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Added sugar intake by adolescents: A population-based study

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Abstract *The aim of the present study was to estimate the prevalence of added sugar intake within the maximum limit of 5% of the total energy of the diet and test associations with demographic/socioeconomic characteristics, health-related behaviors and nutritional status in adolescents. A population-based, cross-sectional study was conducted with two-stage cluster sampling. The amount of free sugar in the diet was estimated using a 24-hour dietary recall. Among the 924 adolescents evaluated, only 20.1% (95% CI: 16.8-23.9) met the recommendation of not exceeding 5% of total calories with added sugar. Higher prevalence rates of adherence to the recommendation were found among males (22.0%), adolescents aged 15 to 19 years (24.3%), those born outside the state of São Paulo (30.4%), those with less screen time (27.5%), those with a lower number of household appliances (0-7: 29.5%; 8-15: 20.3%) and those with higher diet quality scores (2nd tertile: 17.7%; 3rd tertile: 37.2%). The findings demonstrate factors associated with added sugar intake from an epidemiological perspective, revealing the simultaneity of inappropriate behaviors, that is, the adolescents who consume more sugar also have longer screen time and worse overall diet quality.*

Key words *Sugar, Food consumption, Adolescent, Health surveys*

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Introduction

The World Health Organization (WHO) previously recommended that the intake of added sugar be limited to a maximum of 10% of the total energy value of one's diet, but reduced this figure to 5% in 2015[1]. Added sugar is that extracted from foods and subsequently incorporated into meals and processed food products, such as cookies, soft drinks and sweets[2]. The sugars most often added to foods and food products are sucrose (table sugar) and high-fructose corn syrup, the latter of which is produced by the enzymatic isomerization of glucose into fracture and revolutionized the industry of sweeteners and soft drinks[3].

In Brazil, a tendency toward a reduction in the purchasing of table sugar occurred between 1987 and 2009, but a significant increase occurred in the acquisition of highly processed foods, which are energy dense as well as high in sugar, sodium and both total and saturated fat[4]. In a 16-year period from 1987 to 2003, the Brazilian diet came to have more sugar from highly processed foods (from 17.4% to 35.5%), with increases in the contribution of soft drinks (200%) and cookies (100%) to the total intake of free sugar[5]. In the USA, nearly 90% of added sugar comes from highly processed foods, the three main sources of which are soft drinks (17.1%), sweetened juices (13.9%) and cookies, cakes and pies (11.2%), with table sugar accounting for 8.7% of added sugars in the American diet[6].

In the human organism, sugar is converted into energy through reactions that can lead to the depletion of vitamins, such as thiamine, niacin and riboflavin, which are necessary for the oxidation of glucose[7]. A high sugar intake favors the development of health problems, such as nutritional deficiency[7], dental caries[1], weight gain[1,8,9], arterial hypertension[8,10], type 2 diabetes[8,9,11], cardiovascular disease[8-11], metabolic syndrome[8] and non-alcoholic fatty liver disease[8,12]. Researchers have found that, independently of metabolic syndrome, the consumption of soft drinks increases the occurrence of non-alcoholic fatty liver disease for reasons related to the metabolism of fructose; moreover, the use of aspartame and caramel dye promotes insulin resistance and inflammation[12].

Public health measures directed at the reduction in the amount of sugar in the diet are required to contain the epidemic of chronic non-communicable diseases, but face resistance in the form of the political and economic influence exerted by the food industry and producing countries[13,14]. In Brazil, the Ministry of Health and Brazilian Association of Food Industries (ABIA) are discussing setting gradual voluntary goals to diminish the sugar content in processed foods and similar accords are being established for the reduction in sodium[15]. The Dietary Guidelines for the Brazilian population, published in 2014, was a measure of considerable importance to the promotion of healthy eating and the protection of food culture in Brazil. This guide organizes foods based on the extent and purpose of industrial processing, recommending the moderate use of sugar as a cooking ingredient for foods, such as home-made fruit-based sweets, and warning the population to avoid the intake of sugar from highly processed products[16].

Considering the increase in the consumption of foods rich in sugar and its association with the development of chronic diseases, it is important to evaluate the diet of adolescents in an attempt to prevent current and future harm to health. Thus, the aim of the present study was to estimate the prevalence of added sugar intake and its association with demographic/socioeconomic variables, health-related behaviors and body mass index in adolescents aged 10 to 19 years residing in the city of Campinas, state of São Paulo, Brazil.

