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Association between advertising patterns and ultra-processed food in small markets

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Abstract *This article aims to characterize the advertising appeals present in the food environment to market ultra-processed foods and to analyze the nutritional profile of these foods according to PAHO criteria and the presence of food additives. Cross-sectional study, with data audited in 20 small supermarkets in São Paulo. The INFORMAS protocol was used to classify the advertising messages. The foods were classified according to NOVA. The PAHO profile model was used to classify foods high in critical nutrients. Advertising patterns were identified by factor analysis. The association between patterns and food groups was investigated by linear regression. More than 95% of the ultraprocessed foods had at least 1 critical nutrient in excess. There was a positive association between the new brand, fun and advantageous pattern with snacks, ready-made products, dairy products and cookies; between the new brand and suggested use pattern with dairy products. The standardization of food advertising in small retail stores is associated with offering snacks, dairy products, ready-to-eat foods and cookies, products that exceed critical nutrients.*

Key words *Food advertising, Marketing, Product commercialization, Processed foods, Cross-sectional studies*

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Introduction

The food environment is the physical, economic, political and socio-cultural context in which consumers engage with the food system to make their decisions about acquiring, preparing and consuming food[1]. Recent conceptual models describe the food environment as a critical place in the food system to implement interventions to support sustainable diets and address the global syndemic of obesity, undernutrition and climate change, emphasizing its importance for food choices[2]. The food environment is complex and multidimensional and influences eating patterns[3]. This environment can present a risk factor for obesity and an unbalanced and unhealthy diet when it poses obstacles such as cost, difficulties accessing and lack of availability of healthy food, advertising of ultra-processed products and lack of information[4].

The consumer food environment is the space in which food is available, where it is possible to plan and make purchases to prepare meals. This environment includes food retailers, such as supermarkets, grocery stores, fresh food markets, markets, restaurants and bars[5]. Within these spaces, factors such as food availability, price, placement on store shelves and advertising influence food choices, food consumption and spending on food[6,7].

Data from Brazilian population surveys[8] show a relationship between the recent increase in consumption of ultra-processed foods and obesity and other chronic non-communicable diseases[4]. Ultra-processed foods are generally high in sugars, fats and sodium, low in fiber, vitamins and minerals, and contain a range of synthetic additives. In addition, they tend to be aggressively marketed and widely available in the consumer food environment, especially in supermarkets[9].

A study in Brazil found that shopping in supermarkets is associated with an increase in the purchase of ultra-processed foods[10] and that supermarkets are the most common food shopping choice. In supermarkets, customers are exposed to a range of marketing strategies that use different methods to appeal to customers, including packaging and labelling, product placement, promotional pricing and brand advertsing[11].

The marketing of ultra-processed foods is one of the most important factors influencing the purchase and consumption of these foods, especially among children and adolescents[12]. The range of advertsing methods used by food retailers, including displays, posters and overhanging signage, promotional leaflets and flyers, and promotional islands encourage impulse buying and the purchase of unhealthy foods[13]. Advertising messages using nutrition and health claims increase consumers' perceptions of the healthiness of foods, even when the claim is not consistent with the real nutrition value of the food[14].

According to the literature, the marketing strategies used by food retailers can either favor or hinder the purchase of healthy food[15]. Brazil's regulatory agency, ANVISA, recently issued new labelling requirements for packaged food products (RDC Resolution n. 429/2020), advancing the debate on nutrition labelling on commercial foods and beverages. However, gaps remain in the discussion of advertising on food packaging and in the consumer food environment. Further research is therefore warranted to investigate the relationship between advertising in the consumer food environment and sales of foods high in critical nutrients like salt, fat and sugar. The evidence produced by such studies can provide valuable inputs to help shape policies regulating the marketing and labelling of foods and beverages in the food environment, thus assisting consumers to make healthy food choices. To promote the creation of healthy food environments it is vital to explore the relationship between advertising claims and the nutrient content of foods available in the consumer environment. To this end, the aim of this study was to characterize the advertising claims used in the consumer food environment to sell ultra-processed foods and analyze the nutrient profile of these types of products according to the criteria adopted by the Pan American Health Organization (PAHO) and presence of food additives.

