

Timing of First Sugar Exposure and Dental Caries Experience at 48 Months of Age: A Longitudinal Analysis Nested Within a Birth Cohort

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Abstract

Purpose

to investigate the age of sugar introduction, types of sugary products introduced during first year of life, and whether early sugar exposure was associated with ECC at 48 months of age.

Methods

variables included child's diet during first year, oral hygiene habits, maternal age at childbirth, household's education level. Caries experience was determined by Caries Assessment Spectrum and Treatment (CAST) instrument. Four regression models were defined, Poisson regression with a log link was used.

Results

all 183 children included were exposed to sugar within the first year of life, most between 8 and 12 months of age; 95.1% of parents reported performing oral hygiene in their children at 12 months. At 48 months, 48.1% of the children had caries experience. No statistically significant associations were identified between early sugar exposure and dental caries outcomes: sugar introduction (Model A: PR = 1.01; CI: 0.95–1.08; Model C: PR = 1.00; CI: 0.92–1.08); children who did not consume added sugar vs ≥ 2 /day (Model B: PR = 0.89; CI: 0.57–1.38) or consumed sugar once per day vs ≥ 2 /day (Model B: PR = 0.94; CI: 0.59–1.50); those who did not consume added sugar vs ≥ 2 /day (Model D: PR = 0.64; CI: 0.37–1.12) and consuming sugar once per day vs ≥ 2 /day (Model D: PR = 0.77; CI: 0.43–1.38).

Conclusion

a high prevalence of sugar consumption and dental caries was observed. Introduction of sugar during first year of life was not associated with caries experience at 48 months of age.

INTRODUCTION

Non-communicable diseases (NCDs) result from a combination of genetic, physiological, environmental, and behavioural factors.(World Health Organization 2025) According to the World Health Organization (WHO), at least 43 million people worldwide death was associated to NCDs in 2021.(World Health Organization 2025) Although dental caries is not associated with mortality, it is considered one of the most prevalent NCDs. It results from dysbiosis within the oral biofilm, caused by a complex interaction between bacteria and fermentable carbohydrates. This process is influenced among others by salivary flow, fluoride exposure, the frequency of sugar consumption, and oral hygiene habits.(Schwendicke et al. 2019) The concept of dental caries as NCDs stems from its lack of transmissibility, as well as its long

duration and slow progression. It is related to modifiable behavioural factors, as other diseases in the same category.(Ardenghi et al. 2022) When it affects children under 71 months, it is named “Early Childhood Caries” (ECC), and it can negatively impact the oral health-related quality of life of children and their families, particularly regarding oral and psychological symptoms. (Zaror et al. 2022)

Evidence consistently shows that early exposure to free sugars substantially increases the risk of developing ECC, more than doubling the likelihood of the disease occurrence,(Boustedt et al. 2022) and it may be influenced by sociodemographic and behavioural factors, such as lower maternal education, a younger maternal age, caregivers consuming sugar frequently, and a shorter duration of breastfeeding. (Feldens et al. 2025b) There is a key distinction between free and added sugars based on their source. Free sugars include all monosaccharides and disaccharides added to foods by manufacturers or consumers, plus those naturally present in honey, syrups, and fruit juices.(Boustedt et al. 2022; Feldens et al. 2022) Added sugars, however, are a narrower category. They refer only to the sugars integrated during processing or preparation, excluding the natural sugars found in juices or honey.(Feldens et al. 2022) Essentially, while all added sugars are classified as free sugars, the reverse is not always true.

During infancy, formation of feeding habits is a complex process, deeply shaped by caregivers' beliefs and attitudes, as well as by the emotional and cultural connections individuals form with food.(Haines et al. 2019) WHO, already for many years, advises against giving foods or drinks containing added sugars to children under two years of age. Furthermore, sugar intake should still be limited for individuals over two years of age.(World Health Organization 2018) Research on the role of sugar in dental caries continues to grow. Emerging perspectives emphasise the central role of dietary sugars in the development of dental caries, as they are essential substrates for acid production within the biofilm. (Dame-Teixeira et al. 2026) Rather than acting as an isolated factor, sugars function as key ecological drivers that shape microbial composition and activity. It has been suggested that this central role should be more explicitly incorporated into clinical protocols, including dietary assessment and patient counselling.(Dame-Teixeira et al. 2026)

Considering that delaying sugar intake is expected to contribute to ECC prevention, (Feldens et al. 2025a) it is worth investigating the impact of early introduction of sugar and its frequent consumption over the years in relation to ECC onset. Understanding what children eat when and how different foods are introduced is not only a starting point for preventing dental caries, but also for comprehending its recurrence in children who have previously undergone treatment. Therefore, this study aimed to investigate whether the exposure of sugar during the first year of life, and types of sugary products introduced were associated with early childhood caries at 48 months of age. This investigation was conducted within a hierarchical conceptual framework of socioeconomic and behavioural determinants.

