






Commercial foods for infants under the age of 36 months: an assessment of the availability and nutrient profile of ultra-processed foods

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Abstract

Objective: Considering the negative impact of the consumption of ultra-processed foods on health, the current study assessed the availability and nutritional profile of commercial ultra-processed foods for infants in Natal, Brazil.

Design: A cross-sectional exploratory study.

Setting: Foods targeted at children under the age of 36 months sold in retail establishments located in high- and low-income areas of the one capital city of Brazil.

Participants: 1645 food products consisting of ninety-five different types of food were available. The foods were assessed according to the NOVA classification: minimally processed, processed and ultra-processed. The nutritional content per 100 g was assessed according to processing classification.

Results: Half of foods founded were breast milk substitutes and cereal foods (31.6 and 26.3%, respectively). The foods were predominantly ultra-processed (79%) and only 4.2% were minimally processed, with similar proportions of ultra-processed foods being found in both high- and low-income areas. After excluding breast milk substitutes and follow-up formulas, all cereals, food supplements and some of the fruit or vegetable purees were ultra-processed, higher in energy density, fat, carbohydrate and protein and low in fibre ($P < 0.05$).

Conclusions: The findings reveal that ultra-processed foods for infants are widely available in Brazil, reaffirming the need to strengthen the regulation of foods for infants and young children by introducing complementary measures designed to promote the production and marketing of foods manufactured using lower levels of processing.

Keywords
Infant foods
Nutrition labelling
Ultra-processed foods
Food legislation
Obesity

Children's dietary habits directly influence nutritional status, growth and development and consequently have an impact on child health and risk of disease in adulthood⁽¹⁾. Exclusive breast-feeding up to 6 months of age is therefore recommended, followed by the introduction of unprocessed or minimally processed foods^(2,3). However, ultra-processed foods make up an increasing proportion of children's diets to the detriment of fresh foods⁽⁴⁾ and it is estimated that the percentage of daily energy intake from the former ranges from 33.3% to 74%^(5,6).

Ultra-processed foods are formulations of ingredients that result from a series of industrial processes such as fractionation, extrusion, molding and pre-frying. In addition, these foods are characterised by the presence of ingredients of rare culinary use, the so-called food additives, such as colourants, flavours and flavour enhancers⁽⁷⁾. The consumption of ultra-processed foods during childhood has also been linked to overweight, diabetes, increased waist circumference, high serum cholesterol and cardiometabolic alterations^(6,8–11). In 2019, the FAO

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of the United Nations stressed the importance of assessing the extent of food processing based on the NOVA classification system and developing public policies and actions to promote home-prepared meals and reduce the manufacture and consumption of ultra-processed foods⁽¹²⁾.

In response to the growing prevalence of childhood obesity – reaching 14% globally⁽¹³⁾ and 15% in Brazil^(14,15) – in 2016, the World Health Assembly issued a resolution calling on countries to implement the WHO's 'Guidance on Ending the Inappropriate Promotion of Foods for Infants and Young Children'⁽¹⁶⁾. The Guidance lays out recommendations on the marketing of foods to children, aimed at protecting breast-feeding and preventing obesity and chronic diseases.

A study conducted by the WHO in four countries in the WHO European Region found that food products targeted at infants under 6 months of age listing sugar and concentrated fruit juice on the ingredients list, such as fruit or vegetable purees, were widely available⁽¹⁷⁾, warning of the inappropriate promotion of such foods. Although research has been conducted on the consumption of ultra-processed infant foods^(18–20), we were unable to find any studies in the literature assessing foods for infants according to the NOVA food processing classification.

In view of the health impact of ultra-processed food intake, childhood obesity prevention plans and the need to collect data on commercially available food products targeted at infants to help map their availability and nutrient profile and inform policies, the aim of the current study was to assess the availability and level of processing of different categories of industrialised foods for children under the age of 36 months and identify differences in the nutrient profile of the foods and label information.

Methodology

Study characterisation

We conducted a quantitative, cross-sectional exploratory study of foods for infants sold in retail establishments in Natal, the capital of the State of Rio Grande do Norte, Brazil.

