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Consumption of Ultra-Processed Foods and Dental Caries in Children and Adolescents: A Systematic Review with Meta-Analysis

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Abstract

Objective: *To evaluate the association between the consumption of ultra-processed foods (UPF) and the incidence of dental caries in children and adolescents.*

Methods: *A systematic literature review was conducted on studies published in the last 5 years. SCIELO, EMBASE, and Web of Science databases were used as information sources, employing the following Boolean operators: children OR adolescents AND ultra-processed foods AND dental caries. The identified articles were screened using RAYYAN. The risk of bias was determined using the National Heart, Lung, and Blood Institute (NHLBI) tool.*

Results: *A total of 199 articles were found, with 191 studies excluded and eight included that met the PICO question requirements. The eight included studies analyzed 9,841 children or adolescents. It was observed that UPF induced an 83% increase in the risk of caries (OR = 1.83; 95% CI: 1.34-2.50) in the group.*

Conclusions: *The consumption of ultra-processed foods is associated with a higher risk of dental caries in children and adolescents in the analyzed studies.*

Keywords: Food. Ultra-Processed. Dental Caries. Review.

Introduction

Dental caries is a sugar-dependent dysbiosis and remains one of the non-communicable diseases with the highest global prevalence, constituting a relevant public health problem, especially in the pediatric and adolescent population. Its multifactorial genesis is widely recognized, involving a complex interaction between diet, oral microbiota, oral hygiene, and host susceptibility [1]. According to the World Health Organization (WHO), approximately 60 to 90% of school-aged children suffer from dental caries; these figures become even more alarming in underdeveloped and impoverished countries where access to oral health care is limited [2].

The positive association between free sugar consumption and dental caries represents a consolidated scientific consensus. The relationship between sugar intake in childhood and the incidence

of caries in adolescence indicates that these factors are directly linked [3]. In the contemporary context of food systems, characterized by the global hegemony of ultra-processed foods (UPF), a new and potent nutritional risk factor has been introduced that demands further investigation. These products are industrial formulations rich in free sugars, fats, salt, and additives, possessing physicochemical characteristics, such as adherent texture and a high capacity to reduce oral pH, which can potentiate their carcinogenicity [4].Although the role of ultra-processed foods (UPF) in the development of chronic non-communicable diseases, such as obesity and diabetes, is established, their specific impact on oral health, particularly in the etiology of dental caries, is not completely elucidated.

Recent evidence, such as study [5], indicates that the effect of UPF on caries may not be mediated by nutritional status, but rather by oral hygiene habits (OHH), suggesting indirect and complex pathways that also involve socioeconomic factors and concurrent risk behaviors. However, the literature remains fragmented, with gaps regarding the magnitude of this association in young populations, the role of mediating variables, and the influence of methodological heterogeneity in studies, predominantly cross-sectional, limiting causal inferences. Given this gap, a rigorous synthesis of current knowledge is imperative.

This systematic review's main objective is to consolidate and critically evaluate the available scientific evidence on the association between the consumption of ultra-processed foods and the prevalence or incidence of dental caries in children and adolescents.

Methods

This systematic review was conducted according to the PRISMA 2020 guidelines [6]. It was submitted and approved on the PROSPERO platform 2025 CRD42025123499[7].

Eligibility Criteria

This study's protocol was based on the PICO methodology. Population: children and adolescents consuming ultra-processed foods and sweets; Intervention: consumption of ultra-processed products and sweets; Comparison: no consumption of ultra-processed products and sweets; Outcome: incidence of dental caries.

The review question was: "Among children and adolescents who consume ultra-processed foods, is this consumption associated with a higher incidence of dental caries compared to those who do not consume them?" Articles from cross-sectional studies, published in the last 5 years, in Portuguese or English, without restriction of country or socioeconomic context, with full text freely available, and addressing children and adolescents aged between 1 and 18 years were included in this study.

Information Sources and Search Strategy

After a pilot search systematically conducted in the databases by two evaluators simultaneously, independently, and double-blind, the following databases were selected: SCIELO, EMBASE, and WEB OF SCIENCE, with search strategies adjusted according to each selected database. The complete search strategies are presented in Table 1.

