



Diet quality among adolescents has deteriorated: a panel study in Niterói, Rio de Janeiro State, Brazil, 2003-2008

A queda na qualidade da alimentação dos adolescentes brasileiros: um estudo de painel em Niterói, Estado do Rio de Janeiro, Brasil, 2003-2008

La caída en la calidad de la alimentación de los adolescentes brasileños: un estudio de panel en Niterói, Estado de Río de Janeiro, Brasil, 2003-2008

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Abstract

This study aimed to analyze changes in the diet quality of adolescents from public schools in Niterói, Rio de Janeiro State, Brazil, over a five-year period. Data on the food consumption of adolescents (12-19 years) were obtained by means of two sets of 3-day food records in two school-based, cross-sectional studies conducted in 2003 and 2008. The Brazilian Revised Healthy Eating Index (BHEI-R) was used to estimate dietary quality. From 2003 to 2008 there was an overall decrease in the scores attributed to “total vegetables”, “dark green and orange vegetables”, and “meat, eggs, and legumes”, but there was an increase in the score for “milk and dairy” (4.0 vs. 5.2; $p < 0.01$). Among female adolescents, the BHEI-R decreased (64.1 vs. 62.4; $p = 0.04$), as did the scores attributed to “total vegetables”, “dark green and orange vegetables”, “meat, eggs, and legumes”, and “solid fat, alcohol, and added sugar”. In contrast, among males, only the “whole grains” score decreased (0.2 vs. 0.1; $p = 0.04$). From 2003 to 2008, the diet quality of female public school students declined in Niterói.

Diet Surveys; Food Consumption; Adolescent

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Introduction

During adolescence (10 to 19 years), adequate diet is important for proper growth and development. Thus, monitoring adolescents' food intake is crucial for supporting interventions to promote healthy dietary habits in this age group.

According to the 2008-2009 *Brazilian Dietary Survey*, adolescents showed worse eating habits than adults and the elderly¹. Adolescents' dietary intake has also been marked by high energy-dense items, excessive sugar, fat, and sodium, and low amounts of vegetables, fruits, calcium, and iron^{2,3,4}. Such food choices can contribute to unbalanced energy intake and inadequate intake of vitamins and minerals, thus promoting excess weight gain and jeopardizing adolescents' health^{5,6}.

The usual approach to assess dietary exposure focuses on the evaluation of energy and/or nutrient intake or food and/or food group consumption. However, this approach does not allow the investigation of the combined effect of several dietary components and/or provide a suitable basis for interventions. Thus, approaches that seek to evaluate overall diet are important for supporting intervention development aimed at healthy eating⁷. Such approaches include indices that assess diet quality, such as the *Revised Healthy Eating Index* (RHEI) proposed by Guenther et al.⁸. The diet quality indices evaluate how closely a diet approaches a theoretical "eating pattern" defined on the basis of food guidelines and dietary recommendations⁹.

Guenther et al.⁸, based on 2005 *Dietary Guidelines for the American Population*¹⁰, developed the RHEI, emphasizing whole grains, vegetables, beneficial fats, and energy from solid fats, alcohol, and added sugar. Based on the American RHEI⁸ and the *Brazilian Dietary Guidelines*¹¹, Previdelli et al.¹² proposed the *Brazilian Revised Healthy Eating Index* (BHEI-R), aimed at characterizing both healthy and harmful aspects of the diet; additionally, Andrade et al.¹³ evaluated the validity and reliability of this index, concluding that it is reliable and structurally valid to monitor diet quality in Brazil. The BHEI-R has been used to summarize diet quality, highlighting key dietary characteristics, and is considered a useful tool in nutritional epidemiology¹⁴.

Previous studies have reported the decline in adolescents' diet quality^{5,15}. Despite the topic's relevance, there are few studies in Brazil on trends in food consumption during adolescence. The present study used the BHEI-R¹² to analyze changes in adolescents' diet from 2003 to 2008.