Methods

Study population and sampling process

A population-based, cross-sectional study was conducted using data from a health survey performed between 2008 and 2009 in the city of Campinas (hereafter referred to as the ISACamp survey) with community-dwelling individuals residing in urban areas of the city. The sample was selected using a probabilistic two-stage cluster sampling procedure. In the first stage, 50 census sectors were selected with probability proportional to size given by the number of homes in the sector. In the second stage, the systematic selection of homes was performed based on the list of addresses in the selected sectors. The list was updated in the field.

The calculation of the number of individuals needed to compose the sample was based on a 50% prevalence rate (corresponding to the maximum variability for the frequency of the events studied), 95% confidence level, 4% and 5% sampling error and a design effect of 2, totaling 1000 individuals in each age group: adolescents (10 to

19 years), adults (20 to 59 years) and seniors (60 years or older). Considering an 80% response rate, the sample size was increased to 1250. To obtain the desired sample size in each domain, 2150, 700 and 3900 homes were selected independently for interviews with adolescents, adults and seniors, respectively. Further details on the sampling process can be found in a study by Alves[17]. The present investigation involved the analysis of data from male and female adolescents who completed the 24-hour dietary recall (24HR).

Data collection and variables analyzed

Trained, supervised interviewers collected the data using a questionnaire organized in blocks of topics that was tested in a pilot study. The section on eating habits included the 24HR, which was administered throughout the course of one year on different days of the week and with the support of a photo album for dietary surveys. Training of the interviewers for the use of the 24HR was performed by a nutritionist who monitored the quality of the data collected and counseled the team in cases of possible flaws in filling out the 24HR. The at-home interviews were held with all residents in the age group selected for that household.

The dependent variable was added sugar intake not surpassing a maximum of 5% of the total energy intake of one's diet. Sugar intake was estimated from the 24HR.

The 24HR was quantified for the transformation of the amounts of foods and meals reported in the home recipes into grams or milliliters. For such, information available on home measure tables[18,19], food labels and customer service publications was used. The dietary calculation of ingested foods was performed using the Nutrition Data System for Research, version 2007 (NCC Food and Nutrient Database, University of Minnesota, USA).

The following were the independent variables:

Demographic and socioeconomic variables: sex, age group (in years), place of birth, schooling of head of household (in years of study), household income *per capita* (using the Brazilian monthly minimum wage as reference), number of home appliances (refrigerator, freezer, washing machine, air conditioner, vacuum cleaner, etc.), private health insurance (yes or no) and whether the participant attended school.

Health-related behaviors: smoking, consumption of alcoholic beverages, screen time (television and computer in hours/day), practice of physical activity during recreation (active: adolescents aged 10 to 17 years who practiced at least 60 minutes of physical activity per day at least five days a week and adolescents 18 to 19 years who practiced at least 150 minutes weekly distributed among at least three days)[20]; Score on the Brazilian Healthy Eating Index-Revised (BHEI-R)[21], categorized in distribution tertiles. The BHEI-R has been adapted and validated for the Brazilian population and has 12 components: nine related to food groups (total fruits; whole fruits; total vegetables; dark-green/orange vegetables and legumes; total cereals; whole-grain cereals; milk and milk byproducts; meat, eggs and legumes; and oils), two related to nutrients (sodium and saturated fat) and one assessing the percentage of energy from saturated and *trans* fats, alcohol and added sugar. The components receive scores ranging from zero (minimum) to 5, 10 or 20 (maximum), depending on the component and the intake level of the food items. The total BHEI-R score corresponds to the sum of the 12 components and ranges from zero (worse) to 100 points (best diet quality)[21].

Body mass index (BMI): calculated from reported measures of weight and height. For the classification of the nutritional status of the adolescents, the cutoff points of BMI for age recommended by the WHO were used: BMI < 3rd percentile = underweight; ≥ 3rd and ≤ 85th percentile = ideal range; > 85th and ≤ 97th percentile = overweight; and > 97th percentile = obese[22].