Table 1: Search Strategies for Literature Studies

Embase (n=112)	Web Of Science (n=77)	SCIELO (n=10)
Population: ('child'/exp OR 'child' OR 'children' OR 'adolescent' OR 'teenager' OR 'young people'/exp OR 'adolescent'/exp) AND Intervention: ('ultra-processed food'/exp OR 'industrialized food' OR 'candy' OR 'sweets' OR 'ultraprocessed') AND Outcome: ('dental caries'/exp OR 'caries' OR 'caries, dental' OR 'cariogenesis' OR 'carious dentine' OR 'carious teeth' OR 'dental caries' OR 'dental caries susceptibility' OR 'dental decay' OR 'dental fissure' OR 'dental fissures' OR 'fissure, tooth' OR 'root caries' OR 'tooth caries' OR 'tooth decay' OR 'tooth fissure' OR 'dental erosion'/exp OR 'dental erosion' OR 'dental surface erosion' OR 'enamel erosion' OR 'eroded enamel' OR 'eroded teeth' OR 'eroded tooth' OR 'erosion, tooth' OR 'erosive dental change' OR 'erosive dental lesion' OR 'erosive dental wear' OR 'erosive tooth damage' OR 'erosive tooth lesion' OR 'erosive tooth substance loss' OR 'erosive tooth surface change' OR 'erosive tooth surface loss' OR 'erosive tooth wear' OR 'tooth erosion' OR 'tooth surface erosion') → Adição de filtros de idade e ano de publicação	P – Tópico: (Child OR Adolescent OR Teenager OR Children OR Young People) AND I – Tópico: ("Ultra-processed foods OR Industrialized foods OR sweets OR confectionery OR candy AND O – Tópico: (Dental caries OR Tooth decay OR Tooth erosion) → Adição de filtro de ano de publicação.	População: (Criança OR Adolescente) AND Intervenção: (Alimentos ultraprocessados OR Alimentos industrializados OR doces OR confeitaria OR balas) AND Desfecho: (Cárie dentária OR Erosão dentária) → Adição de filtro de ano de publicação.

Descriptive caption: Search strategies used in the Embase, Web of Science, and Sci ELO databases, including descriptors and Boolean operators related to population (children and adolescents), exposure (ultra-processed/industrialized foods), and outcomes (dental caries and tooth erosion), with age and publication year filters applied.

Selection Process

The selection process was carried out on the Rayyan platform (https://rayyan.qcri.org) by two authors independently. Initially, screening was performed based on the titles and abstracts of the studies, with the aim of identifying irrelevant records. Subsequently, the full texts were evaluated for inclusion or exclusion, and disagreements were resolved by consensus. If no consensus was reached, it was resolved by a third reviewer. From this, data from the included articles were selected and extracted.

Data Collection Process

The following data were extracted from the eight selected studies: authors, year of publication, research location, number of participants, number and percentage of participants with caries, number and percentage of participants consuming ultra-processed foods (UPF), effect measure used, and study conclusion.

Assessment of Risk of Bias of Studies

Since only cross-sectional studies were identified, critical assessments of methodological quality and reporting of the studies were performed using the National Heart, Lung, and Blood Institute (NHLBI) quality assessment tool for observational cohort and cross-sectional studies. This tool uses a checklist consisting of 14 questions to be answered with "yes," "no," and "not applicable." In the tool, 1 point is scored for each "yes" answer and 0 for all other answers. In general, the total score of the study would be the number of "yes" answers. Scores above 12 are considered "good," meaning the study has a low risk of bias. Scores below 9 are considered "medium," meaning the study is of acceptable quality. Scores below 9 mean that the study is "fair" [5], meaning it has strengths and weaknesses but presents a significant risk of bias. For this study, only observational cohort articles had their quality assessed [7].

Synthesis Methods

The extracted data were entered into two tables, the first covering study characteristics and the second being a summary table with the main qualitative and quantitative results of each study. Quantitative data were grouped into categorical variables, and the relationship between exposure to ultra-processed foods and the development of caries was calculated using the odds ratio (OR) accompanied by 95% confidence intervals (95% CI). These data were used for meta-analysis construction. Statistical analysis was conducted using R software, version 4.3.1, for Windows 10, with the meta package, version 6.5.0 (R Core Team, 2023). In the presence of low heterogeneity ($I^2 < 10\%$ and $p > 0.05$), a fixed-effect model using the Mantel-Haenszel method, Figure 3 (Higgins; Thompson, 2002), was applied. I^2 values close to 25%, 50%, and 75% indicated low, moderate, and high heterogeneity, respectively (Figure 3).

