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Consumption of ultra-processed foods and growth outcomes in early childhood: 2015 Pelotas Birth Cohort

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Abstract

The current study aims to describe the consumption of ultra-processed foods, from 2 to 4 years old, and evaluate its association with growth outcomes during the same period. It is a prospective cohort study using data from the 2015 Pelotas-Brazil Birth Cohort. Outcomes assessed at the 2- and 4-year-old follow-ups were BMI-for-age *Z*-score and length/height-for-age *Z*-score. The exposure was a score of ultra-processed food consumption calculated at each follow-up by summing up the positive answers for the consumption of nine specific items/subgroups of ultra-processed foods: (i) instant noodles; (ii) soft drink; (iii) chocolate powder in milk; (iv) nuggets, hamburger or sausages; (v) packaged salty snacks; (vi) candies, lollipops, chewing gum, chocolate or jelly; (vii) sandwich cookie or sweet biscuit; (viii) juice in can or box or prepared from a powdered mix and (ix) yogurt. Crude and adjusted analyses between the score of ultra-processed foods and the outcomes were run using generalised estimating equations. Prevalence of consumption of ultra-processed foods increased from 2 to 4 years old, for all evaluated items/subgroups, except yogurt. In prospective analyses, higher scores of ultra-processed food consumption were associated with higher BMI-for-age *Z*-score and lower length/height-for-age *Z*-score, after adjustment for confounders. Ultra-processed food consumption, measured using a short questionnaire with low research burden, increased from 2 to 4 years old and was related to deleterious growth outcomes in early childhood. These results reinforce the importance of avoiding the consumption of these products in childhood to prevent the double burden of malnutrition and non-communicable chronic diseases throughout the life.

Keywords: Ultra-processed food: Growth: Childhood: Cohort studies

The past decade has been marked by the recognition of the deleterious effects of dietary patterns based on ultra-processed foods on health[1]. These products are industrial formulations of processed food substances (oils, fats, sugars, starch and protein isolates) that have been extracted or refined from whole foods, containing little or no whole food, and typically including flavourings, colourings, emulsifiers and other cosmetic additives[2].

Volume sales of ultra-processed foods (kg)/capita have been increasing in most regions of the world, including upper-middle- and lower-middle-income countries, where the annual growth rate was 2·8 % and 4·4 %, respectively, from 2009 to 2019[3]. In the same period, ultra-processed foods sales in Brazil presented an annual growth rate of 1·9 %[3]. In 2017–2018, ultra-processed foods represented 19·7 % of the total energy content consumed by the Brazilian population and 26·7 % of the total energy content consumed specifically by adolescents (10 to 17 years old)[4].

The consumption of ultra-processed foods among children is strongly associated with a nutrient profile linked to increased risk of noncommunicable chronic diseases[5–7]. Young children precisely represent the population of greatest concern since these products are extremely palatable and convenient to eat or drink and rely on persuasive marketing[2]. This population is more vulnerable to advertisements, which may influence their eating behaviours and preferences[8]. For young children (2 to 5 years old), ultra-processed foods represented 47·3 % in Australia in 2011–2012 and 58·2 % in the USA in 2009–2014 of the total energy intake[5,9]. In low- and middle-income countries, the consumption of ultra-processed foods is lower compared with high-income countries, but young children are the largest consumers

Abbreviation: GEE, generalised estimating equations.

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of these products, in comparison with other age groups, in Chile, Colombia and Mexico[7,10,11]. There are no data from population-based studies about the dietary share of ultra-processed foods for Brazilian young children.

Few studies have investigated the relationship between ultra-processed food and health outcomes in early childhood. In these studies, the consumption of ultra-processed products was related to higher waist circumference, total and LDL-cholesterol, blood pressure, BMI and fat mass index[12–15]. The consumption of a set of products characterised as ultra-processed foods was also related to a lower length-for-age *Z*-score in children from a lower-middle-income country[16]. Considering that literature is scarce on the relationship between ultra-processed food and health outcomes, mainly in relation to prospective studies among children younger than 4 years of age, we aimed to describe the consumption of ultra-processed foods and evaluate its association with growth outcomes from 2 to 4 years old, in a South-Brazilian birth cohort.