Methodology

Study design and sample

We conducted a cross-sectional study using data from advertising messages on ultra-processed foods and beverages collected in the consumer food environment. Convenience sampling was used to select a group of small grocery stores (up to three checkouts)[17] in three cities in the Metropolitan Region of Sao Paulo. Twenty grocery stores were visited (10 in Osasco-SP, three in São Paulo-SP and seven in São Bernardo do Campo-SP). Using Google Maps, we selected stores located within a 2km-radius from the

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researchers' place of study and residence to facilitate access to the establishments. The stores selected in Osasco and São Bernardo do Campo were located in low-income neighborhoods, while those in São Paulo were from middle to high-income neighborhoods.

Consumer food environment audit

We carried out an internal audit of the grocery stores using the previously validated AUDITNOVA audit instrument[18]. For the purposes of this study, only the 18 ultra-processed foods considered by the AUDITNOVA were assessed. The instrument was adapted to capture information on the marketing strategies used in the stores. The researchers identified which of the 18 foods were sold in the store and recorded the advertising messages related to each food in their entirety (for example: Practicing joy is good for you! Now even more crispy! Give it try!). The messages were codified and grouped into categories with similar themes following a specific protocol described below. The researchers were previously trained to use the data collection protocols developed for the application of AUDITNOVA[18]. The data were collected in July and August 2018.

Study variables

The advertising messages were grouped into nine categories of advertising claims adapted from the INFORMAS (International Network for Food and Obesity/non-communicable Diseases Research, Monitoring and Action Support) Protocol – Food Promotion Module[19]. The aim of the protocol is to provide guidance on the monitoring of food marketing in different countries. The following categories were used: 1. Sensory-based characteristics (taste, texture, appearance, aroma); 2. New brand development; 3. Suggested use (e.g. great for lunchboxes); 4. Suggested users are children or whole family; 5. Emotive claims (fun, feelings, popularity); 6. Puffery (claiming to be advantageous over other products); 7. Convenience; 8. Price (promotions and gifts); 9. Health and nutrition.

Classification of food groups

To facilitate data organization and analysis, the foods were grouped according to the ultra-processed food groups considered by the NOVA food classification[9] as follows: sweets snacks (ice cream, jellies, chocolate, chewing gum and candies), savory snacks (corn chips, popcorn), fats and oils (margarines), ready-to-eat foods -(instant noodles, soups, ready-made seasonings), reconstituted meats (sausages, salami, bologna, ham), sugar-sweetened beverages (soft drinks, powdered juices, nectar), dairy products (milk drinks, cream cheese), baked products (cakes, breads and farofas), cookies and crackers (cookies, crackers, sandwich cookies), sugary cereals (breakfast cereals, cereal bars).

Processing of nutrient content data

We collected information on ingredients and nutrients (macro and micronutrients) from the food ingredient lists and nutrient facts labels. All items on the list were included except food additives, which were analyzed separately. Information on additives was collected from the manufacturers' website. When the information was not available on the manufacturers' website, it was collected in the stores.

The additives were grouped as follows: emulsifiers (lecithin, mono and diglycerides of fatty acids, and maltodextrin)[20]; acidulants (citric, lactic, malic, acetic, fumaric, sorbic and phosphoric acids)[21]; and three groups of sweeteners (non-caloric artificial – aspartame, sucralose, saccharin and acesulfame potassium; non-caloric natural – stevia; and caloric – sorbitol, mannitol, lactitol and isomalt)[16].

The macro and micronutrients were calculated per 100 grams or 100 ml. As it is not mandatory for food manufacturers to declare the free sugars content on the nutrient facts label in Brazil, based on PAHO criteria[16], we estimated free sugars content based on the total sugars content declared on the nutrient facts label. However, as it is also not mandatory for manufacturers to declare the total sugars content on the nutrient facts label, only 41% of the products declared the sugar content. For sugar-sweetened beverages and dairy products with sugar on the ingredient list, total sugars content was therefore estimated based on carbohydrate content per 100g/ml using the definition of total sugars established in the nutrient profile model proposed by the WHO Regional Office for Europe[22].