The establishments included pharmacies, mini-markets (stores with up to five check-outs), supermarkets (stores with more than five check-outs)⁽²¹⁾ and bakeries located in low- and high-income neighbourhoods. Data were collected from packaging and food labels using an electronic baby food form⁽²²⁾. Using data obtained from the city council, we selected the lowest and highest income neighbourhoods in each of the city's districts^(23–26). After defining the neighbourhoods, establishments were identified using store locators (<https://aplocal.com.br/>; <https://www.telelistas.net/>; and <https://www.guiamais.com.br/natal-rn>), resulting in the selection of 345 stores. The address of each establishment was then confirmed using Google Maps (<https://www.google.com.br/maps>) and by making telephone contact, resulting in a final sample of 142 establishments.

Finally, the establishments were categorised by sector tract (<https://mapas.ibge.gov.br/bases-e-referenciais/bases-cartograficas/malhas-digitais>) and the order of data collection was defined by randomly selecting each tract. Additional six establishments that were not found in the electronic search but were present in the neighbourhoods were included, resulting in a final sample of 146 visited establishments.

Data collection

The data were collected between November 2018 and April 2019 using a mobile baby food questionnaire hosted on the KoBoCollect open-source platform⁽²²⁾. We collected information from the packaging and labels of all food products sold in the establishment indicated for children under the age of 36 months, regardless of whether the product had been found in another store included in the study. The following information was collected for each product: store characteristics, type of food, age group for which the product was indicated, fortification with vitamins and minerals, the ingredients list, brand, health claims, visual information and a photograph of the food label.

General characterisation of the foods

The foods were categorised according to their purpose and nature as follows⁽¹⁷⁾: (a) breast milk substitutes, (b) follow-on formulas, (c) growing-up milks, (d) biscuits/wafers/crisps, (e) cereal/porridge, (f) fruit/vegetable puree, (g) juice/smoothie/tea/other drinks, (h) meat or fish-based meals, (i) powdered drinks, (j) desserts, (k) soups, (l) yogurt and (m) other.

Health and nutrient claims and the visual information on the packaging were also identified and further details on the type of health and/or developmental claims, and nutrient claims were recorded: Health claims evaluated were: (a) strengthening the immune system, (b) helps growth and development, (c) improving cognitive skills and (d) preventing allergies. The nutrient claims assessed were fortification with vitamins and minerals, addition of salt, sugar, milk proteins, lactose, gluten and the presence of natural ingredients. Visual information related to the entire packaging was also collected, such as cartoon images, mothers and children.

Processing classification and nutritional information

Using the photograph of the ingredients list, the foods were categorised based on the NOVA classification system as follows: minimally processed, processed and ultra-processed⁽⁷⁾.

Foods whose ingredients list included only unprocessed foods such as fruit and vegetables were classified as minimally processed. Products with culinary ingredients such as salt, sugar and fats were classified as processed, while those lists contained additives whose function was to enhance flavour, colour or texture, such as flavourings, colourants



and emulsifiers, were classified as ultra-processed. For the classification of ultra-processed products, the use of industrial techniques such as extrusion, hydrogenation and carbohydrate modifications, such as maltodextrin, was also taken into account.

The nutritional composition of the foods was assessed according to the per 100 g and per serving nutritional information, based on the statement about energy value (kcal), carbohydrates (g), protein (g), total fats (g), saturated fats (g), *trans*-fats (g), Na content (mg) and fibre (g) present on label. For the current analysis, the sugars were not included because they were not on the label and all breast milk substitutes and follow-up formulas were excluded because they are specifically formulated to meet the daily nutritional recommendations.

Statistical analysis

The data were extracted from the baby food database to an Excel spreadsheet and analysed using SPSS 7. The categorical variables were presented as relative and absolute frequencies, and the nutritional information was presented as medians and SD. Differences in the categorical variables across processing classifications and availability of foods by area (high- and low-income) were assessed using the χ^2 test, while differences in the nutrient profile between processing classification were assessed using the Kruskal–Wallis test. A significance level of 0.05 was adopted for both tests. Duplicate food products were eliminated for the analyses, except for availability between establishment of high- and low-income areas.