Materials and methods

This study is a secondary analysis of two cross-sectional school-based studies in the city of Niterói, Rio de Janeiro State, Brazil, in 2003 and 2008, which examined adolescents 12 to 19 years of age enrolled in public schools, with the primary objective of assessing biochemical markers of cardiovascular diseases.

The two studies adopted the same sample design to ensure comparability. Selection of participants was based on a cluster sample design (with one selection stage), and the original sample size was calculated assuming 25% prevalence of hypercholesterolemia (the most common alteration in blood lipids in adolescents¹⁶), 95% confidence interval (95%CI), and 5% maximum error. Estimated sample size was 600 students, and allowing for predicted losses of 30%, the final sample size was set at 780 adolescents¹⁷. The probability of selecting classes from each school was proportional to the total number of students in each age group in each school; as a result, in 2003, 28 classes were selected, and in 2008 30 classes were selected among the 33 public schools chosen for the studies. Pregnant adolescents and those with physical disabilities that prevented anthropometric assessment were excluded from the study.

The two studies were approved by the respective Institutional Review Boards of the Clementino Fraga Filho University Hospital (2003) and the Martagão Gesteira Institute of Pediatrics and Childcare (2008), both belonging to the Federal University of Rio de Janeiro (UFRJ). Only adolescents who provided an informed consent form signed by a parent or guardian or by the adolescents themselves (when they were 18 or older) were allowed to participate in the study.

A digital scale was used to measure weight, with participants barefoot and wearing light clothing. Height was measured with a portable stadiometer, following the recommendations of Gordon et al.¹⁸. Body mass index (BMI = weight/height²) by age and sex was used to classify weight status according to World Health Organization guidelines¹⁹, and adolescents with z-score > +1 were considered overweight.

Dietary assessment and analysis

In both studies, adolescents completed a set of 3-day dietary records (two weekdays and one weekend day), after being instructed to describe all foods and beverages (except water) consumed on the specified days, plus time and place of meals. After they completed the records, a nutritionist reviewed the food records with the partici-

pant to clarify or complete data as needed. Energy and nutrient intakes were estimated using the NutWin software (Escola Paulista de Medicina, Universidade Federal de São Paulo, São Paulo, Brazil), based on the U.S. Department of Agriculture food composition table. For foods not in that database, food composition was obtained from the Brazilian Food Composition Table ²⁰.

Brazilian Revised Healthy Eating Index (BHEI-R)

To estimate BHEI-R, foods were grouped according to the BHEI-R food groupings. Mixed dishes including more than one food group (e.g., sandwiches, pizzas, stuffed pasta, chocolate milk, and other mixtures) were broken down into their ingredients, classified in the appropriate groups.

BHEI-R is estimated by adding all points attributed to 12 components characterizing different aspects of the diet. Nine of these components are based on food groups: “total grains” (all grains, whether whole or not); “whole grains” (only whole grains); “total fruit” (all fruits and fruit juices); “whole fruit” (only fruits in pieces, excluding fruit juices); “total vegetables” (all vegetables and legumes); “dark green and orange vegetables and legumes”; “milk and dairy”; “meat, eggs, and beans”; and “oils” (sources of mono- and polyunsaturated fatty acids and omega-3). Two components are related to nutrients (“sodium” and “saturated fat”), and the last component consists of calories from “solid fat, alcohol, and added sugar” (SoFAAS), which include foods providing solid fats (for example, butter, lard, and hydrogenated vegetable fats), alcoholic beverages, and added sugar (including table sugar, soft drinks, jams, jelly, and other processed foods) (Table 1).