To determine whether the ultra-processed food was nutritionally unbalanced, we used the PAHO Nutrient Profile Model[16] for critical nutrients. The following critical nutrients were analyzed: free sugars, sodium, total fats, saturated fats and other sweeteners. We did not include

trans fats because, despite the inclusion of this information on food labels being mandatory since 2003, a study reported that current legislation fails to ensure that manufacturers provide clear information about the trans fat content of packaged foods[23]. The following cutoff points set out in the PAHO Nutrient Profile Model[16] were used to classify whether a food was high in a critical nutrient: sodium ≥ 1 mg of sodium per kcal; free sugars ≥ 10% of total energy value comes from free sugars; saturated fats ≥ 10% of total energy value comes from saturated fats[16].

Statistical analysis

Exploratory factor analysis was used to determine patterns of advertising claims related to food groups. This method was chosen because we did not know which potential combinations of advertising claims to expect for each ultra-processed food group. The Kaiser-Meyer-Olkin (KMO) test was used to measure sampling adequacy and how suited the data was for factor analysis, where a value of > 0.6 indicates that sampling is adequate. The following criteria were used to determine the number of factors to retain in the exploratory factor analysis: eigenvalue > 1.0 and Cattell's scree test. Orthogonal rotation was performed using the varimax method, which adjusts the factors to find a better distribution of factor loadings, producing a simpler and more easily interpretable structure of factors. Factor loadings after rotation of > 0.20 were taken to indicate an advertising claim pattern. After extracting the factors, we calculated standardized scores for each factor and each food group, where the higher the score, the stronger the association with the food group.

The variables were analyzed using descriptive statistics (means and 95% confidence intervals and relative frequencies of the presence of critical nutrients and additives in each food group). Linear regression models were used to measure the association between advertising claims patterns and food groups, where the outcomes were the pattern scores and the exposure variables were the food groups. A correlation coefficient of > 1.0 was considered to indicate a strong positive association. Statistical analyses were performed using Stata version 15.

The purpose and procedures of the study and possible risks were explained to the store owners and each owner signed an informed consent form. The study protocol was approved by the research ethics committee (CAAE Nº 69045917.5.0000.5421).

Results

A total of 202 advertising messages were identified in the 20 stores audited by this study. The ultra-processed foods that accounted for the largest share of advertising messages were sugar-sweetened beverages (28.2%), followed by baked goods and cookies and crackers (both 25.8%), reconstituted meats (16.8%), and sweet snacks (10.9%).

Table 1 shows the mean content of macro and micronutrients per 100 g/ml for each ultra-processed food group. The groups that showed the highest means for energy value were savory snacks, cookies and crackers and sugary cereals, respectively, while the groups with the highest carbohydrate content were cookies and crackers, sugary cereals and savory snacks, respectively. The group with the highest mean protein content was reconstituted meats. The groups with the highest mean fat content were savory snacks and reconstituted meats, while the groups with the highest mean saturated fat content were margarines and savory snacks. The highest mean total sugar contents were found in sweet snacks and sugary cereals, while the groups with the highest mean sodium content were ready-to-eat foods and reconstituted meats. Sugary cereals had the highest mean fiber content.

The analysis of the critical nutrients showed that more than 80% of sweet snacks were high in free sugars and more than 50% were high in total and saturated fats. All ready-to-eat foods were high in sodium and more than 70% of cookies and crackers were high in total fats. The overwhelming majority of ultra-processed foods (more than 95%) were high in at least one critical nutrient (Table 2).

The foods with the highest mean number of ingredients (excluding additives) were sugary cereals (14.9), reconstituted meats (10.8) and savory snacks (10.2), while the foods with the highest number of additives were dairy products (13.3), reconstituted meats (11.3) and fats and baked goods (approximately nine each). With regard to types of additives, 50% of dairy products contained emulsifiers and sweeteners and 66.6% contained acidulants; almost 30% of reconstituted meats contained acidulants; 85% of baked goods contained emulsifiers and 38,5% contained sweeteners; and approximately 30% of sugar-sweetened beverages contained sweeteners (Table 3).

Four patterns of advertising claims were identified: Pattern 1, which we named the "new brand, fun and advantageous pattern" and con-

Table 1. Mean content of macro and micronutrients per 100g/ml of the ultra-processed food groups using advertising claims in the consumer food environment. São Paulo, 2018.