Results

Of the 148 visited establishments, two refused to allow data collection and forty-six (32%) did not sell foods for infants. Of the 100 stores that sold infant foods, 33% (*n* 33) were mini-markets, 32% (*n* 32) pharmacies, 20% (*n* 20) supermarkets and 15% (*n* 15) bakeries. The visits to the establishments (*n* 100) resulted in a total sample of 1645 analysed foods.

Most of the establishments (67%, *n* 67) were located in high-income neighbourhoods. In these areas, foods were mostly sold in pharmacies and supermarkets, whereas in low-income neighbourhoods they were mostly sold in mini-markets and bakeries (Table 1).

Only six of the twelve product categories were found in the visited stores. A total of ninety-five different foods were found after excluding duplicate products. Of these, 31.6% (*n* 30) were breast milk substitutes and 26.3% (*n* 25) were cereals (Fig. 1).

With regard to processing classification, 79% (*n* 75) of the foods were ultra-processed, 16.8% (*n* 16) processed and 4.2% (*n* 4) minimally processed and these proportions were similar in low- and high-income areas ($P=0.172$)

(Table 2). It is important to highlight that breast milk substitutes and follow-up formulas are classified as ultra-processed due to the manufacturing process. Therefore, these foods cannot have lower processing levels, unlike cereals, fruit purees and meat or fish-based meals.

More than half of the ultra-processed foods were breast milk substitutes (40%, *n* 30) and cereals (33%, *n* 25), such as infant formulas. The only categories classified as minimally processed were fruit and vegetable purees. The majority of the ultra-processed foods were indicated for the 6–12 months age group (60%). Most of the products carried nutrient claims, such as fortified with vitamins and minerals (98.7 and 90.7%, respectively) and gluten-free (62.7%), while 13.3% bore health claims (Table 3).

When analysing their nutritional composition (excluding infant formulas), all the cereals and other foods (food supplements) were ultra-processed and with higher absolute values per 100 g of total and saturated fat, protein and carbohydrate content and lower in fibre than other processing classifications ($P<0.001$) (Table 4). Overall, the median energy density of the ultra-processed foods was 1540 kJ (386 kcal), being 6.5% of total energy from proteins, 73.9% from carbohydrates and 19.6% from lipids. All the meat or fish-based meals were processed.

Discussion

The findings provide some important insights into the nutrient profile and level of processing of foods for children aged up to 36 months. The data presented show that the large majority of the foods were ultra-processed (as breast milk substitutes, infant formulas, cereals), regardless of area, and that the foods from this group had a higher energy, carbohydrate and fat content and a smaller fibre than those from the minimally processed and processed groups. Industrialised foods make up an increasing proportion of children's diets, accounting for almost half of the energy intake of children in Brazil (21.5%)⁽²⁷⁾ and almost half in Canada (48%)⁽²⁸⁾.

We did not find a very wide variety of industrialised foods, being made up mainly of infant formulas and cereal foods (Fig. 1). These findings contrast with those of a WHO study conducted in cities in Hungary, Austria, Israel and Bulgaria using the same baby food questionnaire which showed that products were predominantly fruit or vegetable purees and meat or fish meals⁽¹⁷⁾. This low availability of industrialised infant foods found in the Brazilian market may be a limitation of the study. However, this low availability may reflect some restraints imposed by the Brazilian norms for commercialisation of infant foods, and also the population's traditional eating patterns⁽²⁷⁾. Locally, it still may predominate a traditional dietary pattern rich in unprocessed or minimally processed foods and cooked at home. We can also see the dominance of one or two brands in the manufacture of these foods (data not showed), which can limit the diversity of foods.

Table 1 Types of establishments by number of foods and processing classification in high- and low-income areas

Type of establishment	Number of establishments				*P establishments	Number of foods				*P foods
	High-income		Low-income			High-income		Low-income		
	n	%	n	%		n	%	n	%	
Pharmacies	29	43	3	9	<0.001	631	45	30	11	<0.001
Mini-markets	13	19	20	61		120	9	153	59	
Supermarkets	17	26	3	9		618	45	60	23	
Bakeries	8	12	7	21		15	1	18	7	
Total	67	100	33	100		1384	100	261	100	

* χ^2 test.

