DOI: 10.1590/1413-812320182411.25632017

The consumption of ultra-processed products is associated with the best socioeconomic level of the children's families

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Abstract *The aim of this study was to evaluate the intake of ultra-processed foods and associated factors in prepubertal children. It is a cross-sectional study with 378 children aged 8 and 9 years enrolled in public and private schools in Viçosa-MG. Food intake was assessed by three 24-hour dietary recalls. Dietary data were entered into the Diet Pro® 5i software to quantify energy intake. The Two-Step Cluster technique was used to analyze food consumption groups, with the Stata 13 software package. The foods were grouped and classified as "healthy" and "unhealthy" eating markers. The association between the sociodemographic variables and the groups formed was examined by Poisson Regression. Two food groups were formed: "healthy" and "unhealthy". The caloric intake of ultra-processed foods was lower in the "healthy" group (20.5%) than in the "unhealthy" group (24.1%; P = 0.043). The multivariate model showed that private school children (PR = 1.25, P <0.001), who did not receive Bolsa Familia (PR = 1.13, P = 0.036) and had working mothers (PR = 1.38, P <0.001) had increased probability of unhealthy food consumption. Ultra-processed food intake was associated with greater purchasing power of families of prepubertal children.*

Key words *Child, Processed foods, Socioeconomic factors.*

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Introduction

In recent decades, the dietary pattern of the Brazilian population has been changed, with a decrease in the consumption of fresh and minimally processed foods andincrease in intake of processed and ultra-processedfoods[1,2]. These changes result in a higher energy density diet, in association with an increase in the intake of chemical additives, sugar, sodium, saturated and trans fat, and a decrease in fiber intake[2,3].

Ultra-processedfoods (UPF) are industry formulations made from food-derived substances[3,4]. The National School Health Survey (PeNSE) shows an increase in the intake of unhealthy foods such as fried foods, sausages, sweet or savoury packaged snacks,and carbonated soft drinks[5]. This increase may be related to the school environment that influences students' dietary choice, since most of the food advertisements in the media refer to industrialized products[2].

Even though there are still few studies evaluating the individual UPF intake, it is known that household availability of ultra-processedfoods increased with overweightprevalence[6]. According to data from the Family Budget Survey (POF 2008-2009), 14% of Brazilian children aged 5 to 9 years were obese and 33.5% overweight[7]. This scenario is worrisome, since the nutritional status and eating pattern acquired in childhood tend to remain in adulthood[8].

Sociodemographic factors such as parental income and education may be associated with the consumption of ultra-processed foods; however, studies are conflicting regarding these associations. Some studies have found an association between higher UPFintake and poorer diet quality with lower income and education of individuals[9-11], while other studies show higher UPFintakewithincreasing income and education[12-14]. From the foregoing, therefore, this study aimed to evaluate the intake of ultra-processedfoods and associated factors in prepubertal children.

Methods

Population and study design

This is a quantitative, descriptive, cross-sectional study with a representative sample of 378 children aged 8 and 9 years enrolled in public and private schools in the urban area of Viçosa, Minas Gerais. The participants of this study came from the School Health Assessment Survey (PASE), a population-based cross-sectional investigation aimed at investigating the cardiovascular health of children in Viçosa, MG, Brazil.

The municipality of Viçosa is located in Zona da Mata Region and has a landarea of 299 km^2 and 72,244 inhabitants, 93.2% of the population livingin urban areas[7]. In 2015, the municipality had 24 urban public and private schools with 1,464 children aged 8 and 9 yearsenrolled.

The sample was calculated using the statistical programEpi Info (version 7.2; Atlanta, GA),based on thetotal population of students aged 8 and 9 years according to data collected in urban schools in 2014/2015. The calculationconsidered the total student population (n = 1464 students); prevalence of 50% since the study considered multiple outcomes; desired accuracy of 5%; 95% confidence level, and 20% increase to cover losses[15], totaling 366 children. Then, considering the numerical proportion of each school, the number of children to be sampled in each school was proportional to the total number of students of each school. Students were randomly selected until the number of students required for each school was completed.

