

Ultraprocessed food consumption and factors associated with a sample of public school bases in the South of Brazil

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Abstract *This study aims to evaluate the consumption of ultraprocessed foods and its association with sociodemographic, behavioral and nutritional factors in schoolchildren from public schools in Caxias do Sul-RS. A cross-sectional study was conducted with 1,309 students aged 6-16 years. The consumption of ultraprocessed foods was obtained by means of a questionnaire according to the self-report of the student. A pre-tested questionnaire was used to evaluate the characteristics of the students. A Poisson regression analysis was performed following a statistical hierarchical modeling to determine factors associated with outcome. Results with p value ≤ 0.05 were considered statistically significant. A high prevalence of ultraprocessed food consumption was identified (69.7%) among schoolchildren. After adjusted analysis, higher prevalence of ultraprocessed food consumption was associated with buying/taking snacks to school and snacking. Nutritional counseling was also associated with protection against the consumption of these foods. Nutrition education actions are necessary for schoolchildren and caregivers in order to reduce the consumption of ultraprocessed foods by schoolchildren, especially in snacks.*

Key words *Obesity, Diet, Food and Nutrition, Food Consumption, Child health, Cross-sectional studies*

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Introduction

It is estimated that around 40 million children and adolescents worldwide are overweight or obese. In Brazil, studies have shown a significant increase in the number of overweight children and adolescents in the past few years. Data from Family Budget Survey (*Pesquisa de Orçamentos Familiares*) (2008–2009) have revealed that 47.8% of children with ages between 5 and 9 and 25.4% of adolescents with ages from 10 to 19 are either overweight or obese¹. Recently, national results of Scholar Health National Survey (PeNSE 2015) have shown that 23.7% of Brazilian students with ages between 13 and 17 were overweight².

Excess weight in children and adolescents is a great public health challenge, because it is a significant risk factor for the early onset of cardiac diseases³. Obesity and excess weight are multi-factored conditions which have among their main causes some modifiable environmental factors such as being sedentary, a diet rich in saturated fats and sugar and low consumption of fruit and vegetables, as well as genetic factors^{4,5}.

The Food Guide for the Brazilian Population⁶ classifies foods by their degree of processing: *in natura*, obtained directly from plants or animals without any alteration; minimally processed foods, which are foods *in natura* that have been washed or trimmed, or submitted to other processing that does not involve adding salt, sugar, fats, oils or other substances; processed foods, that are manufactured in factories with the adding of salt, sugar, or other culinary use substances to make them more durable and palatable; and ultraprocessed foods, which are industrial formulas entirely or mostly made with substances extracted from foods (oils, fats, sugar, starch, protein) derived from parts of foods and that have more than five ingredients. Ultraprocessed foods should be avoided because of their high level of artificial ingredients⁷ and usually are high in calories, sugar, sodium, and saturated fats, as well as a low level of fibers and other essential micronutrients^{7,8}.

The consumption of ultraprocessed foods associated with genetic and environmental risk factors have an unfavorable effect on health, because it favors the development of non-communicable chronic diseases such as obesity, high cholesterol, and metabolic syndrome^{9,10} and may contribute to an inadequate consumption of micronutrients among children and adolescents, which may hinder their growth and their development⁶.

In spite of it, national and international studies have shown that the consumption of ultrap-

rocessed foods is on the rise in this population¹¹, because they are easily accessible and convenient, because they are either ready to eat or ready to heat and demand low or no preparation at all. In Brazil, a transversal study done with data from PeNSE (2015) has found that around 40% of 9th grade students have reported daily consumption of at least one ultraprocessed food³. In a study done in Northeast Rio Grande Do Sul, 45.84% of daily food intake by adolescents aged 11 to 18 come from ultraprocessed foods^{9,12}.

The term “ultraprocessed foods” is still new in Brazil, so there is not much research done on the association of the consumption of those foods and their determinants. The present study have focused on social, economic, behavioral, and nutritional determinants in children and adolescents with the main goal of advancing the knowledge on associated factors and of contributing to the promotion of healthy nutritional habits in this population. This study has analyzed the consumption of ultraprocessed foods in relation to sociodemographic, behavioral, and nutritional factors in students from municipal schools in the city of Caxias do Sul-RS.