METHODS

Study design and ethical considerations

A longitudinal study was conducted with newborns at the University Hospital of Brasília (HUB) to assess the timing of first sugar exposure in infancy and dental caries at 48 months of age. The study design adheres to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE). (Vandenbroucke et al. 2014)

This study was approved by the Research Ethics Committee (REC) for Human Subjects at the Faculty of Health Sciences, University of Brasília (CAAE XXXXXXX) and the informed consent form was signed by the parents.

Target population

This study included all infants born between August 2017 and July 2018 at the maternity ward of the HUB whose parents consented to participate. Newborns admitted to the Intensive Care Unit (ICU) were excluded. Parents were invited to return with their infants for follow-up appointments at 6 months, and annually at 12, 24, 36, and 48 months.

A total of 969 mothers were initially invited to participate in the maternity cohort study. Of these, 435 children were included in the 12-month follow-up, and 277 children were included in the 48-month follow-up. A total of 208 children attended both the 12-month and 48-month follow-up assessments. Of these children, 25 were excluded due to a lack of data regarding the timing of sugar introduction, leaving 183 included in the study (Fig. 1). The present analysis included all children with complete data; therefore, sample size calculation was not performed. Effect estimates are presented as prevalence ratios with corresponding confidence intervals to allow assessment of the direction and precision of the observed associations.

Figure 1 - Flowchart representing the sample selection process.

Data Collection and variables

Data were collected through structured questionnaires administered to parents during 12-month and 48-month follow-ups. The questionnaire was developed for the cohort study, and it had not undergone formal validation. Maternal age at childbirth and child sex were recorded as general characteristics. At the 12-month follow-up, data on household head education, dietary habits, and oral hygiene practices were collected.

Household head education was determined as follow: not attending school, unable to read or write; not attending school, but able to read and write; incomplete primary education; complete primary education; incomplete secondary education; complete secondary education; incomplete higher education; complete higher education; postgraduate studies. These data were converted into years of schooling and dichotomised as < 11 years or ≥ 11 years of study (corresponding to incomplete and complete secondary education, respectively).

Dietary variables included the age in which the child was first exposed to sugar (in months), as reported by the parents, and the frequency of added sugar consumption. Caregivers were asked whether they added sugar during food preparation for the child (yes/no). If affirmative, they were further asked to report the frequency of use (how many times a day), which was subsequently categorised as once per day or two or more times per day. The consumption of specific sugary products (processed foods, sweetened yoghurt, Maizena® biscuits, filled biscuits, boxed juice) was assessed as yes/no variables.

Oral hygiene practices were assessed based on parental reports. Caregivers were first asked whether oral hygiene was performed for the child (yes/no). In addition, which method was used to clean the child's mouth, with response options: toothbrush with fluoridated toothpaste, toothbrush with non-fluoridated toothpaste, gauze, cloth, toothbrush only, silicone toothbrush, or other methods. For the purposes of this study, these responses were categorised as use of toothbrush with fluoridated toothpaste and do not use toothbrush and fluoridated toothpaste. These variables were analysed separately as performance of oral hygiene and use of a toothbrush with fluoridated toothpaste.

At 48-month follow-up, children were examined in a dental chair under appropriate artificial light using a dental mirror, a WHO millimetre probe, and a triple syringe. Dental Caries was assessed using the Caries Assessment Spectrum and Treatment (CAST) instrument.(Frencken et al. 2013) The highest CAST code was used to register the tooth condition. This instrument also allows the classification of the tooth according to the following disease stages: pre-morbidity (code 3), morbidity (codes 4 and 5), severe morbidity (codes 6 and 7), and mortality (code 8).(Ribeiro et al. 2018) ECC at 48 months of age was defined considering the child's caries experience, considering all non-cavitated and cavitated lesions. Additionally, data were categorised according to the severity and morbidity stages based on the CAST instrument.

