Types of ultra-processed foods consumed in Brazil: A systematic review

Tipos de alimentos ultra-processados consumidos no Brasil: Uma revisão sistemática

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ABSTRACT

To investigate the consumption of ultra-processed foods (UPF) based on the NOVA food classification, comparing the types of foods consumed between the age groups. A systematic review following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses. The articles were selected using the descriptors searched for MeSH in the databases: Pubmed / Medline, Lilacs and Scielo. 4,239 articles were selected in the initial research, 45 were included. The contribution of ultra-processed foods to the total amount of energy ranged from 15.0% to 54.7%, being greater in children and adolescents. For babies, this happens before the age of six months, consuming instant noodles, chocolate and stuffed cookies, expanding the variety of UPF foods as they age. For teenagers, the most consumed foods are soft drinks, pizza, gelatin, cakes, cookies, candies and hamburgers, in addition to those consumed in childhood. Among adults and elderly, the most consumed foods were bread, hot dog bread, sweet bread, sugary drinks, treats, cakes, cookies, pizza, snacks and sausages. UPF consumption varies according to the age group in Brazil, being higher among children and adolescents. The introduction occurs at the beginning of infant feeding and the types of UPF expands with increasing age.

Keywords: Food Consumption, Nutritive Value, Food Quality, Ultra-processed foods.

RESUMO

Investigar o consumo de alimentos ultra-processados (UPF) com base na classificação alimentar NOVA, comparando os tipos de alimentos consumidos entre as faixas etárias. Uma revisão sistemática, seguindo os itens Preferred Reporting Items for Systematic Reviews e Meta-Analyses. Os artigos foram selecionados usando os descritores pesquisados por MeSH nas bases de dados: Pubmed / Medline, Lilacs e Scielo. Foram selecionados 4.239 artigos na pesquisa inicial, 45 foram incluídos. A contribuição dos alimentos ultra-processados para a quantidade total de energia variou de 15,0% a 54,7%, sendo maior em crianças e adolescentes. Para bebês, isto acontece antes dos seis meses de idade, consumindo macarrão instantâneo, chocolate e biscoitos recheados, expandindo a variedade de alimentos UPF à medida que envelhecem. Para os adolescentes, os alimentos mais consumidos são refrigerantes, pizza, gelatina, bolos, biscoitos, balas e hambúrgueres, além daqueles consumidos na infância. Entre adultos e idosos, os alimentos mais consumidos foram pão, pão de cachorro quente, pão doce, bebidas açucaradas, guloseimas, bolos, biscoitos, pizza, salgadinhos e salsichas. O consumo da UPF varia de acordo com a faixa etária no Brasil, sendo maior entre crianças e adolescentes. A introdução ocorre no início da alimentação infantil e os tipos de UPF se expandem com o aumento da idade.

Palavras-chave: Consumo de alimentos, valor nutritivo, qualidade dos alimentos, alimentos ultra-processados.

1 INTRODUCTION

The dietary profile of the populations has changed over the years and has been characterized by the consumption of high energy density foods and the replacement of dietary fibers by products rich in fats and sugars, with a high level of processing

(POPKIN, 2006). Recently, it has been suggested that food processing, more specifically the type, intensity and purpose, is linked to the worst human health conditions (MONTEIRO, Carlos Augusto, 2009).

There has been a drastic change in consumption patterns, with ultra-processed products gradually replacing unprocessed and freshly prepared meals (AYTON; IBRAHIM, 2019) for ready-to-eat foods. The frequent exposure to UPF sensory signals, large portion sizes, the availability of a wide variety of products, foods with high energy density and palatability are important elements in the onset of chronic non-communicable diseases (CHANDON; WANSINK, 2012; GRAAF, DE; KOK, 2010) and higher mortality risk among in the adult population (SCHNABEL et al., 2019). UPF are ''formulations mostly of cheap industrial sources of dietary energy and nutrients plus additives, using a series of processes'' and containing minimal whole foods (MONTEIRO, Carlos A. et al., 2019; MONTEIRO, Carlos Augusto et al., 2010; MONTEIRO, Carlos Augusto; CANNON; et al., 2018) are energy-dense, high in unhealthy types of fat, refined starches, free sugars and salt (FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, 2019; MACHADO, Priscila P et al., 2019; STEELE, Eurídice Martínez; MONTEIRO, Carlos A., 2017) and various food additives and are poor sources of protein, dietary fibre, and micronutrients (AYTON; IBRAHIM, 2019; MARTÍNEZ STEELE et al., 2018).

In this regard, the new version of the *Guia Alimentar Para a População Brasileira* (Food Guide for the Brazilian Population) gives guidance on meals and aspects related to eating behaviour, including cultural, social, economic, and environmental factors, with this NOVA food classification (BRASIL, 2014) and also and also the *Guia Alimentar para Crianças Brasileiras Menores de 2 anos* (Food Guide for Brazilian Children under 2 years) which considering the specificity and relevance of the first years of life (BRASIL, 2019). These documents aimed to confront a scenario marked by the increase of overweight and obesity, chronic non-communicable diseases and to reverse the patterns of food acquisition and consumption of the Brazilian population. For example, the evolution in families food purchases was evaluated from three surveys (*Pesquisa de Orçamentos Familiares* -POF - Brazilian Family Budgets Survey), from 1987 to 2003, which demonstrated that during the last three decades the unprocessed or minimally processed foods or with processed culinary ingredients, has been steadily replaced by ready-to-eat or ready-to-heat UPF products.(MONTEIRO, Carlos Augusto et al., 2011) The UPF represented more than one-quarter of total energy purchased by metropolitan

Brazilian households, and more than one-third of that is purchased by the higher income quintile (MONTEIRO, Carlos Augusto et al., 2011). Another POF-based study established temporal trends in household food and drink consumption, showing that the caloric share of ready-to-eat products significantly increased between 2002-2003 and 2008-2009 (from 23.0% to 27.8 % of total calories), mainly because of the increase in consumption of UPF (20.8 % to 25.4 %) (MARTINS, Ana Paula Bortoletto et al., 2013). Regarding the caloric contribution of the diet, individuals over 10 years old demonstrated an average daily energy consumption of 1,866 kcal, with 69.5% being provided by natural or minimally processed foods, 9.0% by processed foods and 21.5% by UPF, documenting its largely negative impact on quality of the food of the Brazilian population (LOUZADA, M. L. Da C.; MARTINS, Ana Paula Bortoletto; et al., 2015a).

The rapid increase in the production and consumption of unhealthy food is accompanied by high availability and sales in developed countries and an increasing trend in developing countries. For example, in 2016, bakery products were the main contributors to UPF volume sales (13.1-44.5%), while carbonated beverages contributed most to beverage volume sales among UPF (40.2-86.0%); in 80 countries studied, the volume of UPF sales per capita is positively associated with the trajectories of adult body mass indexes (VANDEVIJVERE et al., 2019).

In Latin America, from 2000 to 2013, per capita sales of these products increased 26.7%. In countries with the highest UPF sales (Mexico and Chile), the population had a higher average body mass index (MOUBARAC, J.-C.; PAN AMERICAN HEALTH ORGANIZATION; WORLD HEALTH ORGANIZATION, 2015). Other countries besides Brazil, as Uruguay (SALUD., 2016) Ecuador (GOETSCHEL et al., 2018), Peru (SERRANO; CURI, 2019) and Canada (GOVERNMENT CANADA, 2019) included the concept of UPF in their food-based dietary guidelines. Hence, the NOVA food classification and these food guides have received international recognition from Food and Agriculture Organization of the United Nations,(FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, 2019) Pan American Health Organization (MOUBARAC, J.-C.; PAN AMERICAN HEALTH ORGANIZATION; WORLD HEALTH ORGANIZATION, 2015) and United Nations Children's Fund(UNICEF, 2019).

In this sense, reduce the UPF participation in the diet, increase the consumption of unprocessed or minimally processed foods and encourage the consumption of freshly prepared meals can be an effective way to substantially improve the nutritional quality of

diets in the countries and contribute to the prevention of obesity and other chronic diet-related diseases(RAUBER, Fernanda et al., 2018). For example, eliminating UPF from the diet decreases energy intake and results in weight loss(HALL et al., 2019).

Some reviews have already evaluated the food consumption in some specific age ranges, however those studies lack a wider coverage of the Brazilian population of various ages (COSTA, Caroline Santos et al., 2018). In this context, this review aims to investigate the consumption of ultra-processed foods (UPF) based on the NOVA classification, comparing the foods consumed between age groups.

2 METHODS

2.1 GUIDELINES

The guiding question used to write this review was: What is the consumption and type of UPF in the Brazilian population according to age groups? The manuscript was structured based on the following guidelines: (a) formulation of the research question and objective of review; (b) search for peer reviewed papers indexed at online databases; (c) establishment of inclusion and exclusion criteria by reading the abstracts and full texts; (d) data extraction from selected publications and (e) presentation and discussion of results. The present methodology was developed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (MOHER et al., 2010).

2.2 SEARCH STRATEGY

The publication search covered the databases *Pubmed/Medline*, *Lilacs* and *Scielo*. The search terms ('ultra processed' OR 'ultraprocessed' OR 'ultra-processed' OR 'ready-to-eat' OR 'ready-to-consume' OR 'industrialized' OR 'fast-food' OR 'fast food' OR 'fastfood' OR 'junk food' OR 'prepared food' OR 'candy' OR 'ice cream' OR 'chocolate' OR 'carbonated beverage' OR 'soft drink' OR 'sweetened beverage' OR 'snacks' OR 'sausage' OR 'hot dog' OR 'burger' OR 'dietary patterns' OR 'dietary behaviors' OR 'dietary habits') AND ('brazilian' OR 'brazil') extracted from MeSH (Medical Subject Headings, from NCBI), were used. The search covered the period from 2009 to September 2019, limited to the article title and/or abstract, regardless of being the main outcome. The search was last updated on October 2019.