Method

This was a cross-sectional observational study with school children aged 6 to 16, enrolled in municipal public schools in Caxias do Sul-RS, Brazil. Research Project was submitted to and approved by the Committee of Ethics in Research at the University of Caxias do Sul.

Sample selection was semi probabilistic by clusters. Initially the neighborhoods that had public schools were randomly selected according to monthly nominal household income per capita. In case a neighborhood had more than one school, a second draw was done until there was only one left. Ten schools were selected in total, and schools located in rural areas or with less than 200 students were left out.

Size sample calculation considered an estimated number of 35,302 students enrolled in Primary School in municipal schools from Caxias do Sul; confidence interval (CI) of 95%; an estimated prevalence of excess weight in students of 30%; and an acceptable margin of error of 2.5%, which resulted in an estimated sample size of 1,282 students. Adding 10% for losses and refusals, the result was 1,418 students selected for the sample.

Data collection was done from May 2015 to December 2016. With the consent from the Mu-

nicipal Secretary of Education, school principals were contacted, and all of them accepted to participate in the study. Students with ages from 6 to 16 were included in the sample. Students with the following conditions were excluded: physical handicap which made impossible to take anthropometric measurements; special restrictive diets; mental disorder or illness that made impossible for the children to answer the questionnaire.

Parents or legal guardians of the selected children were previously informed about the research by a Free Consent Form. After the form was signed by the responsible adult, a standard questionnaire was given to the children, and their anthropometric measurements were taken. All of the participants were assured of the complete confidentiality of their information. Students received an explanation about the goals and the importance of the project and later they were invited to participate in the study by signing a Term of Voluntary Consent and they returned the questionnaire which their parents answered about eating habits and anthropometric measurements.

Data collection was taken by undergraduate students of Nutrition, previously trained for that, and by the authors of the study. In each class, interviewers explained how to fill in the questionnaires and answered questions about the procedures. In classes from 1st to 3rd grade, interviewers asked the children individually all the questions from the questionnaire and then took their anthropometric measurements. Groups of five children of the same gender were instructed to enter a reserved room, where they were invited to take off their shoes, coats and heavier clothing, remaining only with the pants and t-shirt of their school uniform. Then the students were taken in duos to the room of nutritional evaluation. Anthropometric measurements were taken by the nutritionists and by the undergraduate students who were trained for data collection.

After the complete filling of the questionnaires, the reviewing and codification of the results took place. In the case of any discrepancies, the student was identified and then asked to clarify their answers.

The classification of foods according to the degree of processing was based on the validated questionnaire by Assis et. al.¹³, which divides the distribution of foods according to meals (breakfast, morning snack, lunch, afternoon snack, dinner and evening snack or supper). The degree of processing was classified according to the Food Guide (2014)⁶. Ultraprocessed foods were: chips, salty snacks, French-fries, pizza, hamburger, can-

dy, cookies, ice-cream, lollypops, pies, cakes with filing and frosting, chocolate, soda, and chocolate milk. For the analysis of consumption of ultraprocessed foods we considered the consumption of at least one of these foods in one meal of the day.

Anthropometric analysis were done using *AnthroPlus*^{®14} software. For the analysis of excess weight, we used BMI (Body Mass Index) for each age. Classification was done according to z score, with a value of over one being considered as excess weight¹⁵. The value of body mass was taken with a portable scale; brand Cauduro[®], with maximum capacity of 150kg and precision of 100g¹⁶. Height was measured using a stadiometer, brand Sanny[®], with maximum height of 200 cm and precision of 0.1 cm, fixed with adhesive tape on a smooth wall with no skirting, using standard procedure¹⁶. All the measurements were taken twice and the final result was the mean of these measurements.

Demographic variables considered in the study were: gender (male/female) and skin color (white, brown, black and other). Socioeconomic variables included: family income (family income quartile) and parents' level of education. Behavioral variables were number of meals (≤ 3 meals per day or > 3 meals per day), as well as each one of them separately: breakfast, morning snack, lunch, afternoon snack, dinner and supper. Consumption of school meals was marked as "yes" when food provided by the school was eaten at least twice per week. For the variable buys/takes lunch to school (yes/no), the student was asked whether they usually bring their lunch from home or they buy it at school or on their way to school. For the variable nutritional counseling (yes/no), we asked the students whether they had already received any prescribed diet or had any nutritional counseling.

