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ORIGINAL

Are Brazilian adolescents eating enough fruits and vegetables? An assessment using data from the Study of Cardiovascular Risk in Adolescents

Os adolescentes brasileiros estão comendo frutas e vegetais suficientes? Uma avaliação com dados do Estudo de Risco Cardiovascular de Adolescentes

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ABSTRACT

Objective

To estimate the usual consumption of fruits and vegetables by Brazilian adolescents.

Methods

We used 24-hour dietary recall data from the Study of Cardiovascular Risk in Adolescents conducted in 2013-2014 with 71,740 adolescents between 12 and 17 years old. The usual consumption of fruits and vegetables was estimated in the

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Statistical Analysis Software using the model of the United States National Cancer Institute, and evaluated according to sex, age, place of residence, economic class, and nutritional status of the participants.

Results

The mean of usual fruit and vegetable consumption was estimated at 171g/day, mostly fruits (128g/day), mainly in the form of fruit juice (64.8%). The minimum fruit and vegetable consumption of 400g/day recommended by the World Health Organization was reached only by 2% of the adolescents. The adolescents' socioeconomic class or nutritional status had no impact on the usual fruit and vegetable consumption, but adolescents from northern Brazil had a significantly lower consumption than those from the midwestern region. Orange was both the most consumed fruit on a daily basis (mean of 42.6g/day, 90% as juice) and the most reported fruit (by 12.7% of the adolescents), followed by apples (10g/day; 5.6%) and bananas (8.4g/day; 8.3%). Tomato was the most consumed vegetable (9.2g/day), reported by 11.5% of the adolescents.

Conclusion

Public health policies are necessary to encourage fruit and vegetable consumption among Brazilian adolescents, including of pure juice, essential foods to prevent chronic diseases in adulthood.

Keywords: Adolescent. Diet. Fruit. Vegetables.

RESUMO

Objetivo

Estimar o consumo de frutas e vegetais por adolescentes brasileiros.

Métodos

Foram utilizados os dados do Estudo de Risco Cardiovascular de Adolescentes conduzido em 2013-2014 com 71.740 adolescentes entre 12 e 17 anos, que responderam ao questionário recordatório de 24 horas. O consumo usual de frutas e vegetais foi estimado no programa Statistical Analysis Software usando o modelo do Instituto Nacional de Câncer dos Estados Unidos e avaliado de acordo com sexo, idade, residência, classe econômica e estado nutricional dos participantes.

Resultados

O consumo médio usual estimado de frutas e vegetais dos participantes foi de 171g/dia, sendo 128g/dia de frutas, principalmente na forma de suco in natura (64,8%). O consumo mínimo de 400g/dia recomendado pela Organização Mundial da Saúde foi alcançado por apenas 2% dos adolescentes. A classe socioeconômica e o status nutricional não impactaram o consumo usual, mas adolescentes do norte do Brasil tiveram um consumo significativamente menor de frutas e vegetais se comparados com aqueles da região centro-oeste. A laranja foi a fruta mais consumida no período do estudo (média de 42.6g/dia, 90% como suco) e a mais relatada (por 12,7% dos adolescentes), seguido de maçã (10g/dia; 5,6%) e banana (8,4g/dia; 8,3%). Tomate foi o vegetal mais consumido (9,2g/dia), reportado por 11,5% dos adolescentes.

Conclusão

Políticas públicas são necessárias para encorajar o consumo de frutas e vegetais entre os adolescentes brasileiros, inclusive na forma de suco puro, pois são alimentos essenciais para prevenir o desenvolvimento de doenças crônicas na vida adulta.

Palavras-chave: *Adolescentes. Dieta. Frutas. Vegetais.*

INTRODUCTION

Adolescence is a period characterized by rapid growth, and adequate food consumption during this phase is critical for development [1]. Fruits and Vegetables (F&V) are important sources of potassium and magnesium, essential for maintaining bone mineral density, and their consumption during adolescence has a direct relationship with bone mineral density in adults [2]. F&V are also sources of fiber, folic acid, vitamins, and antioxidants, acting as protective factors against the development of several diseases, including dyslipidemia, obesity, diabetes, metabolic syndrome, and cardiovascular diseases [3,4].