Assessment of Certainty of Evidence

The assessment of the certainty of evidence reliability was conducted according to the GRADE (Grading of Recommendations Assessment, Development and Evaluation) methodology, where it was classified based on the criteria of risk of bias, indirect evidence, inconsistency, imprecision, and publication bias. For observational studies, the certainty of evidence starts from the basal concept of low certainty of evidence, which can be upgraded (increasing the certainty of evidence) or downgraded (reducing the certainty of evidence), depending on the tool's analysis.

Ethical Aspects

This review exclusively used secondary data available in scientific publications, and no additional data from research participants were requested from any author. Thus, there was no direct involvement of human subjects, animals, or biological material; therefore, submission to an Institutional Review Board (IRB) was not required.

Results

Study Selection

The search strategy identified 199 articles in the three databases used. During screening, 27 duplicate studies were excluded, 144 articles were excluded after reading titles and abstracts, then 29 articles were read in full, and of these, only 8 met the requirements of our PICO question and the previously established inclusion criteria. The study selection process followed the flowchart shown in Figure 1.

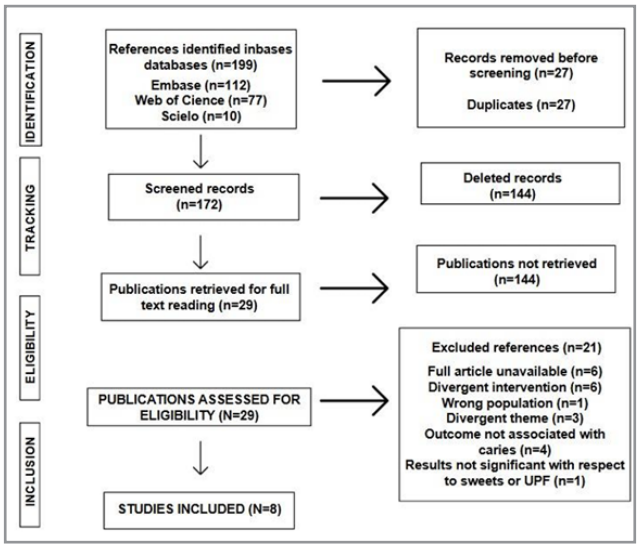

Figure 1: Study selection process (adapted from PRISMA)

Descriptive caption: Flowchart of the process of identification, screening, eligibility, and inclusion of studies, according to PRISMA guidelines, showing the number of records selected, excluded, and included at each stage.

Risk of Bias of Studies

All eight evaluated studies showed good methodological quality according to the NHLBI checklist for cross-sectional studies (Figure 2), with all articles scoring above 12 points, thus presenting a low risk of bias. Therefore, the overall bias of the arti-

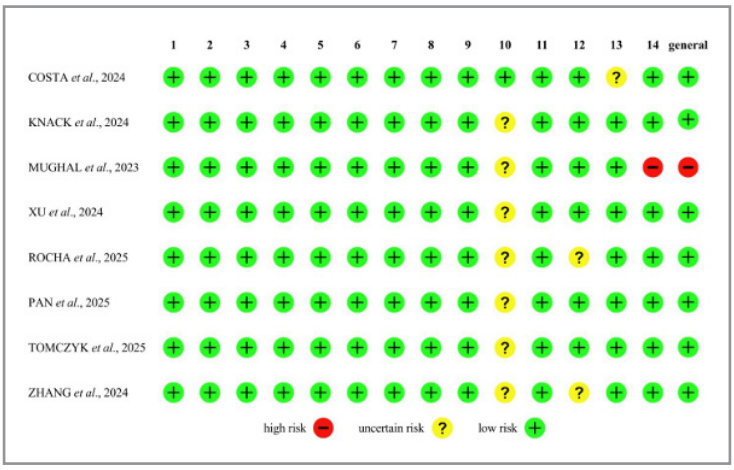

Figure 2: Risk of bias by criterion and overall, for cross-sectional studies

Descriptive caption: Flowchart of the process of identification, screening, eligibility, and inclusion of studies, according to PRISMA guidelines, showing the number of records selected, excluded, and included at each stage.