Methods

Study sample and design

Prospective cohort study using data from the 2015 Pelotas-Brazil Birth Cohort. All newborns to mothers residing in the urban area of Pelotas or neighbourhood adjoining Pelotas, belonging to the municipality of Capao do Leao, in southern Brazil, were eligible for inclusion in the cohort. Mothers of all babies born in each of the five maternity hospitals in the city, from 1 January to 31 December 2015, were invited to participate. These sampling criteria were applied to ensure the comparability with previous Pelotas Birth Cohorts (1982, 1993 and 2004)[17].

The perinatal study was carried out at one of the maternity hospitals at the time of birth, when mothers answered several questions related to antenatal care, socio-economic and demographic information, etc. Follow-up interviews took place at home at 3 and 12 months of age and at a research clinic at 2 and 4 years of age. Data collection was performed by trained interviewers in both follow-ups, using electronic devices with REDCap (Research electronic data capture), a sophisticated web application for building, collecting and managing online surveys and databases in academic research scenarios[18].

This study was conducted according to the guidelines laid down in the Declaration of Helsinki, and all procedures involving human subjects were approved by the School of Physical Education Ethics Committee at the Federal University of Pelotas (CAAE registration number: 26746414.5.0000.5313). Written informed consent was obtained from all parents or legal guardians[17].

Outcomes

Weight and length/height were measured by trained anthropometrists using standardised procedures. Length/height-for-age and BMI-for-age *Z*-scores were generated using Anthro Software[19] and were evaluated as continuous and binary indicators. For sensitivity analyses, overweight was defined as BMI-for-age >+2 SD (standard deviation) and stunting as length/height-for-age <-2 SD, according to the WHO standards[20].

Weight was measured, in both follow-ups, using a Tanita® portable digital scale with a maximum capacity of 150 kg and accuracy of 100 g. Children at 2 years of age were weighed in their mother/caregiver's arms. First, the mother/caregiver is weighed alone, and the weight is recorded (in kg). Next, the mother/caregiver is weighed with the child, and this second weight is recorded. The mother/caregiver's weight is then subtracted from the second reading (mother/caregiver and child together). Length was measured differently at 2-year and 4-year follow-ups. At 2 years old, recumbent length was measured using a fixed horizontal Harpenden® infantometer (amplitude from 30 to 110 cm and precision of 1 mm). At 4 years old, a fixed vertical Harpenden® stadiometer was used (maximum height of 206 cm and precision of 1 mm). In case of impossibility to attend the research clinic, the interviews took place at home using portable equipment in both follow-ups – a SANNY model ES2000 stadiometer with a range from 20 to 105 cm and precision of 0·5 cm and a portable aluminum stadiometer with precision of 0·1 cm, at the 2- and 4-year-old follow-ups, respectively.

Main exposure

Information about consumption of ultra-processed foods, based on the Nova classification[2], was collected at 2 and 4 years old asking the mothers/caregivers if the child usually ate/drank (yes or no) the following food items or subgroups: (i) Instant noodles; (ii) Soft drink; (iii) Chocolate powder in milk; (iv) Nuggets, hamburger or sausages; (v) Packaged salty snacks; (vi) Candies, lollipops, chewing gum, chocolate or jelly; (vii) Sandwich cookie or sweet biscuit; (viii) Juice in can or box or prepared from a powdered mix and (ix) Yogurt. The score of ultra-processed food consumption was the main exposure, calculated based on positive answers for the aforementioned options and, therefore, ranging from zero to nine.

Study covariates

Characteristics collected at perinatal study included sex (boys, girls) and birth weight (in grams) of the child, maternal skin colour (white, brown and black), age (in years) and education (completed years of schooling), and wealth index of the family (in quintiles).

Duration of exclusive breastfeeding (in months) and age of introduction of complementary feeding were collected at the 12-month-old follow-up, and proxy of physical activity and marital status (single, living with a partner) were collected at the 2- and 4-year-old follow-ups. The wealth index was based on the ownership of 14 household assets (vacuum cleaner, television, telephone, radio, DVD player, fridge, freezer, microwave, washing machine, drying machine, dishwasher, notebook, air conditioning, car and motorcycle), having a housekeeper, internet access, cable TV, water supply and paved street, as well as number of bathrooms and rooms in the house, and education level of the family head. A continuous score was calculated using principal component analyses, the first factor was extracted as a continuous variable, and then it was divided into quintiles, where the first quintile indicated the poorest families and the

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highest quintile the wealthiest families[21]. Duration of exclusive breastfeeding (in months) and age at introduction of complementary foods (solid and semi-solid, in months) were defined at the 12-month-old follow-up, and information of marital status and proxy of physical activity were related to the 2- and 4-year-old follow-ups. This covariate was evaluated by the question 'Does <child's name> prefer more active games such as running and jumping or does he/she prefer activities such as drawing, reading, watching TV, using a cell phone or tablet?'