2.3 ELIGIBILITY CRITERIA

This review included articles published in Portuguese, Spanish and English that covered the Brazilian population of any age that portrayed the topic of the consumption of UPF based on the NOVA classification(MONTEIRO, Carlos Augusto et al., 2010).

All studies that evaluated the consumption of UPF by Brazilian individuals were included, as long as they mentioned the consumption of the UPF category and not just one type of food investigated (candy and sweet beverage, among others). Descriptive studies, both cohort, intervention and cross-sectional, were included in the review, excluding review articles. Studies with association between ultra-processed and other outcome and/or exposure were eligible as long as they clearly demonstrated the variables of interest of this review (such as consumption prevalence in the population, age group evaluated and NOVA food classification). In addition, specific populations were also included in this review (individuals with certain health conditions, vegetarian, etc.) as long as they contained the data of interest.

2.4 STUDY SELECTION

Two independent reviewers conducted an initial selection of the articles located in databases, by means of reading the titles and abstracts. The papers selected at this stage were then read in full and were evaluated in accordance with the eligibility criteria. A third reviewer adjudicated regarding whether articles should be kept or excluded in situations in which the two main reviewers disagreed.

2.5 DATA ANALYSIS

The data extracted from selected articles were: state, publication year, study design, sample size, age range, focus and objective of the study, methods and instruments used for evaluation of food consumption and UPF and main findings. Data was organized and summarized in tables suitable for comparative analysis and discussion of results. Subsequently, data on the types of UPF most consumed were compiled, according to the age group, as standard of the World Health Organization standard. For this analysis we considered those studies that provided more detailed consumption information by study population of different foods types with subgroups, since not all articles presented these data.

3 RESULTS

3.1 STUDY SELECTION

The electronic search resulted in 4,239 articles (Figure 1), 2,871 on *Pubmed/Medline*, 999 on *Lilacs* and 369 on *Scielo*. After duplicate exclusion, 2950 titles/abstracts remained to be analysed. Subsequently, an analysis by title was made for the exclusion of articles that did not meet the predefined criteria resulting in 325 articles. After this stage, the abstracts or texts were read in full for the application of inclusion and exclusion criteria. Finally, 46 articles were selected for inclusion in this review based on the NOVA food classification.

Figure 1. Flow chart of the article screening process.
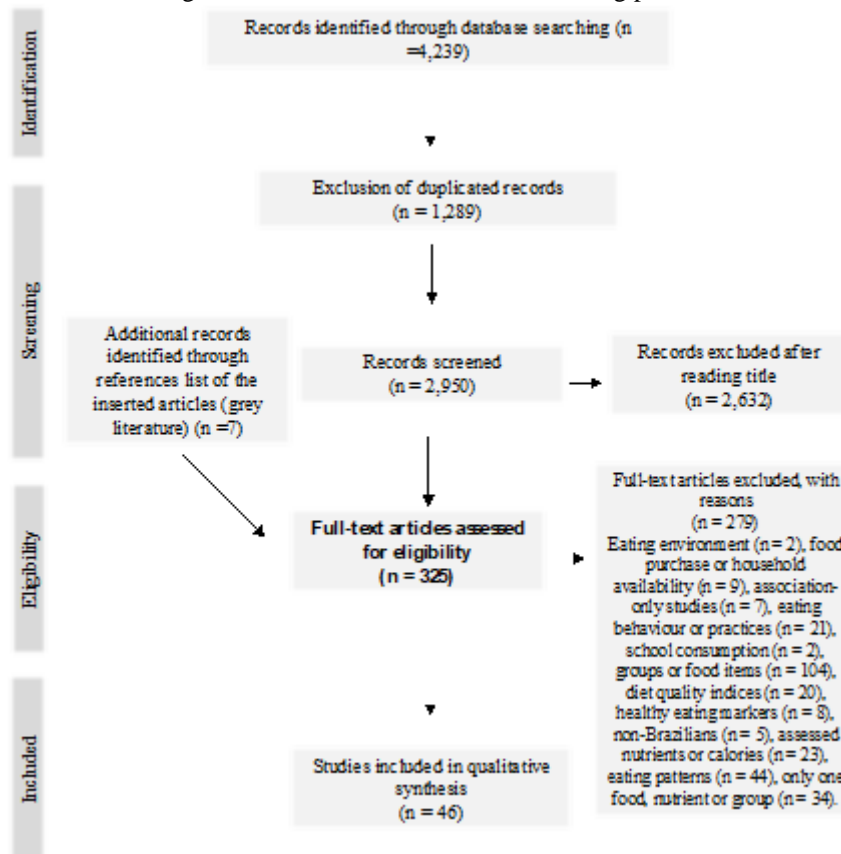
Adapted from Moher et al. (2010)

3.2 STUDY CHARACTERISTICS OF INCLUDED ARTICLES

The results in the Table 1 demonstrate the description of the main characteristics observed in the studies the majority being cross-sectional (n= 40). Most studies were carried out in the southeast region (n=15) followed by south region (n=12), however 11 studies evaluated the national sample. Most of the subjects included in the studies were adolescents (n= 12) and 13 studies included more than one age range. Regarding the

sample size, 24 studies assessed less than 1,000 individuals and only three studies assessed more than 100,000 individuals. Three studies used data from the *Pesquisa Nacional de Saúde do Escolar* (National School-Based Student Health) survey, based on data collected in 2012 (ELIAS et al., 2019; LONGO-SILVA et al., 2016a) and 2015 (COSTA, C. Dos S. et al., 2018). Other eight studies used data from POF 2008-2009 (ANDRADE, G. C. et al., 2019; CANELLA et al., 2018; COSTA LOUZADA, DA et al., 2018; LOUZADA, M. L. Da C.; BARALDI, Larissa Galastri; et al., 2015; LOUZADA, M. L. Da C.; MARTINS, Ana Paula Bortoletto; et al., 2015b, 2015a) and two of them used only an subsample (ARAUJO et al., 2017; SPERANDIO et al., 2017). Most of the studies included in this review used a food frequency questionnaire (n=17) or 24-hour recalls (n=17). Different classification of UPF were used among the studies. Seventeen used the four groups of NOVA classification and sixteen classified the UPF in three groups, grouping the culinary ingredients with fresh or unprocessed groups.

Table 1. Description of the main characteristics observed in the studies selected for the present systematic literature review related to consumption of ultra-processed foods by the Brazilian population (n=44).

Author / year / country	Design and sample	Evaluation of food consumption	Objectives	Exposure	Outcome	Food classification	Main results
National (LOUZADA, M. L. Da C.; BARALDI, Larissa Galastri; et al., 2015)	Descriptive: cross-sectional study with 30,243 individuals aged 10 years or over in the National Household Budget Survey 2008–2009.	Two 24-h food records	The aim of this study was to evaluate the relationship between the consumption of ultra-processed foods and obesity indicators among Brazilian adults and adolescents	Excess weight	Consumption ultra-processed foods	• Minimally processed • Processed • Ultra-processed	Mean reported energy intake was 1,908 kcal. With 29.6% of these calories from ultra-processed foods, ranging from 1,784 kcal in the lower quintile to 2,060 kcal in the upper quintile of consumption. The consumption of ultra-processed foods was associated with higher body-mass-index and greater prevalence of both excess weight and obesity in adolescents and adults. The percentage of energy from ultra-processed foods was higher among women, those with urban residence, non-smokers and those with higher levels of physical activity, education and income.
National (LOUZADA, M. L. Da C.; MARTINS, Ana Paula Bortoletto; et al., 2015b)	Descriptive: cross-sectional study with 32,898 representative sample of the Brazilian population aged 10 years or over in the National Household Budget Survey 2008–2009.	Two 24-h recall	To evaluate the impact of consuming ultra-processed foods on the micronutrient content of the Brazilian population's diet.	Impact of consuming ultra-processed foods	Micronutrient content of the diet.	• Natural or minimally processed (including culinary preparations based on these foods) • Processed • Ultra-processed	Mean daily energy intake per capita was 1,866 kcal, with 69.5% coming from natural or minimally processed foods, 9.0% from processed foods and 21.5% from ultra-processed foods. For 16 of the 17 micronutrients studied, the content of such found in the fraction referring to the ultra-processed foods was below the level found in the fraction referring to the natural or minimally processed foods.