Training and calibration

Prior to data collection, six examiners with experience in paediatric care underwent training that included both theoretical and practical components. The training covered the administration of questionnaires to parents and the performance of clinical examinations in children of similar age to those included in the study, aiming to standardise the application of the instruments used in the main investigation. A total of 42 teeth were evaluated and scored independently by each examiner, and Kappa coefficients of intra- and inter-examiner agreement exhibited substantial agreement (0.79 and 0.76, respectively). (Landis JR and Koch GG 1977)

Statistical analysis

Data were tabulated in Microsoft Excel and analysed using SPSS version 21.0 (Chicago, IL, USA). Descriptive analyses characterised the sample at 12 and 48 months of age. Categorical variables were expressed as absolute and relative frequencies, and continuous variables as means, standard deviations,

and ranges. The distribution of sugary food consumption was described according to age at first sugar exposure.

Analyses followed a hierarchical conceptual framework including distal socioeconomic factors, child characteristics, early dietary exposure, and oral health behaviours. Distal variables included household head education and maternal age at birth; child sex was included at the next level. Main exposures were age in which sugar was introduced and frequency of added sugar at 12 months. Proximal variables included oral hygiene practices in the first year of life and use of toothbrushes with fluoridated toothpaste.

Four regression models were defined a priori: Models A and B evaluated associations between sugar exposure variables and caries presence at 48 months of age, while Models C and D assessed associations with the number of carious teeth at 48 months (considering all non-cavitated and cavitated lesions in primary teeth), respectively. Poisson regression with log link and robust variance was used to estimate prevalence ratios (PR) and 95% confidence intervals (CI) for binary outcomes. Due to overdispersion in count data (mean = 2.9; SD = 4.0), negative binomial regression was used for count outcomes.

Model building followed a sequential hierarchical approach. The unadjusted model initially included only the main exposure and outcome variables. Subsequent models progressively incorporated distal socioeconomic variables (education level of the head of the family and maternal age), followed by child sex, dietary exposure variables (age of sugar introduction and frequency of sugar addition), oral hygiene practices at 12 months of age (including use of a toothbrush and fluoridated toothpaste), and finally dental caries outcomes at 48 months of age (presence/absence of caries and number of carious teeth). Effect estimates and confidence intervals are presented in the Supplementary Material.

RESULTS

A total of 183 children were included in the study. Most household heads had 11 or more years of schooling (67.8%), and most mothers were aged 31 years or older at childbirth (47.5%, mean 29.9 SD = 6.5). The sample showed balanced sex distribution (52.5% male) (Table 1).

All children were exposed to free sugar within the first year of life, mainly between 8 and 12 months of age (mean 8.2 SD = 2.3). However, when parents were asked about offering added sugar to their infants during this same period, 54.1% reported not having done it. (Table 1). Oral hygiene during the first year was performed in 95.1% of the children, and 47.5% of the parents mentioned using toothbrush with fluoridated toothpaste to do so (Table 1).

At 48 months of age, the prevalence of dental caries was 48.1%, including both non-cavitated and cavitated lesions. Among the affected children, 15.8% were in pre-morbidity stage and 31.1% had reached morbidity stage. Mean number of carious teeth was 2.9 (SD = 4.0), with values ranging from 1 to 18 (Table 1).

Table 1
Characteristics of the sample (n = 183).

Variable	n	%
Maternal age at birth (years)		
≤ 20	13	7.1
21 to 30	83	45.4
≥ 31	87	47.5
Child Sex		
Sex male	96	52.5
Sex female	87	47.5
12 months		
Household head education		
Household head education ≥ 11 years	124	67.8
Household head education < 11 years	59	32.2
Sugar introduction (months)		
0 to 3	1	0.5
4 to 7	73	39.9
8 to 12	109	69.6
≥ 13	0	0
Added Sugar		
Do not use added sugar	99	54.1
Added sugar used once a day	61	33.3
Added sugar used ≥ 2 a day	23	12.6
Oral hygiene (12 month follow up)		
Yes	174	95.1
No	9	4.9
Use of toothbrush + fluoridated toothpaste	87	47.5
Do not use toothbrush + fluoridated toothpaste	96	52.5
48 months		

Variable	n	%
Maternal age at birth (years)		
Presence of dental caries		
No	95	51.9
Yes	88	48.1
Severity		
Sound	93	50.8
Sealed/filled	2	1.1
Dental caries in enamel	29	15.8
Dental caries in dentine	59	32.2
Morbidity		
Healthy	95	51.9
Pre-morbidity	29	15.8
Morbidity	57	31.1
Severe Morbidity	1	0.5
Mortality	1	0.5

Table 2 shows the distribution of sugary foods consumed among children. Consumption of sugary foods was frequent in the cohort. The most reported items were Maizena®-type biscuits (78.7%), processed foods (67.8%), and sweetened yoghurt (52.5%). Table 3 shows number of sugary items consumed according to age. Across all four regression models, no statistically significant associations were identified between early sugar exposure variables and dental caries outcomes at 48 months of age (Table 4).