BHEI-R was calculated with the procedures proposed by Guenther et al. ⁸. Initially, the energy (kcal) provided by each food group in the 3-day dietary records was estimated. Then the energy density of each analyzed food group per 1,000kcal was calculated (Equation 1).

$$\text{Energy density form the food group in 1,000kcal} = \frac{\text{total energy provided by the food group in three days of food records (kcal)} * 1,000}{\text{total energy intake in three days of food records}} \quad (1)$$

For components based on nutrients (sodium, saturated fat) the density of nutrients per 1,000kcal was estimated, according to Equation 2:

$$\text{Nutrient density in 1,000kcal} = \frac{\text{total nutrient intake in three days of food records} * 1,000}{\text{total energy intake in three days of food records (kcal)}} \quad (2)$$

As shown in Table 1, the score assigned to each component of BHEI-R was defined according to the number of servings or nutrient amount consumed per 1,000kcal. To estimate the number of servings consumed in each food group, the mean energy content food group portion defined by the Brazilian Ministry of Health was taken as the reference ¹² (Table 1). The cutoff points for maximum, intermediate, and minimum scores of BHEI-R components were based on the *Brazilian Dietary Guidelines* ¹¹ and internationally accepted dietary recommendations for saturated fat and sodium intake, plus information on SoFAAS intake from a population-based study (Table 1) ^{8,21,22,23}. A detailed description of the criteria for minimum, intermediate, and maximum scores of each component can be found in Previdelli et al. ¹².

Data analysis

The Kolmogorov-Smirnov test was applied to verify the symmetry of distributions of continuous variables. The Student t-test and Mann-Whitney test were used to assess continuous variable variations in the five-year period from 2003 to 2008. Means and 95%CI of the BHEI-R and component scores were calculated. In addition, the proportion of adolescents who had the minimum and maximum scores for each component was estimated. The contribution of all SoFAAS foods and soft drinks, solid fats, and added sugar to total energy intake was estimated. All analyses were stratified according to sex, age group (< 15 / ≥ 15 years old), and weight status (non-overweight / overweight). Tests with p-values < 0.05 were considered statistically significant.

Data were analyzed using the IBM SPSS, version 21 (IBM Corp., Armonk, U.S.A).

Results

In 2003, 764 adolescents were considered eligible for the study, 610 (80%) were examined, and 433 (71% of examined) completed 3-day food records. In 2008, 918 adolescents were eligible for the study, 700 (76%) were examined, and 510 (73% of examined) completed 3-day food records.

Male adolescents totaled 31% of the sample in 2003 and 36% in 2008 (p = 0.1). There was no difference in the mean age of adolescents between the two years (2003: 16.9 years, SD = 1.5; 2008: 16.1 years, SD = 1.8). The proportion of overweight adolescents was 16.9% in 2003 and 22% in 2008 (p = 0.06).

From 2003 to 2008, mean BHEI-R score decreased from 64.4 (SD = 10.0) to 63.1 (SD = 10.9)

Table 1

Components and scoring criteria in the *Brazilian Revised Healthy Eating Index* (BHEI-R).

Components based on food groups *	Criteria for maximum score	Maximum score (points)	Intermediate score	Minimum score (zero points)		
Total grains	2.0 servings/1,000kcal	5	Apportioned according to consumption	No consumption		
Whole grains	1.0 servings/1,000kcal	5				
Meat, egg & beans	1.0 servings/1,000kcal	10				
Total fruit	1.0 servings/1,000kcal	5				
Whole fruit	0.5 servings/1,000kcal	5				
Total vegetables	1.0 servings/1,000kcal	5				
Dark green and orange vegetables & legumes	0.5 servings/1,000kcal	5				
Milk & dairy	1.5 servings/1,000kcal	10				
Oils **	0.5 servings/1,000kcal	10				
Components based on nutrients						
Saturated fat	≤ 7% TEI (according to the Brazilian Society of Cardiology)	10			8 points: > 7 and < 10% do TEI (according to WHO guidelines) Between 10 and 15% of TEI, the points are calculated proportionally	≥ 15% of TEI ***
Sodium	≤ 750mg/1,000kcal (adequate intake – Dietary Reference Intake)	10	8 points: 1,000mg/1,000kcal * Between 1,000mg and 2,000mg/1,000kcal the points are calculated proportionally	≥ 2,000mg/1,000kcal #		
Energy supplied by food sources of SoFAAS	≤ 10% TEI ##	20	Apportioned according to consumption > 10% and < 35% do TEI	≥ 35% ### of TEI		

SoFAAS: solid fat (saturated e trans), alcohol, and added sugar; TEI: total energy intake; WHO: World Health Organization.