For the statistical analysis of the data we did a double entry on EPI-DATA (Epidata Association, Odense, Denmark) version 3.1. There were also comparisons done on the typing and their consistency. After typing, data were analyzed on Stata version 14 (StataCorp, CollegeStation, Texas, USA). Results were presented in a descriptive manner with absolute and relative frequency. Pearson's Chi-square test and Linear Association were done. Associations between the independent variables and ultraprocessed food consumption were analyzed by Poisson regression with robust variation. Variables with p value ≤ 0.20 on the gross analysis were taken to an adjusted analysis, based on a conceptual model of determination with three levels. First level included sociodemo-

graphic variables: gender, age, skin color, grade/class, time of classes, parents' level of education and family income; second level included variables of eating habits: school meals consumption, buys/takes lunch to school, nutritional counseling, breakfast, morning snack, lunch, afternoon snack, dinner and supper. On the last level there was excess weight. The variables buys/takes lunch to school, prescribed diet, breakfast, morning snack, lunch, afternoon snack, supper were adjusted because the variables on the first level and excess weight did not present a value $p \leq 0.20$. After adjustments, variables with p value ≤ 0.05 were considered to be associated with the ending.

Results

There were 1,309 participants in the largest study with ages 6 to 16, all enrolled in elementary and middle school. However, only 1,128 students presented complete answers to all questions in reference to the variables analyzed in this study.

According to Table 1, the majority of the participants was female (54.5%), with ages from 6 to 11 (70.5%), white/Caucasian (56.8%) and enrolled in grades 1 to 4 (59%). About half of their parents had a High School diploma and 33.5% had a monthly family income of over R\$ 1,600.00. In relation to the children's eating habits, most of them consumed school meals (91.2%) and had more than three meals a day (89.9%).

There was a high prevalence of ultraprocessed food consumption. According to our analysis, 69.7% (CI95% 67.0 to 72.3%) of students had at least one ultraprocessed food per day. The medium ultraprocessed food consumption was 1.5 (± 1.6) and the maximum quantity ingested was of 12 ultraprocessed foods per day.

About the number of meals per day, the study found that students who had more than three meals a day consumed more ultraprocessed foods than the students who said they had less than three meals a day (74.5% vs. 47.6%; $p < 0.001$). About the kind of meal they had, there was a higher prevalence of ultraprocessed foods consumption in the students who said they had the following meals: evening snack (80.1% vs. 63.9%; $p < 0.001$), breakfast (77.6% vs. 22.4%; $p = 0.008$), afternoon snack (90.7% vs. 9.3%; $p = 0.008$), morning snack (57.8% vs. 42.2%; $p < 0.001$) and lunch (99.1% vs. 0.9%; $p < 0.001$) (Table 1).

Higher prevalence of ultraprocessed foods consumption was also related to buys/takes lunch to school (55.5% vs. 44.5%; $p = 0.007$). On the other hand, students who had already had nutri-

tional counseling presented a lower prevalence of ultraprocessed foods consumption when compared to those who never had any kind of nutritional counseling (21.3% vs. 78.7%; $p < 0.001$) (Table 1).

On Table 2 there are the results from the gross and adjusted analysis. Only the variables classified on Level 2 remained in the multivaried model because they had a value $p < 0.20$. After adjusting for confusion factors, the variables buys/takes lunch to school ($p = 0.02$) and nutritional counseling ($p = 0.002$) remained associated to the ending as well as the meals morning snack ($p = 0.006$) and evening snack ($p < 0.001$). We observed that the fact that the student buys or takes his lunch/snacks to school increased the prevalence of ultraprocessed foods consumption by 9.0%, while having had any nutritional counseling decreased it by 15.0%. In relation to the meals, having morning and evening snacks was associated to an increase of ultraprocessed foods consumption by 12% and 19%, respectively.

Discussion

This study has found that students who bought or took their lunch to school had a higher prevalence of ultraprocessed foods consumption, as well as those who usually had morning and evening snacks. On the other hand, students who had some kind of nutritional counseling during their lives had a lower prevalence of ultraprocessed foods consumption. This study serves as an alert on the degree of processing of foods usually consumed as snacks and suggests actions of education on nutrition focused on the substitution of manufactured snacks for minimally processed or processed foods.