Table 2
Consumption of selected sugary foods among children (n = 183).

Food item	Category	n	%
Processed foods	No	59	32.2
	Yes	124	67.8
Sweetened yogurt	No	86	47.0
	Yes	96	52.5
	No response / Don't know	1	0.5
Maizena® biscuit	No	37	20.2
	Yes	144	78.7
	No response / Don't know	2	1.1
Filled biscuit	No	146	79.8
	Yes	35	19.1
	No response / Don't know	2	1.1
Boxed juice	No	147	80.3
	Yes	33	18.0
	No response / Don't know	3	1.6

Table 3
Number of sugary items consumed according to age at first sugar exposure (n = 180).

Age at first sugar exposure	0 items	1 item	2 items	3 items	4 items	5 items
0–3 months	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (100.0%)	0 (0.0%)	0 (0.0%)
4–7 months	4 (5.6%)	9 (12.5%)	18 (25.0%)	25 (34.7%)	10 (13.9%)	6 (8.3%)
8–12 months	18 (16.8%)	11 (10.3%)	38 (35.5%)	24 (22.4%)	6 (5.6%)	10 (9.3%)

Table 4
Regression models result (n = 183).

Main exposure	Model	Result	Interpretation
Sugar introduction	A	PR 1.01 (0.95–1.08)	No evidence of association
Do not add sugar vs ≥ 2 /day	B	PR 0.89 (0.57–1.38)	
Add sugar once/day vs ≥ 2 /day	B	PR 0.94 (0.59–1.50)	
Sugar introduction	C	PR 1.00 (0.92–1.08)	
Do not add sugar vs ≥ 2 /day	D	PR 0.64 (0.37–1.12)	
Add sugar once/day vs ≥ 2 /day	D	PR 0.77 (0.43–1.38)	

DISCUSSION

This study evaluated the age at which sugar was first introduced, the types of sugary products introduced during the first year of life, and their association with caries experience at 48 months of age. Initially, it might be surprising that no statistically significant associations were observed, but these findings not only provide important insights into dietary patterns in childhood, as they highlight the complexity of factors that influence the development of ECC.

An important finding was that all 183 children were exposed to sugar during the first year of life, mainly between 8 and 12 months, despite 54.1% of parents reporting no addition of sugar during food preparation up to 12 months. This data clearly shows that the absence of added sugar during food preparation does not necessarily mean that the child will not be exposed to significant amounts of sugar through processed foods, highlighting gaps in parental knowledge about sugar content in commonly consumed products. A study conducted in Portugal found that most adults struggle to identify sources of sugar and were unfamiliar with WHO consumption guidelines. (Prada et al. 2020) Similarly, research on children's consumption of sugary drinks showed that half of the parents believed that 100% fruit juice meant that the product contained no sugar at all. (Musial et al. 2021) These findings suggest that the high prevalence of sugar consumption observed in the present study may not necessarily reflect intentional practices, but rather limited awareness of sugar content and the widespread presence of added sugars in processed foods.

This study revealed a high prevalence of ECC (48.1%), with 32.1% of affected children presenting lesions in stages of morbidity, severe morbidity or mortality, indicating progression to dentine or pulp involvement. Although no statistically significant associations were identified between early sugar exposure and caries experience, previous studies have reported mixed findings regarding this relationship. Dietary practices such as the consumption of biscuits, cookies and fast food doubled the risk of dental caries (Boustedt et al. 2022), while early sugar introduction has been linked to higher caries experience, with children exposed before 12 months of age presenting up to 48% more caries than those introduced after 24 months of age.(Echeverria et al. 2023) In contrast, Manohar et al. found no

statistically significant or clinically relevant association between trajectories of sugary food intake and dental caries in preschool children after adjustment.(Manohar et al. 2021) Some investigations have proposed that ECC may be influenced by the early introduction of sugar and frequent consumption over time, suggesting that delaying sugar intake could contribute to its prevention. However, modifying these behaviours does not necessarily result in a reduction in ECC. (Feldens et al. 2025a)

