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Changes in beverage consumption among adolescents from public schools in the first decade of the century XXI

Modificações no consumo de bebidas de adolescentes de escolas públicas na primeira década do século XXI

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ABSTRACT: ***Objective:*** To evaluate the changes in beverage consumption among adolescents between 2003 and 2008. ***Methods:*** Two school-based cross-sectional studies were carried out with public school students (12 to 19 years-old) from Niterói, Rio de Janeiro, Brazil. Data from three food records were used to estimate daily, weekdays and weekend average consumption (volume and percent contribution for total daily energy intake) of milk and milk-based beverages, sugar sweetened beverages, fresh squeezed fruit juices, caffeinated and alcoholic beverages. Beverage consumption age-adjusted means for weekdays and weekends were compared using linear regression (Generalized Linear Models – GLM). ***Results:*** A total of 433 adolescents were examined in 2003, and 510 in 2008. The prevalence of overweight was 17% in 2003 and 22% in 2008 ($p > 0.05$). Milk was the most consumed beverage, being reported by 89% of adolescents, followed by sodas (75%). In general, in the five-year period, there was an increase in the prevalence of consumption of alcoholic drinks, guarana syrup refreshment, and processed fruit drinks, especially on weekdays. The soft drink was the largest contributor to the total energy consumption, corresponding on average to 4% of daily energy intake. ***Conclusion:*** The main changes in the beverage consumption among adolescents from Niterói, in the first decade of the XXI century, were the tendency to reduce the consumption of milk and the increase in the consumption of processed and alcoholic beverages.

Keywords: Adolescent. Nutritional Status. Food consumption. Food habits. Beverages. Serial cross-sectional studies.

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RESUMO: ***Objetivo:*** Avaliar mudanças no consumo de bebidas em adolescentes entre 2003 e 2008. ***Métodos:*** Foram realizados dois estudos transversais de base escolar com estudantes de 12 a 19 anos de idade de escolas públicas de Niterói, Rio de Janeiro. Dados de três registros alimentares foram utilizados para estimar o consumo médio diário, de dias de semana e de final de semana (volume e a contribuição para a ingestão diária de energia) de leite, bebidas à base de leite, bebidas com adição de açúcar, suco de frutas frescas, bebidas cafeinadas e bebidas alcoólicas. Foram utilizados Modelos Lineares Generalizados (GLM) para estimar médias ajustadas por idade e as diferenças nos estimadores segundo os dias de semana. ***Resultados:*** Foram investigados 433 adolescentes em 2003 e 510 foram investigados em 2008. A prevalência de excesso de peso foi de 17% em 2003 e de 22% em 2008 ($p > 0,05$). O leite foi a bebida mais consumida, sendo relatada por 89% dos adolescentes, seguido dos refrigerantes (75%). De maneira geral, no período de cinco anos, verificou-se aumento da prevalência de consumo de bebidas alcoólicas, bebidas à base de xarope de guaraná e sucos processados, especialmente nos dias de semana. O refrigerante foi a bebida que mais contribuiu para o consumo energético total, correspondendo, em média, a 4% da ingestão energética diária. ***Conclusão:*** As principais mudanças no perfil de consumo de bebidas entre os adolescentes de Niterói na primeira década do século XXI foram a tendência para redução do consumo de leite e o aumento no consumo das bebidas processadas e das bebidas alcoólicas.

Palavras-chave: Adolescente. Estado nutricional. Consumo de alimentos. Hábitos alimentares. Bebidas. Estudos transversais seriados.