Data analyses

Initially, the sample was described according to socio-economic characteristics at baseline (perinatal study), comparing participants with complete information for both the exposure and outcome at 2- and 4-year-old follow-ups (analytical sample) to the original cohort, using χ^2 test for proportions and *t*-test for mean differences (frequencies for categorical and means-SD for continuous variables). Then, the outcomes were described by mean (SD) and frequencies (%), and the consumption of each selected subgroup of ultra-processed foods was described at 2- and 4-year-old follow-ups by frequencies (%) and respective 95 % CI. The distribution of the score of ultra-processed food consumption was also described for each follow-up. We used generalised estimating equations (GEE) to evaluate the association between the score of ultra-processed food consumption (as a count, in terciles and dichotomised considering the mean/median of the score for the 4-year-old follow-up) and the outcomes. GEE use the generalised linear model to estimate regression parameters with the specification of a working correlation matrix that accounts for the repeated nature of measures and the within-subject correlation of responses on dependent variables of many different distributions, including normal, binomial and Poisson[22]. In the current study, regression coefficients represent the mean response of the dependent variable (considering the period from 2 to 4 years of age) for each change in the categories of the score of ultra-processed food consumption in the same period. We obtained crude and adjusted estimates and their respective 95 % CI, estimating β for continuous outcomes (including the Gaussian family in the GEE commands) and prevalence ratios (PR) for dichotomous outcomes (including the Poisson family in the GEE commands), considering the significance level of 5 %. Crude analyses considered only the main exposure and the outcomes in the models. We included the study covariates as potential confounders in the adjusted analyses, using the backward selection procedure by levels. First, we included all variables of the first level (sex and birth weight of the child, maternal age, education, skin colour and wealth index of the family at baseline) and kept in the model only those with a *P* value<0·2. Then, variables of the second level were included (duration of exclusive breastfeeding and age of introduction of complementary feeding at the 12-month-old follow-up), and the same procedure was done. Finally, variables of the third level were included (marital status and proxy of physical activity at the 2- and 4-year-old follow-ups), and those with *P* value<0·2 were considered as potential confounders. For both crude and adjusted analyses, interaction between the main exposure and a time variable (follow-up) was tested, but no evidence of effect modification was found.

All analyses were performed using the Stata® statistical package, version 16.1 (StataCorp. 2019. Stata Statistical Software: Release 16. StataCorp., LLC). GEE models were run using the command *xtgee* in the software. Before using the GEE command, the data set was set up (long format) informing the variable that represents the follow-up using the command *xtset*.

Results

The analytical sample of this study included 3498 children with complete information for the exposure and outcomes for both follow-ups. In this sample, mean maternal age and years of schooling were, respectively, 27·6 (6·6) and 10·0 (3·9) years. About 70 % of the mothers self-declared having white skin colour. Among the newborns, 50·6 % were boys, and mean birth weight was 3184·3 (541·9) g. There were no differences in the perinatal variables when comparing the analytical sample to the original cohort (Table 1).

The mean BMI-for-age z-score was 0·55 (1·05) and 0·70 (1·19) at the 2- and 4-year-old follow-ups, respectively. Accordingly, the prevalence of overweight (BMI-for-age >+2 SD) increased from 7·6 % to 12·9 % from 2 to 4 years of age. Mean length/height-for-age z-score was -0·02 (1·11) and -0·20 (1·09), respectively, at the 2- and 4-year-old follow-ups, and the prevalence of stunting was 3·3 % and 4·0 %, respectively (Table 2).