There was a high prevalence of ultraprocessed food consumption in students from the municipal schools in Caxias do Sul (69.7%) and the mean was of 1.5 per day (± 1.6). Other Brazilian studies had also shown this high prevalence^{3,17-20}. According to PeNSE (2015), the daily consumption of at least one ultraprocessed food was reported by 39.7% of the students, that is the same as saying that seven out of ten Brazilian students said they eat one portion of ultraprocessed foods every day³. Data from the second edition of PeNSE (2012) had shown a prevalence of regular consumption (≥ 5 days per week) of candy, soda, cookies, fried snacks and chips respectively in 41.3%, 33.3%, 32.5%, 15.8% and 13% of teenagers¹⁷. According to another study at the center

Table 1. Prevalence of ultraprocessed foods consumption according to sociodemographic, behavioral and nutritional variables in students from municipal schools in Caxias do Sul-RS (N=1.128).

Characteristics	N (%)	Ultraprocessed foods consumption	
		%	Value p
Gender			0.27*
Male	513 (45.5)	72.4	
Female	615 (54.5)	69.4	
Age			0.71*
6 to 11	796 (70.5)	70.1	
12 to 16	332 (29.4)	69.0	
Skin Color			0.26*
White	641 (56.8)	71.1	
Mixed/Black/Other	487 (43.2)	68.0	
Grade/Year			0.95*
1st to 4th	665 (59.0)	69.6	
5th to 9th	463 (41.0)	69.8	
School attendance			0.25*
Morning	496 (44.0)	71.5	
Afternoon	630 (56.0)	68.9	
Parents' Level of Education (n=849)			0.46**
Primary, incomplete	249 (25.3)	69.1	
Primary, complete	228 (23.2)	71.5	
High School, complete	405 (41.2)	70.9	
College, complete	102 (10.4)	63.5	
Family income (R\$ - Reais)			0.32**
<1600	307 (33.5)	67.4	
1600 to 2600	304 (33.1)	72.8	
>2600	306 (33.4)	70.7	
Consumes School Meals			0.22*
Yes	938 (91.2)	71.9	
No	90 (8.8)	66.0	
Buys/takes lunch to school			0.007*
No	571 (55.5)	68.1	
Yes	457 (44.5)	75.3	

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of reference for children's obesity at University Hospital Bettina Ferro de Souza (Belém-PA, Brazil) 71.4% of school students consume sweets (ultraprocessed foods)¹⁸. Another study in the State of Santa Catarina had also identified a high consumption of ultraprocessed foods by school students: 67.6% had them twice or more a day¹⁹. In northwest Rio Grande do Sul, there was an estimated 87.86% prevalence in students²⁰.

In this study, we have found a high prevalence of ultraprocessed food consumption in students, especially on snacks. According to their reports, the most consumed ultraprocessed foods in breakfast and snacks were: cookies, sweets, chocolate milk, yogurt, chips, juices, soda, among

others. Consistently with this study, a population-based cross-sectional study has found that the most frequently consumed cookie or biscuit in breakfast was the kind with sweet filling, independently from gender and socioeconomic level, ranging from 15.18% to 20.59%²¹. We suggest more practical approaches, such as workshops for students and parents, might contribute to the change in consumption of ultraprocessed foods in favor of the less processed ones.

Ultraprocessed foods habitually consumed by school students, according to the Food Guide for the Brazilian Population, are industrial formulations mostly or completely made out of substances extracted from oils, fats, sugar, starch,

Table 1. Prevalence of ultraprocessed foods consumption according to sociodemographic, behavioral and nutritional variables in students from municipal schools in Caxias do Sul-RS (N=1.128).

Characteristics	N (%)	Ultraprocessed foods consumption	
		%	Value p
Nutritional Counseling			<0.001*
No	809 (78.7)	73.4	
Yes	219 (21.3)	61.6	
Breakfast			0.008*
No	252 (22.4)	64.8	
Yes	874 (77.6)	73.3	
Morning Snack			<0.001*
No	475 (42.2)	65.7	
Yes	650 (57.8)	75.7	
Lunch			<0.001*
No	10 (0.9)	40.0	
Yes	1116 (99.1)	71.7	
Afternoon snack			0.008*
No	105 (9.3)	60.4	
Yes	1021 (90.7)	72.6	
Dinner			0.25*
No	38 (3.4)	63.2	
Yes	1088 (96.6)	71.7	
Supper/Evening snack			<0.001*
No	603 (53.5)	63.9	
Yes	523 (46.5)	80.1	
Number of Meals			<0.001*
≤3	126 (11.1)	47.6	
>3	1007 (88.9)	74.5	
Excess weight			0.20*
No	733 (65.0)	72.4	
Yes	395 (35.0)	62.9	

*Value p for Chi-square test to compare proportions; ** Value p for Chi-square test for linear tendency.

proteins, derived from food substances and that contain more than five ingredients⁶. Ultraprocessed foods should be avoided for their high content of artificial ingredients. Excessive consumption of these foods is linked to the increase in chronic diseases such as obesity, heart diseases and metabolic diseases²².