* Score based on *Brazilian Dietary Guidelines* 11;

** Oils: sources of mono and polyunsaturated fatty acids and omega-3;

*** This limit corresponds to the 85th percentile of saturated fat intake distribution observed in the 2003 *São Paulo Food and Health Survey* (ISA-Capital 2003) 42;# This limit is the twice the recommendation from the *Brazilian Dietary Guidelines* 11;## This limit corresponds to the 16th percentile of energy supplied by food sources of solid fat (saturated and trans), alcohol, and added sugar intake distribution observed in the 2003 *São Paulo Food and Health Survey* (ISA-Capital 2003) 42;### This limit corresponds to the 85th percentile of energy supplied by food sources of solid fat (saturated e trans), alcohol, and added sugar intake distribution observed in the 2003 *São Paulo Food and Health Survey* (ISA-Capital 2003) 42.

($p = 0.04$), due mainly to a drop in the consumption of “total vegetables”, “dark green and orange vegetables and legumes”, and “meat, eggs, and beans” and an increase in the intake of SoFAAS foods. Nevertheless, there was an increase in the mean score attributed to the “milk and dairy” group, from 4.0 to 5.2 points ($p < 0.01$) (Table 2).

In 2003, 38% of adolescents did not consume any portions of “whole fruit” (obtaining zero points for this component) and 76% reported no consumption of “whole grains”; in 2008, these proportions did not change significantly (42% and 78%, respectively) (Table 3).

There was also a significant increase in the number of adolescents who reported not consuming “dark green and orange vegetables and legumes” (14% vs. 27%; $p < 0.05$) or “total fruit”

(18% vs. 25%; $p < 0.05$) in the target period. However, the proportion of adolescents consuming at least three daily portions of “milk and dairy” rose from 5% in 2003 to 11% in 2008 ($p < 0.01$) (Table 3).

Across the two studies, there was no variation in the “sodium” score (mean 4.7 in both studies) (Table 2), although this mean represents less than 50% of the maximum score (10 points), indicating high sodium intake. Mean sodium intake was 2,911mg/day in 2003 and 3,355mg/day in 2008 ($p \leq 0.01$); these means are higher than the tolerable upper intake level (2,300mg) recommended by the U.S. Institute of Medicine 22. In both studies, less than 1% of adolescents reported sodium intake below 750mg/1,000kcal, defined as the limit for adequate intake according to the U.S. Insti-

Table 2

Mean scores and 95% confidence intervals (95%CI) of the components of the *Brazilian Revised Healthy Eating Index* (BHEI-R) in adolescents enrolled in public schools in Niterói, Rio de Janeiro State, Brazil, 2003 (N = 433) and 2008 (N = 510).

BHEI-R and components	Maximum score	2003		2008		p-value*
		Mean	95%CI	Mean	95%CI	
BHEI-R	100	64.4	63.4-65.3	63.1	62.1-64.0	0.04
Total fruit	5	1.7	1.6-1.9	1.7	1.5-1.8	0.38
Whole fruit	5	1.6	1.4-1.8	1.6	1.5-1.8	0.85
Total vegetables	5	3.6	3.4-3.7	3.4	3.2-3.5	0.04
Dark green and orange vegetables & legumes	5	3.0	2.9-3.3	2.7	2.5-2.9	< 0.01
Total grains	5	4.9	4.9-5.0	4.9	4.9-5.0	0.66
Whole grains	5	0.2	0.2-0.3	0.2	0.1-0.2	0.28
Meat, egg & beans	10	8.8	8.6-8.9	8.5	8.4-8.7	0.04
Milk & dairy	10	4.0	3.7-4.3	5.2	4.9-5.4	< 0.01
Oils **	10	7.4	7.2-7.7	7.2	7.0-7.5	0.28
Saturated fat	10	8.0	7.8-8.2	8.2	8.1-8.4	0.52
Sodium	10	4.7	4.5-5.0	4.7	4.4-4.9	0.84
SoFAAS	20	16.1	15.6-16.6	14.4	13.9-15.1	< 0.01

SoFAAS: solid fat (saturated e trans), alcohol, and added sugar.