In this context, nutrition should be understood not only in terms of nutrient content, but also in relation to the degree of food processing and its potential impact on health. (Petridi et al. 2026) A systematic review demonstrated that children's dietary quality and patterns are significantly associated with dental caries. (Zheng et al. 2025) Diets characterised by low intake of fruits and vegetables have been consistently related to early childhood caries (Sandy et al. 2024), while lower consumption of processed sugars has been associated with reduced caries incidence. (Dipalma et al. 2026) Moreover, these early-life dietary patterns may have long-term implications, as associations between sugar consumption in infancy and dental caries in permanent teeth have also been reported. (Feldens et al. 2021) In the present study, the high prevalence of sugar consumption, combined with limited variability in early dietary exposure, may have reduced contrast between exposure groups, limiting the ability to detect statistically significant associations. In addition, the wide variation in the number of carious teeth indicates substantial heterogeneity, with some children bearing a disproportionately high disease burden.

Interestingly, a high level of oral hygiene performance was observed at 12 months of age, even considering that there was a variability in the use of fluoridated toothpaste. Only 47% of participants followed the recommended oral hygiene practices for infants, which are brushing twice daily with an optimal amount fluoridated toothpaste.(American Academy of Pediatric Dentistry 2021; FDI World Dental Federation 2024) Anyway, the high prevalence of early oral hygiene practices may have reduced the impact of sugar exposure on caries development. Maternal age and household head education may be related to early sugar consumption, oral hygiene habits and the presence of caries. Previous studies have shown that low maternal education and a lower perception of oral health are associated with the presence of carious lesions in children (Foxman et al. 2023; Kerguen et al. 2025), and limited knowledge about nutrition and oral health is associated with the consumption of sugary drinks and processed foods.(Dipalma et al. 2026) The sample consisted of infants with household heads who had 11 or more years of schooling, in addition, most of the mothers were 31 or older (mean age 29.9) when their children were born. However, it is worth noting that the present study found a similar percentage among mothers aged 21 to 30, indicating a homogeneous distribution and limiting comparisons between groups.

This study has some limitations. Dietary exposure was assessed at a single time point (12 months of age), which may not reflect cumulative sugar consumption throughout early childhood. In addition, parental reports of sugar intake and oral health behaviours may have introduced bias and misclassification, particularly due to hidden sugars in processed foods. The homogeneous distribution of sugar consumption and oral hygiene practices may have reduced variability across groups, limiting the ability to detect associations. Furthermore, the sample size may have been insufficient to detect

modest effects, increasing type II error. Follow-up interruptions during the COVID-19 pandemic also contributed to participant attrition and may have affected sample representativeness.

From a public health perspective, an umbrella review found that increasing taxes on sugary products would reduce their consumption in high-income and low- and middle-income countries. Although this isolated intervention could have a positive impact, it should be combined with other strategies. (Hajishafiee et al. 2023) The findings of this study support the need for preventive approaches that extend beyond the timing of sugar introduction and address overall dietary patterns in early childhood. Although recommendations such as reducing sugar intake and promoting the use of fluoridated toothpaste are widely disseminated, they may not be sufficient on their own to prevent new carious lesions. (Oliveira et al. 2025) In practice, guidance is not always aligned with the realities experienced by children and their families, both at home and in school environments. Moreover, the surrounding food environment plays a critical role, as access to and availability of healthier options can facilitate the adoption of healthier behaviours. (Oliveira et al. 2025)

Encouraging good oral hygiene habits from childhood and providing guidance on using fluoride toothpaste and dental floss properly can reduce the impact of dietary risk factors on dental caries development. Given that early sugar exposure may influence long-term eating behaviours, educational strategies targeting parents and caregivers should begin early and consider contextual factors, including food processing, added sugars, and nutritional literacy. Future studies should prioritise longitudinal assessments and larger samples to better capture the cumulative impact of sugar consumption on dental caries.

CONCLUSION

A high prevalence of both sugar consumption during the first year of life and caries experience at 48 months of age was observed. Neither the age at which sugar was first introduced nor the reported frequency of sugar consumption up to the age of 12 months were associated with caries experience or caries severity at 48 months of age. These findings reinforce the multifactorial nature of early childhood caries and suggest that preventive strategies should address broader behavioural and contextual determinants beyond early sugar exposure alone.

Declarations

Author Contribution

All authors contributed to the study conception and design. E.M.T., C.M., S.C.L. and V.P.P.C. worked on study conceptualization and design, coordinated and supervised data collection, critically reviewed the manuscript for important intellectual content, and approved the final manuscript as submitted. C.M. and P.A.A.K. performed all statistical analyses, drafted the manuscript. I.Q.D.Q., W.N.S.A, T.N.N.P. and I.M.V.: collected data, critically reviewed the manuscript for important intellectual content, and approved the

final manuscript as submitted. All authors gave their final approval and agreed to be accountable for all aspects of the work.