INTRODUCTION

In many parts of the world, important changes in the eating habits of adolescents have been observed, whose consumption is characterized by reduced amounts of vegetable, fruit, calcium, iron, protein sources, and high intake of processed foods with high energy density and rich in fat, sugar, and sodium[1]. Such habits contribute to the excessive weight gain and early development of metabolic disorders, which until recently were more common among middle-aged individuals, such as dyslipidemia[2], alterations in the metabolism of insulin and glucose[3], and blood pressure elevation[4]. In this scenario, beverages, especially those added with sugar, have been highlighted owing to their probable role in the development of obesity and in the control of satiety. The calories from the consumption of beverages have been listed as an important source for increased consumption of energy, and the contribution of beverages with added sugar for the epidemic of overweight and obesity[5] and diabetes[6] has been evidenced. Moreover, the consumption of this kind of beverage has been associated with worse quality in diet and reduction of milk consumption[7]. The excessive consumption of beverages with added sugar has been related to the inappropriate intake of calcium, fibers, proteins and vitamin D[8], excess of weight, increased waist circumference, increased cholesterol, serum triglycerides, and blood pressure[9,10].

The intake of namely unhealthy foods, such as beverages with added sugar, among Brazilian adolescents has been observed in nationwide researches. For example, results

from the National Student Health Survey (NSHS) of 2012 revealed that 33.2% of the adolescents consume soft drinks in 5 or more days of the week, considering this is one of the markers for unhealthy diet more often mentioned by students[11]. Besides, data from the National Food Survey (2008 – 2009) showed that the adolescents had increased consumption of beverages with added sugar, such as juice, soft drinks, and refreshments, with a mean consumption of those beverages in this age range (122 mL daily) higher than the double of the mean for adults and elderly persons[12]. Analyzing the data from those nationwide surveys, Pereira et al.[13] verified that the mean global contribution of beverages in the intake of energy by Brazilians was 17.1%, considering that, among adolescents, this contribution was more significant than among adults and elderly persons.

Several studies showed an increased consumption of beverages with added sugar in different contexts. In Brazil, an analysis developed by Levy et al.[14] with data of household availability of food in the country showed that, between the 1970s and the 2000s, the consumption of soft drinks increased 400%. In Mexico, Barquera et al.[15] analyzed the changes in the consumption of beverages between the years of 1999 and 2006 from the data of researches with national representativeness, observed that, in this period, the consumption of high calorie beverages, such as beverages with added sugar, increased more than twice among adolescents from 10 to 18 years of age. In the United States, Nielsen and Popkin[16] showed that, between 1977 and 2001, the changes in the consumption of beverages were marked by the increased consumption of beverages with added sugar and reduction of milk intake.

Despite these evidences, there are few studies that specifically examine the consumption of beverages among Brazilian adolescents, especially focusing on changes in their intake. This way, this study analyzes data from two cross-sectional studies, with identical methodological design, with the objective of evaluating the changes in beverage consumption among adolescents in urban areas in Brazil in the first decade of the 21st century.

METHODS

The data of beverage consumption were obtained from two cross-sectional school-based studies developed in 2003 and 2008, with adolescents between 12 and 19 years of age, students in 13 public schools in the city of Niterói, located in the metropolitan region of Rio de Janeiro, Brazil.

Originally, both studies had the objective of evaluating biochemical risk markers for cardiovascular diseases and the evolution of anthropometric meadures in adolescents. Thus, in order to ensure comparability, the same sample design in conglomerates with a stage of selection (random drawing classes) was adopted on both studies, with the same schools being selected as the sample for both studies. The calculation of the size of the sample considered a confidence interval of 95%, maximum error of 5%, and the prevalence of hypercholesterolemia of 25%, with an estimated sample size of

600 students, adding up 30% owing to possible no-answers, estimating a final sample size of 780 adolescents[17]. Pregnant adolescents and those with physical disabilities, which would prevent an anthropometric evaluation, were not considered eligible.

Both projects were approved by the Ethics Committees (CEP) of the institutions involved: CEP of the School Hospital Clementino Fraga Filho, on June 11, 2002, and by the CEP of the Pediatrics and Childcare Institute Martagão Gesteira, on April 11, 2008. Only the adolescents who presented their Informed Consent signed by their legal guardians or by themselves, when older than 18 years of age, took part in the studies.