* Mann-Whitney test;

** Oils: sources of mono and polyunsaturated fatty acids and omega-3.

tute of Medicine ²² and related to the maximum score for this BHEI-R component (Table 3).

Female adolescents' total BHEI-R score decreased from 2003 to 2008 (64.1 vs. 62.4; p = 0.04), as did their score for "total vegetables" (3.5 vs. 3.2; p = 0.02), "dark green and orange vegetables and legumes" (3.0 vs. 2.5; p < 0.01), "meat, eggs, and beans" (8.7 vs. 8.4; p < 0.01), and SoFAAS (16.3 vs. 14.5; p < 0.01). In contrast, males only showed a significant reduction in "whole grains" (0.2 vs. 0.1; p = 0.04), while the "milk and dairy" score increased in both sexes (p < 0.01) (females: 3.9 vs. 5.2; males: 4.2 vs. 5.1) (Table 4).

There was an increase in the contribution of SoFAAS foods to total energy intake in the study period, from 22% to 26% (p < 0.01). Increased soft drink consumption appears to be the main factor responsible for this change, as the contribution of such beverages to total energy intake increased from 15% in 2003 to 19% in 2008 (data not shown).

In both 2003 and 2008, there were no significant differences in overall BHEI-R and components according to adolescents' weight status (non-overweight vs. overweight) and age group (< 15 years old vs. ≥ 15 years old) (data not shown).

Discussion

The present study analyzed dietary data obtained in two cross-sectional school-based studies aiming to assess changes in the diet of adolescents from public schools in Niterói, from 2003 to 2008. This period saw a decrease in adolescents' diet quality as revealed by reduced mean BHEI-R score, which was due to decreased scores for the consumption of vegetables, legumes, meat, and eggs. There was also an increase in the consumption of SoFAAS foods, especially soft drinks. Sodium intake remained above the recommended level, and the consumption of fruits, whole grains, and milk and dairy products remained below the recommendations in both studies.

Other studies have also shown low consumption of fruits and vegetables and high intake of soft drinks and sweet and savory snacks among adolescents ^{1,24}. However, in Brazil, only Wendpap et al. ²⁵ had previously used the BHEI-R to evaluate the diet quality of 1,326 10-14 year-old adolescents from Cuiabá, Mato Grosso State, which presented a mean BHEI-R of 75.1 points. The difference in the BHEI-R between adolescents in Niterói and Cuiabá can be explained by the use of a food frequency questionnaire to obtain data on food consumption in Cuiabá. The FFQ has been associated with measurement er-

Table 3

Proportion (%) of adolescents from public schools in Niterói, Rio de Janeiro State, Brazil, with minimum (zero) and maximum score on the *Brazilian Revised Healthy Eating Index* (BHEI-R) components, 2003 (N = 433) and 2008 (N = 510).

BHEI-R and components	Minimum score (%)		Maximum score (%)	
	2003	2008	2003	2008
Total fruit	17.8 *	24.5*	8.8	9.8
Whole fruit	38.1	41.7	13.9	15.3
Total vegetables	0.2	0.2	50.6	45.9
Dark green and orange vegetables & legumes	14.3 *	27.2 *	50.6	47.3
Total grains	0.0	0.0	93.5	92.7
Whole grains	75.8	77.5	0.2	0.2
Meat, egg & beans	0.0	0.0	52.2	46.5
Milk & dairy	2.3 *	0.6 *	5.1 *	10.6 *
Oils **	0.5	0.0	39.3	36.5
Saturated fat	1.2	0.8	20.3	15.7
Sodium	11.1	13.9	0.9	0.6
SoFAAS	5.5	9.2	35.3	34.1

SoFAAS: solid fat (saturated e trans), alcohol, and added sugar.

