

Dental Caries and Associated Factors in Indigenous Children from Bahia, Brazil

Patrícia Santos Lima¹, Evily Aragão de Souza¹, Gabriel Santos Fernandes¹,
Amanda Araújo de Carvalho², Maria Cristina Teixeira Cangussu³ and Tatiana Frederico de Almeida^{3*}

¹Undergraduate Students, School of Dentistry, Federal University of Bahia (FOUFBA), Salvador, Bahia, Brazil.

ORCID: 0000-0003-4239-6464

²Doctoral Student in Dentistry, School of Dentistry, Federal University of Bahia (FOUFBA), Salvador, Bahia, Brazil.

ORCID: 0000-0001-9295-9486

³Professor, School of Dentistry, Federal University of Bahia (FOUFBA), Salvador, Bahia, Brazil.

ORCID: 0000-0002-6118-6668

*Correspondence:

Tatiana Frederico de Almeida, Professor, School of Dentistry, Federal University of Bahia (UFBA), Salvador, Bahia, Brazil.

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ABSTRACT

Introduction: Oral health is essential to well-being and quality of life during childhood. However, among Indigenous children, childhood is characterized by limited coverage of dental services and the lack of continuous preventive programs.

Objective: To analyze the prevalence and severity of dental caries and associated factors among Indigenous children aged three to ten years living in villages served by the Indigenous Health Special District of Bahia (DSEI-BA), Brazil, through a population-based epidemiological survey encompassing the nine health hubs of the DSEI-BA. Materials and

Methods: This cross-sectional epidemiological study was conducted in 2025 among Indigenous peoples receiving healthcare services from the DSEI-BA. Data collection was carried out by dentists, oral health assistants, and undergraduate and graduate students from the School of Dentistry at the Federal University of Bahia. Oral examinations were performed to assess dental caries using the dmft and DMFT indices. In addition, structured interviews were conducted with the children's caregivers to collect information on sociodemographic and behavioural characteristics, as well as access to healthcare services. Associations were analyzed using Poisson regression with robust variance to estimate adjusted prevalence ratios (PRs) and their respective 95% confidence intervals (95% CIs).

Results: A total of 222 Indigenous schoolchildren aged three to ten years participated in the study. Regarding oral hygiene practices, 91.89% of the children used toothpaste once a day, 91.44% used a toothbrush, and 75.23% did not use dental floss. The prevalence of dental caries was 77.03% in the primary dentition and 27.93% in the permanent dentition. In the multivariable analysis, the presence of dental caries in the primary dentition remained associated with dental pain in the previous 12 months (PR = 1.26; 95% CI: 1.09–1.43). In the permanent dentition, dental caries was associated with being aged 7–10 years (PR = 2.96; 95% CI: 1.84–4.76) and not having attended a dental appointment during the previous year (PR = 1.54; 95% CI: 1.04–2.30).

Conclusion: Dental caries is a highly prevalent oral health condition among Indigenous children in Bahia, Brazil. A broader understanding of the oral health conditions of Indigenous peoples is essential to strengthen preventive initiatives, with particular emphasis on family-centred oral health education.

Keywords

Oral health epidemiology, Childhood, Indigenous people.

Introduction

The 2022 demographic census revealed that Brazil has more than 1.7 million people who self-identify as Indigenous, corresponding to 0.83% of the country's population [1]. In addition, the Indigenous Health Secretariat (SESAI) reports a total of 819,125 indigenous people living in 7,057 villages across the country [2]. In the state of Bahia, this population is distributed across 147 villages and nine health hubs, covering approximately 32 municipalities and totalling 34,472 individuals [2].

The Special Indigenous Health Districts (DSEIs) were established to ensure the right of Indigenous peoples to universal and comprehensive healthcare through a service delivery model that considers the cultural, epidemiological, and operational characteristics of this population [3]. Therefore, knowledge of the prevalence and distribution of oral health conditions among Indigenous peoples is essential for the development and implementation of strategies aimed at improving their health status [4].