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Data Availability

The data that support the findings of this study are openly available in the Open Science Framework (OSF) at <https://osf.io/as68x/>, including raw data and supporting materials. Additional data are provided in the supplementary material of this article. All data have been de-identified to ensure participant confidentiality.

References

1. American Academy of Pediatric Dentistry. Perinatal and infant oral health care. The Reference Manual of Pediatric Dentistry Chicago, Ill.: American Academy of Pediatric Dentistry; 2021;262–6.
2. Ardenghi TM, Simon-Soro A, Cagetti MG. Understanding dental caries as a non-communicable and behavioral disease: Management implications. 2022; 24(3):764479; doi: 10.3389/froh.2022.764479.
3. Boustedt K, Roswall J, Twetman S. Free sugars and early childhood caries development: a prospective cohort study. European Archives of Paediatric Dentistry. Springer Science and Business Media Deutschland GmbH; 2022 Oct 1;23(5):829–33; <https://doi.org/10.1007/s40368-022-00745-3>
4. Dame-Teixeira N, Melo JLMA de, Parolo CCF. Caries Microbiome: time to move from blame to balance. Caries Res. S. Karger AG; 2026;1–23; <https://doi.org/10.1159/000550472>
5. Dipalma G, Inchingolo AM, Fiore A, Chieppa S, Carone C, Tartaglia FC, et al. Role of nutrition in prevention of dental caries in children and adolescents: a systematic review. BMC Oral Health [Internet]. 2026 26, 495. <https://doi.org/10.1186/s12903-026-07839-0>
6. Echeverria MS, Schuch HS, Cenci MS, Motta JVDS, Bertoldi AD, Britto Correa M, et al. Early Sugar Introduction Associated with Early Childhood Caries Occurrence. Caries Res. S. Karger AG; 2023 Jul 1;57(2):152–8; <https://doi.org/10.1159/000529210>
7. FDI World Dental Federation. Perinatal and Infant Oral Health Care. Int. Dent. J. Elsevier Inc.; 2024 Feb 1;74(1):167–8; <https://doi.org/10.1016/j.identj.2023.10.009>
8. Feldens CA, de Barros Coelho EMR, Vítolo MR, Rodrigues PH, Kramer PF, Peres KG. Effectiveness of a Sugar Consumption Prevention Program in the First Year of Life on the Occurrence of Early

- Childhood Caries: A Multicentric Randomized Trial in Brazil. *Caries Res.* S. Karger AG; 2025a Jul 1;59(3):174–84; <https://doi.org/10.1159/000541028>
9. Feldens CA, Cury JA, Kramer PF, de Barros Coelho EMR, Vítolo MR, Peres KG. Understanding the Risk Factors for Early Life Sugar Consumption: A Scoping Review. *Caries Res.* S. Karger AG; 2025b Aug 1;1–14; <https://doi.org/10.1159/000547729>
 10. Feldens CA, Pinheiro LL, Cury JA, Mendonça F, Groisman M, Costa RAH, et al. Added Sugar and Oral Health: A Position Paper of the Brazilian Academy of Dentistry. *Frontiers in Oral Health.* 2022;3(April):1–7; <https://doi.org/10.3389/froh.2022.869112>
 11. Feldens CA, Dos Santos IF, Kramer PF, Vítolo MR, Braga VS, Chaffee BW. Early-Life Patterns of Sugar Consumption and Dental Caries in the Permanent Teeth: A Birth Cohort Study. *Caries Res.* S. Karger AG; 2021 Nov 1;55(5):505–14; <https://doi.org/10.1159/000518890>
 12. Foxman B, Davis E, Neiswanger K, McNeil D, Shaffer J, Marazita ML. Maternal factors and risk of early childhood caries: A prospective cohort study. *Community Dent. Oral Epidemiol.* John Wiley and Sons Inc; 2023 Oct 1;51(5):953–65; <https://doi.org/10.1111/cdoe.12794>
 13. Frencken JE, de Souza AL, van der Sanden WJM, Bronkhorst EM, Leal SC. The Caries Assessment and Treatment (CAST) instrument. *Community Dent. Oral Epidemiol.* Denmark; 2013 Feb;41(1):e71–7; <https://doi.org/10.1111/cdoe.12027>
 14. Haines J, Haycraft E, Lytle L, Nicklaus S, Kok FJ, Merdji M, et al. Nurturing Children’s Healthy Eating: Position statement. *Appetite.* Academic Press; 2019. p. 124–33; <https://doi.org/10.1016/j.appet.2019.02.007>
 15. Hajishafiee M, Kapellias K, Listl S, Pattamatta M, Gekas A, Moynihan P. Effect of sugar-sweetened beverage taxation on sugars intake and dental caries: an umbrella review of a global perspective. *BMC Public Health.* BioMed Central Ltd; 2023 Dec 1;23(1); <https://doi.org/10.1186/s12889-023-15884-5>
 16. Kerguen J, Nabet C, Azogui-Lévy S, Bonnet AL, Vital S, Pierrat V, et al. Introduction of fruit juice and sugar-sweetened beverages before 6 months of age and early childhood caries at 3.5 years: the ELFE cohort study. *Eur. J. Pediatr.* Springer Science and Business Media Deutschland GmbH; 2025 Apr 1;184(4); <https://doi.org/10.1007/s00431-025-06093-w>
 17. Landis JR, Koch GG. The measurement of observer agreement for categorical data. *Biometrics.* 1977;33(1):159–74.
 18. Manohar N, Hayen A, Scott JA, Do LG, Bhole S, Arora A. Impact of dietary trajectories on obesity and dental caries in preschool children: Findings from the healthy smiles healthy kids study. *Nutrients.* MDPI AG; 2021 Jul 1;13(7); <https://doi.org/10.3390/nu13072240>
 19. Musial S, Abioye A, Murillo AL, Eskander J, Sykes O, Rodriguez L, et al. Introducing Juice and Sugar-Sweetened Beverages in Early Infancy: Parental Knowledge and Intended Behaviors. *Clin. Pediatr. (Phila).* SAGE Publications Inc.; 2021 Feb 1;60(2):109–18; <https://doi.org/10.1177/0009922820961080>