Characteristics of Studies

The studies were conducted in Brazil (n=3), China (n=3), Pakistan (n=1), and Poland (n=1). All studies performed an assessment using a questionnaire that determined consumption profile, hygiene habits, brushing frequency, and other factors related to dental caries. The authors also stated that they had at least one properly trained professional to assess the incidence of caries in the studied population. We had a total of 9,841 participants, comprising children and adolescents between 3 and 19 years old, of whom 69.50% had caries (Table 2).

Table 2: Characteristics of studies included in the review

Author/Year	Location	Online address	Study type	Population	Intervention
Costa et al., 2024	Brazil	https://doi.org/10.1038/s41598-024-75813-3	Cross-sectional study	Adolescents aged 18 to 19 years (n=2,515)	Consumption of ultra-processed foods
Knack et al., 2024	Brazil	https://doi.org/10.1590/1414-	Cross-sectional study	Children and adolescents aged 12 to 14 years (n=358)	Consumption of ultra-processed foods
Mughal et al., 2023	Paquistão	https://doi.org/10.53350/pjmhs2023174329	Cross-sectional study	Children aged 3 to 12 years (n=370)	Consumption of sweets
Xu et al., 2024	China	https://doi.org/10.1186/s12903-024-04663-2	Cross-sectional study	Preschool children aged 3 to 6 years (n=570)	Consumption of sweets and soft drinks
Rocha et al., 2025	Brazil	https://doi.org/10.1590/pboci.2025.084	Cross-sectional study	505 mothers of preschool children aged 3 to 5 years enrolled in the municipal public network	Consumption of soft drinks, artificial juices, sweets, cakes, and cookies
PAN et al., 2025	China	https://doi.org/10.3290/j.ohpd.c_2029	Cross-sectional study	Children aged 5 to 12 years (n=125)	Consumption of sweets and sugary drinks, nighttime eating

TOMCZYK et al., 2025	Polônia	https://doi.org/10.17219/dmp/184054	Cross-sectional study	5,099 Polish adolescents (2,496 aged 12 years and 2,603 aged 15–18 years) selected from public schools	Consumption of sweets, sugary drinks, chips, juices
ZHANG et al., 2024	China	https://doi.org/10.3290/j.ohpd.b5245819	Cross-sectional study	Children aged 3 to 6 years residing in rural areas of Heishanzui Township (n=329)	Consumption of sweets

Descriptive caption: Key findings from the studies included in this systematic review

Synthesis Results

Table 3: Summary of studies with meta-analysis

Author and Year	Total number of participants	Participants with caries	Measures of effect	Study outcome
Costa et al., 2024	2,515 adolescents (18-19 years old).	1,338 (53.16% of the sample).	- Effect Measure: Standardized Coefficient (SC) from Structural Equation Modeling (SEM). - Value: Direct effect of UPF consumption on the number of carious teeth: SC = 0.071 (in all three tested models). Total effect of UPF consumption on the number of carious teeth: SC = 0.067 (model 1), SC = 0.068 (models 2 and 3).	- A positive SC indicates a direct association; that is, an increase in UPF consumption is associated with an increase in the number of carious teeth. The value of 0.071/0.067 indicates the strength of this standardized relationship. P-values < 0.05 indicate statistical significance.
Knack et al., 2024.	358 students (12-14 years old).	98 (27.3% of the sample).	- Effect Measure: Adjusted Odds Ratio (OR) from binary logistic regression. - Value: For the quantity of processed and/or ultra-processed foods consumed per day: OR = 1.09 (95% CI 1.03–1.14).	- An OR of 1.09 means that for each unit increase in the quantity of processed and/or ultra-processed foods consumed per day, the chance of having caries increases by 9%. The 95% CI does not include 1.0, and the p-value (0.002) indicates statistical significance.
Mughal et al., 2023.	370 children (3-12 years old).	370 (100% of the sample).	- Effect Measure: The article indicates a "direct relationship" and tests the statistical significance (p-value) of the association between sugar intake frequency and sugar type with the DMFT index, using the Eta-square test. - Value: p = 0.00 for sugar type and intake frequency.	- Although it shows a statistically significant association, the article does not provide a quantitative effect measure like OR or SC for this relationship.
Xu et al., 2024	540 children (5-12 years old).	341 (59.8% of the children).	- Effect Measure: Adjusted Odds Ratio (OR) from logistic regression. - Value: Soft drink 4.414 (95% CI; 2.534-6.451); Sweet foods: 4.531 (95% CI: 3.421-6.354).	- An OR of 4.414 for the frequency of sugary beverage consumption indicates a 4.414 times higher probability of presenting caries. Meanwhile, an OR of 4.531 for the frequency of sweet consumption indicates a 4.531 times higher probability of presenting caries. A P-value = 0.005 indicates significance.