The data were collected in the school by trained examiners and after the standardization process to take anthropometric measures[18]. The status of the weight was classified based in the *z* scores of the body mass index (BMI = weight/height^2) considering excess of weight for the *z* scores above + 1, as proposed by the WHO[19]. In order to take the anthropometric measures, the examinee stood barefoot and with light clothes. For the measurement of weight, in both studies, a digital portable scale by Kratos (PPS platform) was used, with a capacity of 150 kg and variation of 50 g. In 2003, the height was measured with a portable estadiometer by Leicester, and the *Alturaexata* was used in 2008; both instruments had variation of 0.1 cm. The measures of height were taken twice, and the mean of both measures were considered as long as their variation did not exceed 0.5 cm. In case the variation would exceed this value, the measures would be repeated. Owing to the high precision of the digital scale, the body weight was measured only once.

MEASUREMENT AND ANALYSIS OF THE INFORMATION OF BEVERAGE CONSUMPTION

The adolescents completed 3-day food records within a week, with 2 days during the week and 1 day on the weekend. Nutritionists trained for this activity guided the participants to describe all foods and preparations they ate on the specified days, the quantities in household measures, and the time and place of the meal. At the time of collecting the food records, the nutritionists would review, along with the students, the information recorded. At this moment, the evaluator probed whether there was any omission of items, refined the information about the quantities consumed, and elucidated situation that could rise confusion, such as preparations or nonrecognized foods, long period without any entries, or very few entries for 1 day. Besides, the interviewers also asked about the items usually omitted in food diaries, such as butter, coffee, candy, sweets, and small snacks, among others.

For the analysis of the data of food consumption, the Nutwin software was used (*Programa de Apoio à Nutrição, Escola Paulista de Medicina*, São Paulo), which uses as a database the food composition table of the United States Department of Agriculture (USDA). For the foods that were not in the database of this software, we used the information of the Brazilian Table of Food Composition (*Tabela Brasileira de Composição de Alimentos* – TACO)[20], of the Table of Chemical Composition of Foods[21], and of the

Table of Household Measures[22], preferably in that order. The composition of processed foods was obtained from the nutritional information available on food labels. In order to evaluate the implausible food intake, we adopted the proposal by Andrade et al.[23] as a criterion, which considers as being acceptable the energy intake of over 500 kcal and less than 6,000 kcal. However, in this study, we did not observe adolescents with information about daily intake of energy outside these limits.

We analyzed the consumption of milk and dairy products (milk, chocolate flavored milk), yogurt/milky beverage (beverages resulting from a mix of milk and buttermilk, added of food products), beverages with added sugar (guarana syrup-based beverages, soda, and processed juices), fresh fruit juice, caffeinated beverages (coffee, tea, and mate), and alcoholic beverages (beer, liquor, wine, vodka, and whiskey). Water intake was not evaluated.

In order to standardize the calculation of the quantities of mixed preparation beverages, such as, for example, latte, it was estimated the combination of the respective foods in equal parts, based on the rules proposed by the Brazilian Institute of Geography and Statistics[12], which were also adopted in order to standardize the amounts of sugar added to the drinks in 10% (10 g of sugar for each 100 mL of beverage). In relation to artificial powdered juice and the chocolate powder, the specification from the manufacturer was used, respectively, 35 g of powder for each 1000 mL of water and 20 g of powder for each 160 mL of milk.

ANALYSIS OF THE DATA

For the analysis, the design effect of the sample and the expansion based on sample weight were considered. The prevalence, the means and 95% confidence intervals (95%CI) of the weekly beverage consumption were estimated, as well as the consumption in days of the week and on weekends for 2003 and 2008. The consumption of beverages was measured in volume (mL) and in energy provided by the beverages (kcal), evaluating the contribution of beverages for the total daily energy intake. The analysis regarding energy intake from beverages were estimated for the overall population and considering only the group of consumers of each specific beverage. In order to estimate the overall mean, it was estimated the mean of the 3 days of consumption for each beverage for each adolescent. In order to estimate the mean consumption of beverages during the days of the week, we considered the consumption reported for the 2 days of the week. In order to estimate the mean beverage consumption for the weekend, it was estimated its mean consumption during weekends.

