

Exclusive breastfeeding and introduction of ultra-processed foods in the first year of life: a cohort study in southwest Bahia, Brazil, 2018

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Abstract

Objective: To analyze association between exclusive breastfeeding (EBF) and the introduction of ultra-processed foods in children under 12 months old. **Methods:** This was a Cohort study, conducted with children in Vitória da Conquista, Bahia, Brazil. The main exposure was EBF (days: <120; 120-179; ≥180). The outcome variable was the introduction of four or more types of ultra-processed foods in the first year of life. Poisson regression analysis was used. **Results:** 286 children were evaluated, of whom 40.2% received four or more ultra-processed foods and 48.9% EBF for less than 120 days. EBF for less than 120 days (RR=2.94 – 95%CI 1.51;5.71) and for 120-179 days (RR=2.17 – 95%CI 1.09;4.30) was associated with the outcome after adjustment by socioeconomic, maternal, paternal and child variables. **Conclusion:** EBF for less than 180 days increased the risk of introducing four or more ultra-processed foods in the first year of life.

Keywords: Breastfeeding; Infant Nutrition; Industrialized Foods; Longitudinal Studies.

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Introduction

Use of ultra-processed foods has been increasing over the years in the homes of Brazilian families.¹ Consumption of these foods is not recommended in the first two years of life, as they have negative health impacts in the short or long term.² However, their introduction occurs early, even in the first semester of life, a period for which exclusive breastfeeding is recommended.²⁻⁴

Ultra-processed foods are industrially produced, in various stages of processing, and have a high amount of ingredients such as salt, sugars, fats, preservatives and additives, among others.^{2,5} In addition, they are highly palatable, produced to offer pleasant and attractive flavors, which can generate addiction and influence eating habits throughout life.^{2,6} Consumption of ultra-processed foods is related to increased overweight/obesity, dyslipidemias, hypertension, diabetes *mellitus* and allergies in children, adolescents and adults.⁶⁻¹¹

Ultra-processed foods are industrially produced, in various stages of processing, and have a high amount of ingredients such as salt, sugars, fats, preservatives and additives, among others.

Adequate and healthy eating, on the other hand, is an important health promotion factor, which is fundamental for satisfactory growth and child development, especially in the first two years of life. Therefore, exclusive breastfeeding is recommended in the first 6 months, and then complemented with other foods – fresh or minimally processed – up to 2 years or over.² The positive impacts of breastfeeding include reduction of the infant mortality rate, protection against infections, decreased risk of chronic diseases, improvement of oral cavity performance and intelligence levels.^{2,12-14}

A study conducted in southeastern Brazil observed that early interruption of exclusive breastfeeding was associated with higher consumption of ultra-processed foods in preschoolers.¹⁵ Breastfeeding for less than 6 months was associated with higher scores of inadequate complementary feeding in children receiving care at a Primary Health Care Center in a municipality in the interior region of São Paulo state.¹⁶ Furthermore, the literature points to high consumption of ultra-processed foods by infants in Brazil, especially biscuits, jelly and 'petit suisse' cheese.^{3,4}

No studies were found to assess the influence of exclusive breastfeeding on the introduction of ultra-processed foods in the first year of life, despite the importance of adequate child nutrition in this first period and its repercussions, both in childhood and in adulthood.²

The objective of this study was to analyze association between exclusive breastfeeding and the introduction of ultra-processed foods in children under 12 months old.

Methods

This is a prospective cohort study, linked to a larger project entitled 'Breastfeeding and complementary feeding practice follow-up in children under 1 year of age living in the municipality of Vitória da Conquista – Bahia',¹⁷ conducted with mothers/children from the urban area of the municipality, from February 2017 to October 2018. The cohort study data collection, performed in all maternity hospitals in the municipality (February to October 2017), continued in subsequent visits to the participants' houses, when the children were 30 days old (March to December 2017), 6 months old (July 2017 to May 2018) and 12 months old (February to October 2018). This study used data collected in maternity hospitals when the children were 6 and 12 months old.