National (LOUZADA, M. L. Da C.; MARTINS, Ana Paula Bortoletto; et al., 2015a)	Descriptive: cross-sectional study with 32,898 representative sample of the Brazilian population aged 10 years or over in the National Household Budget Survey 2008–2009	Two 24-h food records.	To assess the impact of consuming ultra-processed foods on the nutritional dietary profile in Brazil.	Consuming ultra-processed foods	Nutritional dietary profile in Brazil.	• Natural or minimally processed (including culinary preparations based on these foods) • Processed • Ultra-processed	The average daily energy consumption per capita was 1,866 kcal, with 69.5% being provided by natural or minimally processed foods, 9.0% by processed foods and 21.5% by ultra-processed food. The nutritional profile of the fraction of ultra-processed food consumption showed higher energy density, higher overall fat content, higher saturated and trans-fat, higher levels of free sugar and less fiber, protein, sodium and potassium, when compared to the fraction of consumption related to natural or minimally processed foods.
Rio Grande do Sul (BIELEMANN, Renata Moraes et al., 2015)	Descriptive: cross-sectional study with 4,202 individuals mean age 22.8 years (range 21.9 to 23.7 years) in 1982 birth cohort in the Urban area of Pelotas, south Brazil	Validate Food Frequency Questionnaire	To evaluate the consumption of ultra-processed foods, its associated factors, and its influence on nutrient intake in young adults.	Associated factors (gender, marital status, current education (years of schooling), change of income from birth to 23 years of age, and nutritional status) and its influence on nutrient intake in young adults.	Consumption of ultra-processed foods.	• Unprocessed or minimally processed • Processed foods used as ingredients of culinary preparations or the food industry • Ultra-processed foods or food products	The consumption of ultra-processed foods corresponded to 51.2% of the total caloric intake and was higher among women, individuals with higher education, and individuals who were never poor and eutrophic. This was positively correlated with the consumption of fat, cholesterol, sodium, iron, calcium, and calories ($p < 0.001$) and was negatively correlated with the consumption of carbohydrates, protein, and dietary fiber ($p < 0.001$).
Rio Grande do Sul (RAUBER, F. et al., 2015)	Prospective cohort study with 345 children of low socioeconomic status aged 3 and 4 years and 7 and 8	24-h recalls mothers reported	Investigated whether children's consumption of processed and ultra-processing	Consumption of processed and ultra-processed products at 3e4 years	Changes in lipid concentrations.	• Unprocessed and minimally processed foods; • Processed culinary	The percentage of daily energy provided by processed and ultra-processed products was 42.6 ±8.5% at preschool age and 49.2 ±9.5% at school age, on average. The main products consumed were breads,

	years from São Leopoldo, south Brazil.		products at preschool age predicted an increase in lipid concentrations from preschool to school age.			ingredients; processed and • Ultra-processed	savory snacks, cookies, candy and other sweets in both age groups (provided 33.9% and 37.9% of the total energy intake at Preschool and school age). This consumption at preschool age was a predictor of a higher increase in total cholesterol and LDL cholesterol from preschool to school age.
Rio Grande do Sul (SPARRENBER GER et al., 2015)	Descriptive: cross-sectional study with 204 children aged 2 and 10 years old divide in Preschool and School from Porto Alegre, south Brazil.	24-h recall	To evaluate the contribution of ultra-processed food on the dietary consumption of children treated at a Basic Health Unit and the associated factors. To identify the age at which ultra-processed foods are introduced in the diet of infants enrolled in public daycare centers and analyze these foods' nutritional composition according to the Traffic Light Labelling system adapted to the Brazilian norms	Sociodemograph ic and anthropometric characteristics. Characteristics	Contribution of ultra-processed food in the dietary consumption	• Unprocessed or minimally processed • Processed for culinary use • Ultra-processed	The energy intake on average, was 1,672.3 kcal/day, with 47% from ultra-processed foods and showed a direct association with the increase in the child's age (p < 0.001). In the ultra-processed foods group, was observed a more significant contribution of lipids, carbohydrates, sodium and trans-fat consumption per children.
São Paulo (LONGO-SILVA et al., 2015)	Descriptive: two cross-sectional studies with 636 nursery aged children (4 and 36 months) in the day care centers of São Paulo, southeast Brazil.	Interviewed with mothers about the age of introduction of instant noodles, snack chips, encased meat, chocolate, ice cream, and stuffed cookies.		Age at which ultra-processed foods are introduced in the diet of infants	Consumption ultra-processed foods	• Ultra-processed (chocolate, ice cream, stuffed cookies, instant noodles, snack chips, encased meat and another)	Before 12 months of age 70.6% of children had consumed instant noodles, 65.9% snack chips, 54.7% encased meat, 67.1% chocolate, 36.9% ice cream, and 68.7% stuffed cookies. In addition, all foods were classified as red for saturated fat and sodium and 50.0% were classified as red for total fat.

			and recommendations				
National (LONGO-SILVA et al., 2016a)	Descriptive: cross-sectional study with 109,104 adolescents from 9th grade. Brazilian students (high school) using PenSE 2012**	Self-report structured questionnaire	To investigate the frequency of consumption of obesogenic foods among adolescents and its association with sociodemographic, family, behavioral, and environmental variables.	Sociodemographic, family characteristics, Behavioral, school structural	Regular obesogenic food consumption	• Regular consumption (three or more days a week) of four foods, food groups, or prepared foods obesogenic: fried snacks, packaged snacks, sugar candies, and soft drinks.	Regular food consumption ultra-processed food ranged from 27.17% to 65.96%. The variables female gender, mobile phone ownership, Internet access at home, tobacco use, alcohol consumption, regular physical activity, eating while watching television or studying, watching television for at least 2 hours a day, and not willing to lose weight were associated of all foods analyzed.
Rio de Janeiro(ALVES-SANTOS et al., 2016)	Prospective cohort: 189 women between 20 and 40 years that were evaluated at 1st and 3rd gestational trimesters at Public health care center in Rio de Janeiro, southeast Brazil.	Semi-quantitative food frequency questionnaire was applied twice during pregnancy; at the first trimester and at the third trimester.	To estimate food intake changes from pre-conception to gestational period according to the degree of food processing.	Age, per-capita family income in Brazilian currency, Education, daily caloric intake, marital status, smoking habit, alcohol Consumption, parity, skin color.	Changes in the profile of food intake according to characteristics of food processing	• Unprocessed/minimally processed • Sugar/fat • Processed • Ultra-processed	The pre-conception total energy intake was 2,415 kcal with unprocessed or minimally processed food group represented 48.8% of total energy intake and ultra-processed food with 43.1%. The total energy intake of unprocessed or minimally processed food group was significantly higher (p= 0.048), and the caloric share of ultra-processed food group was significantly lower (p= 0.032) during pregnancy compared to the pre-conception period.
National (ARAUJO et al., 2017)	Descriptive: cross-sectional study with 3855 adolescents between 14 and 18 years living in the	Food records from two non-consecutive days	To evaluate the quality of food choices according to adolescent	Adolescent Individual earnings	Food choices	• Culinary preparations (unprocessed or minimally processed foods	The mean intakes of processed foods and ultra-processed foods and drinks increased according to household income tertile, while the mean intake of culinary preparations decreased

	selected households evaluated in the National Household Budget Survey 2008–2009.		Individual earnings in Brazil.			and processed culinary ingredients) • Processed • Ultra-processed	with increasing per capita income (all p<0·01). The adolescents with individual income consume more snacks, and also items of the traditional Brazilian diet. The differences in food consumption were more influenced by family income than adolescents' individual earnings.
Alagoas (MELO, I. S. V. DE et al., 2017)	Descriptive: cross-sectional study with 249 adolescents between 14 and 19 years old from Public federal school of Murici, northeast Brazil.	Food Frequency Questionnaire validate	To assess the consumption of minimally processed, processed and ultra-processed foods by adolescents from a poor Brazilian city and to determine if it was associated with excess weight, high waist circumference and high blood pressure.	Presence of excess weight, high waist circumference, and high blood pressure	Consumption of minimally processed, processed and ultra-processed foods	• Minimally processed • Processed • Ultra-processed	Intake of minimally processed food weekly or more was 56.6%, followed ultra-processed foods with 46.2% and the processed foods with 38.1%. The consumption of minimally processed foods was inversely associated with excess weight.
Rio Grande do Sul(KARNOPP et al., 2017)	Descriptive: cross-sectional study with 770 children up to 72 months from Urban area of Pelotas, south Brazil	24-h recalls mothers reported	To evaluate food intake according to the degree of processing, according to income and age group, in a representative sample of children under 6 years old.	Income and age group	Food consumption according to the degree of processing	• Fresh and minimally processed • Culinary ingredients and processed rivers • Processed • Ultra-processed	The daily average energy consumption was 1,725Kcal being the ultra-processed foods accounted for 19,7% of total energy. The energetic participation of ultra-processed foods in the feeding of children younger than 6 years old is high and increases with advancing age.

Alagoas (LONGO-SILVA et al., 2017)	Descriptive: cross-sectional study with 359 preschool children aged 17 to 63 months attending day-care centers from Maceió, northeast Brazil	Structured questionnaire	To identify the age of introduction of ultra-processed food and its associated factors among preschool children.	Describing sociodemographic characteristics, gestational characteristics, behavioral characteristics and biological antecedents	Time until the introduction of the ultra-processed foods in the child's diet	• Ultra-processed: bouillon cubes, processed meats, soft drinks and artificial juices, sandwich and plain cookies, petit-suisse cheese, industrial food thickeners, industrial baby food, snacks and chips, instant noodles, ice-cream, gelatin, sweets and margarine.	The median time until ultra-processed food introduction was six months and approximately 75% of preschool children had received one or more ultra-processed food in their diet. Between the 3rd and 6th months, there is a significant increase in the probability of introducing ultra-processed food in the children's diet; and while the probability in the 3rd month varies from 0.15 to 0.25, at six months the variation ranges from 0.6 to 1.0. The unplanned pregnancy, absence of prenatal care and income >2 minimum wages were independent risk factors for the introduction of ultra-processed food.
Maranhão(BATALHA et al., 2017)	Descriptive: cross-sectional study integrated within the prospective cohort study BRISA*, with 1185 children aged 13-35 Months from São Luís, northeast Brazil	24-hour recall mothers reported	To evaluate the consumption of processed and ultra-processed foods among children aged 13-35 months and its associated factors	Socioeconomic and demographic characteristics, social and health assistance-related variables and maternal behavioral and reproductive characteristics	Consumption of processed and ultra-processed food	• Unprocessed or minimally processed • Processed culinary ingredients • Processed and ultra-processed	On average, children consumed 1,226 Kcal/day, being 25.8% in the processed and ultra-processed food products and 74.2% from the group of unprocessed or minimally processed foods and culinary preparations. A high intake of processed and ultra-processed food products was associated with low maternal education (up to 8 years), and bigger child's age (>17 months)
National (SPERANDIO et al., 2017)	Descriptive: cross-sectional study 4,260 individuals from Northeast region and 1,715 from Southeast in the Sample	Two daily diet records on non-consecutives	To evaluate the impact of the Bolsa Família Program on food consumption in the northeast and	Socioeconomic and demographic characteristics and impact of the Bolsa Família Program	Absolute and relative consumption of fresh or minimally processed foods, culinary	• Unprocessed or minimally processed foods • Processed for culinary use • Ultra-processed	Average daily energy consumption of beneficiaries residents in the Northeast was 1,410 Kcal, being 67.9 % from unprocessed or minimally processed foods, 6.8% from culinary ingredients, 10.4% from processed for culinary use and 15% from ultra-