Food groups		Energia (kcal)	Carbohydrate (g)	Protein (g)	Total fat(g)
	n	Mean (95% CI)	Mean (95% CI)	Mean (95% CI)	Mean (95% CI)
Sweet snacks	22	284.6 (227.2; 341.9)	44.5 (35.4; 53.5)	7.4 (3.3; 11.5)	8.9 (4.4; 13.3)
Savory snacks	17	480.0 (452.0; 508.0)	56.7 (53.7; 59.7)	5.9 (5.4; 6.4)	25.5 (21.9; 29.0)
Fats and oils	4	720.0 (-)	0.0 (-)	0.0 (-)	80.0 (-)
Ready-to-eat foods	16	223.1 (190.7; 255.4)	30.2 (22.8; 37.7)	18.6 (12.3; 24.9)	1.4 (0.8; 3.7)
Reconstituted meats	34	299.9 (207.7; 392.1)	2.9 (2.1; 3.7)	18.9 (13.1; 24.6)	21.8 (13.7; 29.8)
Sugar-sweetened beverages	57	122.5 (84.9; 160.0)	25.9 (18.3; 33.5)	0.0 (-)	0.0 (-)
Dairy products	6	242.7 (133.4; 351.9)	31.7 (0.8; 62.5)	6.2 (4.2; 8.3)	9.8 (1.0; 20.5)
Baked goods	26	334.8 (308.3; 361.4)	55.4 (51.3; 59.4)	6.1 (5.2; 6.9)	10.0 (7.5; 12.4)
Cookies and crackers	11	451 (443.7; 458.4)	66.4 (64.6; 68.2)	7.9 (6.9; 8.9)	16.4 (15.1; 17.6)
Sugary cereals	9	387.4 (349.8; 425.0)	58.5 (33.7; 83.3)	6.1 (2.7; 9.5)	4.4 (3.0; 11.8)
Food groups		**Saturated fat (g)**	**Estimated total sugar (g)**	**Sodium (mg)**	**Fiber (g)**
	n	**Mean (95% CI)**	**Mean (95% CI)**	**Mean (95% CI)**	**Mean (95% CI)**
Sweet snacks	22	4.6 (2.2; 7.1)	33.6 (24.1; 43.1)	356.6 (76.1; 637.1)	0.7 (0.2; 1.2)
Savory snacks	17	9.6 (7.9; 11.2)	0.6 (0.0; 1.2)	537.9 (485.5; 590.2)	1.9 (0.4; 3.4)
Fats and oils	4	23.0 (21.0; 25.0)	0.0 (-)	622.5 (607.7; 637.3)	0.0 (-)
Ready-to-eat foods	16	0.7 (0.3; 1.8)	21.0 (14.9; 26.9)	1670.2 (1393.2; 1947.3)	0.4 (0.1; 0.9)
Reconstituted meats	34	8.3 (5.0; 11.5)	-	1319.6 (1003.7; 1635.5)	0.3 (0.1; 0.45)
Sugar-sweetened beverages	57	0.0 (-)	23.2 (16.5; 30.0)	180.2 (77.1; 283.2)	0.6 (0.4; 1.7)
Dairy products	6	6.2 (0.6; 12.9)	6.7 (3.9; 9.5)	157.1 (2.1; 316.3)	1.5 (0.2; 3.3)
Baked goods	26	3.2 (2.4; 3.9)	31.7 (-)	343.2 (295.6; 390.8)	3.3 (2.2; 4.5)
Cookies and crackers	11	6.1 (4.5; 7.8)	16.9 (4.4; 29.4)	469.1 (331.5; 606.7)	3.8 (1.8; 5.7)
Sugary cereals	9	0.6 (0.6; 1.9)	29.9 (21.4; 38.4)	305.9 (236.4; 375.4)	6.2 (2.9; 9.4)

95%CI: 95% confidence interval.

* Food groups: sweets snacks – ice cream, jellies, chocolate, chewing gum and candies; savory snacks – corn chips, popcorn; fats and oils – margarines; ready-to-eat foods – instant noodles, soups, ready-made seasonings; reconstituted meats – sausages, salami, bologna, ham; sugar-sweetened beverages – soft drinks, powdered juices, nectar; dairy products – milk drinks, cream cheese; baked products – cakes, breads and farofas; cookies and crackers – cookies, crackers, sandwich cookies; sugary cereals – breakfast cereals, cereal bars.