Vitória da Conquista, a municipality in southwestern Bahia, the third largest in the state in terms of territorial extension and fifth largest in the interior region of the Northeast, covers an area of 3,705.838km² and had a human development index (HDI) of 0.678 in 2010; its estimated population for 2020 is 341,128 inhabitants.¹⁸ There are four maternity hospitals in the municipality: one of them provides care exclusively via the Brazilian National Health System (SUS); another provides only private care; while a further two provide both public and private care. In 2016, the four maternity hospitals in the municipality performed 5,541 deliveries.

The study included healthy mothers and their healthy live newborns from the urban area of Vitória da Conquista who did not need hospitalization in an intensive care unit (ICU), non-twin and with gestational age equal to or greater than 37 weeks. Mothers with human immunodeficiency virus (HIV) and children born with malformations that compromised breastfeeding, such as cleft palate, were considered ineligible.

The sample was selected in the maternity hospitals in the municipality, during visits made by undergraduate

and graduate students responsible for data collection. On each day of the visits, three 'mother/live birth' pairs were selected at random 24 hours postpartum. If on the day of the visit, there were only three or fewer mother/live birth pairs at 24 hours postpartum, all of them were invited to participate as long as they met the inclusion criteria. Three pairs of mothers/live births were selected per visit at each maternity hospital, to enable follow-up of the participants over time.

After selecting the sample, information continued to be collected both from the medical records of the maternity hospitals and also through interviews in which a questionnaire was administered. Subsequently, three home visits were made after the children turned 30 days, six months and 12 months of life. Questionnaires were administered on all three occasions. The data obtained in the maternity hospital and selected for this study was comprised of: socioeconomic, demographic, maternal, paternal, gestational and breastfeeding information in the first hour of life. The interview at 6 months of age included information about the duration of exclusive breastfeeding and at 12 months, maternal information, such as work and marital status and about the child, including guidance on complementary feeding, person responsible for feeding the child, total breastfeeding, introduction of ultra-processed foods, age at which these foods were given for the first time, and whether the child attended or had attended day care or school.

The outcome variable of this study was the introduction of four or more types of ultra-processed foods, polarized between 'No' and 'Yes'. In order to define the items of this variable, the mothers were asked, at the time of the interview, about whether they gave their children 11 types of ultra-processed products – artificial juice, soft drink, yogurt/dairy drink, 'petit suisse' cheese, chocolate, biscuits, stuffed cookies, sweet food, snacks, instant noodles and sausage – before the child was 12 months old.^{5,19}

The independent variable studied was exclusive breastfeeding (EBF), which was asked about in the interview when the children were 6 months old, based on the mother's answer to the following question:

"How long has your child been breastfed exclusively?"

The answer to this question was categorized into days: <120; 120-179; and ≥ 180 . This categorization was based on the median EBF of 120 days and the recommendation for EBF up to 180 days.² EBF was considered when the infant received only breast milk, directly from the breast

or pumped beforehand, without provision of any other liquid or solid – except for medications, vitamins and mineral supplements.²

The covariates of interest corresponded to socioeconomic characteristics of the mother, father and child:

- a) family income (in minimum wages: <1; ≥ 1);
- b) maternal and paternal education (in years of studies: <8; ≥ 8);
- c) maternal and paternal age (in years: <20; 20-34; ≥ 35);
- d) maternal race/skin color (white/yellow; black/brown);
- e) maternal work (no; yes);
- f) maternal marital status (without partner; with partner);
- g) parity (primiparous; multiparous);
- h) number of prenatal consultations (<6; ≥ 6);
- i) guidance of a health professional on complementary feeding (no; yes);
- j) attends or has attended day care or school (no; yes);
- k) person responsible for feeding the child (mother or father; other); and
- l) breastfeeding in the first hour of life (no; yes)

To calculate the sample size of the cohort, 59.3% prevalence of exclusive breastfeeding at 30 days of life was used as reference. This is a cohort study conducted with mothers/babies in the first month of lactation, in Feira de Santana, Bahia,²⁰ taking relative risk of 1.2, power of 80% and a 95% confidence level. The minimum number for the study sample was 252, to which 30% compensation was added for possible losses, resulting in a sample of 328 mothers/children. The number of mothers/live births selected in each maternity hospital was proportional to the number of deliveries performed in each of them. The power of the sample was calculated to be 98.6%, considering a 95% confidence interval and the incidence of introduction of ultra-processed foods according to exclusive breastfeeding obtained in this study.