20. Oliveira LB, de Freitas Mattos F, Paiva SM, Bönecker M. Why do my patients still have early childhood caries? a critical appraisal. *Braz. Oral Res. Sociedade Brasileira de Hematologia e Hemoterapia*; 2025; <https://doi.org/10.1590/1807-3107bor-2025.vol39.065>
21. Petridi E, Magriplis E, Kotopoulou S, Myrintzou N, Charidemou E, Philippou E, et al. Associations Between Consumption of Ultra-Processed Foods and Diet Quality Among Children and Adolescents. *Nutrients*. MDPI AG; 2026 Jan 14;18(2):272; <https://doi.org/10.3390/nu18020272>
22. Prada M, Saraiva M, Garrido M V., Rodrigues DL, Lopes D. Knowledge about sugar sources and sugar intake guidelines in Portuguese consumers. *Nutrients*. MDPI AG; 2020 Dec 1;12(12):1–17; <https://doi.org/10.3390/nu12123888>
23. Ribeiro APD, Maciel IP, de Souza Hilgert AL, Bronkhorst EM, Frencken JE, Leal SC. Caries assessment spectrum treatment: the severity score. *Int. Dent. J.* Wiley-Blackwell Publishing Ltd; 2018 Apr 1;68(2):84–90; <https://doi.org/10.1111/idj.12331>
24. Sandy LPA, Helmyati S, Amalia R. Nutritional factors associated with early childhood caries: A systematic review and meta-analysis. *Saudi Dental Journal*. Elsevier B.V.; 2024. p. 413–9; <https://doi.org/10.1016/j.sdentj.2023.12.001>
25. Schwendicke F, Splieth C, Breschi L, Banerjee A, Fontana M, Paris S, et al. When to intervene in the caries process? An expert Delphi consensus statement. *Clin. Oral Investig.* Germany; 2019 Oct;23(10):3691–703; <https://doi.org/10.1007/s00784-019-03058-w>
26. Vandembroucke JP, von Elm E, Altman DG, Gøtzsche PC, Mulrow CD, Pocock SJ, et al. Strengthening the Reporting of Observational Studies in Epidemiology (STROBE): Explanation and elaboration. *International Journal of Surgery*. Elsevier Ltd; 2014 Dec 1;12(12):1500–24; <https://doi.org/10.1016/j.ijsu.2014.07.014>
27. World Health Organization. Guideline: Sugars intake for adults and children. World Health Organization. 2018;57(6):1716–22.
28. World Health Organization. Non-communicable chronic diseases. <https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases>. 2025.
29. Zaror C, Matamala-Santander A, Ferrer M, Rivera-Mendoza F, Espinoza-Espinoza G, Martínez-Zapata MJ. Impact of early childhood caries on oral health-related quality of life: A systematic review and meta-analysis. *Int. J. Dent. Hyg.* 2022; 20(1):120-135; <https://doi.org/10.1111/idh.12494>
30. Zheng M, Park SY, Bolton KA, Foong-Fong Chong M, Grafenauer S, Xi B. Dietary Intake Trajectories from Early Life and Associated Health Outcomes: A Systematic Review. *Advances in Nutrition*. Elsevier B.V.; 2025; 16(11). <https://doi.org/10.1016/j.advnut.2025.100528>