The non-inclusion criteria were:regular use of medications that could alter nutritional status, body composition, lipid profile, blood pressure and/or glycemic metabolism; physical disability-to perform anthropometric measurements; and disorders of the gastrointestinal or oropharyngeal tract leading to changes in food intake. A pilot study was conducted with 39 children aged 8 and 9 years, corresponding to 10% of the sample. These children were randomly selected to test the questionnaires and food surveys. Children selected for the pilot study were not included in the final sample.

This study was carried out accordingto the guidelines of the Declaration of Helsinki and approved by the Human Research Ethics Committee of the Federal University of Viçosa (UFV). All parents and children were informed about the purpose of the study, as all participants signed the Informed Consent Form.

Socioeconomic and demographic conditions of families

The interviews with the parents or guardians were conducted by nutritionists using a semi-structured questionnaire related to socioeconomic and environmental conditions, includingself-declared race, income, education, participation in health care programs, type of

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school, and physical activities. To evaluate family income, data on the income of all household residents and the number of people dependent on the declared income were collected to calculate the per capita income. For the individuals'classification, it was consideredthe median of per capita income.

Food consumption

Dietary intake was assessed by three 24-hour dietary recalls, conducted by a nutritionist, over non-consecutive days, including one on the weekend day.The children responded the food survey accompanied by their parents or guardians, preferably the one directly involved with the child's diet.

Household utensils and a photograph album with food serving sizes were used to assist participants in estimating the portion sizes[16]. Dietary data analysis was performed using Diet Pro® 5i software (version 5.8) to quantify energy intake[17]. The foods were grouped and classified as "healthy" and "unhealthy" eating markers. For this classification, we took into consideration the recommendations of the Food Guide for the Brazilian population[18], which promotesconsumption of fresh or minimally processed foods ("healthy" eating markers) overultra-processedfoods ("unhealthy" eating markers) (Box 1).

In this study, the industrial formulations made with five or more ingredients such as additives, antioxidants, stabilizers, and preservatives[19]were considered as ultra-processedfoods. As we found no recommendations regarding UPF consumption, we considered as "regular" when it was below the 75thpercentile of the sample, while for the consumption of healthy dietary marker foods, we considered as "regular" when the intake was above the 75th percentile.

Data analysis

The analysis of food intake profilesof children was performed using the Two-Step Cluster (TSC) technique in the Stata software version 13.0. The method allows clustering the sample into profiles of individuals with similar food consumption. After forming the clusters, their association with the sociodemographic variableswas assessed.

Intake of food groups among the clusters formedwas compared by the Student's t test. The bivariate analysis was performed using Poisson regression models with robust variance, with the clusters formed as the dependent variable and the eating habits and socioeconomic aspects as the explanatory variables. The Prevalence Ratio (PR) was calculated using a 95%confidence interval (95% CI).A significance of 5% was adopted for all the analyses.

Results

In this study, 52.1% (n = 197) of the children were female, 50.3% (n = 190) were 9 years old, 68.5% (n = 259) were non-white, and 70.9% (n = 268) were enrolled in public schools.

The dietary profile of the individualswas classified in two groups: "healthy" and "unhealthy". The "healthy" group consisted of 116 children (30.7%), representing less than half of the children in the sample (Table 1).

Rice and beans, vegetables, milk, fruit, and meat were present in both groups. However, among the markers of unhealthy eating, we highlight the presence of ultra-processed foods (fast foods, cookies, and sausages), which differentiate between "healthy" and "unhealthy" profiles (Table 1).

The contribution of each variable to the formation of the profiles is measured by the regular or irregular consumption of the food groups (according to the 75th percentile). Some groups (condiments, industrialized beverages, instant noodles, and sweets) had a similar consumption in all clusters, therefore, they could not differentiate them and, at the end of the statistical analysis,they were not included in the food groupsformed.