	Brazilian Household Budget Survey, Brazil		southeast regions of Brazil.		ingredients, processed and ultra-processed foods	• Culinary ingredients	processed foods and non-beneficiaries 1,557 kcal, being 57% from unprocessed or minimally processed foods, 6.7% from culinary ingredients, 13,8% from processed for culinary use and 22,6% from ultra-processed foods. Regarding the Southeast region the average consumption beneficiaries daily energy 1,467 kcal, being 57,8% from unprocessed or minimally processed foods, 6.5% from culinary ingredients, 11.6% from processed for culinary use and 16.6% from ultra-processed foods and non-beneficiaries 1,636 kcal, being 67.9 % from unprocessed or minimally processed foods, 6.8% from culinary ingredients, 12,6% from processed for culinary use and 23.1% from ultra-processed foods.
Rio de Janeiro (OLIVEIRA, A. S. D. DE et al., 2017)	Descriptive: cross-sectional study with 1,039 high school students between 13 and 19 years old from Public and private schools, elected for convenience in Rio de Janeiro, Southeast Brazil.	Qualitative Food Frequency Questionnaire	To examine the prevalence of the behavioral risk factors – both isolated and clustered – for chronic diseases, among adolescents and its association with various social and demographic variables was estimated.	Sociodemographic variables and behavioral risk factors (physical inactivity, sedentary habits, alcohol consumption, smoking, overweight and inadequate eating habits such as a non-regular consumption of	Occurrence and co-occurrence of behavioral risk factors for Non-Transmissible Chronic Diseases	• Ultra-processed: bread loaves, powdered chocolate, stuffed biscuits or wafers, curds and cheese, instant noodles, industrialized fruit juice, industrialized tea or mate, guarana-based refreshments, soda, chips and	The median daily intake of energy from ultra-processed food was 54.7% highest in girls ($p<0.05$)

				fruits and vegetables and a high consumption of ultra-processed foods).		snacks, readymade pizzas, hot dogs, hamburgers, nuggets, candy and industrialized sweets, chocolate, ice cream or popsicles, and gelatine.	
Rio Grande do Sul (D'AVILA; KIRSTEN, 2017)	Descriptive: cross-sectional study with 784 adolescents (both sexes and aged between 12 and 19 years) from public and private schools in the municipality of Palmeira das Missões, South Brazil.	Semiquantitative questionnaire of frequency of food consumption	To evaluate the consumption of ultra-processed foods and related factors in adolescents.	Socioeconomic factors, nutritional status, level of physical activity, and blood pressure levels.	Caloric intake from ultra-processed foods	• Minimally processed • Processed • Ultra-processed	The consumption of Minimally processed foods was 1,163.7 kcal, processed food was 229.7 and Ultra-processed foods was 1.496, representing 49.2% the median total energy consumption (3,039 kcal/day). These was associated with socioeconomic level, physical activity level, and nutritional status.
Sao Paulo (LEITE et al., 2018)	Descriptive: cross-sectional study with 513 children under 10 years old (292 aged <6 years, 221 aged ≥6 years); Santos, Southeast Brazil.	24-hour recall mothers reported	To investigate the association between neighbourhood food availability and the consumption of ready-to-consume products, either processed or ultra-processed, and	Greater consumption products and unprocessed/minimally processed foods in food stores	Higher availability of ready-to-consume products and unprocessed/minimally processed foods in food stores	• Foods and minimally processed • Processed culinary ingredients to be combined with foods to make meals and dishes; • Processed or ultra-processed	The medium proportion of consumption for foods and minimally processed foods was 51.5%, for processed culinary ingredients to be combined with foods to make meals and dishes was 11.5% and for processed or ultra-processed food 37%. The availability of ultra-processed food stores was associated with increased your consumption (p<0·001) and decreased foods and minimally processed foods

				unprocessed/minimally processed foods by children.		consumption among children (p<0·001).
Southeast and south(SILVEIRA, Jonas Augusto Cardoso Da et al., 2017)	Descriptive: cross-sectional study 533 individuals aged >16 years old (vegan, lacto vegetarian, ovo-vegetarian and lacto-ovo vegetarian) population through social networks (Facebook, Twitter and whatsapp groups)	Food Frequency Questionnaire	To investigate the association between excessive ultraprocessed intake and overweight, adjusting for potential confounders.	Geographic and demographic characteristics, history of vegetarianism and self-reported anthropometrics And types of vegetarianism	Consumption of Sugar-Sweetened Beverages, Ultra-Processed Food	• Daily consumption of ultra-processed	60% of the participants ate ultra-processed food at least once a day and the frequency of excessive daily intake (≥3x/day) was 16%. The vegans (11.4%) presented lower daily frequency of ultra-processed foods intake than the other vegetarian groups (19.5%) that include animal products in their diets. The consumption of ultra-processed food ≥3x/day were associated with overweight.
Maranhão (ALMEIDA, A. K. D. A. et al., 2018)	Descriptive: cross-sectional study with 29 children between 3 – 12 years old conducted in 2017 in São Luís, Northeast Brazil.	24h recall	To analyze the consumption of ultra-processed foods among children with autism spectrum disorder (ASD) and its association with nutritional status	Socioeconomic status, nutritional status and eating behavior	Consumption of ultra-processed foods	• Fresh or minimally processed • Processed • Ultra-processed	Consumption of ultra-processed foods was responsible for 28% (560 kcal/day) of caloric contribution. Overweight children consumed a higher mean percentage of ultra-processed foods than those who were not overweight (34.2% vs. 19.4%).
Rio Grande do Sul (BIELEMANN, Renata M et al., 2018)	Prospective cohort with 3,427 children 6 years old who participated in the 2004 Pelotas Cohort Study	Semiquantitative food frequency questionnaire	To examine the association between early feeding practices and consumption of ultra-processed foods in children at age 6 years.	Effects of early feeding practices.	Proportion of daily energy intake from ultra-processed foods.	• Unprocessed or minimally processed • Processed culinary ingredients • Processed • Ultra-processed	40.3% of total daily energy intake at 6 years came from ultra-processed foods. Children exclusively breastfed for ≥3 months and those who had solid foods introduced at ≥4 months consumed a lower proportion of daily energy intake from ultra-processed foods.

Minas Gerais (CONCEIÇÃO, A. R. DA; CASTRO MORAIS, DE; SOUZA, E. C. G. DE, 2018)	Descriptive: cross-sectional study with 64 adults aged from 25 to 57 years old in the rural area of the city of Viçosa, Southeast Brazil	Survey on eating habits, which consisted in obtaining detailed information (type, preparation, and brand) about the quantities of foods normally, in at-home measurements.	To evaluate the relationship between the degree of food processing and antioxidant consumption in adults living	Consumption of dietary antioxidants.	Degree of food processing.	• *In natura* or minimally-processed • Culinary ingredient (butter was the only food found) • Processed • Ultra-processed	The consumption in general was 1,400kcal/day for *in natura*, 140kcal/day for processed and 71 kcal/ day for ultra-processed. Was difference between sexes was verified in the consumption of calories from ultra-processed foods, being higher in females (p = 0.02)
Minas Gerais(BENTO et al., 2018)	Descriptive: cross-sectional study with 1,357 students attending the fourth year between 6 and 15 years old from elementary school at Belo Horizonte, Southeast Brazil	24-h recall	To compare the participation of food groups in the diet of student's accordance with the number of school meals consumed daily.	Consume school meals or consumes one, two, or three school meals daily).	Participation of fresh and minimally processed foods, processed, and ultra-processed foods in the diet.	• Fresh and minimally processed • Processed • Ultra-processed	The median of fresh and minimally processed food consumption was 528.2 g/1000 kcal, processed was 51.2 g/1000 kcal and ultra-processed food was 157.2 g/1000 kcal participated in the children's diet. Ultra-processed food participation was 18.0% lower among students that consumed two school meals and 26.0% lower among children that consumed three meals daily and presented more 7% Higher ingestion of fresh and minimally processed food in comparison to students that did not consume school meals.
National(COSTA , C. Dos S. et al., 2018)	Descriptive: cross-sectional study with 102,072 9th grade students of elementary Public	Food Frequency Questionnaire foods	To investigate the association between sedentary behavior and consumption of	Daily time spent in sedentary behavior.	Daily consumption of at least one group of ultra-processed food.	• Daily consumption of at least one group: goodies; salty soft drinks	The daily consumption of at least one group of ultra-processed was reported by 39.7% with higher prevalence's among girls, among adolescents living in the Southeast and Midwest,

and private school from rural and urban areas nationwide in Brazil, using PenSE 2015** in 26 capitals and the Federal District, Brazil		ultra-processed foods among Brazilian adolescents			and processed / processed foods such as hamburger, ham, bologna, salami, sausage, sausage, instant noodles, packet chips, salty crackers.	from schools private and in the highest fifths of index of maternal goods, education and in adolescent's sedentary behavior> 2 hours per day.
National(CANELLA et al., 2018)	Descriptive: cross-sectional study with 32,900 individuals aged 10 years or more in the National Household	Two daily diet records on non-consecutives	To characterize the individual consumption of vegetables in Brazil and to analyze their relation with the consumption of ultra-processed foods	Caloric intake of ultra-processed foods, Household income per capita, housing area region of the household, date of birth and sex.	Consumption of vegetables.	• Ultra-processed foods including crackers and chips; cakes, pies, and cookies; cereals; processed meats, hamburgers, and sausages; confectionaries; fast food; margarine; industrial sauces; sliced bread, hamburger buns, hot dog buns, and similar products; ready or semi-ready dishes; ultra-processed cheeses; soft drinks and other sugary drinks.	Of the total calories consumed in one day, 20.5% was from ultra-processed foods being higher women consume and the more youngers. In relation to ultra-processed foods, average household purchase accounted for 18.0% of the total calories and individual consumption accounted for 20.5%