Oral health plays a fundamental role in individual well-being and population quality of life. However, oral diseases remain among the most prevalent chronic conditions worldwide, affecting approximately 3.5 billion people, according to estimates from the *Global Burden of Disease* study [5]. Untreated dental caries in permanent teeth is among the most prevalent health conditions globally. In contrast, dental caries in the primary dentition is one of the most common chronic diseases during childhood, with substantial effects on pain, food intake, growth, school performance, and children's quality of life [6]. Consistent with this perspective, the *Global Oral Health Action Plan 2023–2030* identifies the reduction of oral health inequalities, the strengthening of health promotion and preventive initiatives, the expansion of universal access to dental services, and the monitoring of oral diseases as key priorities. Particular attention is given to populations experiencing greater social vulnerability, including Indigenous peoples [7].

Epidemiological studies conducted among different Indigenous ethnic groups have reported a high prevalence of dental caries, tooth loss, and dental pain, as well as limited availability of dental services and preventive interventions. In several communities, dental care is predominantly curative and emergency-oriented, highlighting the need for strategies focused on oral health prevention and promotion.

Dental caries is a multifactorial disease resulting from an imbalance within the oral environment. It is characterised by a dynamic process of demineralisation and remineralisation that ultimately results in the loss of mineralised dental tissue. Its development is associated with a range of social, economic, behavioural, dietary, and oral hygiene factors [8–12]. During childhood, dental caries affects the primary dentition and is defined by the presence of

one or more decayed, missing, or filled tooth surfaces in children younger than six years of age. This condition directly affects the quality of life of both children and their families [12–14].

Childhood is a critical period for establishing and maintaining oral health throughout the life course. Among Indigenous children, this stage is marked by even greater challenges due to limited coverage of dental services and the scarcity of continuous preventive programs [14]. The literature indicates that dental caries is the most prevalent oral disease among Indigenous schoolchildren, with higher rates than those observed in non-Indigenous populations [15–19].

In addition to its physical consequences, dental caries and dental pain affect emotional and social aspects of children's lives, including school participation, sleep, and food intake, thereby compromising their overall development [4,13,14]. National studies have shown that the prevalence of dental caries among Indigenous schoolchildren may exceed 80%, with a substantial proportion of untreated lesions and early tooth extractions [15–19].

Given this context, strengthening preventive initiatives is essential, including family-centred health education, training for Indigenous health workers, and expanded access to dental care. Therefore, this study aimed to analyze the prevalence, severity, and factors associated with dental caries through a population-based epidemiological survey conducted among children aged 3–10 years living in villages served by the nine health hubs of the DSEI-BA.

Materials and Methods

This cross-sectional epidemiological study is part of a broader research project entitled “*Oral Health Survey of Indigenous Peoples in the State of Bahia*”, which was designed and conducted by the Collective Oral Health Research Group at the School of Dentistry of the Federal University of Bahia (UFBA), in partnership with the Special Indigenous Health District of Bahia (DSEI-BA). This population-based study included all Indigenous peoples receiving care through the Indigenous Health Subsystem in the state of Bahia.

The study population was selected through a sampling process designed to ensure representativeness across all health hubs in the state and included individuals living in 129 Indigenous villages. Indigenous people living in camps and in urban areas of municipalities who were not covered by DSEI services were excluded.

The sampling design ensured that the study sample was representative of the DSEI population across age groups for assessing oral health conditions. Based on the sample size calculation, the minimum required sample for children aged 3–10 years was estimated at 272 individuals. Children participated in the oral health assessment only after their parents or legal guardians had signed the written informed consent form and the children had

provided their assent, documented through the written assent form.

Individuals who were outside the predefined age range, had physical or mental disabilities or health conditions that prevented the oral examination from being performed, or declined to undergo the examination were not eligible to participate. Children whose parents or legal guardians did not authorize their participation by signing the written informed consent form were also excluded.

Two research instruments were used: an oral health assessment form and a structured questionnaire completed by the parents or legal guardians of the participating children. The questionnaire was designed to collect sociodemographic and behavioural data, including dietary, oral hygiene, and oral health habits, as well as information on access to healthcare services. Oral health assessments were conducted through epidemiological examinations under natural light, following the recommendations of the World Health Organisation (WHO) and the SB Brasil 2023 project regarding biosafety procedures, the instruments used to assess oral health conditions, diagnostic criteria, and the indices applied [20].