Data analysis

The prevalence rates of added sugar intake not exceeding 5% of the total energy intake of the diet were estimated. Associations with the independent variables were determined using the Rao-Scott test with a 5% level of significance. Crude and adjusted (sex and age) prevalence ratios (PR) and 95% confidence intervals (CI) were calculated. Variables with a p-value < 0.20 on the association test were incorporated into the Poisson multiple regression model, which was developed in two steps. Demographic/socioeconomic variables were incorporated in the first step and those with a p-value < 0.05 remained in the model. Health-related behaviors and BMI were incorporated in the second step and those with a p-value < 0.05 remained in the model. Both steps were adjusted by total dietary energy intake (kcal)[23]. The interviews were digitized in a databank developed in Epidata 3.1 (Epidata As-

soc., Odense, Denmark) and the statistical analysis were performed with the aid of the Stata 11.0 program (Stata Corp., College Station, USA), using the *svy* module, which enables the incorporation of complex sampling weights in the survey.

Ethical aspects

This study received approval from the Human Research Ethics Committee of the State University of Campinas and the Brazilian National Research Ethics Committee. Adult participants signed a statement of informed consent. For participants less than 18 years of age, a legal guardian signed the statement of informed consent.

Results

Among the 929 adolescents identified in the selected homes, five declined to provide information for the 24-hour dietary recall. Thus, the information from 924 individuals aged 10 to 19 years was analyzed. Mean age was 14.1 years (95% CI: 13.9 to 14.4 years).

The sample had similar proportions of boys (51.0%) and girls. The 10-to-14-year-old age group accounted for the largest portion of the sample (54.9%). Individuals born in the city of Campinas (75.8%), segments with a lower family income (63.3%) and lower schooling of the head of the household (75.3%) and those who studied at public schools (65.7%) accounted for the majority of the sample. Moreover, 79.0% were not physically active during recreational activities, 78.2% had a longer screen time (> 3 hours/day) and 73.6% were either underweight or within the ideal range (Table 1).

Sugar intake accounted for 12.4% (95% CI: 11.6 to 13.1) of the total energy intake of the adolescents: 12.0% (95% CI: 11.1 to 12.9) among the boys and 12.7% (95% CI: 11.9 to 13.7) among the girls. The main sources of free sugars were beverages (54.8%), cookies (12.8%), sweets (12.4), cakes/breads (9.9%), table sugar/honey (7.9%) and other foods, such as chips, pizza and pasta (2.2%) (data not presented in table).

The prevalence of added sugar intake within the 5% limit of total energy intake of one's diet was 20.1% and was higher among adolescents aged 15 to 19 years, those without private health insurance and those attending public school. Lower prevalence rates were found in the subgroups of adolescents with an income higher than the Brazilian monthly minimum wage, those with 16 or more appliances in the home and those whose heads of families had 12 or more years of schooling (Table 2).

Table 1. Distribution of sample according to demographic/socioeconomic variables, health-related behaviors and body mass index among adolescents aged 10 to 19 years. Campinas Health Survey (ISACamp, 2008-2009).

Variables and categories	n	%	95% CI***
Sex			
Male	466	51.0	47.6 – 54.2
Female	458	49.0	45.7 – 52.4
Total	924	100.0	
Age group (in years)			
10-14	508	55.0	51.2 – 58.7
15-19	416	45.0	41.3 – 48.8
Place of birth			
Campinas	701	75.8	67.7 – 83.8
Other municipality in state of São Paulo	104	11.4	7.7 – 15.0
Other state	119	12.8	7.6 – 18.0
Schooling of head of household (years)			
0-7	387	41.5	31.7 – 51.3
8-11	313	33.8	27.3 – 40.3
12 or more	213	24.7	16.0 – 33.2
Income per capita (in minimum wages)			
< 0.5	292	31.3	24.2 – 38.4
≥ 0.5-1	300	32.0	25.6 – 38.3
> 1	332	36.7	28.6 – 44.7
Attends school			
No	144	15.4	12.0 – 18.8
Yes, public	617	65.7	57.4 – 74.0
Yes, private	162	18.9	10.1 – 27.6
Physical activity during recreation			
Inactive / insufficiently active	733	79.0	74.0 – 84.1
Active	191	21.0	15.9 – 26.0
Screen time (hours/day)			
≤ 3	198	21.8	16.3 – 27.3
> 3	707	78.2	72.7 – 83.7
BMI (kg/m2)			
Underweight / eutrophic	603	73.6	70.7 – 76.5
Overweight / obese	216	26.4	23.5 – 29.3

*n: number of individuals in unweighted sample; **%: estimates take into account design effect and sample weights; ***CI: confidence interval.