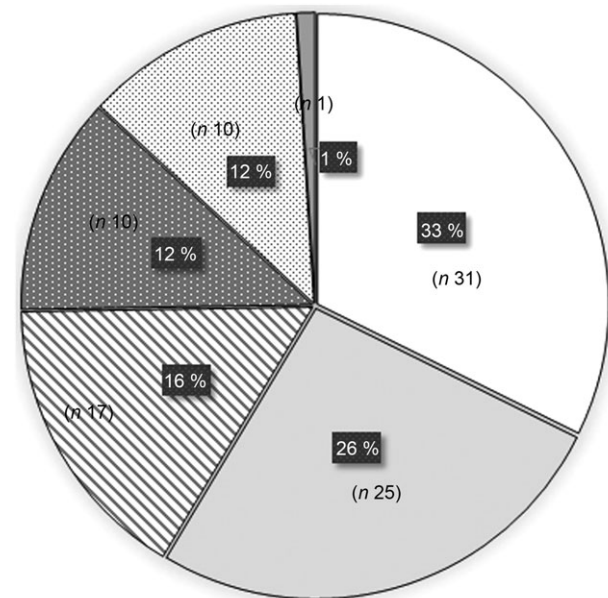


Fig. 1 Different types of commercially available foods targeted at children aged between 0 and 36 months in Natal-RN, Brazil (November 2018–April 2019). □, Breast milk substitutes; ▨, cereals; ▩, meat or fish-based meals; ▤, follow-on formulas; ▥, fruit/vegetables puree; ▦, others

Table 2 Type of foods according to the NOVA classification in high- and low-income areas

Processing classification	High-income		Low-income		P*
	n	%	n	%	
Minimally processed	49	3.6	5	1.7	0.172
Processed	237	17.6	47	15.9	
Ultra-processed	1064	78.8	243	82.4	
Total	1350	100	295	100	

* χ^2 test between high- and low-income.

We also found yogurts, biscuits and juices bearing cartoon images on the package making reference to children, but without any direct indication for the under 36 months age group. Similar results were found by another study in Brazil⁽²⁹⁾. This is because national legislation strongly regulates the promotion of foods for children aged under

36 months, specially infant formulas, cereals, purees and soups, but not other products such as milk, juices, cookies, petit suite and others^(30–36). The same legislation also prohibits advertisements that suggest that the product is superior to breast milk, and images/pictures on packaging of products for children aged under 36 months. In this regard, the regulation of the marketing and sale of food targeted at infants could serve a greater number of foods in Brazil.

A report published in 2019 by the FAO highlights the importance of examining the level of food processing, since various studies have shown a positive association between ultra-processed food consumption and non-communicable chronic diseases⁽¹²⁾. Evidence also shows that high intake of ultra-processed foods is increasingly common among children, meaning that it is important to examine differences in the nutrient profile and processing classification of commercial foods for infants across different socio-economic contexts and between developed and developing countries⁽³⁷⁾.

It is known that ultra-processed foods have a negative impact on diet quality because they are higher in energy density, fats, free sugars and Na and lower in fibre than unprocessed and minimally processed foods⁽³⁸⁾. The present study found a similar nutrient profile for ultra-processed foods. It is also important to stress that the large majority of the foods examined by the current study were ultra-processed, showing that these foods are widely available in both high- and low-income areas. Moreover, even though there was no significant difference, in low-income neighbourhoods the proportion of minimally processed foods (fruit or vegetables purees) was half (1.7%) in comparison with high-income areas (3.6%). This is probably explained by the lower purchasing power of residents of low-income areas, resulting in a lower availability of minimally processed foods in these areas or it may be that in these areas people still prefer to prepare food at home.