Over two million deaths worldwide could be prevented with adequate F&V consumption [4,5]. In order to prevent chronic diseases, a minimum consumption of 400 grams (or five servings) of F&V, excluding potatoes and other starchy tubers, is recommended per day for all age groups [5]. Various factors influence F&V consumption in each population, including food availability in the household, healthy eating encouragement at school, and sociocultural and demographic characteristics [6]. Family support and having meals together with the family also have a positive impact on F&V consumption by adolescents, a dietary habit that may remain in adulthood [7,8].

In a review study, Machado *et al.* [9] found a low prevalence of adequate F&V consumption in Brazil, with higher prevalence among women, older individuals, and those with higher education levels and socioeconomic statuses. Low-frequency F&V consumption was observed by the Brazilian National Survey of School Health (2015 PeNSE), conducted with 10,926 adolescents between 13 and 17 years old [10]. In most studies carried out in the country, juice consumption is not included in the estimations, although the 2014 Brazilian Dietary Guideline encourages the consumption of fresh and minimally processed F&V, such as natural fruit juices [11].

This study aimed to perform a descriptive analysis of the usual F&V consumption (including pure juice and smoothies) by Brazilian adolescents, using data from the *Estudo de Riscos Cardiovasculares em Adolescentes* (ERICA, Study of Cardiovascular Risk in Adolescent), the largest study conducted with this population in the country, as well as to assess the impact of sociodemographic factors on consumption.

METHODS

ERICA is a national school-based multicenter cross-sectional study which was carried out from 2013 to 2014 with adolescents between 12 and 17 years old in Brazilian cities with more than 100,000 inhabitants. Pregnant women and adolescents with any degree of disability were excluded. In total, 75,060 adolescents from 1,251 public and private schools around the country participated in the study. Among them, 71,740 adolescents answered a 24-hour dietary recall (24h) and filled out a questionnaire in an electronic data collector with sociodemographic questions (sex, age, and place of residence), and information for economic classification, among others. In a random subsample of two students per classroom (7% of the sample), the students responded to a second 24h on a non-consecutive day, which allowed the estimation of the intra-individual variability, used to correct the distribution and to calculate the usual food consumption. Photographs of usual utensils and containers were shown during the application of the questionnaire, when asked by the adolescents, to help them estimate the servings. Details of the sampling process and *data collection are published elsewhere [12]. The study was approved by the Ethical Committee of the Universidade Federal do Rio de Janeiro* (n. 45/2008) and in each of the other Brazilian States and the Federal District. All participants signed a written informed consent form.

The nutritional status classification was estimated for each participant using the anthropometric method, which estimates the Z-Score of the body mass index for age and according to sex, and is indicated for children and adolescents [13]. The weight and height of each participant were measured by the interviewer. The economic classification of the adolescents was estimated based on the Brazilian Economic Classification Criterion of the Brazilian Association of Survey Companies [14]. This criterion considers the number of bathrooms in the house, consumer goods (television, radio, automobile, washing machine, DVD, refrigerator, and freezer), domestic workers paid monthly and the level of education of the head of the family. Due to lack of data, economic classification was not possible for 31.7% of the adolescents.

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Consumption of fresh (*in natura*) F&V, juice, smoothies (milk whipped with fruit and/or vegetable), and vegetables that are only consumed after cooking, such as pumpkin and okra, were considered in the study. Canned fruit or vegetables, processed products involving heat, fruit drinks, and nectars were not included. Unspecified F&V were reported in generic terms such as fruit, juice, smoothie, vegetable, salad, and fruit cocktail (nonalcoholic). The content of each fruit and/or vegetable in the juice, smoothie, and vinaigrette preparations is shown in Table 1. When considering preparations with unspecified fruit and/or vegetable, the average content found in similar preparations was used.

Table 1 – Food-as-reported by the participants of the Brazilian adolescent population (ERICA, Brazil, 2013-2014) and the proportion of fruits and or/vegetables*.