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Table 3 shows that adolescents who used a computer or television more than three hours a day had higher added sugar intake. Moreover, higher prevalence rates of added sugar intake within the 5% limit of total energy intake were found with the increase in diet quality scores, with a nearly sevenfold higher rate among adolescents with the best diet quality (third tertile) compared to those with the worst diet quality (first tertile).

The results of the Poisson multiple regression analysis (Table 4) indicate that meeting the acceptable limit of added sugar in the diet was more frequent among adolescents aged 15 to 19 years, males, individuals not having been born in the state of São Paulo, those with a smaller number of appliances in the home, those who dedicated less time to the use of a TV and computer and those with higher diet quality scores.

Discussion

In the present study, only 20.1% of the adolescents complied with the WHO recommendation of added sugar intake not exceeding 5% of the total energy intake of one's diet. Moreover, some segments of the population proved to be more

Table 2. Prevalence and prevalence ratios (PR) of added sugar intake within maximum limit of 5% of total energy intake from diet according to demographic and socioeconomic variables in adolescents aged 10 to 19 years. Campinas Health Survey (ISACamp, 2008-2009).

Variables and categories	n*	Prevalence (95% CI)	PR (95% CI)**	$PR_{adjusted}$*** (95% CI)
Sex		p = 0.179		
Male	466	22.0 (17.3-27.4)	1	1
Female	458	18.2 (14.5-22.5)	0.83 (0.62-1.09)	0.82 (0.62-1.08)
Total	924	20.1 (16.8-23.9)		
Age group (in years)		**p = 0.003**		
10-14	508	16.6 (13.2-20.8)	1	1
15-19	416	24.3 (19.7-29.5)	1.46 (1.14-1.86)	1.46 (1.14-1.87)
Place of birth		**p = 0.010**		
Campinas	701	18.2 (14.8-22.1)	1	1
Other municipality in state of São Paulo	104	21.2 (15.1-28.9)	1.17 (0.79-1.71)	1.15 (0.78-1.70)
Other state	119	30.4 (21.1-41.7)	1.67 (1.20-2.34)	1.58 (1.13-2.21)
Schooling of head of household (years)		**p = 0.036**		
0-7	387	21.8 (16.3-28.4)	1	1
8-11	313	23.2 (18.5-28.6)	1.06 (0.75-1.51)	1.07 (0.76-1.51)
12 or more	213	13.2 (9.0-18.8)	0.60 (0.38-0.95)	0.59 (0.38-0.92)
Income per capita (in minimum wages)		**p = 0.046**		
< 0.5	292	25.5 (19.7-32.3)	1	1
≥ 0.5-1	300	20.4 (15.0-27.0)	0.80 (0.56-1.13)	0.81 (0.57-1.14)
> 1	332	15.2 (10.7-21.3)	0.60 (0.39-0.91)	0.57 (0.38-0.87)
Number of appliances in home		**p < 0.001**		
0-7	190	29.5 (21.7-38.7)	2.17 (1.40-3.38)	2.24 (1.45-3.44)
8-15	468	20.3 (16.8-24.2)	1.49 (1.05-2.12)	1.55 (1.10-2.19)
16 or more	265	13.6 (9.7-18.7)	1	1
Private health insurance		**p = 0.008**		
Yes	310	14.4 (10.1-19.9)	1	1
No	609	23.2 (19.1-27.8)	1.61 (1.12-2.31)	1.67 (1.17-2.39)
Attends school		**p = 0.012**		
No	144	27.8 (20.5-36.4)	2.12 (1.25-3.61)	1.87 (1.08-3.23)
Yes, public	617	20.3 (16.6-24.7)	1.55 (0.96-2.52)	1.64 (1.03-2.61)
Yes, private	162	13.1 (8.2-20.3)	1	1

*n: number of individuals in unweighted sample; **CI: confidence interval; **PR: prevalence ratio; ***PR adjusted for sex and/or age group; p: p-value of chi-squared test.

Table 3. Prevalence and prevalence ratios (PR) of added sugar intake within maximum limit of 5% of total energy intake from diet according to health-related behaviors and BMI in adolescents aged 10 to 19 years. Campinas Health Survey (ISACamp, 2008-2009).