The "healthy" group showed higherintake of vegetables and milk, while the children of the "unhealthy" group showed higher intake of fast foods, cookies and sausages (Table 2).

The assessment of the caloric intake of UPF consumed in each group showed that the energy contribution in the "healthy" group (20.5%) was lower than in the "unhealthy" group (24.1%) (p = 0.043).

The univariate analysis showed an association between sociodemographic and environmental variables with children dietary profile. We found that the "unhealthy" consumption was higher in children from private schools (PR = 1.28 (1.20-1.37), p = <0.001), who always brought snacks to school (PR = 1 , 13 (1.01-1.27), p = 0.022), did not receive Bolsa Familia/BFP (Family Grant) (PR = 1.22 (1.10-1.36), p = <0.001), had higher family income (PR = 1.13 (1.05-1.23), p = 0.001), and had working mother (PR = 1.26 (1.21-1.31),

Chart 1. Classification of foods into healthy and unhealthy eating groups.

	Food Groups	Food
Healthy Eating Indicators	Milk	Skimmed, whole, lactose free, and powdered.
	Rice and Beans	White and Brown Rice and Beans
	MeatandEggs	Boiledbeef, pork and chicken; boiled chicken egg
	Vegetablesandgreens	
	Fruit	
Unhealthy Eating Indicators	Sausage products	Sausage, Ham, Salami, and Mortadella.
	Fast food snacks	Hot dogs, hamburgers, pizza, lasagna, fried snacks, ham and cheese sandwich.
	Sugars and sweets	Adding sugar, chocolate, candies, lollipops, chocolate, desserts, ice cream and milkshake.
	Industrialized drinks	Artificial juices, soft drinks and chocolate drinks
	Cookies	Sweet biscuits, stuffed biscuits and savory chips.
	Condiments	Mayonnaise, Mustard, Ketchup, English Sauce and Tomato Sauce.
	Pasta	Instant noodles

Table 1. Children's food groups. Viçosa, MG, 2015.

Healthy Cluster n (%) 116 (30.7)	Unhealthy Cluster n (%) 262 (69.3)
Rice and Beans	Fast-foods
Vegetables and Greens	Cookies
Milk	Sausages
Fruit	Rice and Beans
Meat	Vegetables and Greens
	Milk
	Fruit
	Meat

Two Step Cluster Analysis

Table 2. Average consumption of food groups by children in each cluster. Viçosa, MG, 2015.

Food Groups (g/day)	Healty Cluster 116 (30.7%)	Unhealthy Cluster 262 (69.3%)	P value
Rice and beans	203.9	193.4	0.385
Vegetables and greens	74.3	41.9	<0.001
Milk	159.6	132.7	0.036
Fruit	83.1	64.9	0.084
Meat	35.3	31.3	0.286
Fast-food	25.5	58.8	<0.001
Cookies	84.0	109.5	<0.001
Sausages	12.0	20.2	<0.001

Student's t test.

p = <0.001). In contrast, non-white children (PR = 0.91 (0.84-0.99), p = 0.031) and those who did not engage in physical activity (PR = 0.91 (0.84-0.98), p = 0.026) had less consumption of the "unhealthy" group (Table 3). The adjusted multivariate regression model showed that private school children, who did not receive a family grant (BolsaFamília) and had working mothers showed higher consumption of food from the "unhealthy" group (Table 4).

Discussion

This study identified two food consumption profiles (clusters) and the intake of fast foods, cookies, and sausages differentiated the "healthy" and "unhealthy" profiles.

The "healthy" food group had lower prevalence in the sample (30.7%), reflecting the reality found by another study, in which only 9% of Brazilian children reached the recommended servings of fruits and vegetables[20]. The results showed no difference between the groups for fruit intake, because in both groups the consumption was below the recommended. However, these foods are essential for health since they are sources of vitamins and minerals, besides preventing the risk of chronic diseases[21,22].