Food-as-reported	Fruit and/or vegetable	%
Apple and milk	Apple	33.3
Banana and milk	Banana	27.0
Banana and orange juice	Banana	20.0
	Orange	50.0
Carrot and orange juice	Carrot	30.0
	Orange	75.0
Carrot, orange, and sugar beet juice	Carrot	15.0
	Orange	75.0
	Sugar beet	15.0
Guava, juice	Guava	30.0
Lemon juice	Lemon	20.0
Mango juice	Mango	30.0
Melon juice	Melon	52.0
Orange and sugar beet juice	Orange	75.0
	Sugar beet	30.0
Orange juice	Orange	95.0
Papaya juice	Papaya	50.0
Papaya and milk	Papaya	33.3
Peach juice	Peach	50.0
Pineapple juice	Pineapple	40.0
Strawberry and milk	Strawberry	33.3
Strawberry juice	Strawberry	50.0
Sugar beet juice	Sugar beet	30.0
Vinaigrette	Onion	13.5
	Sweet pepper	5.6
	Tomato	20.2

Note: *Estimated from Araújo and Guerra [40].

The usual fruits and/or vegetable consumption in grams per day was estimated using the Statistical Analysis Software (SAS, version. 9.4), applying the model of the National Cancer Institute and the DISTRIB and MIXTRAN macros developed for SAS [15]. The model considered the sample weight and the complexity of the sample design, which used the Fay-modified Balanced Repeated Replication (Fay-BRR) technique.

The usual F&V consumption data were stratified according to sex, age group (12 to 14 and 15 to 17 years old), nutritional status (very low weight, low weight, adequate, overweight, and obesity), regions of Brazil (North, Northeast, Southeast, South, and Midwest), and economic class (A, B1, B2, C1, C2 and DE). The mean and the 25, 50, 75, 90, and 95th percentiles were estimated, with their respective 95% confidence intervals. The usual consumption means and percentiles between the various

groups were considered significantly different when there was no overlap in the respective confidence intervals. When the prevalence of zeros was high, the SAS macro failed to run and the estimation of the usual consumption was not possible. This was the case for total vegetables and for specific fruits and vegetables.

The mean consumption for the 10 most consumed fruits and vegetables, the percentage consumed *in natura*, and the percentage of adolescents that reported the consumption were estimated by the Stata Software V.14.2 using the first 24h data, considering the expansion factors and the complexity of the sample design.

RESULTS

In total, Brazilian adolescents reported the consumption of 35 different fruits and 39 vegetables, with unspecified F&V representing 30% of the records. Table 2 shows the number and percentage of adolescents

Table 2 – Distribution of the usual daily fruits and vegetable consumption by the Brazilian adolescent population (ERICA, Brazil, 2013-2014).