* Comparison of 2003 and 2008: $p < 0.05$;

** Oils: sources of mono and polyunsaturated fatty acids and omega-3.

Table 4

Means and 95% confidence intervals (95%CI) for the *Brazilian Revised Healthy Eating Index* (BHEI-R) components, by gender, in adolescents enrolled in public schools in Niterói, Rio de Janeiro State, Brazil, 2003 (N = 433) and 2008 (N = 510).

BHEI-R and components	Girls					Boys				
	2003		2008		p-value *	2003		2008		p-value *
	Mean	95%CI	Mean	95%CI		Mean	95%CI	Mean	95%CI	
BHEI-R	64.1	63.0-65.3	62.4	61.2-63.6	0.04	64.9	63.2-66.6	64.2	62.6-65.8	0.38
Total fruit	1.7	1.5-1.9	1.7	1.5-1.9	0.48	1.7	1.4-2.0	1.7	1.4-1.9	0.71
Whole fruit	1.7	1.4-1.9	1.7	1.4-1.8	0.53	1.5	1.2-1.9	1.7	1.4-1.9	0.56
Total vegetables	3.5	3.3-3.7	3.2	3.0-3.4	0.02	3.7	3.5-4.0	3.7	3.4-3.9	0.65
Dark green and orange vegetables & legumes	3.0	2.7-3.2	2.5	2.3-2.8	< 0.01	3.2	2.8-3.5	3.1	2.7-3.4	0.57
Total grains	4.9	4.9-5.0	4.9	4.9-5.0	0.41	4.9	4.9-5.0	4.9	4.9-5.0	0.71
Whole grains	0.2	0.1-0.3	0.2	0.1-0.2	0.97	0.2	0.1-0.3	0.1	0.1-0.2	0.04
Meat, egg & beans	8.7	8.6-8.9	8.4	8.1-8.6	< 0.01	8.8	8.6-9.1	8.9	8.6-9.1	0.95
Milk & dairy	3.9	3.6-4.3	5.2	4.9-5.5	< 0.01	4.2	3.7-4.6	5.1	4.7-5.5	< 0.01
Oils **	7.2	6.9-7.5	7.0	6.7-7.3	0.41	7.9	7.4-8.3	7.6	7.2-7.9	0.31
Saturated fat	7.8	7.5-8.0	8.2	7.9-8.4	0.29	8.4	8.1-8.7	8.4	8.1-8.6	0.57
Sodium	4.9	4.6-5.2	4.7	4.4-5.0	0.75	4.4	4.0-4.9	4.5	4.1-4.9	0.74
SoFAAS	16.3	15.7-16.8	14.5	13.8-15.2	< 0.01	15.6	14.5-16.7	14.4	13.4-15.4	0.32

SoFAAS: solid fat (saturated e trans), alcohol, and added sugar.

* Mann-Whitney test;

** Oils: sources of mono and polyunsaturated fatty acids and omega-3.

Note: girls vs. boys: 2003 (oils; saturated fat: $p < 0.05$); 2008 (total vegetables; dark green and orange vegetables and legumes; meat, egg and beans; oils: $p < 0.05$).

rors, especially over-reporting of healthy foods like fruits and vegetables^{26,27}.

Freedman et al.²⁸ applied the *Healthy Eating Index* 2005 to analyze food intake among Americans two years or older and estimated a mean score of 1.0 for the “whole grains” group. Although this score was low, it was still five times higher than in adolescents (0.2). Moreover, in this study, the mean SoFAAS score was double that observed in the United States (8.4 points). Krebs-Smith et al.²⁹ also used the *Healthy Eating Index* 2005 to investigate whether food intake in the American population agreed with dietary guidelines between 1970 and 2007. The authors reported that SoFAAS sources were being provided in harmful amounts, and that the “total fruit”, “total vegetables”, “whole fruit”, and “milk and dairy” components were below the recommended limits. Nevertheless, it should be pointed out that there are important methodological differences between these studies and the present analysis, particularly the target age group and the dietary assessment tool applied to assess food consumption.