The children were examined while seated in chairs. The oral examination assessed the presence of dental caries using the dmft and DMFT indices. Data collection was conducted in households or community settings, in accordance with the planning and organisational arrangements established by Indigenous leaders and local healthcare teams. The examinations were performed by eight dentists, with the support of oral health assistants from the Indigenous Health Subsystem in the state of Bahia, as well as two final-year undergraduate dental students and three graduate students. All examiners were appropriately trained and calibrated to perform the oral examinations.

Examiner calibration was conducted before data collection through theoretical training using standardised clinical photographs and problem-based scenarios that were representative of the oral health conditions assessed in the study. The diagnostic criteria were discussed and independently applied by the examiners, followed by consensus sessions with the reference examiner to standardise the interpretation of the findings. Inter- and intra-examiner agreement was assessed using the kappa statistic, which indicated substantial agreement ($\kappa = 0.62$), along with an excellent percentage agreement of 93.8%.

The study protocol was submitted to and approved by the Brazilian National Research Ethics Commission (CONEP) under Certificate of Presentation for Ethical Consideration (CAAE) No. 7.175.934. Data were entered into Microsoft Excel and analyzed descriptively and exploratorily using Stata version 16.

Initially, a descriptive analysis of the variables investigated was conducted to characterise the study population in terms of sociodemographic and behavioural characteristics, utilisation of dental services, and oral health conditions. Categorical variables

were presented as absolute frequencies (n) and relative frequencies (%), whereas quantitative variables were described using measures of central tendency and dispersion according to their distribution. The prevalence of dental caries and dental pain, the clinical consequences of untreated dental caries (as assessed using the PUFA index), and the need for dental treatment were estimated for the overall sample and the groups of interest.

Subsequently, bivariate analyses were performed using Pearson's chi-square test to investigate the associations between the presence of dental caries in the primary and permanent dentitions and the independent variables. Variables with $p < 0.20$ were included in the multiple Poisson regression model with robust variance to estimate prevalence ratios, using the simultaneous entry procedure (non-hierarchical model). Variables with a significance level of 5% ($p < 0.05$) were retained in the final model, and adjusted prevalence ratios (aPRs) and their respective 95% confidence intervals (95% CIs) were estimated.

Multicollinearity among the independent variables was assessed using the Variance Inflation Factor (VIF), with values greater than 10 indicating multicollinearity. The goodness of fit of the final model was assessed using the deviance test by comparing the residual deviance with the corresponding degrees of freedom. Models showing no evidence of lack of fit ($p > 0.05$) were considered adequately fitted.

Results

A total of 222 children aged 3–10 years living in Indigenous health hubs in the state of Bahia participated in this study. According to the findings, most children were aged 3–6 years (52.25%), were female (55.41%), and attended school regularly (96.85%). Among the individuals eligible for the study, sample losses were observed due to several operational and logistical factors. Some losses were attributed to the failure of children's parents or legal guardians to return questionnaires, which prevented the collection of sociodemographic and behavioural information, as well as data on healthcare service utilisation. In addition, difficulties with geographical access limited data collection in some villages. Data collection was also not feasible in one of the DSEI-BA base hubs because the dentist responsible for the local team resigned during the study period and was not replaced in time to conduct the fieldwork. These factors contributed to the reduction in the initially planned sample size.

Most families reported a monthly household income below one minimum wage (85.14%). Regarding the educational level of parents or legal guardians, most respondents (93.24%) reported completion of primary or higher education. Regarding household size, most respondents reported living in households with 5 or more residents (50.90%). A high proportion of families reported receiving social benefits (74.32%) (Table 1).

Table 1: Sociodemographic Characteristics of Indigenous Children Aged 3–10 Years, Bahia, Brazil, 2025 (n = 222).

Variables	n	%
Gender		
Female	123	55.41
Male	99	44.59
Age		
3- 6 years	116	52.25
7 -10 years	106	47.75
Regular school attendance		
No	7	3.15
Yes	215	96.85
Caregiver's educational level		
Elementary education or higher	207	93.24
Less than elementary education	15	6.76
Number of people living in the household		
< 5	109	49.1
≥5	113	50.9
Monthly household income		
Two minimum wages or more	33	14.86
Until two minimum wages	189	85.14
Receipt of government social benefits		
Yes	165	74.32
No	57	25.68

Table 2: Behavioural Characteristics of Indigenous Children Aged 3–10 Years, Bahia, Brazil 2025 (n=222).

