk and dairy (10)	3.95 (0.13)	4.35 (0.14)*	3.70 (0.17)	4.43 (0.18)*	3.86 (0.16)	4.21 (0.18)	4.91 (0.16)	4.99 (0.18)
Meats, eggs and Legumes (10)	8.52 (0.09)	8.54 (0.09)	8.18 (0.19)	8.08 (0.12)	8.68 (0.12)	8.69 (0.11)	8.14 (0.10)	8.24 (0.15)
Oils[c] (10)	9.33 (0.04)	9.14 (0.08)*	9.29 (0.08)	8.80 (0.13)*	9.33 (0.05)	9.20 (0.11)	9.41 (0.09)	9.21 (0.11)
Saturated fat (10)	5.93 (0.13)	6.62 (0.14)*	5.95 (0.17)	6.34 (0.15)	5.85 (0.16)	6.63 (0.19)*	6.33 (0.15)	6.88 (0.17)*
Sodium (10)	2.12 (0.09)	2.60 (0.10)*	2.53 (0.15)	3.38 (0.16)*	2.03 (0.11)	2.49 (0.14)*	1.97 (0.09)	2.30 (0.13)*
SoFAAS[d] (20)	9.40 (0.30)	8.61 (0.26)*	7.83 (0.40)	5.44 (0.26)*	9.46 (0.29)	8.64 (0.36)	11.73 (0.24)	11.93 (0.28)
BHEI-R total (100)	54.99 (0.42)	56.42 (0.50)*	52.03 (0.59)	50.33 (0.42)*	54.87 (0.46)	56.47 (0.66)*	60.73 (0.51)	62.78 (0.57)*

Note: Adolescents (12–19 years old), adults (20–59 years old) and older adults (60 years old or over).
SE – Standard Error.
* Wald test, $p < 0.05$.
[a] Weighted mean.
[b] DGOV&L = Dark-green and orange vegetables and legumes.
[c] Oils = Vegetable oils, seed oils and oily fish.
[d] SoFAAS = total calories from solid fat, alcohol and added sugar.

added sugar intake. There are several mechanisms linking the consumption of these items to health problems, including: increased concentration of triglycerides and decreased concentration of high density lipoproteins (Fried and Rao, 2003).

Changes in dietary structure, associated with economic, social and demographic shifts and their repercussions on the population's health, have been observed in a number of developing countries (Popkin, 2001), including Brazil, and resemble the eating patterns seen in developed countries. Data from the 2003 NHANES, highlight that about 40% of the total energy intake of American children and adolescents from 2 to 18 years old was in the form of "discretionary calories", and half of these calories were from soft drinks, fruit juice, dairy desserts, pizzas and whole milk (Reedy and Krebs-smith, 2010).

In the city of São Paulo, 70% of adolescents consume >10% of their diet total energy value (TEV) in the form of added sugar, with soft drinks contributing most to this percentage (Colucci et al., 2012). Data from the HBS performed by the Brazilian Institute of Geography and Statistics (IBGE) confirms a tendency of increased availability of soft drinks within households, which has risen by 400% in the metropolitan areas of Brazil over a 30-year period (1974–2003) (Levy-Costa et al., 2005).

In the present study, half of the sample had excess body weight and, although the number of physically active had doubled, exercise prevalence was only 14% in 2008 (Table 1).

Several studies have shown the association of lifestyle variables with healthy eating (Lin et al., 2013; Andrade et al., 2010). Both of the ISA surveys revealed that former smokers had better diet quality (Table 3), possibly due to their commitment to improve lifestyle habits. Furthermore, smoker status was associated with a 3-point lower BHEI-R in both survey years, regardless of age and energy intake (Table 4).

The consumption of alcoholic beverages is also a growing concern, and studies have shown some tendencies in alcohol consumption at earlier ages (Gigliotti and Bessa, 2004; Galduroz et al., 2004). Alcohol consumption contributes to decrease SoFAAS component scores. Almost half of the interviewed adolescents have reported drinking alcohol, but an increase consumption along the five analyzed years was not observed (39.7%; 95% CI 34.57–45.06 in 2003 and 34.1%; 95% CI 28.97–39.53 in 2008) Besides the harmful effects of alcohol on health, data from NHANES of 2003–2008 identified poorer diet quality among males and females on days when they consumed alcoholic beverages, highlighting a higher consumption of total fat and lower intake of fruit, milk and dairy products (Breslow et al., 2013). This difference in diet quality among consumers and non-consumers of alcoholic beverages was also found in the population of São Paulo on the ISA 2003 (Table 3).