Parameter	N (%)[1]	Mean (CI) g/day	P50 (CI) g/day	P75 (CI) g/day	P90 (CI) g/day	P95 (CI) g/day
Total F&V	71,740 (100)	171 (162-180)	155 (149-161)	222 (207-237)	296 (269-323)	348 (312-384)
Fruits	40,758 (56.8)	128 (122-135)	115 (105-124)	179 (169-188)	241 (201-281)	280 (212-349)
Fruit juice+smoothie	33,782 (47.1)	86 (83-89)	71 (67-74)	116 (110-123)	170 (151-190)	209 (178-240)
Fruit juice	32,490 (45.3)	83 (80-86)	67 (63-71)	112 (106-119)	167 (147-188)	207 (175-239)
Sex						
Female	39,799 (55.5)	166 (158-173)	150 (144-156)	214 (201-227)	285 (262-308)	334 (303-365)
Male	31,941 (44.5)	177 (167-188)	160 (153-168)	230 (213-247)	307 (278-336)	361 (322-399)
Age						
12-14 years old	32,927 (45,9)	165 (149-181)	149 (137-161)	215 (191-238)	288 (250-325)	339 (290-387)
15-17 years old	38,813 (54,1)	178 (175-182)	162 (157-167)	230 (221-239)	306 (286-327)	360 (330-389)
Nutritional status						
Very low weight	256 (0.4)	167 (155-179)	149 (139-160)	215 (201-230)	293 (269-316)	344 (307-381)
Low weight	1857 (2.6)	169 (163-174)	152 (148-157)	219 (209-230)	292 (270-315)	343 (312-373)
Adequate	52,038 (72.5)	171 (163-178)	154 (150-159)	221 (208-235)	296 (270-321)	347 (312-382)
Overweight	12,050 (16.8)	173 (161-185)	157 (148-166)	224 (205-242)	299 (268-330)	351 (310-391)
Obesity	5,539 (7.7)	175 (158-192)	158 (143-173)	227 (202-252)	303 (266-340)	355 (309-401)
Region						
Midwest	9,353 (13.0)	186 (172-199)[a]	170 (158-181)[a]	239 (219-258)	315 (284-345)	368 (329-407)
South	9,115 (12.7)	179 (168-190)	163 (154-171)	231 (214-247)	306 (278-334)	359 (322-395)
Southeast	16,487 (23.0)	172 (163-182)	156 (150-162)	223 (208-239)	298 (270-326)	350 (313-388)
Northeast	22,272 (31.0)	165 (157-174)	149 (144-154)	215 (200-230)	289 (262-316)	341 (305-377)
North	14,513 (20.2)	158 (149-168)[b]	142 (136-148)[b]	207 (191-223)	279 (252-307)	330 (294-366)
Economic class[2]						
A	6,138 (8.6)	171 (161-181)	155 (148-162)	221 (206-237)	295 (267-323)	347 (311-384)
B1	10,020 (14.0)	171 (162-180)	155 (149-161)	222 (207-236)	296 (269-322)	347 (311-382)
B2	15,305 (21.3)	171 (163-180)	155 (149-161)	221 (207-236)	295 (269-321)	347 (313-382)
C1	11,795 (16.4)	171 (163-180)	155 (150-161)	222 (208-236)	296 (270-321)	347 (314-381)
C2	4,864 (6.8)	172 (164-179)	155 (150-160)	222 (208-236)	297 (272-321)	349 (317-381)
D/E	895 (1.2)	171 (164-178)	155 (149-161)	222 (209-236)	294 (270-317)	345 (312-378)
Not classified	22,723 (31.7)	171 (160-182)	155 (147-163)	222 (205-239)	298 (268-327)	350 (311-388)

Note: [1]Number and % of individuals that reported the consumption at least once; [2]Based on the Brazilian Economic Classification Criterion of the Brazilian Association of Research Companies (ABEP, 2013); [a,b]: Different letters are significantly different. P: Percentile; CI: 95% Confidence Interval, Lower (2.5%); Upper (97.5%).

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that reported F&V consumption, the means, and the percentiles of the usual total daily consumption. All adolescents reported the consumption of at least one fruit and or vegetable during the survey. In average, the usual total F&V consumption was 171g/day, reaching 384g/day at the upper confidence interval (CI97.5%) of the 95th percentile (P95) of the consumption distribution (Table 2). The mean usual consumption of 400g/day was reached at the 98th percentile of the distribution (data not shown). About 75% of the mean usual consumption of F&V came from fruits (128g/day; Table 2). Most of the fruit consumption was in the juice form (64.8%; 83g/day), with a mean smoothie consumption of 3g/day (Table 2).

No significant differences were found between the percentage of girls reporting F&V consumption compared with boys (55.5 *vs* 44.5%; Table 2). About 54% of the adolescents were between 15 and 17 years-old; most had an adequate weight (72.5%), with 7.7% of them being classified as obese, although the mean usual consumption did not vary with their nutritional statuses. When the usual F&V consumption was assessed according to the Brazilian region, a significant difference was found only among adolescents from the northern and midwestern regions (means of 158 and 186g/day, respectively), although this difference is not found at higher percentiles (at least not at 75th percentile). The usual F&V consumption did not vary according to the adolescents' economic class (Table 2).

The Table 3 shows the mean consumption of the 10 fruits and vegetables (*in natura*, juice/smoothie, and cooked vegetables) most consumed by the adolescents, the percentage of individuals who consumed it, and the form consumed. Orange is by far the most consumed fruit (42.6g/day; 90% as juice) and the most reported by the adolescents (12.7%), followed by apples (10g/day; 5.6%) and bananas (8.4g/day; 8.3%). *Açai* (*Euterpe Oleracea* Mart.), an Amazonian fruit, had the fourth highest mean consumption by the adolescents (5.64g/day), despite being reported only by 2.3% of them. Vegetables were mainly consumed *in natura*, with tomatoes being the most consumed by the adolescents (9.23g/day; reported by 11.5% of them), followed by lettuce (5.06g/day; 11.8%), and carrots (2.55g/day; 6.2%). Many adolescents reported the consumption of F&V juice, mainly a combination of orange, carrot, and/or beetroot (Table 1). For both fruits and vegetables, there were many reports of consumption without specification (by 17.3 and 12.7% of the adolescents, respectively), mostly as juice/smoothie preparations.