Rocha et al., 2025	505 mothers of children (3-5 years old).	135 (26.8% of the children).	- Effect Measure: Adjusted Odds Ratio (OR) from logistic regression. - Value: For higher frequency of cariogenic UPF consumption: OR = 1.08 (95% CI 1.03–1.14).	- Similar to Article 2, an OR of 1.08 indicates that a higher frequency of cariogenic UPF consumption is associated with an 8% increase in the chance of having caries. A P-value = 0.002 indicates significance.
Pan et al., 2025	125 children (5-12 years old).	78 (62.40% of the sample).	- Effect Measure: Odds Ratio (OR) from logistic regression. - Value: For sweet consumption (> 2x/week): OR = 3.63 (95% CI 1.34-9.84), p=0.011. For sugary beverage consumption (> 2x/week): OR = 3.86 (95% CI 1.48-10.05), p=0.006.	- These ORs indicate a significantly elevated risk of caries for frequent consumption of sweets and sugary beverages, increasing the chances by more than 3 times.
Tomczyk et al., 2025	5,099 participants (2,496 aged 12 years; 2,603 aged 15-18 years).	4,215 (83% of the total sample).	- Effect Measure: Odds Ratio (OR) from logistic regression. - Value: For daily consumption of sweets/candies: OR = 1.42 (95% CI 1.15-1.75), p<0.01. For daily consumption of sugary carbonated beverages: OR = 1.76 (95% CI 1.39-2.23), p<0.001.	- The daily consumption of these items increases the chance of caries by 42% (sweets) and 76% (sugary beverages)
Zhang et al., 2024	329 children (3-6 years old).	12-year-old group: 1,869 (75%).	- Effect Measure: Odds Ratio (OR) from multivariate logistic regression. - Value: For sweet/chocolate consumption (> 2x/day): OR = 2.45 (95% CI 1.25-4.81), p=0.009. For carbonated beverage consumption (> 2x/day): OR = 3.12 (95% CI 1.58-6.17), p=0.001.	- Frequent consumption (more than 2x/day) of sweets/chocolates and carbonated beverages substantially increases the chance of caries (2.45 and 3.12 times, respectively).

Descriptive caption: Summary of studies included in the meta-analysis, presenting authors, sample characteristics, number of participants with caries, effect measures, and main outcomes related to ultra-processed/sugary food consumption and dental caries [8-15]. The 9841 children were observed, of whom 6840 developed caries associated with the intake of ultra-processed foods. The common effect model estimated an overall proportion of 69.50% of these having caries. The risk of developing caries in the group associated with ultra-processed food intake increased by 83% (OR: 1.83 CI: 1.34-2.5). Heterogeneity tests showed moderate values (I^2 = 41.51%), which demonstrates a moderate variation among the analyzed studies.

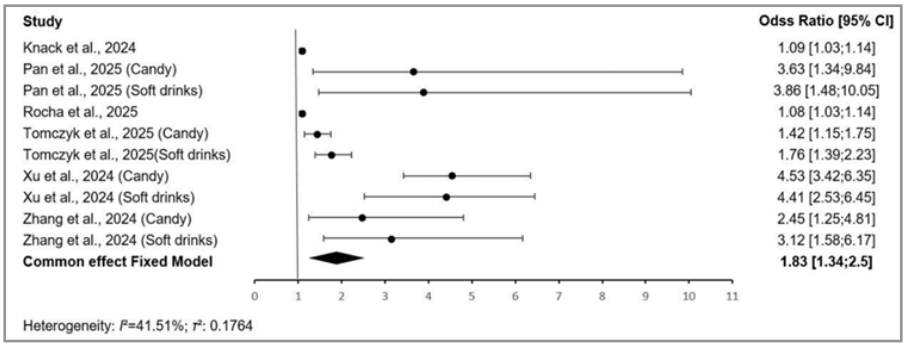

Figure 3: Forest plot of a meta-analysis of studies evaluating the consumption of ultra-processed foods and dental caries in children and adolescents

Descriptive caption: Forest plot of the meta-analysis showing odds ratios and 95% confidence intervals for the association between the consumption of sugary or ultra-processed foods/beverages and dental caries, with a pooled estimate using a fixed-effect model and a measure of heterogeneity across studies.