Source: Authors.

sisted of new brand development, suggested use (e.g. great for lunchboxes), emotive (fun, feelings, popularity), and puffery (claiming to be advantageous over other products) claims; Pattern 2, which included emotive claims and was named the "fun and popular" pattern; Pattern 3, named the "healthy and nutritious" pattern, containing health and nutrition claims; and Pattern 4, made up of new brand development and suggested use claims and named the "new brand and suggested use" pattern (Table 4).

The results of the linear regression analysis showed a positive association between Pattern 1 – New brand, fun and advantageous and savory snacks, ready-to-eat foods, dairy products, and cookies and crackers, and between Pattern 4 – New brand and suggested use and dairy products, and a negative association between Pattern 2 – Fun and popular and reconstituted meats. The positive associations indicate that the number of these claim patterns are higher in the respective food groups, showing that these groups are more likely to be associated with these patterns. No statistically significant associations were found between Pattern 3 – Healthy and nutritious and the food groups (Table 5).

Discussion

Our findings show an association between different types of advertising claims and specific groups of ultra-processed foods. Savory snacks, ready-to-eat foods, dairy products and cookies

Table 2. Relative frequency of critical nutrients in the ultra-processed food groups using advertising claims in the consumer food environment according to the PAHO Nutrient Profile Model (n = 202). São Paulo, 2018.

Ultra-processed food groups*	High in free sugars (%)	High in total fats (%)	High in saturated fats (%)
Sweet snacks	81.8	54.6	54.6
Savory snacks	0.0	100.0	82.4
Fats and oils	0.0	100.0	100.0
Ready-to-eat foods	31.3	6.3	6.3
Reconstituted meats	0.0	85.3	94.1
Sugar-sweetened beverages	94.7	0.0	0.0
Dairy products	33.3	50.0	66.7
Baked goods	3.9	34.6	53.9
Cookies and crackers	27.3	72.7	63.6
Sugary cereals	88.9	11.1	0.0

Ultra-processed food groups	High in sodium (%)	Sweetener (%)	High in at least 1 critical nutrient (%)
Sweet snacks	18.2	27.3	95.5
Savory snacks	64.7	0.0	100.0
Fats and oils	0.0	0.0	100.0
Ready-to-eat foods	100.0	0.0	100.0
Reconstituted meats	100.0	0.0	100.0
Sugar-sweetened beverages	26.3	28.1	100.0
Dairy products	33.3	50.0	100.0
Baked goods	53.9	38.5	100.0
Cookies and crackers	54.6	0.0	100.0
Sugary cereals	33.3	0.0	100.0

* Food groups: sweets snacks – ice cream, jellies, chocolate, chewing gum and candies; savory snacks – corn chips, popcorn; fats and oils – margarines; ready-to-eat foods – instant noodles, soups, ready-made seasonings; reconstituted meats – sausages, salami, bologna, ham; sugar-sweetened beverages – soft drinks, powdered juices, nectar; dairy products – milk drinks, cream cheese; baked products – cakes, breads and farofas; cookies and crackers – cookies, crackers, sandwich cookies; sugary cereals – breakfast cereals, cereal bars.

Source: Authors.

and crackers were associated with a wider variety of advertising claims (Pattern 1 – New brand, fun and advantageous), illustrating that retailers and food manufacturers use a diverse range of strategies to promote these products. In addition, more than 95% of the foods available in the stores assessed by this study were nutritionally unbalanced, exceeding the limits set by the PAHO for at least one critical nutrient and illustrating the mass exposure of consumers to unhealthy foods.

As mentioned above, the stores assessed by the present study located in Osasco and São Bernardo do Campo were located in low-income neighborhoods. A study in Brazil conducted in Jundiaí-SP showed that the concentration of small food retailers is higher in low-income neighborhoods with low levels of education located in urban peripheries[24]. A nationwide study conducted by the Interministerial Chamber of Food and Nutrition Security (CAISAN) in 2018 showed a predominance of "mixed food retailers" (which sell both healthy and unhealthy food) over other types of retailers. This classification of retailer proposed by CAISAN includes grocery stores with similar characteristics to those of our sample[5].