Table 3 – Fruits and vegetables most consumed by the Brazilian adolescent population, estimated based on the first 24h data. (ERICA, Brazil, 2013-2014).

Fruit	Reporting[1] %	Mean (CI) g/day	In natura[2] %	Vegetable	Reporting[1] %	Mean (CI) g/day	*In natura*/cooked[3]
Orange	12.70	42.6 (37.9-47.3)	10.1	Lettuce	11.80	5.06 (4.37-5.75)	*In natura*
Passion fruit	8.97	2.29 (2.11-2.46)	0.68	Tomato	11.50	9.23 (8.24-10.2)	*In natura*
Banana	8.34	8.41 (7.60-9.21)	86.0	Carrot	6.19	2.55 (2.21-2.89)	*In natura*/cooked
Apple	5.56	10.0 (9.17-10.9)	99.7	Chayote	2.90	1.43 (1.22-1.65)	Cooked
Guava	4.95	4.66 (4.15-5.16)	18.6	Cabbage	2.01	0.82 (0.69-0.95)	*In natura*/cooked
Mango	3.11	3.75 (3.33-4.18)	35.9	Cucumber	1.57	0.53 (0.41-0.65)	*In natura*
Pineapple	2.95	4.23 (3.56-4.91)	16.8	Beetroot	1.42	0.93 (0.75-1.10)	*In natura*/cooked
Açai	2.29	5.64 (4.68-6.60)	0	Kale butter	0.92	0.54 (0.43-0.64)	*In natura*/cooked
Strawberry	1.67	2.39 (1.92-2.87)	9.48	Pumpkin	0.81	0.90 (0.71-1.08)	Cooked
Water-melon	0.99	3.18 (2.02-4.35)	100	Okra	0.42	0.48 (0.34-0.61)	Cooked
Unspecified	17.30	30.8 (27.9-33.7)	-	Unspecified	12.70	17.0 (15.5-18.6)	*In natura*/cooked

Note: [1]% of individuals who reported the consumption at least once; [2]The remaining is consumed as fruit juice or fruit smoothie; [3]Some vegetable are only consumed cooked (chayote, pumpkin, and okra) and the exact form of consumption for the other vegetables is not clear in the report. CI: 95% Confidence Interval, Lower (2.5%); Upper (97.5%).

DISCUSSION

The ERICA study was conducted with 71,740 Brazilian adolescents (12 to 17 years old) attending public or private schools in Brazilian cities with more than 100,000 inhabitants during the period of 2013-2014. The adolescents answered a 24-hour dietary recall (24h) and 7% of them filled a second 24h on a non-consecutive day.

All adolescents reported the consumption of fruits and/or vegetables at least once during the period of the survey. The mean usual consumption of 171g/day corresponds to 42.8% of the recommended consumption of 400g/day [5], which was reached by only 2% of the studied population, including juice and smoothie consumption. Several studies conducted in Brazil have also shown that the recommended F&V consumption is not reached by adolescents, although the percentages of those with an adequate consumption were higher than what was found in the ERICA study. None of the studies considered juice consumption in the estimation or this information was not clearly stated. Data from the city of *São Paulo* Health Survey (ISA-Capital 2003) using a 24h (one day) collected from a representative sample of 812 adolescents (12 to 19 years) in 2003 showed that 6.4% of the population consumed 400g/day [16]. In a study conducted in the state of *Sergipe* with a representative sample of 3,992 students (14 to 19 years), the prevalence of adequate F&V consumption (5 servings) was 11.4% [17]. Various studies have investigated the F&V by adolescents worldwide [7,18-21]. Darfour-Oduro *et al.* [21] compared the patterns of F&V consumption of 164,771 adolescents between 13 and 17 years old from 49 low and middle-income countries using data from the Global School-based Student Health Survey (GSHS) from 2004 to 2013. Morocco and India had the highest proportions of adolescents consuming five or more servings per day (29.5%), and Argentina, the only country from South America included in the research, had the lowest proportion of adolescents with an adequate number of servings (4.8%).