Variables	n	%
Frequency of consumption of processed fruit juices		
Infrequent	34	15.32
Frequent	188	84.68
Frequency of soft drink consumption		
Infrequent	7	3.15
Frequent	215	96.85
Need for dental treatment		
No	28	12.61
Yes	194	84.39
Dental visit in the past year		
Yes	134	60.36
No	88	39.64
Use of toothpaste once a day or more		
Yes	204	91.89
No	18	8.11
Use of dental floss		
Yes	55	24.77
No	167	75.23
Use of a toothbrush		
Yes	203	91.44
No	19	8.56

As shown in Table 2 above, in terms of behavioural characteristics, a very frequent consumption pattern (more than 4 times per week) was observed for both industrialised fruit juices (84.68%) and soft drinks (96.85%). Regarding oral healthcare, 87.39% of parents or legal guardians reported that the child required dental treatment, and most schoolchildren had visited a dentist during the previous

year for routine appointments (60.36%). Regarding oral hygiene practices, most children used toothpaste once a day (91.89%) and brushed their teeth (91.44%). However, most did not use dental floss (75.23%) (Table 2).

Regarding oral health conditions, 36.49% of the children had experienced dental pain during the previous 12 months. Dental caries was observed in 77.03% of the children in the primary dentition and in 27.93% in the permanent dentition. Regarding the PUFA index, 15.32% of the children presented clinical consequences of untreated dental caries. The mean dmft score in the primary dentition was 4.04 (standard deviation = 3.83; median = 3). In the permanent dentition, the mean DMFT score was 1.43 (standard deviation = 2.98; median = 0) (Table 3).

Table 3: Absolute and Percentage Distribution of the Main Oral Health Conditions among Indigenous Children Aged 3–10 Years, Bahia, Brazil, 2025 (n = 222).

Variables	n	%
Dental pain during the previous 12 months		
No	141	63.51
Yes	81	36.49
Dental Caries in the Primary Dentition		
No	51	22.97
Yes	51 171	77.03
Dental Caries in the Permanent Dentition		
No	60	72.07
Yes	60 62	27.93
PUFA*		
No	188	84.68
Yes	34	15.32

* Pulpal involvement, ulceration, fistula, or abscess

In the bivariate analysis examining the influence of sociodemographic and behavioural factors on the occurrence of dental caries in the primary dentition, the presence of dental caries was associated with regular school attendance ($p = 0.042$), the occurrence of dental pain during the previous 12 months ($p = 0.001$), and alterations in the PUFA index ($p = 0.001$). The remaining sociodemographic and behavioural variables analysed, including sex, age, caregiver educational level, monthly household income, frequency of consumption of sugar-sweetened beverages, and utilisation of dental services, were not significantly associated with dental caries in the primary dentition ($p > 0.05$) (Table 4).

Analysis examining the influence of sociodemographic and behavioural factors on the occurrence of dental caries in the permanent dentition, the presence of dental caries was associated with age ($p < 0.001$), number of household residents ($p = 0.054$), and access to dental care during the previous year ($p = 0.049$). The remaining sociodemographic and behavioural variables analysed, including sex, caregiver educational level, monthly household income, and frequency of consumption of sugar-sweetened beverages, were not significantly associated with dental caries in

Table 4: Bivariate Analysis of the Association Between Sociodemographic and Behavioural Factors, Access to Dental Care, Other Oral Health Conditions, and Dental Caries in the Primary Dentition among Indigenous Children Aged 3–10 Years, Bahia, Brazil, 2025 (n = 222).