Variables and categories	n*	Prevalence (95% CI)	PR (95% CI)**	$PR_{adjusted}$*** (95% CI)
Smoking		p = 0.109		
Never smoked	882	19.6 (16.3-23.3)	1	1
Ex-smoker/smoker	42	31.0 (17.4-49.0)	1.58 (0.93-2.70)	1.35 (0.77-2.36)
Use of alcoholic beverage		p = 0.118		
Does not drink	773	19.1 (15.8-22.9)	1	1
Drinks	146	25.4 (17.8-34.8)	1.33 (0.93-1.88)	1.11 (0.75-1.63)
Physical activity during recreation		p = 0.126		
Inactive / insufficiently active	733	18.8 (15.2-23.0)	0.75 (0.52-1.08)	0.76 (0.51-1.13)
Active	191	25.1 (18.0-33.8)	1	1
Screen time (hours/day)		**p = 0.009**		
≤ 3	198	27.5 (21.2-34.8)	1	1
> 3	707	17.7 (14.1-22.0)	0.64 (0.46-0.88)	0.68 (0.49-0.94)
Diet quality score (tertile#)		**p< 0.001**		
1st tertile	307	5.5 (3.3-9.3)	1	1
2nd tertile	308	17.7 (13.0-23.6)	3.20 (1.92-5.30)	3.24 (1.95-5.38)
3rd tertile	308	37.2 (31.0-43.9)	6.72 (4.03-11.19)	6.86 (4.12-11.43)
BMI (kg/m2)		p = 0.633		
Underweight / ideal	603	19.5 (15.7-23.8)	1	1
Overweight / obese	216	20.6 (16.0-26.2)	1.06 (0.83-1.35)	1.13 (0.85-1.49)

*n: number of individuals in unweighted sample; **CI: confidence interval; **PR: prevalence ratio; ***PR adjusted for sex and/or age group; ****BMMW: Brazilian monthly minimum wage; p: p-value of chi-squared test; # DQI-R score: 1st tertile (18.68 to ≤ 48.76), 2nd tertile (> 48.76 to ≤ 59.50) and 3rd tertile (> 59.50 to 83.92).

vulnerable to high sugar intake, such as girls, those who had more screen time, those with a higher socioeconomic status, younger adolescents and those with very low diet quality scores.

One of the limitations of this study was the application of only a 24-hour dietary recall, which may not reflect the habitual intake of the adolescents, since considerable variation is found in terms of diet[24]. However, a 24HR is considered adequate for evaluating the mean intake of foods and nutrients when used in a population-based study and administered on different days of the week and in different months of the year[24]. Other limitation related to the use of a 24HR regards the difficulty in recalling all foods ingested in detail and the possibility of either overestimating or underestimating the size of the portions, which are key determinants of information quality. To minimize this limitation, the ISACamp interviewers were duly trained for the administration of the instrument and made use of a photo album[25]. Moreover, the cross-sectional design does not enable interpreting the findings in terms of cause and effect.

The contribution of added sugar to total energy intake was 12.4% (12.0% among boys and 12.7% among girls). This finding is lower than the figure reported in a national study, which was around 20.0% for males and 25.0% for females[26]. The figure was also lower than the 19% reported in a European study (18.9% for boys and 19.9% for girls)[27] and figures reported in an American study (17.5% for boys and 16.6% for girls) involving adolescents aged 12 to 19 years[28]. The lower contribution in the present study may be explained by some factors. In ERICA 2013-2014[26], 10 g of sugar was attributed to each 100 ml of beverage when the habitual consumption of sugar was reported, whereas 5g/100 ml was attributed in the ISACamp survey. Moreover, the consumption of highly processed products is much higher in developed countries than in Brazil[4,6].

The main sources of sugar in the diet of the adolescents were sweetened beverages (54.8%), cookies (12.8%), candies (12.4%), cakes/bread (9.9%) and table sugar/honey (7.9%). In a previous study conducted in Brazil, the foods the most furnished added sugar to adolescents

Table 4. Poisson multiple regression model; Campinas Health Survey (ISACamp, 2008-2009).