The Kolmogorov-Smirnov test was used in order to verify the symmetry of the distributions. To compare the means for beverage consumption between the two studies and between weekdays and weekends, the Generalized Linear Models (GLM) were used. The frequencies were compared by the χ^2-test. The means and frequencies were adjusted by age. The tests with $p < 0.05$ were considered statistically significant.

RESULTS

In 2003, 764 adolescents were considered eligible for the study; 610 (80%) were examined, and 433 (71%) presented complete data about food consumption. In 2008, 918 adolescents were eligible to take part in the study; 700 (76%) of them were examined, and 510 (73%) presented complete data on food consumption. There were no significant differences in the proportions of gender, age range, and weight status ($p \geq 0.05$), when comparing the investigated groups in the overall samokes of the studies between 2003 and 2008 when analyzed in this study (2003: 610 *versus* 433; 2008: 700 *versus* 510).

The mean age of the 433 adolescents examined in 2003 (of which 69.3% were girls) was 16.9 years of age and standard deviation (SD) of 1.5 years of age. The mean age in the study in 2008 was 16.1 years of age (SD = 1.8 years of age), and from the 510 participants, 64.3% of them were girls. It was verified an excess of weight in 16.9% adolescents in 2003 and 22% in 2008 ($p \geq 0.05$). No statistically significant difference was observed for the prevalence of excess of weight according to gender in both periods analyzed.

The consumption of some kind of beverage was reported by 99% of the adolescents studied in both studies. There were no significant differences in the consumption of beverage according to gender. Milk was the drink more often reported by adolescents: 89% of the adolescents reported consuming milk weekly in 2003 and 84% in 2008 ($p = 0.02$). Milk was consumed in greater proportion during weekdays when compared with weekends, with a reduction in the consumption frequency of milk on weekends between 2003 and 2008: in 2003, 70% of adolescents reported consuming milk on weekdays and 65% on weekends ($p = 0.05$); in 2008, these proportions were 76 and 58% ($p < 0.01$), respectively. On the other hand, the consumption of chocolate flavored milk increased between 2003 and 2008 (37 *versus* 44%; $p = 0.04$), considering this product was more conusmed on weekdays rather than on weekends (Table 1).

The group of beverages with added sugar was the second more often reported one by adolescents, with soda being mentioned by 75 and 73% of adolescents in 2003 and 2008, respectively ($p = 0.5$). In 2003, the reference fo soda consumption was lower on weekdays than on weekends (49 *versus* 59%; $p < 0.01$). However, in 2008, the difference in the prevalences of soda consumption between weekdays and weekends disappeared (54 *versus* 57%; $p = 0.20$), observing, therefore, a significant increase in the consumption of those drinks on weekdays (Table 1).

Over 5 years, in general, it was also verified an increase in the proportion of consumption of guarana syrup-based beverages (25 *versus* 33%; $p < 0.01$). However, the proportion of adolescents who reported consuming these drinks during weekdays increased in, approximately, 50% (21 *versus* 31%; $p < 0.01$), considering that in both studies the consumption of those beverages was less frequent on weekends (2003: 7% and 2008: 8%) in comparison to weekdays (Table 1).

Between 2003 and 2008, there was an increase in the prevalence of consumption of processed juice (22 *versus* 25%; $p = 0.02$) and a reduction on the consumption

of tea/mate/coffee (55 *versus* 44%; $p < 0.01$), which was reduced by 22% on weekdays (50 *versus* 39%; $p < 0.01$). Although modest, the consumption of alcohol during weekdays doubled (1 *versus* 2%; $p = 0.04$). In both studies, it was observed greater frequency of processed juice consumption, tea/mate/coffee on weekdays and of alcohol on weekends (Table 1).