Monitoring the intake of milk and dairy products is essential, not only because of the protein value but also because it provides calcium (Miller et al., 2001). Martini et al. (2013) showed a prevalence of inadequate calcium intake of over 70% in the ISA 2008 sample. Despite improved milk and dairy product scores for the adolescent group, values

Table 3
Descriptive statistics of the Brazilian Healthy Eating Index Revised (BHEI-R) according to sociodemographic, anthropometric and lifestyle characteristics. ISA 2003 and 2008. São Paulo, SP, 2003–08.

Variables	ISA 2003		ISA 2008	
	Mean[a] (SE)	p[b]	Mean[a] (SE)	p[b]
Sex				
Male	54.25 (0.46)	0.051	55.59 (0.66)	0.059
Female	55.60 (0.59)		57.14 (0.62)	
Age group (years)				
12 to 19[b]	52.03 (0.59)	<0.001	50.33 (0.41)	<0.001
20 to 59	54.87 (0.46)		56.47 (0.66)	
60 or older	60.73 (0.51)		62.78 (0.57)	
Race[c]				
White	55.28 (0.44)	0.294	56.93 (0.61)	0.106
Non white	54.56 (0.65)		55.70 (0.61)	
Nutritional status[c]				
Not overweight	54.49 (0.52)	0.312	55.89 (0.61)	0.090
Overweight	55.27 (0.61)		57.31 (0.68)	
Leisure-time physical activity[c,d]				
Active[b]	55.23 (1.07)	0.870	56.57 (0.54)	0.436
Not active[b]	55.04 (0.45)		55.50 (1.29)	
Smoking habits[c]				
Never smoked	55.15 (0.46)	<0.001	55.77 (0.37)	<0.001
Former smoker	57.39 (0.86)		61.16 (0.65)	
Smoker	52.70 (0.72)		54.69 (0.81)	
Alcoholic beverage consumption[c]				
No	55.65 (0.52)	0.029	57.01 (0.56)	0.193
Yes	54.54 (0.51)		55.87 (0.75)	

SE – Standard Error.
[a] eighted mean.
[b] Wald test or One-way analysis of variance.
[c] Exclusion of individuals with ignored information.
[d] Active individual practicing at least 30 min of low or moderate intensity physical activity daily, five or more days of the week, or practicing at least 20 min of vigorous intensity physical activity daily, 3 or more days of the week.

Table 4
Factors associated with the Brazilian Healthy Eating Index Revised identified by multiple regression analysis for participants of the ISA 2003 and 2008. São Paulo, SP, 2003–08.

Independent variable		2003			2008		
		β	*p*	r^2	β	*p*	r^2
Energy intake (Kcal)		−0.0021	<0.001	0.089	−0.0013	0.002	0.099
Age group	Adults[a]	2.4469	<0.001		6.1154	<0.001	
	Older adults[a]	7.1968	<0.001		10.7202	<0.001	
Smoking habits	Smoker[b]	−2.9523	<0.001		−3.0910	0.003	
	Former smoker[b]	1.0748	0.241		0.5755	0.610	
Head of household education (years)		−0.0664	0.032		−0.1550	0.155	

Note: Adolescents (12–19 years old), adults (20–59 years old) and older adults (60 years old or over).
[a] In relation to adolescents.
[b] In relation to never smoked.

were under half those recommended by the BHEI-R and well below the score reported for the American adolescent population (7.7 points) (USDA, 2009).

Akin to milk and dairy products, other components of the BHEI-R are of concern due to their insufficient intake. The consumption of fruit and vegetables has a protective effect on risk of obesity, diabetes mellitus type 2, cardiovascular diseases and some types of cancer. The World Health Organization (WHO) reported that an estimated 2.7 million of the deaths registered worldwide in 2000 could have been prevented with adequate consumption of fruit and vegetables (Lock et al., 2005). Table 2 shows that scores for total fruit and whole fruit increased among adults and older adults but not in adolescents.

Studies with the HEI indicate lower scores for the vegetable component registered by the Americans when compared to the Brazilian population (3.2 vs. 3.8 points) (NHANES 2001–04/ISA 2003). The same is true when we compare adolescents (2.4 vs. 3.8 points) but the scores are similar for the older adults (4.3 points).