National(COSTA LOUZADA, DA et al., 2018)	Descriptive: cross-sectional study with 32,898 individuals aged ≥10 years in the selected households evaluated in the Brazilian National Dietary Survey, 2008–2009 Household Budget Survey	Food records from two non-consecutive days	To estimate consumption of ultra-processed foods in the Brazilian population and to examine its relationship with the overall nutritional quality of the Brazilian diet.	Nutritional quality of the diet. Dietary share of each of the food groups to the total energy intake.	Consumption of ultra-processed foods.	• Fresh and minimally processed • Culinary ingredients. Processed rivers • Processed • Ultra-processed	The mean per capita daily dietary energy intake was 1.896 kcal, with 58·1% from unprocessed or minimally processed foods, 10·9% from processed culinary ingredients, 10·6% from processed foods and 20·4% from ultra-processed foods. Consumption of ultra-processed foods was directly associated with high consumption of free sugars and total, saturated and trans fats, and with low consumption of protein, dietary fiber, and most of the assessed vitamins and minerals.
Rio de Janeiro(CUNHA et al., 2018)	Prospective cohort ELANA*** with 1,035 adolescents (mean age 16 years old) in the 1st year of high school from six schools (four private and two public) in the metropolitan area of Rio de Janeiro, Southeast Brazil	Food Frequency Questionnaire.	To evaluate body mass index and body fat Percentage trajectories in adolescents over a 3-year follow-up according to the frequency of ultra-processed food consumption	Adiposity indicator trajectories throughout adolescence	Ultra-processed foods consumption	• Ultra-processed foods	On average the consumption of ultra-processed foods was 11%, being higher daily frequency of ultra-processed consumption at baseline (adolescents in public school 14.5 ± 12.5; compared in private schools = 9.94 ± 7.2, p <0.001).
Rio Grande do Sul(BRAZ DOS SANTOS GRADUANDA NUTRIÇÃO UERJ, [s.d.])	Descriptive: cross-sectional study with 377 Adolescents from 6th to the 9th grade between 10 and 19 years old from municipal schools of Barão do Triunfo, South Brazil.	Food Frequency Questionnaire	To describe the prevalence of ultra-processed food consumption among rural schoolchildren	Sociodemografics	Ultra-processed food consumption	• Ultra-processed foods (soft drinks, processed juices, cakes, sweet or stuffed cookies, desserts, candies, candies, chewing gum, candy, lollipops or other	The highest regular consumption was processed juice (50.8%) followed by goodies (47.6%). Approximately 90% of the population consumes soda, processed juice, cake and treats at least 1 or 2 times a week. Higher regular consumption of soda among boys than girls.

					goodies, embedded foods, and chips) was used as the cutoff point. Regular consumption 5 or more times a week.	
Rio Grande do Sul(CORRÊA, E. N. et al., 2018)	Descriptive: cross-sectional study with 2,195 schoolchildren between 7 to 14 years, attending 30 public and private schools at Florianópolis, South Brazil	Dietary recall questionnaire based on the previous day's intake.	To test the association between the use of food outlets and schoolchildren's Intake of minimally processed and ultra-processed foods.	Sociodemographic variables and overweight	Regular consumption of ultra-processed foods.	• Unprocessed and minimally processed • Processed culinary ingredients • Processed • Ultra-processed	Approximately 99% of the schoolchildren reported that they had eaten both ultra-processed foods on the day before the survey and the consumption was associated the use of snack bars and fast-food outlets among the adolescents (from 11 to 14 years).
Rio Grande do Sul(MARCHESI; CONDE, 2018)	Descriptive: cross-sectional study with 16 elderly people who participated in the *Conviver* project at Caxias do Sul, South Brazil	24- hour food recall with a three-day report	O evaluate the food profile of the elderly population residing in the rural area	Age and dietary profile	Consumption of processed and ultra-processed foods	• Fresh and minimally processed • Culinary ingredients • Processed rivers and foods; • Ultra-processed foods	The consumption of processed and ultra-processed by the elderly represented 30.3% of the total energy value, the main ones being pasta, bread, jam, cheese and salami. The intake of protein, sodium, iron and vitamin C were within the recommendations.
São Paulo(AUDI et al., 2018)	Descriptive: cross-sectional study with 1,013 female inmates between 18 and 65 years at São Paulo, Southeast Brazil	Food frequency questionnaire	To assess the consumption of ultra-processed foods among inmates in a women's prison	Sociodemographic variables, health-related behaviors	Consumption of ultra-processed foods and of consumption of foods with different	• Natural or minimally processed • Processed • Ultra-processed	The prevalence of daily consumption of natural or minimally processed foods was 87.7% and the ultra-processed food for three or more times per week was 98.9%.

					in the State of São Paulo.	degrees of processing
São Paulo(MAIS et al., 2018)	Descriptive: cross-sectional study with parents of 2–9 year old children (n=929) from Campinas and São Paulo, Southeast Brazil	Food frequency questionnaire	To identify food patterns among 2–9-year-olds and investigate sociodemographic, anthropometric and behavioural predictors of less healthy dietary patterns.	Sociodemographic, anthropometric and behavioural characteristics, parental perceived responsibility for child feeding and parental feeding practices	Ultra-processed food pattern score group	- Traditional food (meat, grains, beans, milk and dairy, vegetables and fruits) - Ultra-processed: fast food, artificial juice, chips, sugary snacks, crackers/biscuits /cakes with filling and vegetables	Higher consumption of the ultra-processed foods per children. Lower maternal education, lower income and higher maternal weight status were associated with a greater likelihood of the ultra-processed food pattern consumption. Children who used screen devices during mealtimes, with less educated and overweight mothers had children with a greater risk of high ultra-processed food intake.
South, Southeast, and Northeast regions (SIMÕES et al., 2018)	Descriptive: cross-sectional study with 14,378 adults aged between 35 and 74 years sampled at multicenter cohort of public universities civil servants at six cities from South, Southeast and Northeast regions of Brazil	Food frequency questionnaire	To estimate the contribution of ultra-processed foods to total caloric intake and investigate whether it differs according to socioeconomic position.	Socioeconomic position indicators	Consumption of ultra-processed foods	- Unprocessed or minimally processed - Processed culinary ingredients - Processed - Ultra-processed	The mean for total calorie intake was 2.945kcal/day, unprocessed or minimally processed foods and processed culinary ingredients contributed to nearly two-thirds (65.7%) of the total calorie intake, followed by ultra-processed foods (22.7%), and processed foods (11.6%).The mean caloric contribution percentage of ultra-processed foods decreased with age and was higher among female. And gradually decreased as the education level was higher and decreased according to higher levels of per capita household income.

| , Minas Gerais(FERREIRA et al., 2019) | Descriptive: cross-sectional study with 206 fifth-grade students from private and public municipal schools of Uberlândia, Southeast Brazil | 24-hour recall | To compare and analyze the consumption of minimally processed and ultra-processed foods among students from public and private schools. | Group of children from the sample and descriptive affiliation of the school | Food consumption focused on the description of total energy intake, percentage of total energy intake of each group based on the extent and purpose of food processing, percentage of total energy intake of sugar, and total amount of sodium (mg) and dietary fibers (g) consumed. | • Fresh or minimally processed
• Oils, fats, salt, and sugar, or culinary ingredients
• Processed
• Ultra-processed | Percentage of energy intake was 52% for Fresh or minimally processed foods, 12% for oils, fats, salt, and sugar, or culinary ingredients, 5% for processed foods and 31 % for ultra-processed foods. Energy intake from ultra-processed foods (36 vs. 28%) and amount of sugar (20 vs. 14%) were higher among students from private schools. |
| (RELVAS; BUCCINI; VENANCIO, 2019) | Descriptive: cross-sectional study with 198 mothers with children aged between 6 and 12 months in primary healthcare units of São Paulo, Southeast, Brazil. | 24-hour recall mothers reported | To analyze the prevalence of ultra-processed food intake among children under one year of age and to identify associated factors. | Maternal education, providing healthcare assistance on the first week of the child's life, primary healthcare model, diversity and adequacy of complementary feeding | Ultra-processed food consumption | • Consumption ultra-processed foods | The prevalence of ultra-processed food intake was 43.1%. The highest prevalence of consumption was that of sandwich cookies/chocolates/candies (21.8%), followed by sugary beverages (20.0%) and instant noodles/chips/savory biscuits (18.5%). Infants that were not being breastfed had a higher prevalence of ultra-processed food. Lower maternal education and the child's first appointment at the primary healthcare unit having happened after the first |