Variables and categories	First step $PR_{adjusted}$* (95% CI)	Second step $PR_{adjusted}$** (95% CI)
Sex		
Male	1	1
Female	**0.69 (0.52-0.92)**	**0.73 (0.55-1.00)**
Age group (in years)		
10-14	1	1
15-19	**1.51 (1.18-1.94)**	**1.59 (1.24-2.03)**
Place of birth		
Campinas	1	1
Other municipality in state of São Paulo	1.15 (0.77-1.72)	1.14 (0.74-1.76)
Other state	**1.41 (1.03-1.93)**	**1.39(1.03-1.88)**
Number of appliances in home		
0-7	**1.93 (1.28-2.91)**	1.39 (0.89-2.17)
8-15	**1.46 (1.03-2.07)**	1.31 (0.91-1.89)
16 or more	1	1
Screen time (hours/day)		
≤ 3		1
> 3		**0.74 (0.54-1.00)**
Diet quality score (tertile#)		
1st tertile		1
2nd tertile		**3.05 (1.86-5.01)**
3rd tertile		**5.72 (3.41-9.58)**

*PR: prevalence ratio adjusted for energy (kcal) and demographic/socioeconomic variables. **PR: prevalence ratio adjusted for energy (kcal) and all variables in first step.

were candies and desserts (41.0%), beverages (soft drinks, juices and sweetened fruit drinks) (37.0%) and milk products (10.0%)[29]. In a study conducted in Europe, sweetened beverages, sweets, sugar/honey/jam and chocolate contributed more free sugar to the diet of adolescents[27]. The increase in the consumption of sweetened beverages is a major concern around the world[8,12]. The change in the consumption pattern was quite intense in Brazil. From 1974 to 2003, the participation of soft drinks to the total number of calories increased 400.0%[30]. Among adolescents at public schools in the city of Niterói in the state of Rio de Janeiro, the prevalence of the consumption of beverages with added sugar increased from 81.0% to 86.0% and the list included chocolate milk (37.0% to 44.0%), processed juice (22.0% to 25.0%) and guarana syrup-based drinks (25.0% to 33.0%); moreover, soft drinks stood out as the major source of energy from the diet at both evaluation times[31]. The Brazilian School Feeding Program (PNAE) has sought to reduce sugar intake by limiting the offer of sweets on the school menu to two portions per week (110 kcal/portion)[32] and prohibiting the sale of these products in the cafeterias of public and private schools[33].

In the present study, girls had higher sugar intake than boys. In the Study of Cardiovascular Risks in Adolescents (ERICA 2013-2014) conducted with adolescents aged 12 to 17 years, the contribution of free sugars to the total energy intake was 25.0% among the girls and 22.0% among the boys, which is more than twice the maximum limit stipulated by the Brazilian Ministry of Health (< 10%)[26]. In European adolescents, added sugar represented 18.9% of total energy among males and 19.9% among females ($p < 0.001$)[27]. Data from the National School-based Health Survey (PeNSE) indicate the girls have a higher regular consumption (≥ five days a week) of sweets (58.4% *versus* 42.6%) and cookies (35.8% *versus* 31.1%) compared to boys and similar soft drink consumption (36.6% among females and 37.9% among males)[34]. An analysis of the National Dietary Survey (INA 2008-2009) revealed that 54.0% of the energy availability in the homes of both sexes was from food products high in solid fats and sugar[29].

Added sugar intake was lower among adolescents between 15 and 19 years of age, as a 51.0% greater frequency of meeting the recent WHO recommendation was found in this group. Behavioral changes, such as the omission of meals and concerns with body weight, may partially explain the observed reduction in sugar intake. Among the participants of the ERICA 2013-2014 (Study of Cardiovascular Risks in Adolescents), the prevalence of skipping breakfast went from 20.1% (95% CI: 18.8 to 21.6%) among adolescents aged 12 to 14 years to 24.0% (95% CI: 22.5 to 25.7%) among those aged 15 to 17 years[35]. In the Campinas Health Survey, the prevalence of dissatisfaction with one's weight was 43.7% (95% CI: 37.9 to 49.8%) among those in the ideal weight range, reaching a prevalence ratio of 1.4 (95% CI: 1.1 to 1.7) in the 15-to-19-year-old age group compared to the 10-to-14-year-old age group[36].