According to the ERICA study, Brazilian adolescents prefer consuming fruits rather than vegetables, a result that differs from other studies conducted in the country with different measurement approaches. Using data from 6,529 adolescents (15-19 years of age) of the *Santa Catarina* state in 2011, Silva *et al.* [22] found a higher prevalence of daily consumption of vegetables (20.6%) compared to fruits (16.6%). At the national level, the 2015 PeNSE study showed a significantly higher frequency of vegetable consumption (3.43days/week; 95%CI 3.35-3.52) by 13 to 17-year-old Brazilian adolescents compared to fruit consumption (3.09days/week; 95%CI 3.00-3.17) [10]. The preferences in other countries also vary. A study with German adolescents between 9 and 16 years old showed a preference for vegetables, which accounted for about 70% of the total F&V consumption [18]. In Northern Ireland, fruits represented about 70% of F&V consumption among people between 12 and 15 years old [19].

In the present study, a higher, but not significant, percentage of girls reported F&V consumption compared to boys (55.5 *vs*. 44.5%), with similar mean consumptions. GSHS data showed a significant difference in the number of servings of F&V consumed by boys and girls in about half of the countries included in the study, but without a clear general predominance of any sex. On average, Argentinian girls consume more servings than boys [21]. Data from the 2008-2009 National Diet and Nutrition Survey of the United Kingdom also showed that, on average, girls consume more F&V than boys (11 to 18 years old) (96 *vs*. 84g/d) [20], similarly to what was found in Northern Ireland (238 *vs*. 216g/d; $p<0.01$) [19]. A study in the Netherlands pointed out that reasons for sex differences in F&V consumption include the possibility that boys just like it less than girls, as boys preferred energy-dense foods, such as fatty and sugary foods, to adapt to their higher energy requirement [21,23,24]. However, in the Arab Emirates, boys consume significantly more F&V than girls [7]. Similarly, boys in *Santa Catarina*, Brazil, reported a higher prevalence of F&V daily consumption than girls [22].

The mean usual F&V consumption did not vary with the nutritional statuses of the adolescents, a result similar to that found by Wuenstel *et al.* [24] with Polish adolescents between 13 and 18 years old, using food frequency questionnaires. Adolescents from the midwestern region of Brazil had a mean F&V usual consumption significantly higher than those from the north of the country, which is probably related to the food availability at home and the family income [6,16]. Nonetheless, the usual F&V consumption were practically the same in all economic classes of Brazilian adolescents from the ERICA study. Kelly *et al.* [25] noted that Irish adolescents' F&V consumption was significantly lower in the low and middle social classes compared to the upper social class. The findings of the present study may be compromised, since approximately 32% of the adolescents were not economically classified due to lack of data, although the mean consumption of unclassified adolescents was similar to that of the classified classes. Furthermore, the economic classification may not be the best approach to capture differences in F&V consumption within a population, as it does not include the family income, although the other parameters used in the classification are probably related to income, such as the level of education and number of electrical devices in the household.

Most of the fruit consumed by Brazilian adolescents takes the form of juice, which represents 64.8% of the total fruit consumption. This percentage is much higher than that reported by the National Health and Nutrition Survey of the United States (2011-2012) for 2 to 19 year-olds (34%) [26]. Fruit juice does not always provide the same benefits as the whole fruit, as fiber and vitamin C can be lost during the preparation [11]. However, it still contains a high concentration of polyphenols that play an important role as antioxidants in the organism and might reduce the risk of coronary heart diseases [27,28]. Whether fruit juice consumption causes weight gain in children remains controversial. In a meta-analysis of 8 prospective cohort studies, Auerbach *et al.* [29] concluded that the consumption of fruit juice is associated with a small, not clinically significant weight gain in children between 1 and 6 years old, and it is not associated with weight gain in children between 7 and 18 years old.