Fig. 1 describes the prevalence of consumption for each subgroup of ultra-processed foods. The proportions were higher at the 4-year-old follow-up, compared with the 2-year-old, for all the evaluated sub-groups of ultra-processed foods, except for

Table 1. Comparison between the analytical sample (*n* 3498) and the original cohort (*n* 4275) according to socio-economic characteristics at baseline (perinatal study). 2015 Pelotas Birth Cohort
(Mean values and standard deviations; number and percentages)

	Original cohort (*n* 4275)		Analytical sample* (*n* 3498)		
Variables	*n*	%	*n*	%	*P*-value†
Sex					0·982
Boys	2164	50·6	1769	50·6	
Girls	2111	49·4	1729	49·4	
Maternal skin colour					0·529
White	3024	71·3	2441	70·3	
Brown	551	13·0	453	13·1	
Black	667	15·7	578	16·6	
Wealth index					0·816
Q1 (poorest)	824	20·0	663	19·6	
Q2	829	20·1	698	20·7	
Q3	820	19·9	690	20·4	
Q4	823	19·9	677	20·1	
Q5 (richest)	831	20·1	648	19·2	
	Mean	SD	Mean	SD	
Maternal age (years old)	27·6	6·6	27·6	6·6	0·889
Maternal schooling (years)	10·0	4·0	10·0	3·9	0·787
Birth weight	3169·8	564·2	3184·3	541·9	0·252

* The analytical sample was represented by the participants with complete information for exposure and outcomes for both 2- and 4-year-old follow-ups.
† *P* values were estimated by χ^2 test for proportions and *t*-test for mean differences.

Table 2. Mean (SD) and absolute and relative estimates of outcomes at the 2- and 4-year-old follow-ups (*n* 3498). 2015 Pelotas Birth Cohort (Mean values and standard deviations)

	2-year-old		4-year-old		
Outcomes	Mean	SD	Mean	SD	*P*-value*
BMI-for-age *Z*-score	0·55	1·05	0·70	1·19	<0·001
Length/Height-for-age *Z*-score	−0·02	1·11	−0·20	1·09	<0·001
	n	%	*n*	%	
BMI-for-age >+2 SD	255	7·6	439	12·9	<0·001
Stunting (Length/height-for-age <-2 SD)	116	3·3	139	4·0	0·160

* *P* values were estimated by χ^2 test for proportions and *t*-test for mean differences.