To characterize the sample, categorical variables were presented as absolute (n) and relative (%), and continuous variables, such as means and standard or median deviations. Pearson's chi-square test and Fisher's exact test were used in order to assess the differences between the proportions of mothers/children who remained in the study and those lost to

follow-up. The differences between the proportions of introduction of the ultra-processed foods studied, according to the categories of duration of exclusive breastfeeding, were assessed by the linear trend test. Poisson regression with robust variance was used to analyze the influence of exclusive breastfeeding on the introduction of ultra-processed foods, estimating the crude and adjusted relative risks and respective 95% confidence intervals (95%CI).

For the statistical adjustment, the *stepwise-forward* method was used, according to which the variables are inserted, one by one, in the multiple regression model, hierarchically and in decreasing order of statistical significance with the outcome, adopting $p < 0.20$ as the entry criterion. The variables used as adjustment factors were included using three hierarchical models:

a) in model 1, family income, maternal education, paternal education and maternal work;

b) in model 2, maternal age, paternal age, maternal marital status, parity and number of prenatal consultations were added; and

c) in model 3, guidance of health professionals on complementary feeding was incorporated and the child attending or having attended day care or school.

Association was considered to be statistically significant when $p \leq 0.05$. The Akaike criterion (AIC) was used to assess the quality of the adjustment. The data were analyzed using Stata version 15.0 (Stata Corporation, College Station, USA).

The study project was submitted to the Human Research Ethics Committee of the Multidisciplinary Institute of Health, Federal University of Bahia (CEP-Seres Humanos/IMS/UFBA), and was approved: Protocol No. 1,861,163 and Certificate of Submission for Ethical Appraisal (CAAE) No. 62807516.2.0000.5556, both issued on December 12, 2016. The participating mothers signed the Free and Informed Consent Form.

Results

The baseline of the cohort in the maternity hospitals was comprised of 388 mothers/children. After losses, the final sample of this study was 286 mothers/children followed up to 12 months of life (Figure 1). The losses occurred due to a change of telephone number, address or city, and due to withdrawal. There were no

statistically significant differences between the study sample and the losses to follow-up (from maternity hospital to 12 months), according to the 'family income' ($p=0.297$), 'paternal schooling' ($p=0.060$), 'maternal age' ($p=0.842$) and 'parity' ($p=0.285$) variables (data not shown in tables).

Of the total number of interviewees, most mothers lived with family income above 1 minimum wage (74.0%), had more than 8 years of schooling (77.3%), were between 20 and 34 years of age (70.3%) (median: 28 years) and 50.7% of them were multiparous. Most fathers had more than 8 years of schooling (71.7%) and were between 20 and 34 years old (64.8%) (median: 31 years). Regarding the children's diet, 67.1% of the mothers reported that they had received guidance from health professionals on complementary feeding. As for their children, 40.2% had received four or more types of ultra-processed foods; and almost half of them had received breast milk exclusively for less than 120 days (48.9%) (Table 1). Median introduction of ultra-processed foods was 180 days (minimum of 90 days; maximum of 330 days).

Significantly higher incidence rates of introduction of 'petit suisse' cheese (75.7%), stuffed crackers (32.9%), snacks (25.7%), instant noodles (25.7%), chocolate (22.9%), artificial fruit juice (17.9%), soft drink (17.9%) and sausages (15.7%) in the first year of life were found among children who had received exclusive breastfeeding for less than 120 days. It could be seen that the shorter the duration of exclusive breastfeeding, the higher the proportions of introduction of ultra-processed foods (Table 2).