A study by Machado et al. undertaken in 2018 using data from the 2008/2009 National Household Budget Survey reported that the traditional retailer purchasing pattern (markets and street vendors, small grocery stores, small farmers, butchers) resulted in a lower share of ultra-processed foods in food purchases than the supermarket pattern[10]. However, while the study showed that purchasing food in small retailers was associated with the purchase of healthier food, it did not assess food marketing. According to conceptual models of the food environ-

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Table 3. Mean number of ingredients and additives and absolute and relative distribution of presence of additives in ultra-processed food groups using advertising claims in the consumer food environment (n = 202). São Paulo, 2018.

Food groups**	Number of ingredients*		Number of additives		Presence of acidulants		Presence of emulsifier		Presence sweetener	
	mean	95% CI	mean	95% CI	n	%	n	%	n	%
Sweet snacks	6.0	4.40; 7.60	5.9	4.10; 7.72	5	22.7	14	63.6	6	27.3
Savory snacks	10.2	7.36; 12.99	7.2	5.06; 9.30	11	64.7	11	64.7	0	0.0
Fats and oils	4.8	4.26; 5.25	9.5	8.51; 10.48	4	100.0	4	100.0	0	0.0
Ready-to-eat foods	8.5	8.02; 8.98	4.1	2.55; 5.70	1	6.3	0	0.0	0	0.0
Reconstituted meats	10.9	9.80; 11.91	11.4	10.28; 12.43	10	29.4	3	8.8	0	0.0
Sugar-sweetened beverages	4.4	3.92; 4.89	7.3	6.03; 8.45	57	100.0	21	36.8	16	28.1
Dairy products	10.0	6.55; 13.45	13.3	5.14; 21.52	4	66.7	3	50.0	3	50.0
Baked goods	9.2	7.43; 11.03	9.5	7.43; 11.57	15	57.7	22	84.6	10	38.5
Cookies and crackers	7.8	6.66; 8.97	5.5	3.58; 7.52	3	27.3	9	81.8	0	0.0
Sugary cereals	14.9	13.78; 16.00	2.6	1.46; 3.65	0	0.0	5	55.6	0	0.0

95% CI: 95% confidence interval.
* Ingredients without additives. ** Food groups: sweets snacks – ice cream, jellies, chocolate, chewing gum and candies; savory snacks - corn chips, popcorn; fats and oils – margarines; ready-to-eat foods – instant noodles, soups, ready-made seasonings; reconstituted meats – sausages, salami, bologna, ham; sugar-sweetened beverages – soft drinks, powdered juices, nectar; dairy products – milk drinks, cream cheese; baked products – cakes, breads and farofas; cookies and crackers – cookies, crackers, sandwich cookies; sugary cereals – breakfast cereals, cereal bars.

Source: Authors.

Table 4. Factor loadings and explained variance of the main advertising claims. São Paulo, 2018.

Types of advertising claims	Pattern 1 – New brand, fun and advantageous	Pattern 2 – Fun and popular	Pattern 3 – Healthy and nutritious	Pattern 4 – New brand and suggested use
Sensory based characteristics (taste, texture, appearance, aroma)	-0.99	0.00	-0.10	0.02
New brand development	0.25	0.00	-0.29	0.59
Suggested use (e.g., great for lunchboxes)	0.20	0.00	-0.13	0.36
Suggested users are children or whole family	0.10	0.00	-0.01	0.09
Emotive claims (fun, feelings, popularity)	0.22	0.76	-0.20	-0.56
Puffery (claiming to be advantageous over other products)	0.22	-0.76	-0.20	-0.56
Convenience	0.14	0.00	-0.03	0.16
Price (promotions and gifts)	0.08	0.00	0.00	0.07
Health and nutrition	0.11	0.00	0.97	0.01
Variance explained by factor %	13.69	12.83	12.61	12.61
Total explained variance %	51.74			

Source: Authors.

ment, food marketing exerts a strong influence on food choices and should be assessed in combination with food availability rather than as an isolated factor[2,3]. Our findings show that small food retailers are characterized by advertising claims patterns that prioritize products with low

Table 5. Association between the main patterns retained in the food groups that used advertising claims in the consumer food environment. São Paulo, 2018.