As the consumption of 5 daily servings of F&V is not achieved by most of the world population, the consumption of pure juice (no sugar added) may be a practical choice for those who find fruit consumption not always convenient, requiring a higher effort than consuming juice [21]. Therefore, it may be an effective way to achieve the dietary goal [30]. The 2015-2020 Dietary Guidelines for Americans considers fruit juice nutritionally similar to the whole fruit and half of the recommended daily fruit intake may be replaced by juice [31]. The United Kingdom Eatwell Guide, updated in 2019, allows the replacement of one of the 5 portions/day of F&V by a maximum of 150ml of fruit juice, vegetable juice, or smoothie, and the last version of the Brazilian Dietary Guideline encourages the consumption of fresh and minimally processed F&V, including fruit juices [11,32].

Orange is by far the most consumed and the most reported fruit by adolescents who participated in the ERICA study, mainly in the form of juice, followed by apple and bananas, mostly in natural form. Indeed, oranges, apples, and bananas are the three most numeric fruits produced in Brazil, which is also the biggest exporter of oranges and orange juice worldwide [33]. *Açai* was the fruit with the fourth highest mean consumption by the adolescents, but as it may be eaten with sugar, guarana powder, and other fruits, this consumption may be overestimated. *Açaí* is a dark purple berrylike fruit produced by a palm tree native to tropical rain forests, mainly in the northern state of *Pará*. The fruit is commercialized mainly in the pulp and juice forms, and it is distributed all over the country as well as exported, mainly to the United States [34]. It is rich in flavonoids with antioxidant and anti-inflammatory properties, and its consumption has been associated with improvements in vascular function and has a beneficial role against atherosclerosis [35].

Data on individual consumption are essential to assess the macro and micronutrients by a given population, as well as the intake of toxic chemicals present in food [20,36,37]. About 30% of the ERICA

reports did not specify which fruit and/or vegetable was consumed, a lack of information that was also observed in the National Food Survey conducted in the country in 2008-2009 [38]. F&V are the food with the highest incidence of pesticides, and as consumption data for unspecified food cannot be used to estimate the dietary exposure to these chemicals, the potential risks to consumers are underestimated in the studies [38]. Future surveys should implement strategies to decrease the reporting of unspecified F&V by the participants, so as to allow the use of the whole dataset in dietary risk assessment studies.

ERICA is the largest nutritional study conducted with adolescents in Brazil, and other aspects of food consumption have been investigated using these data, which together with the present study, confirm the inadequate diet of this population. Souza *et al.* [36] showed that the diet of Brazilian adolescents was generally characterized by high sugar intake through the consumption of sweetened beverages and processed foods, which were associated with high intake of sodium, saturated fatty acids, and free sugar. Ronca *et al*. [39] concluded that the overall diet quality of Brazilian adolescents needs urgent improvements since the values of all dietary index components (quality, diversity, and equilibrium) were below half of their ideal scores, regardless of geographic region and socioeconomic status.

The strength of this study is the robustness of the ERICA data given by the representative sample of the Brazilian adolescents. Limitations are mainly related to the collection method used in the ERICA, the 24h, which is subject to limitations related to memory, the interviewee's cooperation, and the difficulties in reporting the amount consumed, which were minimized with the presentation of photographs of measured amounts during data collection. Additionally, economic classification was not possible for about one third of the population, which may have prevented the detection of its impact on F&V consumption.

CONCLUSION

The estimates of the present study are consistent with previous studies that showed insufficient F&V consumption by Brazilian adolescents. Differently from most studies that assessed the F&V consumption of Brazilian adolescents, this study considered the consumption of minimally processed fruit and vegetables preparations (juice and smoothies), as recommended by the current Brazilian and other countries dietary guidelines. Due to its practicality, recommending the consumption of juice is a good strategy to increase F&V consumption among Brazilian adolescents, both within the family and at school, to consolidate this habit in the diet of this population and prevent chronic diseases in adulthood.

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CONTRIBUTORS

AP Brito and ED Caldas designed the concept of the manuscript together. AP Brito was responsible for data treatment and for writing the first draft of the manuscript. ED Caldas reviewed the data and finalized the manuscript, which was approved by both authors

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