Considering the quantities consumed of those beverages, it was observed that, both in 2003 and in 2008, the mean consumption of the *guaraná* syrup-based beverage was higher on weekdays in comparison with weekends (2003: 49 *versus* 26 mL; $p = 0.02$ and 2008: 62 *versus* 29 mL; $p < 0.01$). The same was observed for natural juice (2003: 102 *versus* 80 mL; $p < 0.01$ and 2008: 92 *versus* 53 mL; $p < 0.01$). On the other hand, other beverages were consumed in larger quantities during weekends, notably, soda (2003: 155 *versus* 346 mL; $p < 0.01$ and 2008: 168 *versus* 367 mL; $p < 0.01$), alcohol (2003: 0.3 *versus* 45 mL; $p < 0.01$ and 2008: 13 *versus* 106 mL; $p < 0.01$), and beverages with added sugar in general (2003: 248 *versus* 402 mL; $p < 0.01$ and 2008: 271 *versus* 431 mL; $p < 0.01$) (Table 2).

In relation to the calories provided by those drinks, it was verified an increase in energy from the consumption of beverages in general, both when it was considered the daily

Table 1. Prevalence of beverage consumption on weekdays and on weekends. Adolescent students of public schools in Niterói, RJ, 2003 and 2008.

Beverages	2003 (n = 433) %			2008 (n = 510) %		
	Global	Weekdays	Weekends	Global	Weekdays	Weekends
Milk and dairy products (total)	94	82[b]	78[c]	93	89[b]	73[c]
Milk in natura	89[a]	70	65[c]	84[a]	76[e]	58[c,e]
Yogurt/dairy beverages	16	10[b]	9	19	15[b,e]	8[e]
Chocolate flavored milk	37[a]	27[b,d]	24[d]	44[a]	37[b,e]	26[e]
Beverages with added sugar (total)	81[a]	63[b]	67	86[a]	74[b]	69
Soda	75	49[b,d]	59[d]	73	54[b]	57
Guaraná syrup-based beverages	25[a]	21[b,d]	7[d]	33[a]	31[b,e]	8[e]
Processed juice	22[a]	18[d]	9[d]	25[a]	20[e]	9[e]
Tea/mate/coffee	55[a]	50[b,d]	36[c,d]	44[a]	39[b,e]	31[c,e]
Natural juice	51	41[d]	21[d]	46	41[e]	16[e]
Alcoholic beverages*	6	1[b,d]	5[d]	8	2[b,e]	7[e]

In order to compare the prevalences of beverage consumption between 2003 and 2008, the χ^2 was used: [a]global comparison of 2003 with 2008 ($p < 0.05$); [b]comparison of weekdays of 2003 with 2008 ($p < 0.05$); [c]comparison of weekends of 2003 with 2008 ($p < 0.05$); [d]comparison of weekdays and weekends of 2003 ($p < 0.05$); [e]comparison of weekdays and weekends of 2008 ($p < 0.05$); *beer, liquor, wine, vodka, and whiskey.

mean per capita (269 *versus* 327 kcal; p = 0.01) and the mean percentage contribution of the beverages for the total energy intake/day (13 *versus* 14 %; p = 0.04). The soda was the drink that contributed the most for the total energy intake within the 2 years evaluated (4%). When considering only the individuals who reported the consumption of each beverage, it was also observed an increase in the percentage contribution of beverages to the total caloric intake (13 *versus* 15%; p = 0.02) (Table 3).

Table 2. Means and confidence intervals of 95% of the daily consumption of beverages on weekdays and on weekends. Adolescent students of public schools in Niterói, RJ, 2003 and 2008.