In the crude analysis, exclusive breastfeeding for <120 days increased the risk of introduction of four or more ultra-processed foods. In the adjusted analysis, exclusive breastfeeding for less than 120 days of life (RR=2.94 - CI 95% 1.51;5.71) and from 120 to 179 days of life (RR=2.17 - CI 95% 1.09;4.30) increased the risk of introducing four or more ultra-processed foods in the first year of life, when compared to exclusive breastfeeding for 180 days or more. It could be seen that the power of association between the main explanatory variable and the outcome increased as the models were adjusted (Table 3). Duration of exclusive breastfeeding influenced the introduction of four or more ultra-processed foods in the first year of life, regardless of the adjustment covariates.

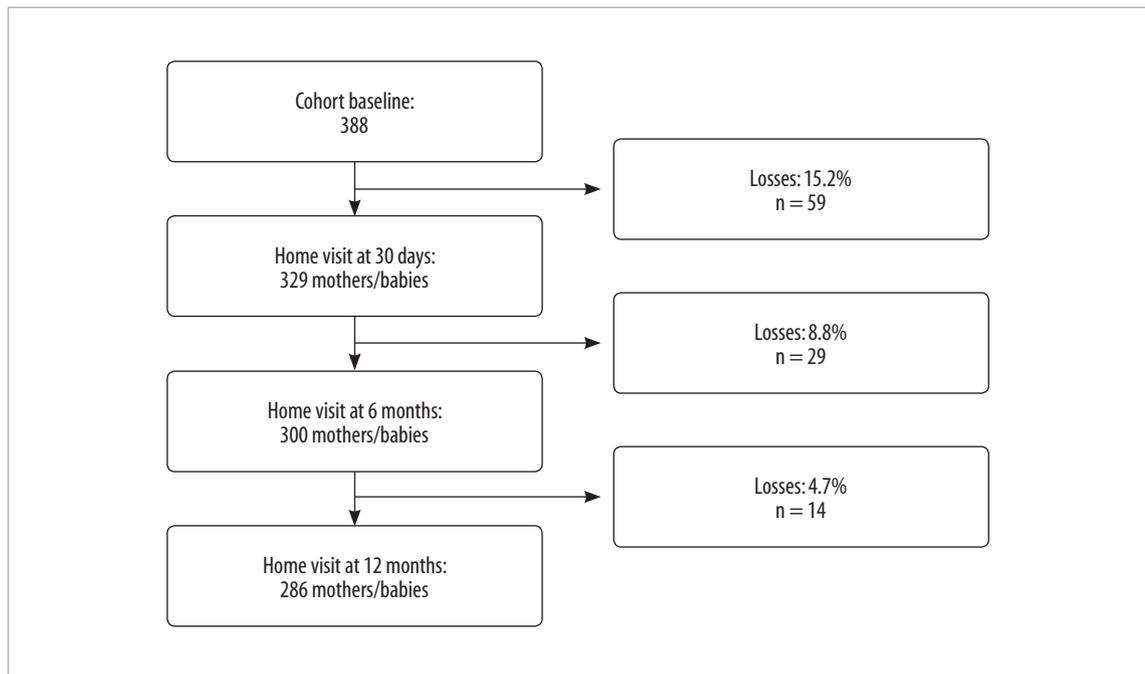


Figure 1 – Process of the sample of mothers/babies according to the cohort study follow-up, Vitória da Conquista, Bahia, 2018

Table 1 – Socioeconomic, maternal and gestational, paternal and related characteristics of children under 12 months (N=286), Vitória da Conquista, Bahia, 2018