Nielsen & Popkin³⁰ also observed variations in soda consumption, reporting that the contribution of sodas to total energy intake increased from 3% to 6.9% from 1977 to 2001 in American children and adolescents 2 to 18 years old. Data on household food acquisition obtained in the 2008-2009 *Brazilian National Household Budget Survey* also showed that household acquisition of soda increased from 19L/per capita/per year in 2002-2003 to 21L/per capita/per year in 2008-2009³¹.

The low score for the “sodium” component in this study could be related to adolescents' food habits, with high intake of processed, sodium-rich foods such as crackers, savory snacks, sodas, and preserved meats³². He et al.³³ reported an association between soda consumption and increased sodium intake in this age group. Guidelines to restrict sodium intake are among the most important measures for primary prevention of cardiovascular disease³⁴.

Regarding the “meat, eggs, and legumes” component, none of the adolescents reached a minimum score. Similar results were observed by Krebs-Smith et al.²⁹, who found that Americans consumed meat and legumes in adequate amounts between 1970 and 2007. There was no deficit in protein intake among the adolescents in this study, and meat consumption was likely elevated.

In this study, female adolescents were more predisposed to diminish their diet quality than males. Rojas³⁵ also indicated that Costa Rican female adolescents had more frequent out-of-

home consumption of candies and cookies and higher inadequacy of fruit and vegetable intake than their male counterparts.

There were no differences in BHEI-R scores between overweight and non-overweight adolescents. Hassapidou et al.³⁶ found that adolescents who were and were not overweight had similar eating habits. This similarity could result from the underreporting of food intake among overweight adolescents because they tend to omit reporting foods that are considered “unhealthy”³⁷. This could also be associated with reverse causality, because overweight adolescents may restrict their intake to reduce weight gain. This is an inherent limitation to the cross-sectional study design in which exposure and outcome are observed simultaneously.

This study has some limitations. For example, the BHEI-R does not take total daily energy intake into account. Although the scores are estimated according to components' energy density, there is no information on energy intake adequacy, which would be important to prevent an energy-unbalanced diet. Nevertheless, the BHEI-R was adapted¹² and validated¹³ in Brazil to monitor dietary quality of ≥ 12 year-old individuals.

The dietary record used to obtain data on dietary intake is associated with the changing usual food consumption; in this study, to reduce measurement error in dietary assessment and to ensure data quality, participants were encouraged to maintain their eating habits and were thoroughly instructed to record foods and beverages consumed. Additionally, during a face-to-face interview, a nutritionist revised the food records to clarify and correct any unclear item. Meanwhile, the food record has strengths; for example, it is not dependent on memory and is considered accurate for obtaining information on the amounts consumed³⁸.

Another possible limitation to this study is the loss in sample size. However, there were no significant differences in the distribution according to sex, age, and weight status when comparing the total 2003 and 2008 samples with the analyzed samples (data not shown). In addition, a sample size of 392 adolescents would be sufficient to detect 2-point differences in the BHEI-R means, with a standard deviation of 10, power of 80%, and 5% confidence level in a two-tailed test³⁹.

This was the first study to analyze time trends in diet quality among adolescents from public schools in Brazil, which was accomplished by comparing adolescents' food intake data obtained in two cross-sectional studies that used the same sample design, targeted the same schools, adopted identical data collection methods, and

thus guaranteed the two studies' comparability. Investigating a public school-based probabilistic sample emphasizes study representativeness in the study area, especially considering that in Brazil, public schools are one of the few institutions that reach the great majority of low-income children and adolescents, thus being a privileged location for research and intervention.

The study's findings support the idea of a nutritional transition in Brazil in recent decades and may represent changes in adolescent diet during a period of major changes in the country's social and economic scenario, marked by economic growth, improved income redistribution, and increased purchasing power among poorer classes^{40,41}. The results of the current study indicate that interventions for adolescents should focus on promoting fresh foods and discouraging consumption of ultra-processed food products, especially those with high added sugar and solid fats.