Fast foods, cookies and sausages consumed by children in the "unhealthy" group havelow nutrients and high energy density[3]. Currently, there is a great advertising appeal regarding this group of foods, which leads to an increasingly

Table 3. Univariate analysis of exploratory variables and association with clusters as dependent variable. Viçosa, MG, 2015.

Variable	Healthy group		Unhealthy group	
	Reference	P-value	RP/ IC (95%)	Valor de P
Skin color				
White	1.0	-	1.0	-
Non-white	1.0	-	0.91 (0.84 – 0.99)	0.031
Sex				
Male	1.0	-	1.0	-
Female	1.0	-	1.04 (0.97 – 1.13)	0.225
School				
Public	1.0	-	1.0	-
Private	1.0	-	1.28 (1.20 – 1.37)	<0.001
Bring snack to school				
Never	1.0	-	1.00	-
Sometimes	1.0	-	0.89 (0.79 – 1.01)	0.085
Always	1.0	-	1.13 (1.01 – 1.27)	0.022
Engagement in physical activity				
Yes	1.0	-	1.00	-
No	1.0	-	0.91 (0.84 – 0.98)	0.026
Receive Bolsa Família Grant				
Yes	1.0	-	1.00	-
No	1.0	-	1.22 (1.10 – 1.36)	<0.001
Per capita income				
<500,00	1.0	-	1.00	-
>=500,00	1.0	-	1.13 (1.05 – 1.23)	0.001
Mothereducation				
< 9 years	1.0	-	1.00	-
≥ 9 years	1.0	-	1.08 (0.99 – 1.18)	0.065
Fathereducation				
< 9 years	1.0	-	1.00	-
> 9 years	1.0	-	1.08 (0.99 – 1.17)	0.059
Workingmother				
No	1.0	-	1.00	-
Yes	1.0	-	1.26 (1.21 – 1.31)	<0.001

Poisson regression with robust variance.

Table 4. Multivariate regression model with clusters as dependent variable. Viçosa, MG, 2015.

Variable	Healthy group		Unhealthy group	
	Reference	P value	RP/ IC (95%)	P value
School				
Public	1.0	-	1.0	-
Private	1.0	-	1.25 (1.15 – 1.35)	<0.001
Receive Bolsa Família Grant				
Yes	1.0	-	1.0	-
No	1.0	-	1.13 (1.01 – 1.26)	0.036
Workingmother				
No	1.0	-	1.0	-
Yes	1.0	-	1.38 (1.28 – 1.49)	<0.001
Engagement in physical activity				
Yes	1.0	-	1.0	-
No	1.0	-	1.01 (0.92 – 1.08)	0.992

Poisson regression with robust variance. Model adjusted for the engagement in physical activity.

frequent consumption among children[23]. This higher consumption may predispose children to overweight and hypertension[24].

According to the Family Budget Survey(POF2008-2009), UPF contributed 28% of daily energy intake[7]. This result is close to our findings, in which UPF contributed with 20.5% in the "healthy" group and 24.1% in the "unhealthy" group and is in line with other studies that evaluated the consumption of ultra-processed foods by children and identified a contribution of 19.7 to 47.0% of this group to total caloric intake[12,14,24].

It is of note that the consumption of processed products has become a habit since the early years of life, with the introduction of complementary feeding[2]. In Brazil, one out of every three children under two has consumed soda and 60.8% have had cookies or cakes[25]. Among schoolchildren, this scenario is no different. A study conducted among schools in Maranhão found higher consumption of soda than fresh fruit juices and the intake in private schools was significantly higher than in the public ones[26].

It is believedthat this high consumption by the child group is due to stores around schools that favor the consumption of UPF products. In Santos (SP), stores that soldUPF were significantly closer to schools than those that sold fresh and minimally processed foods[27]. In addition, food advertising has increasingly focused on encouraging UPF consumption, focusing on the benefits of fortified products. These issues lead the consumer to believe that fortified industrialized products are characterized as healthy. Even 30-second exposures to televised food commercials is believed to influence children's choice of a particular food[28].