Characteristics	n	%	95%CI ^a
Socioeconomic			
Family income^b (in minimum wages)			
≤1	70	26.0	21.1;31.6
>1	199	74.0	68.4;78.9
Maternal education (in years of study)			
≤8	65	22.7	18.2;28.0
>8	221	77.3	72.0;81.8
Paternal schooling^b (in years of study)			
≤8	76	28.3	23.2;34.0
>8	193	71.7	66.0;76.8
Maternal and gestational, and paternal			
Maternal age (in years)			
<20	34	11.9	8.6;16.2
20-34	201	70.3	64.7;75.3
≥35	51	17.8	13.8;22.7
Paternal age^b (in years)			
<20	5	1.8	0.7;4.2
20-34	184	64.8	59.0;70.2
≥35	95	33.4	28.2;39.2
Maternal skin race/color			
White/yellow	69	24.1	19.5;29.5
Black/brown	217	75.9	70.5;80.5

To be continued

Continuation

Table 1 – Socioeconomic, maternal and gestational, paternal and related characteristics of children under 12 months (N=286), Vitória da Conquista, Bahia, 2018

Characteristics	n	%	95%CI ^a
Maternal and gestational, and paternal			
Maternal work			
No	126	44.1	38.4;49.9
Yes	160	55.9	50.1;61.6
Maternal marital status			
With partner	37	13.0	9.5;17.4
Without partner	248	87.0	82.6;90.5
Parity			
Primiparous	141	49.3	43.5;55.1
Multiparous	145	50.7	44.9;56.5
Number of prenatal consultations			
<6	50	17.5	13.5;22.4
≥6	236	82.5	77.6;86.5
Child-related			
Guidance of a healthcare professional on complementary feeding			
No	94	32.9	27.6;38.6
Yes	192	67.1	61.4;72.4
Attends or has attended day care or school			
No	273	95.5	92.3;97.3
Yes	13	4.5	2.6;7.7
Person responsible for feeding the child			
Mother or father	216	75.5	70.2;80.2
Other	70	24.5	19.8;29.8
Amount of ultra-processed foods			
<4	171	59.8	54.0;65.3
≥4	115	40.2	34.6;46.0
Breastfeeding in the first hour of life			
No	148	51.7	45.9;57.5
Yes	138	48.3	42.5;54.1
Exclusive breastfeeding (in days)			
<120	140	48.9	43.2;54.8
120-179	99	34.6	29.3;40.3
≥180	47	16.4	12.5;21.2

a)95%CI :95% confidence interval;b) Family income (n=17), paternal education (n=17) and paternal age (n=12) presented n lower than 286 - data unknown.

Table 2 – Incidence of introduction of ultra-processed foods in children under 12 months of age, according to categorization of the duration of exclusive breastfeeding (N=286), Vitória da Conquista, Bahia, 2018

Ultraprocessed foods	Percentage introduction of ultra-processed foods			p-value ^a
	Exclusive breastfeeding <120 days n (%)	Exclusive breastfeeding 120-179 days n (%)	Exclusive breastfeeding ≥180 days n (%)	
Cookie/Biscuit	128 (91.4)	89 (89.9)	42 (89.4)	0.627
<i>Petit suisse</i> cheese	106 (75.7)	66 (66.7)	22 (46.8)	<0.001
Sweet food	67 (47.9)	38 (38.4)	18 (38.3)	0.147
Stuffed cookie	46 (32.9)	24 (24.2)	7 (14.9)	0.012
Snack	36 (25.7)	14 (14.1)	4 (8.5)	0.003
Instant noodles	36 (25.7)	12 (12.1)	4 (8.5)	0.002
Chocolate	32 (22.9)	11 (11.1)	4 (8.5)	0.006
Yogurt/dairy drink	32 (22.9)	22 (22.2)	9 (19.1)	0.629
Soft drink	25 (17.9)	11 (11.1)	1 (2.1)	0.004
Artificial fruit juice	25 (17.9)	9 (9.1)	2 (4.3)	0.007
Sausages	22 (15.7)	10 (10.1)	2 (4.3)	0.028

a) Linear trend test

Table 3 – Crude and adjusted analysis of the association between exclusive breastfeeding and introduction of four or more ultra-processed foods in the first year of life, Vitória da Conquista, Bahia, 2018