	Dental Carie				
	No		Yes		P-values
	n	%	n	%	
Gender					
Female	27	21.95	96	78.05	0.687
Male	24	24.24	75	75.76	
Age					
3 - 6 years	28	24.14	88	75.86	0.666
7 - 10 years	23	21.7	83	78.3	
Regular school attendance					
No	-	-	7	100	0.042
Yes	51	23.7	164	76.28	
Caregiver's educational level					
Elementary education or higher	49	23.67	158	76.33	0.358
Less than elementary education	2	13.33	13	86.67	
Number of people living in the household					
< 5	22	20.18	87	79.82	0.332
≥5	29	25.66	84	72.34	
Monthly household income					
Two minimum wages or more	6	18.18	27	81.82	0.478
Until two minimum wages	45	23.81	144	76.19	
Receipt of government social benefits					
Yes	34	20.61	131	79.39	0.154
No	17	29.82	40	70.18	
Frequency of consumption of processed fruit juices					
Infrequent	6	17.65	28	82.35	0.422
Frequent	45	23.94	143	76.06	
Frequency of soft drink consumption					
Infrequent	1	14.29	6	85.71	0.579
Frequent	50	23.56	165	76.74	
Caregiver-reported perception of the child's oral health					
No	8	28.57	20	7	0.451
Yes	43	22.16	151	1.43	
Dental visit in the past year					
Yes	31	23.13	103	77.84	0.944
No	20	22.73	68	76.87	
Use of toothpaste once a day or more					
Yes	51	24.51	154	77.27	0.067
No	1	5.56	17	75.49	
Use of dental floss					
Yes	11	20	44	94.44	546
No	40	23.95	127	80	
Use of a toothbrush					
Yes	49	24.14	154	76.05	0.177
No	2	10.53	17	75.86	
Dental pain during the previous 12 months					
No	42	24.14	99	89.47	0.001
Yes	-	11.11	72	70.21	
PUFA*					
No	51	27.13	137	88.89	0.001
Yes	-	-	34	72.87	

*Pulpal involvement, ulceration, fistula, or abscess.

Table 5: Bivariate Analysis of the Association Between Sociodemographic and Behavioural Factors, Access to Dental Care, Other Oral Health Conditions, and Dental Caries in the Permanent Dentition among Indigenous Children Aged 3–10 Years, Bahia, Brazil, 2025 (n = 222).

	Dental Caries				
	No		Yes		P-value
	n	%	n	%	
Gender					
Female	86	69.92	37	30.08	0.425
Male	74	74.75	25	25.25	
Age					
3 - 6 years	99	85.34	17	14.66	0
7 - 10 years	61	57.55	45	42.45	
Regular school attendance					
No	6	85.71	1	14.29	0.414
Yes	154	71.63	61	28.37	
Caregiver's educational level					
Elementary education or higher	147	71.01	60	28.99	0.192
less than an elementary education	13	86.67	2	13.33	
Number of people living in the household					
<5	85	77.98	24	22.02	0.054
≥5	75	66.37	38	33.71	
Monthly household income					
Two minimum wages or more	24	72.73	9	27.27	0.928
Until two minimum wages	136	71.96	53	28.04	
Receipt of government social benefits					
Yes	120	72.73	45	27.27	0.711
No	40	70.18	17	29.82	
Frequency of consumption of processed fruit juices					
Infrequent	21	61.76	13	38.24	0.145
Frequent	139	73.94	49	26.06	
Frequency of soft drink consumption					
Infrequent	5	71.43	62	28.57	0.969
Frequent	155	72.09	60	27.91	
Caregiver-reported perception of the child's oral health					
No	23	82.14	5	17.86	0.204
Yes	137	70.62	57	29.38	
Dental visit in the past year					
Yes	103	76.87	31	23.13	0.049
No	57	64.77	31	35.23	
Use of toothpaste once a day or more					
Yes	147	72.06	57	27.94	0.988
No	13	72.22	5	27.78	
Use of dental floss					
Yes	36	65.45	19	34.55	0.207
No	124	74.25	43	25.75	
Use of a toothbrush					
Yes	145	71.43	58	28.57	0.485
No	15	78.95	4	21.05	
Dental pain during the previous 12 months					
No	105	74.47	36	25.53	0.294
Yes	55	67.9	26	32.1	
PUFA*					
No	137	72.87	51	27.13	0.532
Yes	23	67.65	11	32.35	

the permanent dentition ($p > 0.05$) (Table 5).