Beverages	2003 (n = 433) (mL)			2008 (n = 510) (mL)		
	Global	Weekdays	Weekends	Global	Weekdays	Weekends
	Mean (95%CI)					
Milk and dairy products (total)	158 (137 – 179)	154 (135 – 184)	156 (139 – 174)	162 (151 –173)	163 (149 – 177)	165 (146 – 184)
Milk in natura	82 (70 – 94)	84 (70 – 99)	77 (63 – 91)	74 (62 – 87)	78 (64 – 92)	72 (54 – 91)
Yogurt/dairy beverages	13 (7 – 18)	12 (6 – 18)	15 (9 – 21)	15 (10 – 19)	16 (9 – 22)	14 (8 – 20)
Chocolate flavored milk	63 (51 – 76)	63 (49 – 77)	64 (51 – 77)	73 (61 – 85)	70 (56 – 83)	79 (61 – 97)
Beverages with added sugar (total)	300 (232 – 367)	248[d] (178 – 319)	402[d] (317 – 487)	318 (279 – 356)	271[e] (241 –301)	431[e] (356 – 504)
Soda	218 (163 – 264)	155[d] (103 – 205)	346[d] (263 – 429)	230 (194 – 267)	168[e] (141 – 195)	367[e] (285 – 450)
Guaraná syrup-based beverages	41 (27 – 56)	49[d] (29 – 70)	26[d] (12 – 40)	49 (40 – 59)	62[e] (51 – 73)	29[e] (16 – 41)
Processed juice	40 (28 – 51)	44 (32 – 57)	30 (17 – 44)	38 (29 – 48)	41 (31 – 51)	34 (21 – 48)
Tea/mate/coffee	82 (59 – 104)	84 (55 – 112)	78 (41 – 115)	57(44 – 70)	58 (46 – 71)	58 (42 – 75)
Natural juice	94 (76 – 113)	102[d] (78 – 125)	80[d] (56 – 104)	78 (67 – 89)	92[e] (79 – 104)	53[e] (39 – 66)
Alcoholic beverages*	15 (-5 – 34)	0,3[d] (-4 – 5)	45[d] (-10 – 99)	44 (13 – 75)	13[e] (1 – 26)	106[e] (23 – 189)

In order to compare these quantities, the Student's *t*-test for independent samples was used: [a]global comparison of 2003 with 2008 ($p < 0.05$); [b]comparison of weekdays of 2003 with 2008 ($p < 0.05$); [c]comparison of weekends of 2003 with 2008 ($p < 0.05$); [d]comparison of weekdays and weekends of 2003 ($p < 0.05$); [e]comparison of weekdays and weekends of 2008 ($p < 0.05$); *beer, liquor, wine, vodka, and whiskey.

Table 3. Mean daily energy intake from beverages and their contribution for the total daily energy intake for the overall population of consumers of specific beverages. Adolescent students of public schools Niterói, RJ, 2003 and 2008.

Beverages	2003 (n = 433)				2008 (n = 510)			
	Overal mean		Mean for consumers of each beverage[b]		Overal mean		Mean for consumers of each beverage[b]	
	Daily energy intake from beverages (kcal)[a]	Contribution of beverages for the total daily energy intake (%)[a]	Daily energy intake from beverages (kcal)[b]	Contribution of beverages for the total daily energy intake (%)[b]	Daily energy intake from beverages (kcal)[a]	Contribution of beverages for the total daily energy intake (%)[a]	Daily energy intake from beverages (kcal)[b]	Contribution of beverages for the total daily energy intake (%)[b]
Milk and dairy products (total)	123	6.0	132	6.3	130	6.0	139	6.4
Leite in natura	51	2.5	58	2.8	47	2.1	56	2.5
Yogurt/dairy beverages	9	0.4	54	2.6	10	0.5	57	2.7
Chocolate flavored milk	64	3.1	167	8.0	73	3.4	169	7.9
Beverages with added sugar (total)	115	5.4	139	6.5	125	5.6	150	6.6
Soda	87	4.0	116	5.3	89	3.9	123	5.4
Processed juice	13	0.6	58	2.9	17	0.8	70	3.1
Guaraná syrup-based beverages	16	0.7	59	2.7	19	0.8	58	2.6
Tea/mate/coffee	2	0.1[c]	3	0.1	1	0.05[c]	3	0.1
Natural juice	17	0.8	34	1.7	16	0.8	35	1.6
Alcoholic beverages*	9	0.4	186	8.6	27	0.9	305	10.5