Exclusive breastfeeding (in days)	Introduction of four or more ultra-processed foods							
	Crude analysis		Model 1		Model 2		Model 3	
	RR ^a (95%CI ^b)	p-value ^c	RR ^a (95%CI ^b)	p-value ^c	RR ^a (95%CI ^b)	p-value ^c	RR ^a (95%CI ^b)	p-value ^c
<120	2.76 (1.50;5.07)	<0.001	3.05 (1.51;6.14)	<0.001	2.86 (1.44;5.67)	<0.001	2.94 (1.51;5.71)	<0.001
120-179	1.69 (0.88;3.25)		2.01 (0.97;4.17)		2.07 (1.02;4.22)		2.17 (1.09;4.30)	
≥180	Ref		Ref		Ref		Ref	
Akaike criterion	432.39		356.93		351.70		349.58	

a) RR: relative risk; b) 95%CI : 95% confidence interval; c) Poisson regression with robust variance estimator.

Notes:

Model 1: adjusted for the 'family income', 'maternal education', 'paternal schooling' and 'maternal work' variables.

Model 2: model 1 + 'maternal age', 'paternal age', 'maternal marital status', 'parity' and 'number of prenatal visits'.

Model 3: model 2 + 'guidance of health professional on complementary feeding' and 'attends or has attended day care or school'.

Discussion

The findings of this study show that the frequency of introduction of four or more ultra-processed foods in the 5 year of life and exclusive breastfeeding for less than 120 days was high. Children who received exclusive breastfeeding for less than 180 days, presented a higher risk of having ultra-processed foods (four or more) introduced in the first years of life. The findings are contrary to the guidelines of the Ministry of Health, which recommend EBF up to six months and that ultra-processed foods should not be introduced before 2 years of life.²

Considering that foods introduced in the first years of life influence the child's eating habits, this study was important because it addressed EBF as a determining factor for subsequent food introduction. Among the limitations of the research is the fact that it does not take into account the frequency and quantity of the ultra-processed foods consumed, but only if they had ever been given and at what age. A specific instrument was not applied to evaluate the foods separately, according to the degree of processing, which may affect the number of ultra-processed foods consumed. The four product cutoff point was defined based on the median distribution in the sample, considering that only 12 children had not received any ultra-processed product in the first year of life. This analysis included foods that are consumed more frequently by the population studied. Finally, despite

being ultra-processed food, infant formula was not included in this study because it is a recommended food for children who are not breastfed.

A high frequency of introduction of ultra-processed foods in the first year of life was also found in other studies carried out in southern Brazil.^{3,4} One of these studies, when evaluating the introduction of foods not recommended for children under 1 year of age, living in low-income municipalities in the southern region of the country, found that 78.9% of these children had received sweet/salted biscuits, 73.8% 'petit suisse' cheese and 41.9% sweets/lollipops before 12 months of life.³ Another study, conducted with children aged 4 to 24 months hospitalized in a tertiary hospital, also in southern Brazil, found that 21% of the hospitalized children had not received any type of ultra-processed foods, while the median amount of introduction of these foods was five types,⁴ among the remainder.

Ultra-processed foods should not be given to children in the first 2 years of life, because they are poor in nutrients, contain high energy content, irritate the gastric mucosa and impair digestion and absorption of nutrients.^{2,21} However, these foods are produced with pleasant and attractive flavors, so they entail addiction and influence the child's dietary preferences and, consequently, their consumption habits throughout life.^{2,6} It is important for original flavors to be introduced to the child, by giving fresh or minimally processed foods.² In addition, ultra-processed foods are risk factors for morbidity

and mortality, both in childhood and in adulthood: increased total cholesterol and LDL cholesterol,⁹ increased waist circumference,⁸ overweight/obesity,⁷ hypertension¹⁰ and asthma¹¹, for example.