Food groups**	Pattern 1		Pattern 2		Pattern 3		Pattern 4	
	Coefficient	95% CI	Coefficient	95% CI	Coefficient	95% CI	Coefficient	95% CI
	Referência		Referência		Referência		Referência	
Fats and oils*	Reference	Reference	Reference	Reference	-0,27	(-0,91; 0,36)	0,53	(-0,09; 1,15)
Savory snacks	1.01	(0.39; 1.62)*	-0.39	(-1.02; 0.24)	-0.27	(-0.91; 0.36)	0.53	(-0.09; 1.15)
Sweet snacks	0.06	(-0.97; 1.09)	-0.27	(-1.33; 0.78)	0.25	(-0.81; 1.32)	0.64	(-0.41; 1.68)
Ready-to-eat foods	1.13	(0.51; 1.75)*	-0.03	(-0.67; 0.61)	0.07	(-0.58; 0.72)	0.03	(-0.60; 0.67)
Reconstituted meats	0.77	(0.25; 1.09)*	-0.79	(-1.32; -0.25)*	-0.09	(-0.64; 0.45)	-0.28	(-0.81; 0.25)
Sugar-sweetened beverages	0.87	(0.39; 1.35)*	-0.34	(-0.84; 0.15)	0.00	(-0.50; 0.50)	0.46	(-0.03; 0.95)
Dairy products	1.37	(0.50; 2.24)*	0.05	(-0.85; 0.94)	-0.60	(-1.50; 0.31)	0.94	(0.05; 1.82)*
Baked goods	0.83	(0.28; 1.38)*	0.02	(-0.54; 0.59)	-0.34	(-0.91; 0.24)	0.16	(-0.40; 0.72)
Cookies and crackers	1.14	(0.44; 1.84)*	0.25	(-0.47; 0.97)	-0.62	(-1.35; 0.10)	-0.31	(-1.02; 0.41)
Sugary cereals	0.37	(-0.38; 1.12)	-0.49	(-1.26; 0.28)	0.66	(-0.12; 1.44)	0.12	(-0.64; 0.88)

The models were adjusted according to the PAHO nutrient profile model: high in at least 1 critical nutrient; p-value < 0.05 .
* Food group used as a reference for comparison purposes. ** Food groups: sweets snacks – ice cream, jellies, chocolate, chewing gum and candies; savory snacks – corn chips, popcorn; fats and oils – margarines; ready-to-eat foods – instant noodles, soups, ready-made seasonings; reconstituted meats – sausages, salami, bologna, ham; sugar-sweetened beverages – soft drinks, powdered juices, nectar; dairy products – milk drinks, cream cheese; baked products – cakes, breads and farofas; cookies and crackers – cookies, crackers, sandwich cookies; sugary cereals – breakfast cereals, cereal bars.

Source: Authors.

nutritional value, showing that the advertising practices used by these establishments should be monitored and evaluated.

Manufactures use a diverse range of marketing strategies in the consumer food environment to increase sales and influence consumers at the time of purchase[6,7]. Our results show that savory snacks, dairy products, ready-to-eat foods, and cookies and crackers used the widest range of advertising claims, including new brand development, suggested use, emotive claims and advantageous over other products. In addition, these foods were high in critical nutrients. This is particularly worrying given the increasing consumption of these foods among children[25] and adolescents[26]. Mass marketing in grocery stores combined with the growing availability of ultra-processed foods has contributed to this problem, as the eating behaviors of this age group are influenced[4] by advertising strategies used to promote these types of foods in other media such as television[27].

A study exploring the marketing and quality of foods sold in supermarket chains in Florianópolis assessed 16 online and printed food promotion leaflets advertising 1,786 foods. The findings showed that the proportion of ultra-processed foods advertised on the leaflets was significantly higher than the proportion of fresh or minimally processed foods ($p < 0.001$)[28]. Although the present study did not assess advertising strategies for fresh or minimally processed foods, it is known that, despite their more limited availability[7], these foods contribute to an increase in consumption of healthy foods in environments such grocery stores and supermarkets, especially those located in low-income neighborhoods[29].