Conclusion

This study showed that adolescents from public schools in Niterói, particularly girls, have been choosing processed foods over fresh foods; consequently their diet quality has declined in a five-year span. It also revealed an increase in the consumption of unhealthy foods such as sources of saturated fats, trans-fatty acids, added sugar, and sodium, and a decrease in healthy foods like vegetables, fruits, legumes, and whole grains. In short, this study suggests that the diet quality of adolescents from public schools in Niterói, particularly girls, appears to be deteriorating. These issues should be considered in the formulation of recommendations and dietary guidelines targeting adolescents and should be highlighted when assessing their diet quality.

Contributors

L. S. Monteiro participated in the data collection in the 2008 survey, data entry and analysis, interpretation of the results, and writing of the manuscript. P. R. M. Rodrigues and D. M. L. Marchioni contributed to the analysis and interpretation of results and revision of the text. G. V. Veiga coordinated the research and collaborated in the interpretation of results and revision of the text. R. A. Pereira conceived the manuscript and participated in the data analysis and interpretation and drafting and final revision of the manuscript.

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Resumo

O estudo teve como objetivo analisar as mudanças na qualidade da dieta de adolescentes matriculados em escolas públicas em Niterói, Estado do Rio de Janeiro, Brasil, ao longo de cinco anos. Os dados sobre consumo alimentar dos adolescentes (12-19 anos de idade) foram obtidos através de dois conjuntos de registros alimentares de três dias em dois estudos transversais de base escolar, em 2003 e 2008. O Índice Brasileiro de Alimentação Saudável (IAS-R) versão revisada, foi utilizado para estimar a qualidade da dieta. Entre 2003 e 2008, houve uma queda geral na pontuação atribuída a “total de verduras e hortaliças”, “verduras e hortaliças de cor laranja” e “carne, ovos e legumes”, mas houve um aumento no consumo de “leite e laticínios” (4,0 vs. 5,2; $p < 0,01$). Entre adolescentes femininas, houve uma queda do IAS-R (64,1 vs. 62,4; $p = 0,04$), assim como, do consumo de “total de verduras e hortaliças”, “verduras e hortaliças de cor laranja”, “carne, ovos e legumes” e “gordura sólida, álcool e açúcar”. Por outro lado, entre adolescentes masculinos, houve uma queda apenas no consumo de “cereais integrais” (0,2 vs. 0,1; $p = 0,04$). Entre 2003 e 2008, a qualidade da dieta de adolescentes femininas deteriorou em Niterói.

Inquéritos sobre Dietas; Consumo de Alimentos; Adolescente

Resumen

El estudio tuvo como objetivo analizar los cambios en la calidad de la dieta de adolescentes matriculados en escuelas públicas en Niterói, Estado de Río de Janeiro, Brasil, a lo largo de cinco años. Los datos sobre consumo alimentario de los adolescentes (12-19 años de edad) fueron obtenidos a través de dos conjuntos de registros alimentarios de tres días, en dos estudios transversales de base escolar, en 2003 y 2008. El Índice Brasileño de Alimentación Saludable (IAS-R), versión revisada, se utilizó para estimar la calidad de la dieta. Entre 2003 y 2008, hubo una caída general en la puntuación atribuída al “total de verduras y hortalizas”, “verduras y hortalizas de color naranja” y “carne, huevos y legumbres”, pero hubo un aumento en el consumo de “leche y lácteos” (4,0 vs. 5,2; $p < 0,01$). Entre adolescentes femininas hubo una caída del IAS-R (64,1 vs. 62,4; $p = 0,04$), así como, del consumo de “total de verduras y hortalizas”, “verduras y hortalizas de color naranja”, “carne, huevos y legumbres” y “grasa sólida, alcohol y azúcar”. Por otro lado, entre adolescentes masculinos, hubo una caída sólo en el consumo de “cereales integrales” (0,2 vs. 0,1; $p = 0,04$). Entre 2003 y 2008, la calidad de la dieta de adolescentes femininas se deterioró en Niterói.

Encuestas sobre Dietas; Consumo de Alimentos; Adolescente

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