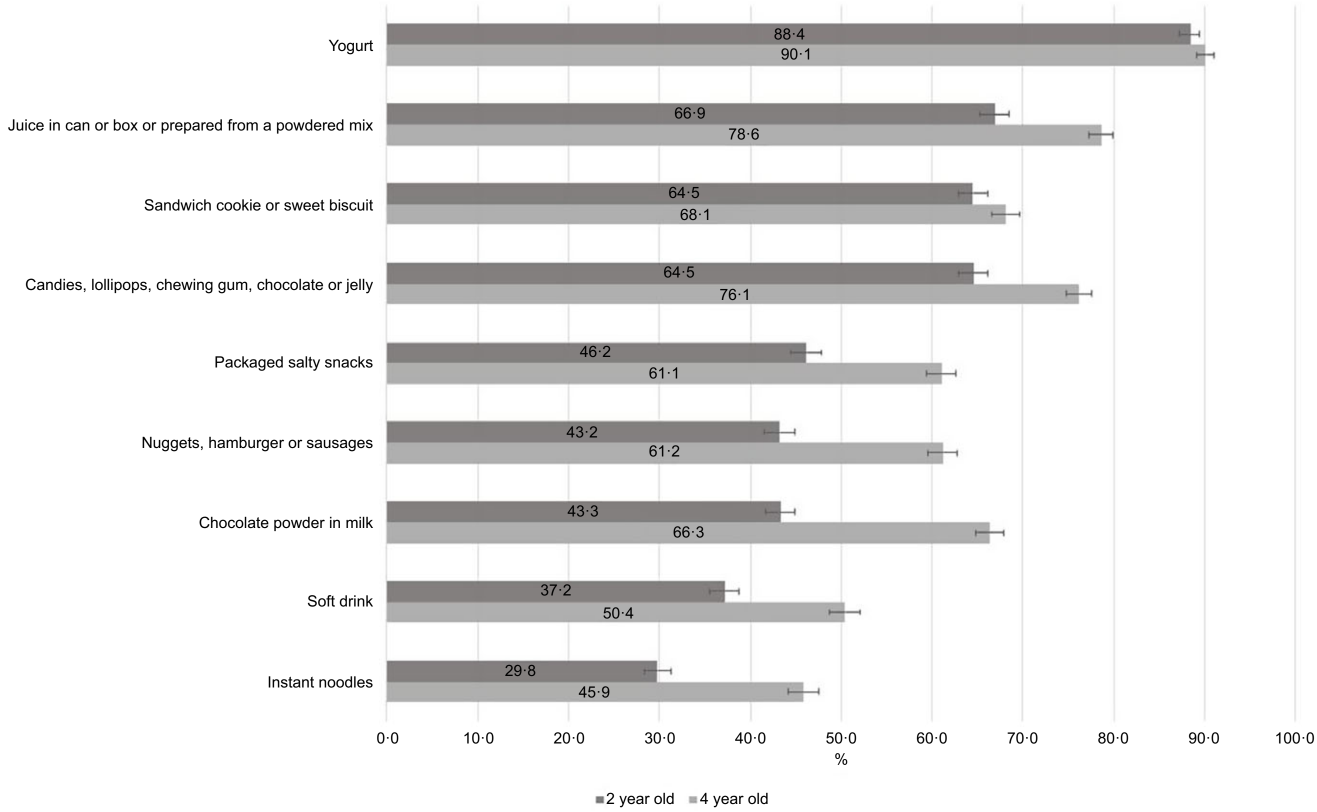

Fig. 1. Prevalence (%) of consumption of selected subgroups of ultra-processed foods at the 2- and 4-year-old follow-ups (*n* 3498). 2015 Pelotas Birth Cohort.

yogurt, which did not present a significant change in consumption from 2 to 4 years old (almost nine in every ten children consumed yogurt in both follow-ups). Besides yogurt, the most consumed subgroups were artificial juice, sweet biscuits and confectionery with proportions around 65 % at 2 years old, ranging from around 68 % to 78 % at 4 years old. The consumption prevalence of packaged salty snacks, nuggets/hamburger/sausages and chocolate powder in milk varied from around 43 % to 46 % in children aged 2 years and from 61 % to 66 % in children aged 4 years. Soft drinks and instant noodles were usually consumed by about 37 % and 30 % of the children at 2 years of age, respectively, and around 50 % and 46 % at 4 years of age (Fig. 1).

Fig. 2 shows the distribution of the score of ultra-processed food consumption, which is equivalent to the number of subgroups usually consumed by each child. Scores ranged from 0 to 9, but 3 (14·3 %), 4 (14·6 %), 5 (13·0 %), and 6 (12·8 %) were the most common at 2 years of age. At 4-year-old follow-up, scores equal to 7, 8 and 9 showed the highest proportions (15·3 %, 17·3 % and 14·6 %, respectively). On average, mothers reported that children usually consumed about 5 (mean 4·84, SD 2·29) and 6 (mean 5·97, SD 2·25) subgroups of ultra-processed foods, respectively, at 2 and 4 years old.

The score of ultra-processed food consumption was associated with growth outcomes between 2 and 4 years old (Table 3). After adjustment for potential confounders, higher scores of ultra-processed food consumption were associated with higher BMI-for-age *Z*-score (*β* 0·02, 95 % CI (0·01, 0·03), *P* value for linear trend 0·001) and lower length/height-for-age