In 2016, the World Health Assembly called on countries to implement the WHO's Guidance on Ending the Inappropriate Promotion of Foods for Infants and Children, with the aim to encourage and support breast-feeding and healthy diets and prevent chronic diseases. The document

**Table 3** Label information on commercially available foods for children aged between 0 and 36 months by processing classification, Natal-RN, Brazil (November 2018–April 2019)

Variable	Processing classification						P*
	Minimally processed		Processed		Ultra-processed		
	n	%	n	%	n	%	
Food type							<0.001
Breast milk substitutes	0	–	0	–	30	40	
Cereal-based foods	0	–	0	–	25	34	
Follow-on formulas/growing-up milks	0	–	0	–	12	16	
Meat or fish meals	4	100	1	6	7	9	
Fruit or vegetable puree	0	–	0	–	1	1	
Others (food supplements)							
Age group (months)							0.098
0–6	0	–	0	–	12	16	
>6 to <12	4	100	12	14	45	60	
>12	0	–	4	29	7	9	
0–36	0	–	0	57	11	15	
Visual information (pictures)							0.002
Yes	4	100	16	100	44	59	
No	0	–	0	–	31	41	
Health claims†							0.225
Growth/development	0	–	0	–	10	13	
Immune system	0	–	0	–	4	5	
Cognitive ability	0	–	0	–	6	8	
Allergy prevention	0	–	0	–100	0	–	
No claims	4	100	16	–	65	87	
Nutrient claims†							<0.001
Fortified with vitamins	0	–	2	13	74	99	
Fortified with minerals	0	–	4	25	68	91	
Gluten-free	4	100	13	81	47	63	
Milk protein-free	0	–	0	–	3	4	
No added sugar	2	50	1	6	9	12	
No added salt	0	–	6	38	0	–	
Lactose-free	0	–	0	–	2	3	
Natural	0	–	0	–	1	1	
No claims	0	–	0	–	0	–	

* χ^2 test.

†May be more than one choice of food.

Table 4 Nutritional composition of commercially available foods for children aged between 0 and 36 months by processing classification, Natal-RN, Brazil (November 2018–April 2019)

Nutritional information	Minimally processed median/100 g	Processed median/100 g	Ultra-processed median/100 g			P*
	Fruit or vegetable purees (n 4)	Meat or fish meals (n 15)	Cereals (n 25)	Fruit or vegetable purees (n 8)	Others† (n 1)	
Energy (kJ)	188	314	1540	230	1979	<0.001
Total fat (g)	0	3	0	0	19	<0.001
Saturated fat (g)	0	0	0	0	7	<0.001
Trans-fat (g)	0	0	0	0	0	–
Carbohydrates (g)	10	8	82	13	68	<0.001
Protein (g)	1	4	6	0	8	<0.001
Na (mg)	3	92	28	0	162	0.249
Fibre (g)	2	1	0	1	0	<0.001

*Kruskal–Wallis test for processing classification, except for *trans-fat*.

†sD was not calculated because there was only one product.

encourages countries to establish rules to regulate the marketing and promotion of these foods⁽¹⁶⁾. In the present study, we found foods with images and health claims that may be inappropriate or misleading, being stated by

guidelines, except where specifically provided in the Codex or national legislation^(39,40).

With regard to visual information on packages, all the minimally processed foods and processed foods, and most



of the ultra-processed foods, had pictures such as cartoon characters and images of ingredients. A comparison with the WHO study⁽¹⁷⁾ mentioned above shows that there are differences between the characteristics of commercially available foods for infants in Europe and Brazil, which is probably due to the rules governing marketing adopted by each country. The WHO study⁽¹⁷⁾ reported that most of the foods had pictures and images of ingredients and carried health claims relating to improvement of cognitive ability, growth, development and the immune system.

All the products analysed by the present study carried nutritional information and statements on *trans*-fatty acid content. In contrast, most of the products examined by the WHO Europe study did not show this information as this statement is not mandatory in the European Union⁽¹⁷⁾. Brazilian legislation governing the use of industrial *trans*-fats in foods was recently updated, providing that their content shall not exceed 2 g/100 g of total fat in foods intended for the final consumer and food intended for supply to retail, as from December 2019⁽⁴¹⁾.