Another result worthy of note in this study was the associations of a higher prevalence of ultraprocessed food consumption and buying or taking lunch to school. Many times parents send their children an industrialized food for lunch because it is more convenient, or faster, or even because they are not aware of the health implications on the consumption of these foods^{23,24}.

Consistently with these findings, another study done in the city of Florianópolis with school students ages 11 to 14 has found an association of the frequency of consumption of ultraprocessed foods with buying foods at fast-food type restaurants²⁵. In 2017, another study that evaluated 1,081 students also observe that 12.2% of them snacked on sweets such as ice-cream, candy, sweet biscuits with filling, and soda, while 22.2% of them snacked on savory treats such as chips, fries and similar foods²⁶. Another study done in the metropolitan area of São Paulo with school children aged 2 to 7 also found an elevated rate of consumption of: processed meats (51%); instant ramen or noodles (51%); chips and crackers

Table 2. Gross and Adjusted analysis for the reason of prevalence of daily ultraprocessed food consumption according to sociodemographic, behavioral, and nutritional variables in students from municipal schools in Caxias do Sul-RS (N=1,128).

Variable	Gross Analysis		Adjusted Analysis	
	RP (CI95%)	Value p*	RP (CI95%)	Value p*
1st Level - Sociodemographic				
Gender		0.26		
Male	1.00			
Female	0.95 (0.88-1.03)			
Age				
6 to 11	1.00	0.71		
12 to 16	0.98 (0.90-1.07)			
Skin Color		0.26		
White	1.00			
Mixed/Black/Other	0.96 (0.89-1.03)			
Grade/Year		0.95		
1st to 4th	1.00			
5th to 9th	1.01 (0.93-1.08)			
School attendance		0.25		
Morning	1.00			
Afternoon	0.95 (0.89-1.03)			
Parents' Level of Education (n=849)		0.52		
Primary, incomplete	1.00			
Primary, complete	1.03 (0.92-1.16)			
High School, complete	1.02 (0.93-1.16)			
College, complete	0.92 (0.78-1.09)			
Family income (R\$ - Reais)		0.33		
<1600	1.00			
1600 to 2600	1.08 (0.98-1.20)			
>2600	1.05 (0.95-1.16)			

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(51%). Also, sweetened drinks (81%) and sweet biscuits, cookies, candy and jelly (77%) had the highest rate of consumption in this population²⁷.

The investment in food ads is evidence of the power of this industry. In 2001, the advertisement budget for the food industry worldwide was estimated around 40 billion dollars. In Brazil, in 2005, this amount reached 1 billion reais. For each dollar spent by the OMS in the attempt to promote healthy eating, 500 dollars are spent by the food industry promoting ultraprocessed foods²⁸.

The present study has also found that, for lunch and dinner, there were the lowest rates of ultraprocessed food consumption. We may highlight the typical composition of these meals in Brazil, mostly rice and beans, pasta, a protein and salads. However, we have obtained data

showing that 70.0% of students also consume ultraprocessed foods in these meals, mainly juices and soda. According to a study in schools in the southern part of the city of São Paulo, boys usually prefer rice and beans and girls usually consume meat based dishes. And in relation to juices and sweet beverages, there was a higher proportion of girls (91.4%) consuming them than the boys (82.4%), but nevertheless the consumption is exceedingly high for both genders²⁹. PeNSE (2009) has also found that there is a regular consumption of beans (62.6%) among adolescents of both genders and among children. In this sense, a study done in the city of Palmas with children aged 5 to 10 has found a high rate (84.0%) of frequent consumption of beans in their meals³⁰. Based on these findings, we should strengthen the consumption of foods *in natura*

Table 2. Gross and Adjusted analysis for the reason of prevalence of daily ultraprocessed food consumption according to sociodemographic, behavioral, and nutritional variables in students from municipal schools in Caxias do Sul-RS (N=1,128).