Regarding breastfeeding, global data revealed that 2 out of 5 children under 6 months were exclusively breastfed in 2018.²² Boccolini et al.,²³ when evaluating the breastfeeding trend in Brazil, found 36.6% prevalence of EBF in children under 6 months of age in 2013. A systematic review and meta-analysis of Brazilian studies published between 2000 and 2015, found 25% prevalence of EBF in the first 6 months of the child's life.²⁴ The findings of that review were higher than those of this study, according to which 16.4% of the children were exclusively breastfed for 180 days or more. It is possible that these differences result from the categorization of EBF time: this study considered interruption in three periods, before 120 days, from 120 to 179 days and at 180 days or more, while the other studies evaluated the prevalence of exclusive breastfeeding in children under 6 months.

Higher incidence rates of ultra-processed feeding in children under 12 months of age (e.g., artificial fruit juice, soft drink, 'petit suisse' cheese, chocolate, stuffed crackers, snacks and instant noodles) were found in children who received EBF for less than 120 days of life. The risk of introducing four or more ultra-processed foods among children under exclusive breastfeeding for less than 120 days of life was 194% higher when compared to the same risk for those who were breastfed exclusively for 180 days or more. Among those who were breastfed exclusively from 120 to 179 days, this risk was 117% higher.

Provision of ultra-processed foods associated with exclusive breastfeeding for less time, as found in this study, corroborates the findings of other studies conducted with preschoolers.^{15,25} A birth cohort study conducted in Pelotas, Rio Grande do Sul, analyzed dietary patterns of children aged 6 years and found high consumption of snacks and treats associated with exclusive breastfeeding for less than one month.²⁵ A study that evaluated association between duration of EBF and consumption of ultra-processed foods, fruits and vegetables in children aged 4 to 7 years, born in Viçosa, Minas Gerais, observed that, for each 1% increase in the duration of EBF, there was a 0.7% decrease in the consumption of ultra-processed foods; while EBF for less than four months increased by 70%

the chance of being in the highest tertile of energy consumption of these foods.¹⁵

Breastfeeding increases the child's acceptance to a wider variety of foods, especially vegetables.²⁶ The flavors of foods consumed by mothers during the breastfeeding period are transmitted to the children by breast milk, which influences the introduction of complementary feeding – which should occur from six months on.² Furthermore, mothers who breastfeed for longer may have a healthier lifestyle and be more aware of the importance of this habit, giving more fruit and vegetables to their children.²⁷ The food intake of mothers and caregivers also influences the children's diet, and it is common for them to give children food of their preference, regardless of whether or not these foods are recommended for children under 2 years of age.¹² In turn, parents who consume more fruit and vegetables provide more of these foods to their children.²⁸

Given infant dependence with regard to food consumption, the need for mothers and caregivers to receive adequate guidance on healthy eating,² including breastfeeding and complementary feeding, stands out. Such guidance should take into account not only nutritional needs but also the social and structural context in which the child lives.²⁹

As such, interruption of EBF and provision of early ultra-processed foods may be related to both the lack of information mothers and caregivers have about healthy eating and to the communication strategies used by health professionals, as obstacles to adhering to the guidance provided.^{4,30}

In view of the results of this study, it is concluded that the frequency of introduction of ultra-processed foods in the first year of life and early interruption of exclusive breastfeeding - EBF - were high. And that shorter duration of exclusive breastfeeding influences the provision of ultra-processed foods in children under 12 months old. Thus, this study can contribute to the planning, implementation and execution of actions, especially in Primary Health Care services, such as the Family Health Strategy (FHS) and the Family Health Support Center (FHSC). These actions should be based on the National Food and Nutrition Policy, other maternal and child health care policies and updated guidelines, such as the 'Food Guide for children under 2 years old'² published by the Brazilian Ministry of Health.

Authors' contributions

Porto JP collaborated with data collection, analysis and interpretation and drafting the manuscript. Bezerra VM and Netto MP collaborated with the concept and design of the study and relevant critical reviewing of the manuscript's intellectual content.

Rocha DS collaborated with the concept, design and coordination of the study, data collection and relevant critical reviewing of the manuscript's content. All the authors have approved the final version of the manuscript, and have declared themselves responsible for all aspects of the work, including ensuring its accuracy and integrity.

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