							week of life were factors associated with the consumption of ultra-processed foods.
National(ELIAS et al., 2019)	Descriptive: cross-sectional study with 109,104 Brazilian adolescents attending the 9th grade between 10 and 19 years (Public and private rural and urban schools) on PenSE 2012** in 26 capitals and the Federal District	Questionnaire based on weekly frequency consumption of different food items	To identify factors associated with asthma in Brazilian adolescents.	Factors socioeconomic, demographic, feeding, environmental, behavioral and health characteristics.	Asthma	• Traditional foods (beans, raw vegetables, raw salads, salads and cooked vegetables, fruits and milk) • Ultra-processed (salted fried, sausages, salted cracker), sweet biscuits, snacks, goodies and soda)	Consumption of traditional foods less than five days in the last week corresponded to 82.1%, and consumption of ultra-processed foods for more than two days a week was 64.4%. The largest number of days of ultra-processed food consumption larger risk association between the consumption and asthma.
National(ANDRADE, G. C. et al., 2019)	Descriptive: cross-sectional study with 34,003 individuals aged ≥10 years in the 2008–2009 Household Budget Survey	Two food records	To describe out-of-home consumption according to the purpose and extent of industrial processing and also evaluate the association between eating out and ultra-processed food consumption, taking account of variance within and between individuals.	Consumption of food away from home	Ultra-processed food consumption	• Natural or minimally processed foods and culinary ingredients • Processed culinary ingredients • Processed • Ultra-processed	69 % came from culinary preparations, 10·6 % from processed foods and 20·4 % from ultra-processed foods. As the frequency of out-of-home consumption increased, a decrease in the proportion of culinary preparations (from 73·3 to 63·4 %) was observed, contrary to the increase in the percentage of ultra-processed foods (from 16·0 to 26·2 %).

Piauí (MONTELES et al., 2019)	Descriptive: cross-sectional study with 617 adolescents aged between14 to 19 years old attending public and private education network at the city of Teresina, Northeast Brazil.	24-hour food recall	To verify the association between the consumption of ultra-processed foods and overweight in adolescents.	Socio-demographic variables and the nutritional status	Consumption of ultra-processed foods	• Unprocessed or minimally processed • Processed foods used as ingredients of culinary preparations or by the food industry • Processed • Ultra-processed	The percentual consumption was 23.0% boys and 25,5% girls and 23.9% from public school and 25.2% from private. Ultra-processed foods presented higher proportions of carbohydrates, lipids and saturated fat in relation to the total diet consumed. However, this food group had a lower proportion of proteins and fibers. Intake of ultra-processed foods was more frequent in females and being overweight was positively associated with the ingestion of ultra-processed foods.
Rio de Janeiro(BERTI et al., 2019)	Descriptive: cross-sectional study with 520 adults between 45 and 54 years working as servants of university campuses, Rio de Janeiro, Southeast Brazil	Food frequency questionnaire	To investigate the food consumption according to the degree of processing and associations with sociodemographic characteristics	Sociodemographic characteristics	Degree of processing of foods	• *In natura*, minimally processed, food preparations based on these foods • Processed • Ultra-processed	The average energy consumption of 2,470 kcal, the group of fresh, minimally processed foods and culinary preparations based on these foods contributed with 59.9%, followed by ultra-processed foods with 27% and processed with 13.3%. The consumption ultra-processed food was higher younger individuals (≤ 44 years) compared to individuals aged 55 to 59 years.
Rio Grande do Sul (COSTA, C. S. et al., 2019)	Randomized controlled trial with 307 children evaluated at 4 and 8 years old from mothers that participated of a dietary counselling on breastfeeding and dietary practices during the	24-h recalls mothers reported	Investigated the association between ultra-processed foods consumption at preschool age and changes in anthropometric measurements from preschool to school age and	Sociodemografic variables, pre-pregnancy BMI, sex, birth weight, breastfeeding, family income, maternal schooling and total Screen. And	Anthropometric measurements	• Minimally processed • Processed culinary ingredients • Processed • Ultra-processed foods and drink products.	The percentage of daily energy provided by ultra-processed foods was 41.8 ± 8.7 % (753.8 ± 191.0 kcal) at preschool age and 47.8 ± 8.9 % (753.8 ± 191.0 kcal) at school age, on average and was associated with increased waist circumference.

	first year of life at São Leopoldo, South Brazil.		glucose profile at school age.		Ultra-processed foods consumption		
Rio Grande do Sul (ANDRETTA et al., 2019)	Descriptive: cross-sectional study with 1,309 students aged between 6 and 16 years in Public schools at Caxias do Sul, South Brazil	Questionnaire consumption considered food ultra-processed in one of the meals taken on the day	To evaluate the consumption of ultra-processed foods and its association with sociodemographic, behavioral and nutritional factors in	Sociodemographic, behavioral and nutritional factors	Consumption of ultra-processed foods	• Ultra-processed foods were considered consumption in one of the meals taken on the day.	69.7% students consumed at least one ultra-processed food per day with average consumption in the 1.5 (± 1.6) and the maximum intake was 12 ultra-processed foods per day. Purchasing or taking the snack to school was found to increase the prevalence of ultra-processed food consumption by 9.0%, while having received life-long nutritional counseling reduced the prevalence of ultra-processed food consumption by 15.0%.
Rio Grande do Sul(FERNANDES, 2019)	Descriptive: cross-sectional study with 200 high risk pregnant women between 15 and 45 years served by a public clinic in South Brazil.	24h recall	To relate pregestational nutritional status, maternal age and number of pregnancies to the distribution of macronutrients and micronutrients according to the type of processing of foods consumed by high-risk pregnant women	Pregestational nutritional status, age, and number of pregnancies	Type of processing of foods consumed by high-risk pregnant women.	• Natural, minimally processed • Processed • Ultra-processed	Average consumption ultra-processed 636.6Kcal /day and the mean percentages of lipids, monounsaturated fatty acids, polyunsaturated fatty acids and sodium intake were higher among ultra-processed foods. Of the total calories consumed, 47.21% were from fresh / minimally processed foods, 38.07% from ultra-processed foods and 14.72% from processed foods. There was a significant inverse correlation between maternal age and total calorie intake and percentage of carbohydrates and proteins from ultra-processed foods. There was also a significant association between pregestational nutritional status and

						total calorie intake and percentage of carbohydrates from UPF
São Paulo(GOMES et al., 2019)	Non-randomized controlled educational intervention study followed on healthy eating and physical activity during pregnancy 365 women 181 and 172 women in the intervention and control groups In public primary health units in Botucatu, Southeast	Two 24-h dietary recalls per trimester, one face-to-face, another by telephone.	To investigate the effect of a prenatal care related educational intervention on the consumption of ultra-processed foods during pregnancy applied to health professionals.	Educational intervention	Consumption of ultra-processed foods	• Unprocessed and minimally processed • Culinary preparations • Processed • Ultra-processed	In the first trimester, the mean percentage of energy from ultra-processed foods in the intervention (23.9%) and control (26.0%) and in the second trimester, was 20.6% intervention and 27.3% control groups with significantly different (p < 0.001). In the third trimester the intervention demonstrated 22.8% and 26.7% to control of the energy consumed ultra-processed foods (p = 0.022).
São Paulo(ENES; CAMARGO; JUSTINO, 2019)	Descriptive: cross-sectional study convenience sample of 200 10 to 18 year-old adolescents from Campinas, Southeast Brazil	Semiquantitative food frequency questionnaire	To evaluate the relationship between ultra-processed food consumption and obesity indicators in adolescents	Obesity indicators and Sex, age, race, economic condition and physical activity	Ultra-processed food consumption	• Raw and minimally processed • Processed cooking ingredients • Processed • Ultra-processed	The average energy intake was 4,176 kcal/day, of which 50.6% was derived from ultra-processed foods and the minimally processed foods accounted for 46.7%.
São Paulo(SARTORELLI et al., 2019)	Descriptive: cross-sectional study was done with 785 pregnant women attending the public health system of Ribeirão Preto, Southeast Brazil	Two 24-hour dietary recalls	To investigate the relationship between food intake (considering the nature, extent, and purpose of food processing) during pregnancy	Socioeconomic, demographic, lifestyle. Excess weight, and gestational diabetes mellitus.	Food intake (considering the nature, extent, and purpose of food processing)	• Unprocessed and minimally processed • Processed culinary ingredients are used to prepare dishes and meals • Processed	Mean total energy intake of women was 2,053 Kcal. The percentage from unprocessed or minimally processed foods was 55% and from ultra-processed food products was 32%. Women classified into the highest tertile of percentage from ultra-processed food intake had a three times higher chance of obesity when

			and overweight, obesity, and gestational diabetes mellitus conditions				• Ultra- processed	com- pared to women with the lowest intake of these foods.
South, Southeast, and Northeast regions of Brazil(LOPES et al., 2019)	Descriptive: cross-sectional study with 8.468 adults between aged 45 to 54 years from sample ELSA of civil servants at public universities in six cities	Food frequency questionnaire	To investigate whether the caloric contribution of ultra-processed foods to diet is associated with C-reactive protein levels, independent of body mass index.	Body mass index and serum C-reactive protein levels:	Percentage energy contribution towards total energy intake that came from ultra-processed foods		• Unprocessed and minimally processed • Processed food ingredients; • Processed • Ultra-processed	Ultra-processed foods contributed almost 23% of the total energy (kcal) intake. Among women, the highest tercile of ultra-processed food intake was associated with mean C-reactive protein levels that were 14% higher than those of the lowest tercile.