Our findings show that dairy products (or milk drinks) had the highest number of ingredients and additives. Studies show that food additives are associated with *inflammation, metabolic* changes and cancer, and can lead to changes in microbiota composition, intestinal barrier and other gastrointestinal disorders[22,21].

Dairy products accounted for the largest share of claims in Pattern 4. "new brand and suggested use". The Suggested use claim was characterized by the keywords "any time", "any place", "to wake up", "eat together at the table" "great for lunchboxes". In other words, expressions that suggest the ideal time or place to eat or drink the product, including the school environment, or that encourage impulsive eating at any time and in any place. This type of advertising is designed to stimulate overeating and is reflected in an increase in consumption of these foods among Brazilian adolescents. According to the 2017-2018 Household Budget Survey[8], adoles-

cents drink nine times more milk drinks than older people and ultra-processed foods account for 27% the total daily calorie intake among adolescents, compared to only 15.1% in the ≥ 60 years age group.

In an attempt to reduce the consumption of ultra-processed foods in Brazil, ANVISA issued new regulations in October 2020[30] governing front-of-package labelling. This type of regulation plays an important role in promoting healthy food choices as food labels provide consumers with information on the nutrient content of foods, potentially reducing intentions to purchase ultra-processed foods due to improved perceptions of the healthiness of these products[31]. The new regulation means customers are able to identify foods with high levels of critical nutrients from the warning labels on the front of the packaging. However, based on the INFORMAS protocols designed to help monitor and benchmark food environments, Brazil also needs to push forward measures to regulate the quality of food sold by food retailers and the advertising strategies used in these environments, which in this study were associated with food groups made up of nutritionally unbalanced foods.

The patterns of advertising claims found in this study show that food retailers and manufacturers use a broad range of different strategies to increase sales and stimulate consumption. These strategies can influence consumers' perceptions of the healthiness of products, leading them to buy certain foods because they believe they are healthy, advantageous or nutritionally superior to others[14].

Ultra-processed food advertising is a barrier to healthy eating[4]. In this regard, the findings of this study provide a deeper understanding of the consumer food environment as a barrier to healthy eating, especially in small retailers, which are present in the majority of Brazilian municipalities and play a fundamental role in supplying food in areas located in urban peripheries with lower socioeconomic status[5]. In addition, the findings highlight the need to broaden discussions regarding the monitoring of food availability and marketing in food retailers. With new regulations in Brazil stipulating that food and drink products high in sodium, fats or sugar must be labelled with front-of-pack nutritional warnings due to come into force next year, the country could see an increase in these types of marketing strategies in the food environment, as witnessed in Mexico when similar regulations were introduced[32].

One of the strengths of this study is that it characterized consumer food environment variables (presence of advertising claims, nutrient profile, and main ingredients and additives), while other studies have focused on specific aspects such as labels, prices or food availability. Our findings therefore provide a more detailed insight into the consumer food environment, especially in low-income areas. Limitations include the fact that the sample was selected using convenience sampling and is not representative of small food retailers. However, the increase in market concentration in the hands of large supermarket chains affects and homogenizes the sales practices and marketing strategies adopted by small food retailers[7], which are similar across different regions of Brazil.

In conclusion, our findings show that a range of different advertising strategies are used in the aisles and on the shelves of small retailers in the Metropolitan Region of Sao Paulo to promote nutritionally unbalanced ultra-processed foods containing various types of food additives. The "new brand, fun and advantageous" pattern was particularly associated with savory snacks, ready-to-eat foods, dairy products and cookies, and all items (100%) in these groups were high in at least one critical nutrient. In addition, the average number of additives contained in dairy products was 13. The findings show that specific advertising patterns were used in the stores to promote certain types of ultra-processed foods. The type of advertising claims used, ranging from the launch of new products to fun, emotive, health and well-being claims, influence food choices in these environments and encourage the consumption of unhealthy foods, underlining the need to develop policies and actions to regulate the consumer food environment in Brazil.

Collaborations

CHK Batista contributed substantially to study conception, planning and data analysis and interpretation; FHM Leite contributed substantially to data analysis and revising the manuscript critically for important intellectual content; CA Borges contributed to data analysis and interpretation and revising the manuscript. All authors approved the final version to be published.

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