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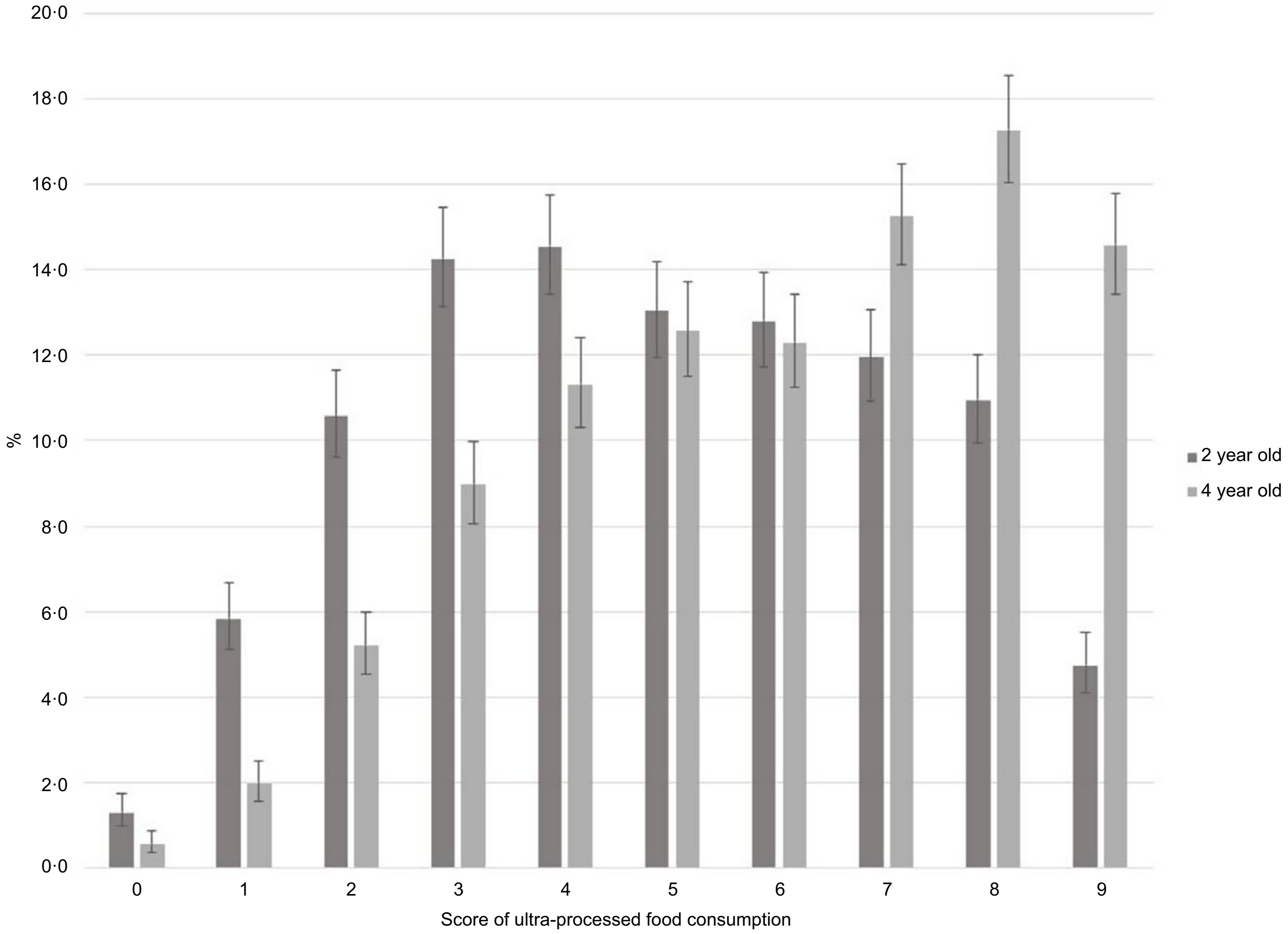

Fig. 2. Distribution of the score of ultra-processed food consumption at the 2- and 4-year-old follow-ups (*n* 3498). 2015 Pelotas Birth Cohort.

Z-score (*β* -0·03, 95 % CI (-0·04, -0·02), *P* value for linear trend < 0·001) from 2 to 4 years old. Also, scores of ultra-processed foods in the highest terciles were associated with a lower length/height-for-age *Z*-score from 2 to 4 years old (*β* -0·06, 95 % CI (-0·11, -0·01), *P* value for linear trend 0·023). Consuming six or more subgroups of ultra-processed foods was associated with a BMI-for-age *Z*-score 0·09 higher (*β* 0·09, 95 % CI (0·04, 0·14), *P*-value < 0·001) and a length/height-for-age *Z*-score 0·10 lower (*β* -0·10, 95 % CI (-0·14, -0·06), *P*-value < 0·001) than the reference group (five or less subgroups).

Discussion

In this South-Brazilian birth cohort, the prevalence of consumption of ultra-processed foods in children increased with age for all evaluated subgroups, except for yogurt. Regarding the association between ultra-processed foods and growth outcomes, prospective analyses showed that, after adjustment for confounders, consumption of ultra-processed foods was associated with higher BMI-for-age *Z*-score and lower length/height-for-age *Z*-score from 2 to 4 years of age. Associations were maintained when evaluating the consumption of six or more subgroups as the exposure.