In the multivariable analysis examining the association between dental caries in the primary dentition and the independent variables, a statistically significant association was observed with the occurrence of dental pain during the previous 12 months (adjusted prevalence ratio [aPR] = 1.26; 95% confidence interval [95% CI]: 1.09–1.43). In the multivariable analysis of dental caries in the permanent dentition and the other covariates, statistically significant associations were observed with older age (aPR = 2.96; 95% CI: 1.84–4.76) and the lack of access to dental care during the previous 12 months (aPR = 1.54; 95% CI: 1.04–2.30) (Table 6).

Table 6: Final Robust Poisson Regression Model of Factors Associated with Dental Caries in the Primary and Permanent Dentitions among Indigenous Children Aged 3–10 Years, Bahia, Brazil, 2025 (n = 222).

	Adjusted prevalence ratio (aPR)	95% CI	P-value
Dental Caries in the Primary Dentition			
Regular school attendance	1.22	0.67 – 2.23	0.519
Dental pain during the previous 12 months	1.26	1.09 – 1.43	0.001
Dental Caries in the Permanent Dentition			
Age older than 7 years	2.96	1.84 – 4.76	0.000
More than six household residents	1.30	0.85 – 1.98	0.222
No access to dental care during the previous year	1.54	1.04 – 2.30	0.033

Discussion

The main findings of this study revealed a high prevalence of dental caries among Indigenous children in Bahia, particularly in the primary dentition. This was accompanied by a substantial need for dental treatment and clinically relevant consequences of untreated dental caries, including dental pain. The findings also highlighted the influence of demographic characteristics and access to dental services, underscoring the role of social inequalities and the organisation of healthcare services in shaping the oral health conditions of this population.

Indigenous peoples in Brazil face significant challenges, particularly regarding their health conditions. Epidemiological surveys addressing Indigenous populations remain scarce in the literature. Nevertheless, published studies have consistently described a concerning oral health scenario [8-11,15-19,21]. In these studies, most children lived in socioeconomically disadvantaged conditions, with a monthly household income of one minimum wage or less. According to Lemos [9], household income may be an important determinant of the adoption of preventive practices and access to oral hygiene resources, thereby directly influencing the occurrence of dental caries.

Families experiencing socioeconomic vulnerability may face greater difficulties in obtaining oral hygiene products, such

as toothbrushes, fluoridated toothpaste, and dental floss [14]. Furthermore, these findings are consistent with those reported by Bertanha [16], who highlighted the association between dental caries prevalence and socioeconomic factors, reinforcing the concept that dental caries has a strong social component. Therefore, dental caries should be understood not only as the result of individual behaviours but also as a reflection of living conditions and structural inequalities that affect specific populations [12,14,16].

An important finding of this study was the high proportion of children who regularly attended preschool or school. The school environment represents a strategic setting for health promotion and disease prevention during childhood. Historically, oral health policies have also supported preventive and health-promoting activities in school settings and have played a fundamental role in reducing the burden of oral diseases [4,7,9,16]. However, among this population, the effectiveness of these initiatives may be limited by the infrequent presence of oral health teams in these settings.

The presence of oral health professionals is essential for implementing educational and preventive practices, including guidance on oral hygiene, supervised toothbrushing, dental floss use, and topical fluoride application [6,7,17]. This context may contribute to the persistence of health inequalities, as studies have shown that Indigenous populations experience poorer oral health conditions than non-Indigenous populations [8-11,17-19]. Therefore, greater integration between healthcare services and school settings is needed, particularly in socially vulnerable communities, as a strategy to promote health and reduce oral health inequalities [4,6,7].

Regarding behavioural factors, the prevention of dental caries is directly related to the mechanical control of dental biofilm, reduced sugar consumption, and access to dental care. In this context, according to Bertanha [16], changes in dietary patterns, increasingly characterized by the consumption of ultra-processed foods, combined with inadequate dental care, contribute to the deterioration of oral health. In the present study, high consumption of industrialised fruit juices and soft drinks, limited access to dental services, and inadequate oral hygiene practices [17-19,21,22] are multiple relevant factors associated with the development of dental caries.