Certainty of Evidence

In this case, the risk of bias was considered to have low certainty of evidence, given that the five analysis outcomes showed non-severe results (risk of bias, inconsistency, indirect evidence, imprecision, and publication bias).

Certainty assessment							Number of patients		Efect		Certainty
Number of studies	Study design	Risk of bias	Inconsistency	Indirect evidence	Imprecision	Other considerations	UAP	Prevalence cárie	Relative (95% CI)	Absolute (95% CI)	
8	observational study	not severe	not severe	not severe	not severe	none	6840 / 9841	69.80%	OR 1.83 (1.34 to 2.5)	695 per 1000	⊕⊕◯◯ Low

Figure 4: Summary of results and certainty of evidence (GRADE) analysis of the Association between ultra-processed food intake and caries.

Descriptive caption: Certainty of evidence (GRADE) table for the association between ultra-processed food consumption and dental caries, presenting study characteristics, risk of bias, consistency, precision, sample size, effect measures, and overall certainty level.

Discussion

This review synthesized recent evidence on the relationship between ultra-processed food consumption and the occurrence of dental caries in child and adolescent populations from different sociocultural contexts. Eight studies published between 2023 and 2025, conducted in South America, Europe, and Asia, were included after a systematized data extraction and analysis process.

Effect measures consistently demonstrated a positive and statistically significant association between frequent UPF intake and an increased prevalence of dental caries. The weighted global Odds Ratio (1.83; 95% CI: 1.34–2.50) indicates that regular consumption of these foods increases the risk of developing dental caries by approximately 83% in children and adolescents.

This significant association reinforces the hypothesis that frequent consumption of these products—characterized by high free sugar content, additives, and low nutritional density—constitutes an important risk factor for oral diseases in this age group [16,17]. The finding that 69.5% of participants presented with caries reflects the high prevalence of both exposure and outcome, a phenomenon consistent with the dietary transition documented in various countries, including Brazil.

Recent studies indicate that higher consumption of ultra-processed foods is consistently associated with a higher prevalence of caries in pediatric populations [18]. The main mechanism involved in this association is the high content of fermentable sugars present in ultra-processed foods, which are metabolized by cariogenic microorganisms, such as Streptococcus mutans, resulting in the production of acids that demineralize tooth enamel [19].

This process is widely recognized by the World Health Organization, which recommends limiting free sugar intake to less than 10% of total caloric intake, with additional benefits observed when consumption is reduced to below 5% [20]. In addition to the direct chemical effect on tooth enamel, frequent consumption of ultra-processed foods also contributes to caries development by replacing protective foods, such as fruits, vegetables, and dairy products, which stimulate salivation and provide essential minerals for remineralization [21].

Furthermore, the frequency of sugary product intake, rather than the total amount, has been shown to be a determining factor in the progression of carious lesions. Recent literature reinforces these findings, in a meta-analysis covering more than 12,000 participants, observed that children and adolescents with higher ultra-processed food consumption had a 70% higher risk of developing dental caries compared to those with reduced consumption. Similarly, demonstrated that increased consumption of soft drinks, cookies, and sugary cereals was associated with higher indices of decayed, missing, and filled (or restored) teeth in Brazilian adolescents.

From a public health perspective, these results highlight the need for intersectoral strategies that integrate the promotion of healthy eating and oral health. Reducing the consumption of ultra-processed foods and sugary drinks-combined with regulatory policies such as restricting advertising aimed at children and front-of-package warning labels—can significantly contribute to reducing the incidence of caries in young populations.

Nevertheless, it is important to acknowledge the methodological limitations of the studies included in this review, especially concerning dietary assessment (often self-reported) and caries diagnostic methods, which varied among studies and were not considered as effect measures. Despite this, the consistency of the results, biological plausibility, and magnitude of the observed effect confer robustness to the association between ultra-processed food consumption and dental caries.

In summary, this review confirms that ultra-processed food consumption is strongly associated with an increased risk of dental caries in children and adolescents. Such findings reinforce the importance of public food and nutrition policies aligned with the recommendations of the Dietary Guidelines for the Brazilian Population and the World Health Organization.

Future longitudinal research and intervention trials are necessary to elucidate the causal relationship and evaluate the impact of sugar reduction policies on children's oral health [22].

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