The prevalence of consumption of ultra-processed foods was high (proportions > 60 %) in both follow-ups and for all subgroups, especially for yogurt, artificial juice, sweet biscuits and confectionery. Packaged salty snacks, nuggets, chocolate powder in milk, soft drinks and instant noodles increased between 15 and 25 percentage points from 2 to 4 years old. Our results agree with a study from New Zealand, which evaluated ultra-processed food consumption among children at ages 12-, 24- and 60-months. The authors reported an increase of the energy contribution from ultra-processed foods with age, and yogurt, crackers and sausages were some of the most consumed subgroups of ultra-processed foods at all time points[23]. In our study, the increase in the number of ultra-processed food subgroups consumed from 2 to 4 years old could reflect an increased timeframe and opportunity for a young child to try out new types of food. Precisely due to this context, nutritional interventions, as the guidance on complementary feeding introduction, for example, have the potential to effectively reduce the consumption of ultra-processed foods when performed during the first year of life[24]. Our findings motivate the need for effective food policies that support nutrition education messages. The Dietary Guidelines for Brazilian Children Under 2 Years of Age[25], which provide information on the degree of food processing and clearly

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Table 3. Crude and adjusted association between the score of ultra-processed food consumption and growth outcomes (continuous) from 2 to 4 years of age (*n* 3498). 2015 Pelotas Birth Cohort
(Coefficient values and 95 % confidence intervals)

	BMI-for-age *Z*-score						Length/height-for-age *Z*-score					
	Crude*			Adjusted†			Crude*			Adjusted†		
Score of ultra-processed foods	*β*	95 % CI	*P* value	*β*	95 % CI	*P* value	*β*	95 % CI	*P* value	*β*	95 % CI	*P*-value
Counting	0·01	0·003, 0·02	0·008	0·02	0·01, 0·03	0·001	−0·03	−0·04, −0·03	<0·001	−0·03	−0·04, −0·02	<0·001
1st tercile	Ref.		0·054	Ref.		0·207	Ref.		<0·001‡	Ref.		0·023†
2nd tercile	0·05	−0·01, 0·10		0·05	−0·01, 0·11		−0·06	−0·11, −0·02		−0·04	−0·08, 0·01	
3rd tercile	−0·02	−0·08, 0·04		0·01	−0·06, 0·07		−0·10	−0·15, −0·05		−0·06	−0·11, −0·01	
Score ≥6												
No	Ref.		0·002	Ref.		<0·001	Ref.		<0·001	Ref.		<0·001
Yes	0·07	0·03, 0·12		0·09	0·04, 0·14		−0·13	−0·17, −0·09		−0·10	−0·14, −0·06	

* Crude analyses considered only the main exposure and the outcomes in the models.
† Backward selection procedure by levels, considering the variables of the first level (sex and birth weight of the child, maternal age, education, skin colour and wealth index of the family at baseline), second level (duration of exclusive breastfeeding and age of introduction of complementary feeding at the 12-month-old follow-up) and third level (marital status and proxy of physical activity at the 2- and 4-year-old follow-ups).
‡ *P* value for linear trend.Generalised estimating equations (GEE) were used to estimate coefficients (*β*), including the Gaussian family in the command.

recommend avoidance of ultra-processed food during early life, is likely to be the most important contribution to support families and guide public policies to promote health and the food and nutritional security of Brazilian children.

Regarding the distribution of the score for the consumption of ultra-processed foods, higher proportions were observed in scores ranging from three to six items at 2 years old and from seven to nine items at 4 years old. Other studies that investigated the consumption of these products using scores (ranging from zero to 13 and zero to 23) found a concentration of values between one and four in data distribution[26,27]. This difference is expected since these studies evaluated only adults, and the recall period was based on the day before the interview.

Our study has shown that, after adjustment for potential confounders, higher scores of ultra-processed food consumption were associated with higher BMI-for-age *Z*-score from 2 to 4 years of age. Although there is robust evidence on the positive relationship between ultra-processed food consumption and overweight and obesity in adults[28], studies regarding this association in children are still scarce. In the INMA Birth Cohort, lower consumption of ultra-processed foods (in servings/d) at 4 years old was associated with a lower BMI-for-age *Z*-score at 7 years old. However, the association was not maintained after confounding adjustment[14]. In the 2004 Pelotas Birth Cohort, a higher energy contribution (%) from ultra-processed foods was associated with a higher BMI and fat mass index from 6 to 11 years of age[15]. A birth cohort study carried out in Avon, England, found that a higher percentage of weight contribution in the total daily food intake from ultra-processed foods was associated with greater increases in BMI, fat mass index, weight and waist circumference from childhood to early adulthood[29].