Our findings show that ultra-processed infant foods totally dominate the market in Natal. All the breast milk substitutes, cereals, follow-on formulas, food supplements and some of the fruit or vegetable purees examined by the current study were ultra-processed and when analysed their nutritional composition (excluding infant formulas), they were higher in energy density, fat, carbohydrates and proteins than the processed (meat or fish-based meals) and minimally processed (fruit or vegetable purees) foods and low in fibre. Louzada *et al.* also reported that the ultra-processed foods consumed by the population were high in energy density, fat, free sugars and Na and low in fibre⁽³⁸⁾.

With regard to infant formulas, it is important to highlight that these products are indicated for special purposes and are classified as ultra-processed due to the nature of the manufacturing process, as opposed to cereals, fruit or vegetable purees and other milks, for example, which can be manufactured using lower levels of processing. In Brazil, cereal-based foods are widely consumed by infants and are an intrinsic part of Brazilian culture. However, there is no need for high consumption of these products, especially if the characteristics of their nutritional composition and degree of processing make them less desirable.

Aguayo-Patrón and Calderón found an association between the consumption of ultra-processed foods and autoimmune diseases such as type 1 diabetes and celiac disease in childhood⁽⁸⁾, while Rocha *et al.* reported a positive association between ultra-processed food intake and cardiometabolic alterations in children, highlighting the importance of assessing these foods⁽⁴²⁾. These findings therefore reinforce the importance of exclusive breast-feeding for the first 6 months of life and continuing breast-feeding with the introduction of complementary

foods thereafter in accordance with the twelve steps to healthy eating for children under 2 years of age recommended by Brazil's Ministry of Health⁽³⁾.

The FAO report mentioned above stresses the importance of developing public policies and actions designed to promote the consumption of minimally processed foods and reduce the production and consumption of ultra-processed foods in view of the association between ultra-processed food intake and non-communicable chronic diseases and their effects on diet quality⁽¹²⁾. Moreover, the WHO highlights the importance of regulating the marketing of foods for infants and young children in response to evidence showing that the inappropriate promotion of these foods hampers the adoption of healthy eating habits during childhood. The document provides recommendations aimed at protecting breast-feeding and preventing childhood chronic diseases, including encouraging home-prepared foods, prohibiting the promotion of foods such as infant formulas, including messages on packaging that highlight the importance of breast-feeding and prohibiting the provision of free samples⁽¹⁶⁾.

This guidance has been adopted in Brazil, with the introduction of legislation regulating the marketing and composition of foods for infants and young children^(39,40) and actions designed to encourage unprocessed or minimally processed food intake and reduce the consumption of ultra-processed foods, such as the *Guia Alimentar para Crianças Brasileiras Menores de 2 anos* or Food Guide for Children under the Age of 2 years⁽³⁾. However, the wide availability of ultra-processed foods targeted at infants and young children in Brazil is still worrying, as indicated by Chemas-Velez *et al.*⁽⁴³⁾.

The findings of the current study therefore reinforce the importance of the WHO's guidance on the assessment of commercially available foods for infants and young children, demonstrating that the foods analysed are predominantly ultra-processed and high in energy density, fat and carbohydrate and low in fibre, especially those consumed by children under 12 months of age, such as cereals. This reveals the need for more effective regulatory measures, including guidance for the infant and young child food industry on the manufacture of foods using lower levels of processing.

The baby food questionnaire proved to be an extremely important tool for assessing the nutrient profile of commercial foods for infants. Since food processing is a widely discussed issue, we recommend that the processing classification of foods should be included in the electronic questionnaire, as was done in the present study.

Conclusion

The current study provides new information about the nutrient profile and level of processing of commercial



foods for infants in Brazil, thus contributing to the implementation of the WHO's Guidance on the assessment of these foods. Our data reveal the predominance of ultra-processed foods on the market, most of which targeted at children aged between 6 and 12 months and high in energy density, fat, carbohydrates and protein and low in fibre. These findings reaffirm the importance of nutrition education to promote the consumption of minimally processed foods, the promotion of breast-feeding exclusive for children 0–6 months age and of the development legislation designed to encourage the infant and young child food industry to provide foods manufactured with lower levels of processing to children older than 6 months of age, compliance with current guidelines on child health.

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