*BRISA: Etiology of Preterm Birth and Consequences of Perinatal Outcomes for Child Health: Birth Cohorts in Two Brazilian Cities; **PenSE: National Survey of School Health, ***ELANA: Adolescent Nutritional Assessment Longitudinal Study; ****ELSA: The Brazilian Longitudinal Study of Adult Health

3.3 UPF CONSUMPTION PER AGE GROUPS

The contribution of UPF to the total diary energy intake (TDEI) ranged from 15% to 54.7% (OLIVEIRA, A. S. D. DE et al., 2017; SPERANDIO et al., 2017). The children under six months old obtain 19.7% of total calories from UPF(KARNOPP et al., 2017) in average. The introduction of UPF occurs early, between 6 and 12 months 43.1% of the TDEI is obtained from UPF (RELVAS; BUCCINI; VENANCIO, 2019) between 13 and 35 months the percentage is 25.8% (BATALHA et al., 2017) and among children from 4 to 36 months, the average time until the introduction of UPF was six months and before 12 months of age 70.6% of children had consumed instant noodles.(LONGO-SILVA et al., 2015).

As they get older, children increase the percentage of UPF consumption. The under 6 years old living consumed 19.7% of calories derived from UPF;(KARNOPP et al., 2017) those between 3 and 12 years, consumed 28.0%(ALMEIDA, A. K. D. A. et al., 2018). A cohort study conducted in the city of Pelotas indicated that children at 6 years old consumed 40.3%,(BIELEMANN, Renata M et al., 2018) similar values were observed at 10 years old (37%),(LEITE et al., 2018) and between 2 and 10 years old (47.0%)(SPARRENBERGER et al., 2015). In two studies carried with data from a cohort study nested in a randomized field trial with the same population the mean percentage consumption was 42.2% at preschool age (4 and 8 years); the percentage rises 48.5% at school age(COSTA, C. S. et al., 2019; RAUBER, F. et al., 2015). A different scenario is observed in northeast, where 75% of preschool children attending day-care centers had received one or more UPF in their diet.(LONGO-SILVA et al., 2017)

The studies assessing adolescents demonstrated that the percentage of TEI the UPF varies from 31.0%(FERREIRA et al., 2019) to 54.7 %.(OLIVEIRA, A. S. D. DE et al., 2017) A nationwide study with schoolchildren showed that the percentage of TEI from UPF was 39.7% per day.(COSTA, C. Dos S. et al., 2018) Regional variations in this percentage were obtained in localized studies; 54.7% among 13 to 19 years old students from southeast region(OLIVEIRA, A. S. D. DE et al., 2017) Two studies conducted in the northeast region concluded that in public and private education networks schoolchildren aged between 14 and 19 obtain 20% of energy derived from UPF(MONTELES et al., 2019) and in Public federal school 46.2% from UPF.(MELO, I. S. V. DE et al., 2017)

In adults, the caloric contribution of UPF ranges from 23% to 51.2%.(BIELEMANN, Renata Moraes et al., 2015; LOPES et al., 2019) In nationwide

surveys with three age groups (over 10 years) the percentage of calories supplied by UPF was between 20.4%(ANDRADE, G. C. et al., 2019) and 29.6%(LOUZADA, M. L. Da C.; BARALDI, Larissa Galastri; et al., 2015). In studies including only adults, the youngest (aged 22 to 24 years) consumed the highest percentage of UPF (51.2%),(BIELEMANN, Renata Moraes et al., 2015) reducing to 27% in individuals between 45 to 54 years old(BERTI et al., 2019) and under 23% between 45 to 54 years old from south, southeast, and northeast(LOPES et al., 2019) and per 22.7% among adults and older 35-74 years, from south, southeast, and northeast(SIMÕES et al., 2018). However, a study of the elderly, with a small sample and elected for convenience, showed a value slightly above 30.3%(MARCHESI; CONDE, 2018). Regional studies observed that pregnant women consumed from 20.6% to 43.1% of calories from UPF(ALVES-SANTOS et al., 2016; FERNANDES, 2019; GOMES et al., 2019; SARTORELLI et al., 2019).

3.4 UPF TYPES

Figure 2 demonstrates the most consumed UPF types detailed in the consulted bibliography according to age range in Brazilian population.

The introduction of UPF in babies diet happens before the age of six months, especially instant noodles, chocolate and stuffed cookies. (LONGO-SILVA et al., 2015) Between 6 and 12 months demonstrated highest prevalence of consumption of sandwich cookies/chocolates/candies (21.8%), followed by sugary beverages (20.0%) and instant noodles/chips/savory biscuits (18.5%). (RELVAS; BUCCINI; VENANCIO, 2019)

The consumption of these foods by Brazilian children expands the range of varieties with increasing age. For example, up to three years old children consume instant noodles, chips, processed meats, chocolate, ice cream, stuffed cookies, crackers, pastries, petit suisse cheese, oatmeal, baby food, industrial soups and baby formulas.(BATALHA et al., 2017; KARNOPP et al., 2017; LONGO-SILVA et al., 2015, 2017) Ultra-processed breads, chocolate powder, processed meat, salted foods such as French fries, soft drinks, sugary milk drinks and artificial juices are still inserted in childhood before adolescence.(ALMEIDA, A. K. D. A. et al., 2018; COSTA, C. S. et al., 2019; MAIS et al., 2018) In adolescence, in addition to these cited foods that are already part of the food habit, the largest consumption of UPF demonstrated by the studies is associated with soft drinks, pizzas, gelatin, cakes and cookies, sweets and burgers (ARAUJO et al., 2017; CORRÊA, E. N. et al., 2018; CUNHA et al., 2018; ENES; CAMARGO; JUSTINO, 2019;

FERREIRA et al., 2019; LONGO-SILVA et al., 2016b; MELO, I. S. V. DE et al., 2017) with some differences between the sexes. Boys consume more hot dogs, fried buns, ham, hamburgers, peanuts, soft drinks, chocolate milk and marmalade drinks, and girls consume more condensed milk, chocolate, and sweet potato chips. (CUNHA et al., 2018)

Adults also eat a variety of UPF. Studies with adults and/or seniors show that the most consumed foods were bread, sugar-sweetened drinks, treats, cakes, biscuits, sweet and savory, pizza, snacks and sausages. (ALVES-SANTOS et al., 2016; AUDI et al., 2018; BERTI et al., 2019; BIELEMANN, Renata Moraes et al., 2015; SILVEIRA, Jonas Augusto Cardoso Da et al., 2017; SIMÕES et al., 2018) with differences between the sexes (BIELEMANN, Renata Moraes et al., 2015). We found only one study exclusively assessing the elderly population, indicating a consumption of 30.3% of the total energy value from the UPF (mainly pasta, bread, jam, cheese and salami) (MARCHESI; CONDE, 2018) Studies that evaluated the three age groups (adolescents, adults and the elderly) were not clear regarding the types of foods most consumed by older people.(ANDRADE, G. C. et al., 2019; AUDI et al., 2018; COSTA LOUZADA, DA et al., 2018; LOUZADA, M. L. Da C.; BARALDI, Larissa Galastri; et al., 2015; LOUZADA, M. L. Da C.; MARTINS, Ana Paula Bortoletto; et al., 2015b, 2015a).

4 DISCUSSION

As a primary result of this review, we found a wide range of UPF consumption by the Brazilian population according to age group. The introduction of these foods begins before the age of 6 months being children and adolescents the main consumers. The energetic contribution of UPF in the children diet (younger than six years old) is high and increases with advancing age.(KARNOPP et al., 2017)

The introduction of sweets happens early, before their first year of life, and commercial children food have high contents of total fat, saturated fat, and sodium, e.g. chocolate, stuffed cookies and ice cream.(LONGO-SILVA et al., 2015) Foods consumed by the mothers during prenatal care and breastfeeding period have been associated with stimulation and taste recognition in childhood. The feeding introduction period is crucial to establish the baby's taste and attitude preferences in relation to feeding.(COSMI, DE; SCAGLIONI; AGOSTONI, 2017) The early introduction of UPF is worrisome, considering that the first thousand days of life, are sensitive to metabolic and nutritional factors which may predispose to short and long term consequences on the individual's health, extending until adulthood (GIESTA et al., 2019).

In children under 2 age years, processed and UPF products contributed to more than a quarter of the total calories consumed and around 40% at 6 y of age (BIELEMANN, Renata M et al., 2018) even smaller than American children with 6 years (57.8%)(STEELE, Eurídice Martínez; MONTEIRO, Carlos A., 2017). On the other hand, the traditional foods from the Brazilian diet (milk and dairy, grains, meat and eggs, fruits, beans and vegetables), are still the main caloric contribution of children's diet(ALMEIDA, A. K. D. A. et al., 2018; MAIS et al., 2018). These are sources of proteins, vitamins and minerals, fiber, antioxidants and carbohydrates in the diet(BARALDI, Larissa Galastri et al., 2018). Therefore, the use of less processed foods is essential for a healthy health and it is necessary to promote the family's culinary practice to increase the consumption of these food(MARTINS, C. A. et al., 2020).