[a]per capita mean, considering the whole population studies; [b]values regarding the individuals who specifically consumed each beverage; for comparison between the means of 2003 and 2008, the Student's *t*-test was used for independent populations: [c]comparison of the percentage contribution of beverages for the total energy consumption of 2003 with 2008 ($p < 0.05$); *beer, liquor, wine, vodka, and whiskey.

DISCUSSION

We analyzed the changes in beverage consumption among adolescents of public schools in the metropolitan area of Rio de Janeiro from the data obtained in two cross-sectional school-based studies in 2003 and in 2008. It was observed a reduction in the prevalence of milk consumption and beverages with added sugar, especially *guaraná* syrup-based beverages. Individually, soda were beverages with the greatest contribution for the mean daily energy intake. It was notorious that the change of habits in the consumption of those beverages, which in 2003, were more frequently consumed on weekends, and, in 2008, they started being as common during weekdays and on weekends.

The prevalence of milk consumption (94%) in Niterói was higher than the frequency of 78.6% observed for adolescents in the Federal District evaluated in a cross-sectional study for the application of the questionnaire of food consumption frequency[14]. The mean daily milk intake observed for adolescents in Niterói (158 mL) was similar to the mean estimated for Brazilian adolescents in the National Food Survey 2008-2009[12]. The findings of this study regarding milk consumption are comparable to the ones observed by Nielsen et al.[24] for adolescents in elementary school and high school who showed reduction in their milk consumption over a period of 5 years. The reduction in milk consumption is concerning, once that, during adolescence, there is a peak in bone density, and the reduction of calcium intake may affect bone health in early life[25].

The mean consumption of soda among adolescents in Niterói was comparable to the one observed by Carmo et al.[26] among students of the city of Piracicaba, São Paulo (230 mL/day). The National Student Health Survey, carried out in 2009, also showed that adolescents often consume soda, once that 37.2% of the students investigated reported having had soda in 5 or more days during the week prior to the investigation[27]. Similarly to what was observed in this study, a study carried out with American adolescents showed that soda contributed with 67% of the calories from beverages with added sugar[28].

In studies with American adolescents, the increased consumption of soda was associated with the reduction of milk and dairy products[29]. The same way, it is possible that, among adolescents in Niterói, the increased consumption of beverages with added sugar may have contributed to for the reduction of milk consumption. The increased consumption of beverages with added sugar has been associated with an impairment in the quality of the diet of adolescents[30], with the onset of overweight and obesity[10] and with type 2 diabetes among adults[31]. The association between the consumption of beverages with added sugar and the increase in obesity has been attributed to lower satiety provided by liquid foods in relation to solid ones, owing to the activation of satiety mechanisms[32], and to the incomplete potential for energy intake, which may contribute to the increased caloric intake and weigh gain[33].

Another important finding of this study was the increase, in the period of 5 years, in the consumption of alcohol, especially during weekdays among adolescents. The consumption of alcohol among adolescents has been reported with frequency both in Brazil[34] and in other countries[35].

These results are disturbing, once that, the sooner the contact with alcohol, the higher the chances of its excessive intake and of alcohol dependency throughout life[36].

The use of food records data described according to the days of the week allowed the evaluation and variation of consumption habits of beverages according to this important source of variability of food consumption[37]. This kind of analysis allows us to raise hypothesis about the main influences on the consumption habits. These analyses are built based on the premise the data of a day in the food entry diary provide reliable information for populational means[38].