Lower sugar intake was found among individuals who had not been born in the state

of São Paulo. Data from the Household Budget Survey (POF) revealed that the contribution of added sugar to total energy intake was higher in the southeastern region of the country (18.1%) and lower in the northern (13.0%), northeastern, southern (16.3%) and central western (16.7%) regions[5]. Regarding the consumption of foods and beverages in the different regions of Brazil, Souza et al.[26] found important variations in the prevalence rates of soft drinks (about 40% in North and Northeast to 51.2% in the South), juices (46.4% in the south to 59.7% in the Northeast), sweets and desserts (23.2% in the North, 33,4% in the Northeast and 45.9% in the South) and cookies (16.6% in the North, 25.1% in the Southeast and 32.2% in the Northeast). The lower intake of added sugar among individuals not from the state in which they reside may be explained by lower access to processed and highly processed food products stemming from a poorer socioeconomic status or the possible conservation of food culture.

The number of appliances in the home, which is an indicator of socioeconomic status, was associated with higher free sugar intake. The results of the PeNSE 2009 (National School-based Health Survey) indicate a significant increase in the regular consumption (≥ 5 days/week) of soft drinks, sweets and cookies with the increase in the "goods and services" score, which is an indicator composed of consumer goods, an in-door bathroom and maid in the home[34]. In Brazil, the caloric contribution of added sugar in items such as soft drinks, sweets, cookies and milk-based beverages increased from 17.4% at the end of the 1980s to 35.5% in 2002-2003[5]. Between two periods of the Household Budget Survey (2002-2003 and 2008-2009), the participation of highly processed foods to the total home energy availability grew nearly five percentage points (20.8% to 25.4%), increasing significantly with the improvement in income[4]. In emerging countries, a 127% increase in calories from sugar occurred in four decades (1963 to 2003), which was related to a broad gamut of factors, such as urbanization, economic growth, marketing, the opening of the market to importation, the expansion of transnational food corporations and the globalization of eating systems, with the replacement of traditional healthy foods for fast food[14].

The prevalence of added sugar intake within the maximum limit of 5% was lower among adolescents with more screen time. In the PeNSE 2012 edition (National School-based Health Survey), the habit of watching television for two or more hours a day was reported by 78.6% (95% CI: 77.9 to 79.3%) of the participants and the habit of eating in front of the TV was reported by 64.0% (95% CI: 60.7 to 67.2%), with no significant difference between sexes[37]. Using data from the PeNSE 2009 edition, Camelo et al.[38] found that watching TV for more than two hours a day significantly increased the odds of the regular consumption of unhealthy foods, such as sweets (odds ratio [OR] = 1.50; 95% CI: 1.40 to 1.61), soft drinks (OR = 1.34; 95% CI: 1.26 to 1.43), cookies (OR = 1.46; 95% CI: 1.35 to 1.57) and processed meats (OR = 1.42; 95% CI: 1.29 to 1.56), which are products that are highly publicized in advertisements. In a cohort study conducted in New Zealand, 61% of children and adolescents (five to 15 years of age) spent more than two hours a day watching TV, to which was attributed 17% of overweight, 15% of compromised cardiopulmonary capacity, 15% of high cholesterol and 17% of smoking at 26 years of age[39].

Adolescents with higher diet quality scores had higher prevalence rates of complying with the recommended 5% limit of added sugar to total energy intake. Using data from the 2008-2009 Household Budget Survey, Louzada et al.[40] found that the portion of the diet referring to *in natura* or minimally processed foods had less free sugar, saturated fat and *trans* fat as well as more dietary fiber, protein and potassium in comparison to the portion corresponding to highly processed products.

The present study identified epidemiological aspects of the prevalence of added sugar intake in adolescents, estimated based on the recommendation of the World Health Organization to reduce the amount of free sugars to a maximum of 5% of the calorie intake of one's diet. The most vulnerable segments to high sugar intake were girls, adolescents who had more screen time and those with a poorer overall diet quality. These findings reveal the simultaneity of inappropriate behaviors and can assist in the development of strategies directed at health promotion and the adoption of positive changes in lifestyle, including a healthy diet, the practice of physical exercise and social relations. The Dietary Guidelines for the Brazilian population[16] and the Intersectoral Strategy for the Prevention and Control of Obesity: Recommendations for States and Municipalities[41] are important instruments for guiding healthy eating behaviors as well as preventing/controlling obesity and other chronic diseases.

Collaborations

D Assumpção performed the statistical analysis, literature review and writing of the manuscript. M Braz proposed the article and contributed to the discussion section. MBA Barros and AA Barros Filho performed critical reviews of the statistical analysis and writing of the manuscript.

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