Variable	Gross Analysis		Adjusted Analysis	
	RP (CI95%)	Value p*	RP (CI95%)	Value p*
2nd Level - Eating				
Consumes School Meals		0.25		
Yes	1.00			
No	1.09 (0.94-1.26)			
Buys/takes lunch to school		0.007		0.02
No	1.00		1.00	
Yes	1.10 (1.03-1.19)		1.09 (1.02-1.17)	
Nutritional Counseling		0.002		0.002
No	1.00		1.00	
Yes	0.84 (0.75-0.94)		0.85 (0.76-0.94)	
Breakfast		0.01		0.55
No	1.00		1.00	
Yes	1.13 (1.02-1.25)		1.03 (0.94-1.14)	
Morning Snack		0.0004		0.006
No	1.00		1.00	
Yes	1.15 (1.07-1.25)		1.12 (1.03-1.21)	
Lunch		0.13		0.17
No	1.00		1.00	
Yes	1.79 (0.83-3.83)		1.66 (0.80-3.46)	
Afternoon snack		0.02		0.06
No	1.00		1.00	
Yes	1.20 (1.03-1.41)		1.19 (0.99-1.36)	
Dinner		0.31		
No	1.00			
Yes	1.14 (0.88-1.45)			
Supper/Evening snack		<0.001		<0.001
No	1.00		1.00	
Yes	1.25 (1.16-1.35)		1.22 (1.13-1.32)	
Number of Meals		<0.001		
≤3	1.00			
>3	1.56 (1.30-1.59)			
3rd Level				
Excess Weight		0.21		
No	1.00			
Yes	0.95 (0.88-1.03)			

*Poisson Regression.

or minimally processed in these two main meals (lunch and dinner), and also giving incentive for the consumption of regional foods.

Worthy of notice is the fact that children who had some form of nutritional counseling during their lives had a lower prevalence of ultraprocessed food consumption. In this context, in Brazil we have the National Program for School Meals (PNAE), whose goal is to complement the

nutrition of children and adolescents enrolled in public schools. As well as offering nutritionally balanced and adequate meals, PNAE also encourages the formation of healthy eating habits. In spite of that, the number of nutritionists in the program is insufficient for the development of activities of nutritional education that might contribute to the decrease of ultraprocessed food consumption³¹.

Recently, Law 13,666/2108³² established that the curriculum in primary and high school should include nutritional and food education in science and biology classes. This law represents an important progress in children nutrition, because nutritional education's main goal is to promote and consolidate healthy eating habits since childhood, and this would contribute in turn for the decrease in ultraprocessed food consumption and for the prevention of non-communicable chronic diseases in every stage of life.

The results found in this study should be interpreted taking into consideration some limitations. Food consumption was related by the student, so there might have been some variations. Another factor worth noticing is that we only classified as ultraprocessed the foods expressly categorized so by the Food Guide for the Brazilian Population⁶, which might mean an underestimation of the real consumption of ultraprocessed foods. For example, bread was classified as processed, however there was not a question of the origin of the bread, which when coming from

a factory that uses food additives should be classified as ultraprocessed. In this sense we suggest that more research should be done with detailing the composition of foods. Also, this research used a sample of students from municipal public schools in Caxias do Sul-RS and private schools were not a part of this study, so the results may be inferred and compared to populations from public schools.

Among the students in this research we found a high rate of ultraprocessed food consumption, so we emphasize the need for developing of health programs focused on prevention and awareness about food consumption patterns directed to students and parents. Emphasis should be given to changes in lifestyle and promoting health, thus avoiding the premature onset of several non-communicable. The role of school as well as the parent's role is fundamental in forming eating habits in children and adolescents. We also emphasize the importance of strict application of the current laws about school menu and also the kinds of foods sold in school cafeterias.

Collaborations

H Theodoro, FR Motter, J Siviero and KG Mendes participated in the design of the project and the data collection instrument and supervised the fieldwork. H Theodoro and FR Motter performed the data analysis. H Theodoro and V Andretta were responsible for reviewing the literature and writing the final article. All authors critically reviewed and approved the final version.

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Article submitted 05/10/2018

Approved 04/06/2019

Final version submitted 06/06/2019

Chief editors: Romeu Gomes, Antônio Augusto Moura da Silva