This study revealed that the prevalence of consumption of beverages with added sugar, in general, and specifically soft drinks and *guaraná* syrup-based beverages increased for weekdays, but they do not change on weekends, which leads us to think that this change may be related to school routine. However, when evaluating the mean beverage intake volume, it was noticed that, on the weekend, the adolescents would have, on average, a volume 60% higher of beverages with added sugar in comparison to weekdays. This difference may represent an increase of 3,000 kcal over an year, which may result in a positive imbalance of energy and possible weight gain.

Studies that evaluated the food consumption on weekdays also have shown similar results to the ones in this study, once that they observe higher ingestion of soft drinks and other beverages with added sugar, alcohol and lower intake of whole grain foods and, as a consequence, more energy and sugar on weekends[39,40]. This pattern of differentiated consumption between weekdays and weekends may be related to a more forgiving behavior during weekends, once there is less concern for schedules and daily routine obligations[41].

The high proportion of nonresponse for the data of food consumption could be considered as a possible limitation of this study; however, there were no significant differences regarding gender, age range, and weight status among the participants of the overall studies and those included in the present analysis. Besides, since the sample of at least 433 adolescents in each group, it is possible to estimate differences in the consumption of beverages of 8.3% points, with confidence interval of 95% and power of 80%[42]. Thus, it is assumed that the nonresponse did not introduce bias to the results observed.

The limitations inherent to the method of food record, such as the need of intense cooperation by the participants, could lead to losses in the quality of the food consumption data. During the collection of the data, there were developed procedures in order to ensure the quality of the data, once that the food records are thoroughly reviewed by trained nutritionists who would clarify notes that could generate doubts, such as incomplete or incomprehensible data; additionally, there were criteria adopted for the critics of the data with the identification of implausible energy intake[23].

A strong point of this study is the representativeness of the samples investigated. Using the same sample design, in 2003 and in 2008, there were selected probability samples of adolescents enrolled between the fifth grade of Elementary School and the third year of High School in public schools in Niterói. It is considered, therefore, that the results presents may be generalized for this group of the population.

The panel study is also a positive characteristic of this study. Panel studies are made by repeated cross-sectional surveys, which provide a means for understanding the dynamics in

the changes of specific aspects of the population[43]. Thus, this study has the merit of focusing changes in the consumption of beverages by adolescents over time, a little privileged area of research in the country.

This analysis had the merit of evaluating the variations of beverage consumption in the period from 2003 to 2008, which was characterized by important changes in the social and economic situations of the country, which affected mainly the most disadvantaged groups economically[44,45] as is the case of the students of public schools evaluated, which experienced increased power of purchase, which would explain, at least in parts, the increased consumption of processed beverages, especially, soft drinks and *guaraná* syrup-based beverages.

The findings of this study are consistent with the typical characteristics of the process, which has been known as nutritional transition, reported in various parts of the world[46,47] and which has also been observed in Brazil over the last decades[14,48,49]. This process is characterized by modifications in the diet and in the pattern of physical activity, which contribute for the increased rates of obesity and noncommunicable chronic diseases related with nutrition. Among these changes, we highlight the increase of beverages with added sugar, whose effect over health has been reported in different contexts[6,33,31].

CONCLUSION

The main changes in the profile of beverage consumption among adolescents in Niterói in the first decade of the 21st century were the trend for the reduction of milk consumption and the increase in the consumption of processed and alcoholic beverages. It has also highlighted the displacement of the consumption of soda to weekdays and the increased consumption of *guaraná* syrup-based beverages.

This particular aspect of food consumption among adolescents, changes along time, have been little studies in Brazil, and the results presented contribute to support initiatives aimed at encouraging healthy food habits in this age group, which should include the consumption of beverages as one of the targets of attention.

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