A study conducted by Branco, Santos, and Nascimento [19] involving children aged 2–8 years living in an Indigenous reserve in the Brazilian Amazon found that 63.50% of the children brushed their teeth one to two times per day. In the present study, 91.89% of the schoolchildren reported using toothpaste at least once a day. Although this proportion was higher than that reported in other epidemiological surveys, the findings still indicate persistent insufficient oral hygiene practices, as only 24.77% of children reported using dental floss.

According to the most recent national oral health survey conducted

in Brazil [20], 41.24% of 5-year-old children in the state of Bahia had untreated dental caries, with a mean dmft score of 2.11. In the present study, 77.03% of the children had dental caries in the primary dentition, with a mean dmft score of 4.04. These findings indicate an extremely high burden of dental caries during early childhood among Indigenous children compared with the statewide average.

This scenario also reflects the social and economic inequalities affecting Indigenous peoples [8-11,16-19]. In addition, the literature reports an even greater severity of dental caries, as observed in the study by Lemos [11], which found a mean dmft score of 5.85 among 5-year-old Indigenous children living in the Xingu Indigenous Park.

Regarding oral health conditions, 27.93% of the children in the present study had dental caries in the permanent dentition. An epidemiological study conducted by Amaral [21] among children and adolescents aged 1–15 years living in riverside communities in the state of Pará reported a mean DMFT score of 2.0 among those aged 10–15 years. In that study, oral health interventions were implemented, including supervised toothbrushing, atraumatic restorative treatment (ART), tooth extractions, and composite resin restorations, to control disease progression.

The discrepancy between the prevalence of dental caries in the primary and permanent dentitions may be explained by children's greater dependence on caregivers for oral hygiene practices, early exposure to fermentable carbohydrates, and a longer duration of exposure to risk factors. Therefore, these findings reinforce the importance of early oral health interventions, including educational initiatives and improvements in dental services, to reduce the impact of dental caries in childhood and prevent its progression into the permanent dentition [9,16].

Regarding the other oral health conditions investigated in this study, the prevalence of dental pain was 36.49%. However, the literature reports even higher estimates, as demonstrated by the study conducted by Branco, Santos, and Nascimento [19] among schoolchildren living in an Indigenous reserve in the Brazilian Amazon, in which 69.50% of the children reported experiencing dental pain. Serra [4] emphasised that dental caries is the leading cause of dental pain in childhood and may result in substantial impairments, including difficulties with chewing and speech, underscoring the negative impact of dental pain on quality of life during this stage.

According to the most recent national oral health survey [20], the PUFA index, which is used to assess the clinical consequences of untreated dental caries, including pulpal involvement, ulceration, fistula, and abscess, showed a prevalence of 14.30% among 5-year-old children in the state of Bahia. In the present study, 15.32% of schoolchildren had a positive PUFA score, a proportion similar to that observed at the state level. When not treated at an early stage, carious lesions may progress to acute pulpal inflammation and

infection, resulting in dental pain.

The high prevalence of dental caries and its clinical consequences observed in this study highlight the substantial need for dental treatment among the schoolchildren evaluated. A total of 87.39% of the children required dental treatment, representing a concerning scenario of unmet oral healthcare needs. The need for dental treatment is directly related to barriers to accessing healthcare services, particularly among socially vulnerable populations, such as Indigenous communities [8-11,13-19].

When examining the association between the presence of dental caries and sociodemographic and behavioural factors, access to dental care, and other oral health conditions in the primary dentition, statistically significant associations were found between dental caries and irregular school attendance, dental pain during the previous 12 months, and a positive PUFA score ($p < 0.05$). In the permanent dentition, dental caries was associated with older age, a higher number of household residents, and lack of access to dental care during the previous year ($p < 0.05$).

The association between the occurrence of dental pain during the previous 12 months and the presence of dental caries was observed in both the bivariate and multivariable analyses (adjusted prevalence ratio [aPR] = 1.26; 95% confidence interval [95% CI]: 1.09–1.43), suggesting that, when left untreated, the disease may progress to more advanced stages and result in important functional consequences in children's daily lives. Changes in dental structures may substantially affect children's everyday activities by impairing chewing and food intake, potentially leading to difficulties in consuming certain foods and to painful sensitivity to different temperatures, such as those of hot or cold beverages [12].