Figures

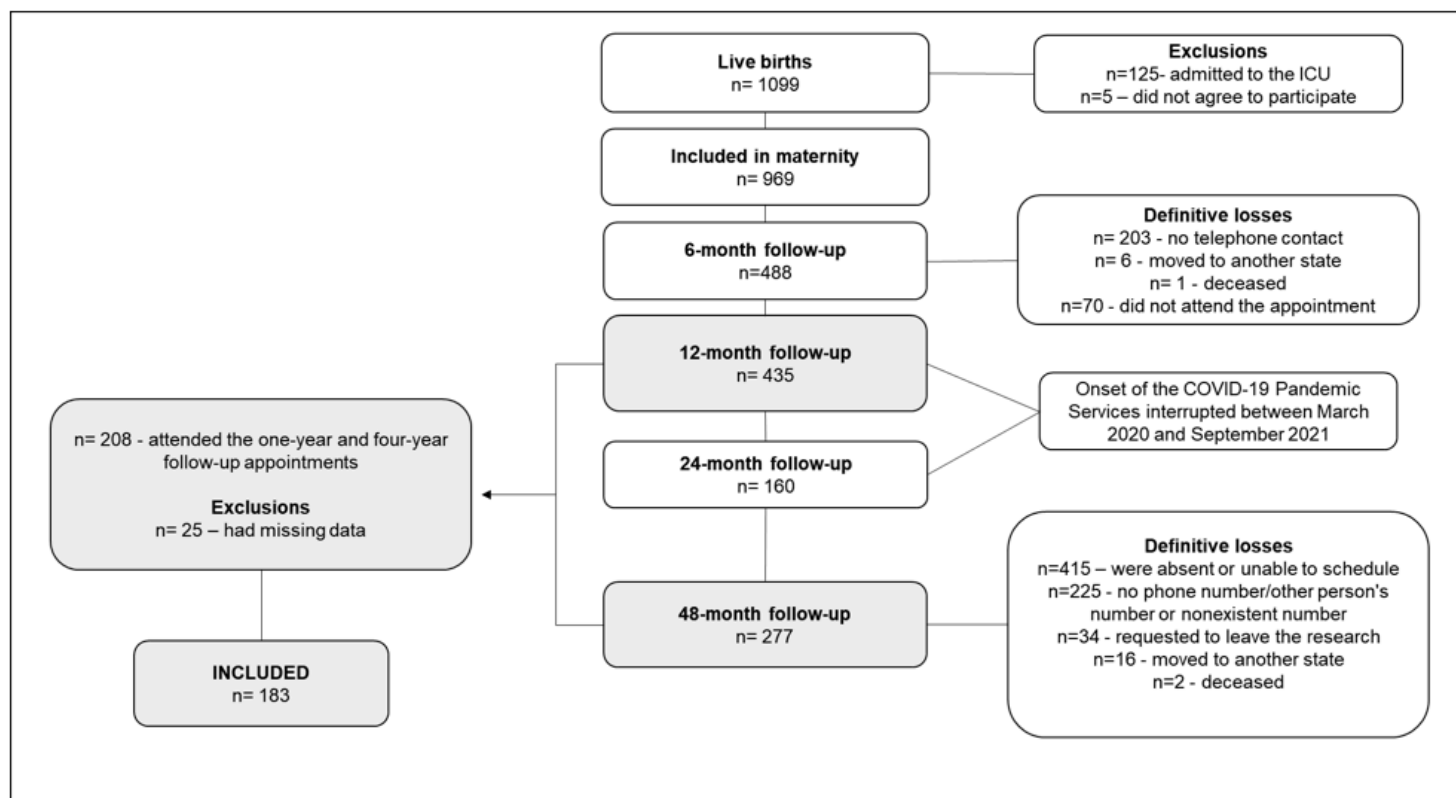


Figure 1

Flowchart representing the sample selection process.

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