Several mechanisms could explain the positive association between ultra-processed food consumption and overweight and obesity. To begin with, ultra-processed foods as a group have a nutrient profile (energy-dense, rich in sugars and fats and poor in fiber and protein) consistent with an increased risk of overweight and obesity. A recent multi-country study including children and adolescents from high- and middle-income countries showed strong associations between the consumption of ultra-processed foods and a higher dietary content of free sugars, higher energy density and lower fibre content[30] – nutrients of public health concern covered by international guidelines[31]. Also, the low content of protein found in dietary patterns based on ultra-processed foods has been linked to a compensatory increase in food intake to achieve a target protein leverage. This mechanism, consequently, contributes to excess energy intake and obesity[32]. Ultra-processed foods are manufactured under processes and techniques that destroy the food matrix, modifying the raw material and affecting the satiety controlling systems in the body, limiting children's ability to regulate energy intake[33,34]. Also, these products are manufactured to be hyperpalatable, with many of them presenting an addictive potential, with effects on neuronal mechanisms[34,35]. Solid ultra-processed foods tend to be soft, as most of the subgroups investigated in the current study, presenting a higher eating rate[36]. Aggressive marketing strategies play an important role in shaping children's taste, consumption, food preferences and families' purchasing decisions, especially for children and adolescents, when product sales are associated with characters or collectible gifts[8]. These characteristics lead to a high potential of displacing whole and healthy foods. Finally, the intake of Bisphenol A, a chemical compound released from the packaging of ultra-processed products, has been associated with an increased risk of developing obesity since it interferes in cellular pathways related to weight and glucose homeostasis[37]. Besides all these mechanisms, there is evidence that unhealthy eating behaviours based on ultra-processed foods in early childhood predict the tracking of unhealthy dietary patterns from infancy to childhood, through shaping food preferences for example[38].

At the same time, our study found an inverse relationship between ultra-processed food consumption and length/height-for-age *Z*-score. This association is a source of concern since we are observing this relationship at the beginning of life (2 to 4 years of age). A study carried out in a low-middle-income country found similar results, where infants (12–23 months of age) in the highest tercile of unhealthy snack foods and beverages consumption presented length/height-for-age about 0·3 SD lower, compared with those in the lowest tercile of consumption. In addition, this relationship was partially mediated through dietary inadequacy (including lack of protein and micronutrients)[16]. Most ultra-processed products are poor in protein and micronutrients and have a great potential for displacing nutrient-dense, unprocessed, or minimally processed foods[2]. In this way, overconsumption of ultra-processed products could lead to a low intake of protein and micronutrients during a critical period of growth and development, when eating behaviours may serve as a foundation for developing future eating patterns.

We are aware that our study has limitations. The exposure was not measured using traditional questionnaires such as 24-h recalls or FFQ but represented a proxy or an estimation of the dietary share of ultra-processed foods. Screeners and scores, as the used in this study, obtained quickly and practically with an easier data collection, have the potential to increase the monitoring and evaluation of ultra-processed food consumption, with low research and interviewed burden compared with traditional questionnaires. The questions used in this study were not validated, and the questionnaire was not planned for this specific purpose. However, the questions were planned with a special focus on the better understanding of the mothers and based on the empirical knowledge about the most consumed food items or subgroups, specifically for the study population. Also, screeners to evaluate the consumption of ultra-processed foods have been validated, presenting a substantial agreement in ranking adult individuals according to the percentage of energy contribution from these foods[25]. An adapted screener investigating the consumption on the day before the interview will be tested against 24-h recalls on the next follow-up of this birth cohort. Other studies investigating what set of food subgroups better reflect the dietary share of ultra-processed foods in childhood could improve the development of short questionnaires focused on this population. Finally, we included in the model a variable representing a proxy of physical activity and not the objective measure, increasing the possibility of residual confounding in the main association. Although there were losses to follow-up, we compared the analytical sample to the original cohort, and we found no differences for the main covariates (at baseline). The strengths of this study include the data from an important prospective birth cohort that applied meticulous methods throughout its follow-ups and the analyses using a longitudinal methodology, contributing to the robustness of the study.

In conclusion, the current study suggests that a higher consumption of ultra-processed foods, measured using a short questionnaire with a low research burden, is related to adverse growth outcomes. Although the observed magnitudes of the effects were small and should be confirmed by other longitudinal studies, they are relevant to reinforce the importance of avoiding the consumption of these products in early childhood, a crucial period of life, in order to prevent the double burden of malnutrition and non-communicable chronic diseases throughout the life.

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Supplementary material

For supplementary material/s referred to in this article, please visit https://doi.org/10.1017/S0007114522002926

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