Figure 2. Ultra-processed foods types more consumed by Brazilian population.
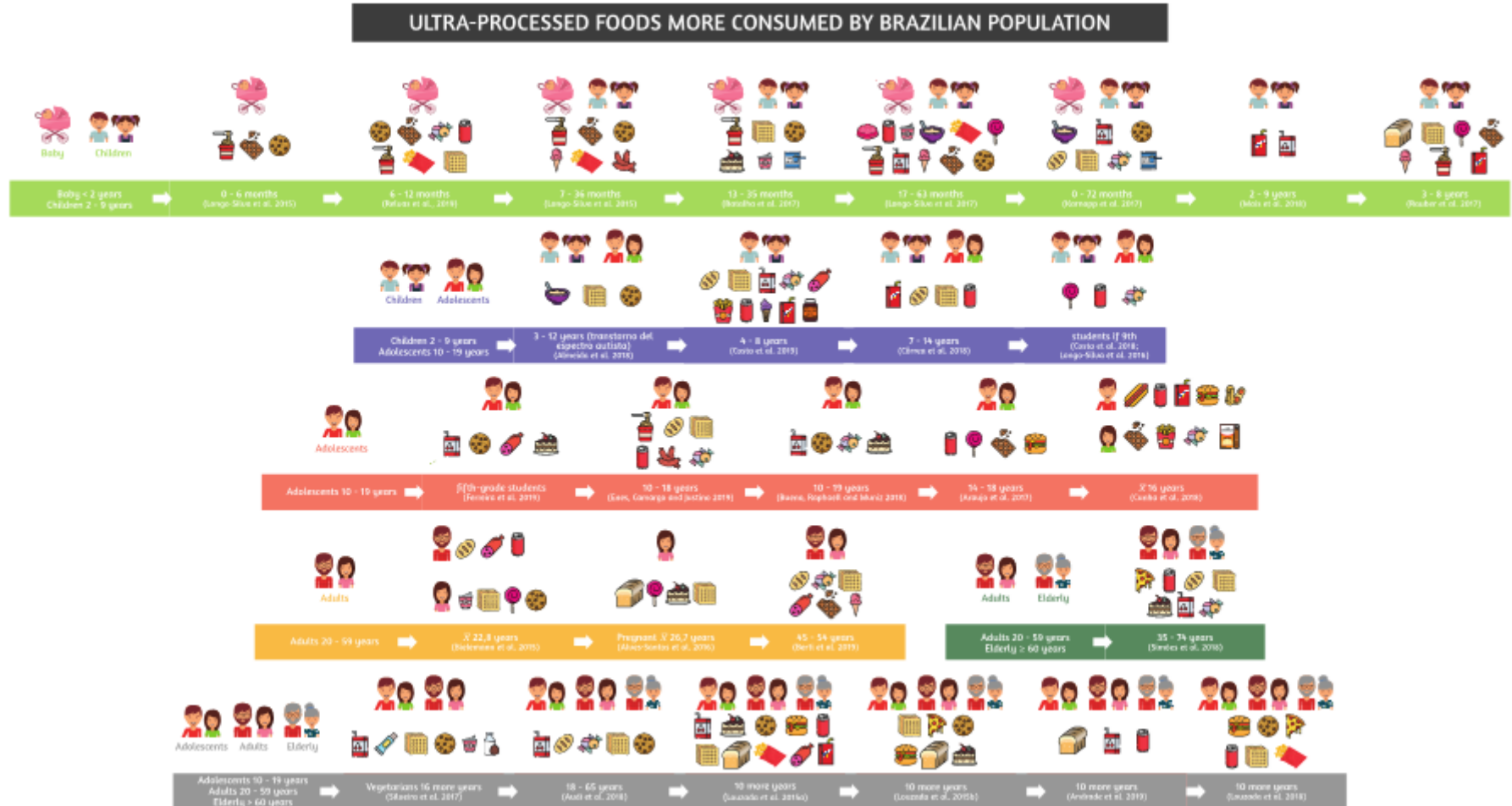
Regarding adolescents, they represent the group that most consumes UPF and this habit tends to be carried into adulthood.(ANDRADE, G. C. et al., 2018) The increasing intake of UPF, as treats, sweetened drinks, processed meats, bakery products and other foods, is simultaneously followed by a decreased intake of raw and cooked vegetables and fruits, resulting in worse diet quality (CUNHA et al., 2018) and increases in salt and sugar intake, food additives and saturated and trans fats(OMENA MESSIAS, DE; SANTOS SOUZA, DOS; SILVA REIS, 2016).

In adults, the contribution of UPF was 23.0 to 51.2% of the TDEI. In Mexican population the average UPF consumption was 30.0%;(MARRÓN-PONCE et al., 2019) Spanish adults was 24.4% (BLANCO-ROJO et al., 2019) and from the French NutriNet-Santé cohort the contribution was 18.0%. A significantly higher UPF consumption is observed in United Kingdom (56.8% of TDEI) (RAUBER, Fernanda et al., 2019) and 60% of calories consumed in the USA (BARALDI, Larissa Galastri et al., 2018). Perhaps, in Brazil and other countries with strong culinary culture (as Colombia, Portugal) (MONTEIRO, Carlos Augusto; MOUBARAC, J. C.; et al., 2018; PARRA et al., 2019) we still have lower consumption of UPF because we have a traditional diet which is not observed in the United Kingdom and USA. Nevertheless, it is known that the intake of UPF is increasing even in Brazil (MOUBARAC, J.-C.; PAN AMERICAN HEALTH ORGANIZATION; WORLD HEALTH ORGANIZATION, 2015; VANDEVIJVERE et al., 2019). These foods presented unfavorable characteristics when compared to processed foods and the Brazilians who consume less UPF are the stratum of the population closer to international recommendations for a healthy diet (LOUZADA, M. L. Da C.; MARTINS, Ana Paula Bortoletto; et al., 2015a). In addition, there are some facilitators for UPF consumption among adults as taste, preference, convenience, dependence and cost (ALMEIDA, L. B. et al., 2018).

Sugary products were the most consumed group among adults, followed by drinks, starchy foods and breakfast cereals, ultra-processed fruits and vegetables and others (FIOLET et al., 2018). Even knowing the UPF disadvantages regarding health, adults have high consumption, e.g. Uruguayan workers from a commercial company reported that UPF have low nutritional quality, they are highly palatable, easy to eat/prepare and are advertised using aggressive campaigns. (ARES et al., 2016)

In pregnancy, UPF intake reduced while minimally processed or unprocessed food intake slightly increased from preconception to gestational period (ALVES-SANTOS et al., 2016). Besides, an educational intervention related to the consumption of UPF

resulted in an absolute reduction in energy intake percentage (4.6%) between the first and second trimester of pregnancy. (GOMES et al., 2019)

More than a third of the calories consumed by the elderly came from UPF. This age range is accompanied by many changes that can make it more difficult for nutritional needs to be met. (LESLIE; HANKEY, 2015) The higher consumption of UPF was associated with relatively high consumption of free sugars, total saturated and trans fats, and with low consumption of protein, dietary fiber, and most of the vitamins and minerals as vitamin D, vitamin E, niacin, vitamin B6, vitamin B12, Fe, Zn, P, Mg, Cu, Se and K (COSTA LOUZADA, DA et al., 2018). These products have low nutritional density and are hyperpalatable, which may contribute to nutritional deficiencies, despite the consumption of large amounts.

It is important to note that the process of choosing, buying and consuming food is driven by a complex combination of biological, social and cultural interactions and the determinants of food intake include individual characteristics, such as nutritional knowledge, as well as structural factors, such as access and purchase prices. (SIMÕES et al., 2018) The UPF still have higher added value than less processed foods in the country (CLARO et al., 2016). Besides that the obesogenic environments and of out-of-home food consumption are associated with consumption of UPF.(ANDRADE, G. C. et al., 2019; DURAN et al., 2016) The mean prices of foods and beverages purchased at supermarkets were 37.0% lower in comparison to other food stores.(MACHADO, Priscila Pereira et al., 2017) Unlike the United Kingdom, where the cost of UPF is on average 13% lower than the cost of unprocessed or minimally processed foods and processed foods together, UPF are about 52% more expensive than both food groups in Brazil (MOUBARAC, J. C. et al., 2013). UPF taxation, together with the tax exemption for healthy foods, would lead to reduced caloric consumption and could be beneficial because (LEIFERT; LUCINDA, 2012) would be able to modify diets and reduce diseases disease (SMITH et al., 2018).

The limitations were reduced by pre-registering a detailed research plan following the PRISMA guidelines. The first refers to the standardization of the new classification according to food groups. Most studies ranked the four groups as proposed by Monteiro, (MONTEIRO, Carlos Augusto et al., 2010) often grouping the raw ingredients together with the processed foods, but two studies grouped processed foods and UPF(BATALHA et al., 2017; LEITE et al., 2018) making it difficult to compare UPF data alone between the studies. The second limitation concerns the assessment of consumption with food

recall or food frequency most used, however the measures of diet quality are approximately comparable (PROCTER-GRAY et al., 2017). Another limitation refers to the age group. As some studies have analyzed more than one age group or different ages, the attempt to minimize this limitation was to use the age groups to analyze the data together.

5 CONCLUSIONS

The consumption of UPF varies by age range in the Brazilian population, being higher among children and adolescents. The introduction of the ultra-processed foods happens early in infant feeding and the food variety expands with increasing age. Such findings reinforce the need to broaden the dissemination of the food *Guia Alimentar para a População Brasileira*, to encourage the development of cooking skills related to preparing meals from unprocessed or minimally processed foods, to regulate nutritional labeling (BLITSTEIN; GUTHRIE; RAINS, 2020; CASTRO, S. E. De; SILVA, T. E. S. Da, 2020) and overcharge foods rich in sugar, fats and sodium.

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