In this study, "unhealthy" consumption was higher among children enrolled in private schools. It is known that in this case, students tend to eat snacks brought from home or bought in the school cafeteria. A study conducted in Rio de Janeiro showed that these snacks are usually high energy densityfoods[29]. Moreover, the National School Feeding Program (PNAE) intervenes to promote healthy eating in public schools[30]. Another study carried out in Paraíba evaluated the height/age index and identified greater nutritional vulnerability of children who did not eat school meals[31].

Children with working mothers had a higher prevalence of food consumption in the "unhealthy" group. It is important to point out that UPfoodshave become attractive to the populationbecause of their practicality, since they require almost nocooking/food preparation.Their consumption increases with the greater participation of women in the labor market and contemporary lifestyle, characterized by lack of time to prepare meals[3].

According to data from the Family Budget Survey (POF 2008/2009), 28% of food expenses were attributed to foodspurchased for consumption away from home, part of which consisted of UPF[7]. However, this change in food profile is not restricted to the Brazilian population. Recent studies have shown that it consists of a consumption phenomenon characterized by the emergence of transnational food industries, followed by a reduction in the relative price of these products[3,32]. In Canada, the participation of UPFs in the population's diet increased from 24.4% to 54.9% between 1938-1939 and 2001[32].

"Unhealthy" consumption was more prevalent among children whose families did not receive Bolsa Familia. It is believed that the families use the BFP benefits to purchase healthy foods, which improves the quality and quantity of families' food[33]. Furthermore, Pedraza et al.[34] observed that the BFP program was effective regarding the recovery and maintenance of children's nutritional status.

It is also noteworthy that in order to receive the BFP benefit,the families are required to meet some conditioning factors, including periodic monitoring of the nutritional and health status of the families; participation in actions of food and nutrition education; and children's school attendance[35]. Theschool attendance guarantees access toschool meals, and as already mentioned, it is a nutritionally adequate diet.

Somestrong points of thiswork should be highlighted. It is one of the few studies conducted in developing countries that investigated factors associated with the consumption of ultra-processed foods in childhoodand is the first population-based study with prepubertal children in Brazil. Because there is a relationship between the intake of ultra-processed foods and the increase of overweight/obesity[36], thechildhood is an important phase to evaluate the factors associated with this consumption.It is a critical period in the formation of healthy eating habits, and every effort must be made to maintain these in adulthood. These findings are consistent with other studies suggesting that the consumption of ultra-processed foods has increased. A limitation to consider in this studyis the lack of some information in the food composition tables, especially

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in relation to ultra-processedfoods, since every day new products appear in the market.

This study allows us to conclude that the consumption of ultra-processed products was associated with the highest socioeconomic conditions of the children's families. These findingspoint out the importance of adopting preventive measures, with emphasis on reducing the consumption of ultra-processedfoods. This will be done through actions of food and nutrition education involving parents and educators to improve the living conditions of children and their families, as well as the access to information on purchase and consumption of healthy foods.

Collaborations

MA Silva: conceived and designed the analysis; collected the data; participated in data interpretation; wrote thepaper. LCMilagres: assisted in the conception and design of the analysis; collected the data; participated in data interpretation; wrote thepaper. APP Castro: assisted in the conception and design of the analysis; collected the data; participated in data interpretation; wrote thepaper. MDSFilgueiras: assisted in the conception and design of the analysis; collected the data; participated in data interpretation; wrote thepaper. NP Rocha: assisted in the conception and design of the analysis; collected the data; participated in data interpretation; wrote thepaper. HHMHermsdorff: supervision of the study; wrote thepaper. GZ Longo: supervision of the study; wrote thepaper. JFNovaes: supervision of the study; wrote thepaper.

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Article submitted 29/05/2017
Approved 17/04/2018
Final version submitted 19/04/2018