Furthermore, dental caries was associated with alterations in the PUFA index in the bivariate analysis, indicating potential shortcomings in both access to and the effectiveness of dental services. Untreated lesions may progress to pulpal infections and acute conditions, which are associated with impaired quality of life. In such cases, more invasive interventions, such as pulp therapy or early tooth extraction, may be required and may interfere with the appropriate development and eruption of the permanent dentition.

In the permanent dentition, a statistically significant association was observed between older age and the presence of dental caries ($p < 0.001$) in both the bivariate and multivariable analyses (adjusted prevalence ratio [aPR] = 2.96; 95% confidence interval [95% CI]: 1.84–4.76). Dental caries was more frequent among children aged 7–10 years (42.45%). This finding may be explained by the longer duration of exposure to risk factors over the life course, which may favour the development and progression of the disease. In addition, children in this age group tend to have greater autonomy regarding dietary and oral hygiene practices, which may contribute to the adoption of unhealthy behaviours. In this context, early disease control is essential for maintaining oral health and promoting long-term well-being [6,7,22].

The bivariate analysis also showed a statistically significant association between a higher number of household residents and the presence of dental caries in the permanent dentition ($p = 0.054$). The relationship between household size and dental caries may suggest the influence of factors associated with household overcrowding. In a study conducted by Branco, Santos, and Nascimento [18] among Indigenous children aged 2–8 years living in an Indigenous reserve in the Brazilian Amazon, 49.5% of caregivers reported that six or more people lived in the household. This finding suggests that individuals living in more crowded households may be more exposed to factors that contribute to dental caries, including unfavourable socioeconomic conditions and greater difficulty maintaining healthy dietary and oral hygiene practices.

A statistically significant association was observed between the lack of access to dental care during the previous year and the presence of dental caries in the permanent dentition, both in the bivariate analysis ($p = 0.049$) and in the multivariable analysis (adjusted prevalence ratio [aPR] = 1.54; 95% confidence interval [95% CI]: 1.04–2.30). The high prevalence of dental caries in childhood requires early interventions. Therefore, limited access to dental care may contribute to the persistence of unfavourable oral health conditions, reflecting inequalities in healthcare access and delivery [4,11,16,22].

This study has some limitations that should be considered when interpreting the findings. The cross-sectional design precludes establishing causal relationships between the factors investigated and the occurrence of dental caries, limiting the analyses to observed associations and preventing assessment of temporality between exposure and outcome. In addition, sample losses resulted from the non-return of questionnaires by parents or legal guardians, difficulties in accessing some villages, and the inability to conduct data collection in one of the DSEI-BA base hubs due to the resignation of the dentist responsible for the local team and the absence of a replacement during the study period. These factors may have reduced the representativeness of the sample and introduced selection bias. Information obtained through interviews with parents or legal guardians was also subject to recall and information bias.

Despite these limitations, the study included Indigenous children from eight of the nine DSEI-BA base hubs and represents the first population-based epidemiological survey of childhood oral health conducted among Indigenous peoples in the state of Bahia. The findings provide relevant evidence to support planning, oral health surveillance, and the organisation of dental care services for this population.

Conclusions

The findings of this study revealed a high prevalence of dental caries among Indigenous children in Bahia, affecting 77.03% of children in the primary dentition and 27.93% in the permanent dentition, in addition to a substantial need for dental treatment.

In the adjusted analysis, dental caries in the primary dentition remained associated with dental pain in the previous 12 months (aPR = 1.26; 95% CI: 1.09–1.43). In the permanent dentition, dental caries was associated with being aged 7–10 years (aPR = 2.96; 95% CI: 1.84–4.76) and not having attended a dental appointment during the previous year (aPR = 1.54; 95% CI: 1.04–2.30).

They indicate that the occurrence of dental caries is influenced not only by clinical factors but also by determinants related to access to healthcare services and the living conditions of this population. The evidence generated by this study supports strengthening Indigenous oral health surveillance. It may guide planning for health promotion, preventive, and early diagnostic initiatives, as well as the reorganisation of dental care within the Indigenous Health Care Subsystem. Continuous monitoring of these indicators may contribute to a more equitable allocation of resources, improve the quality of oral health team activities, and reduce health inequities among Indigenous children.

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