Authors reported unfavorable trends in consumption of vegetables by Spanish (Valdés et al., 2009) but the vegetable consumption increased in Portuguese population; this finding is in agreement with other studies conducted in Sweden (Eiben et al., 2004) and New Zealand (Laugesen and Swinburn, 2000).

The control of the deficiencies of vitamins and minerals is a priority in public health, for this reason, the Dietary Guidelines for Brazilians Population recommends varying the fruits and vegetables, increasing the supply of fiber and vitamins, such as carotenoids, emphasizing the consumption of dark-green and orange vegetables (Ministério da Saúde, 2005). The score to dark-green and orange vegetables and legumes component also declined in adolescents group (3.2 vs. 2.9 points).

The increase in sodium component scores was observed in all age groups. Nevertheless, the values remain very low, and represent half of the scores registered by the American population (2003 NHANES) (2.12 vs. 4.1 points) (USDA, 2008).

According to the Institute for Applied Economic Research - IPEA (2009), in the period between 2003 and 2008 there was an average increase of 28.2% in Brazilian average income, influencing the availability of different food groups. According to data from the 2008 HBS (IBGE, 2011), food groups whose presence in the diet rose uniformly, along with the level of household income included: meats, milk and dairy products, fruits and vegetables. On the other hand, some negative markers of diet quality have been observed among higher income categories, including sweet products, soft drinks, pizza and baked pastries. The presence of soft drinks in the diet was five times greater in the higher income than in the lower income classes.

Data from the 2003 survey showed that the head of the household's education (proxy for income) was inversely associated with diet quality, a relationship that did not remain in 2008. In a study of trends in diet quality from 1999 to 2010 among the US adult population, using the Healthy Eating Index 2010, Wang et al. (2014) showed that family income and education level were positively associated with the index, and the gap between low and high socioeconomic status had widened over time, from 3.9 points in 1999 to 7.8 points in 2000.

In the present study, an increase in diet quality score was observed among adults and older adults, mainly due to increased fruit intake and decreases in saturated fats and sodium consumption. However, consumption for all food groups was inadequate and remains a concern, with low scores in relation to total score. This concern is greatest among the adolescent group, which had the worst diet quality and exhibited a tendency for further declines in this score, as evidenced in the final model of multiple linear regression analysis.

Adolescents are making poorer food choices compared to other age groups. Studies show that adolescents prefer processed foods with high sugar and fat content, affecting health during the development phase (USDA, 2009; Andrade et al., 2010). The latest 2008 HBS (IBGE, 2010) confirms the significant increase in the proportion of Brazilian adolescents overweight: in 1974–75, 3.7% of boys and 7.6% of girls aged between 10 and 19 years were overweight; in 2008–09, these rates were 21.7% and 19.4%, respectively.

This study provides evidence of the urgent need for actions aimed at improving diet quality across all income classes, including families whose head of household has a high educational level, and with a special focus on adolescents. These actions will determine eating behaviors in adult life, preventing the individual from developing future non-communicable chronic diseases.

The limitation of the BMI should be considered. BMI is a surrogate measure of body fatness because it is a measure of excess weight rather than excess body fat. Factor such as muscle mass can influence the BMI and change the nutritional status. However, the use of anthropometric measurements has become, albeit with limitations, the most practical and lowest cost means of analyzing individuals and populations, whether for clinical reasons, for screening projects or for monitoring tendencies (WHO, 1998; Conde and Monteiro, 2006).

Other limitation of this study was evaluating consumption based on one day only. Food consumption may vary from one day to the next, and the evaluation of a single day may not reflect the individual's usual intake. Nevertheless, the 24HR provides details on all types of food consumed and their values, serving as a valuable tool for population-based surveys, such as the present study. Willett (2013) claims that a single 24HR may be adequate to estimate the mean value of consumption when the size and characteristics of the sample are estimated for this purpose.

These data may support the devising of actions to promote consumption of specific food groups, such as fruit and vegetables, milk and dairy products, and whole grains, while also encourage reductions in the use of added sugar and sodium by food manufacturers and in food preparation. In addition, the results can help raise awareness of the need for public actions promoting better lifestyle habits, such as programs encouraging the practice of regular physical activities, and anti-smoking and anti-alcohol campaigns.

Possibilities for further research include updating of the BHEI-R to reflect current dietary guidance and to continue the monitoring of the diet quality in future population-based studies. Research about frequency of eating out, changes in portion sizes, changes in dietary patterns and changes in the intake of energy-dense foods of low nutritional value may shed light on the observed trend.

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