




Incidence of Dental Caries and Associated Factors in the School Period in a Municipality in Southern Brazil

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Academic Editor: Wilton Wilney Nascimento Padilha

Received: January 28, 2022 / **Review:** November 07, 2022 / **Accepted:** May 10, 2023

How to cite: Nazário AC, Traebert J, Traebert E. Incidence of dental caries and associated factors in the school period in a municipality in Southern Brazil. *Pesqui Bras Odontopediatria Clín Integr.* 2024; 24:e220023. <https://doi.org/10.1590/pboci.2024.002>

ABSTRACT

Objective: To estimate the incidence of dental caries and associated factors in the school period from six/seven to ten years of age. **Material and Methods:** A longitudinal study involving 168 children was followed up between 2015 and 2019 in the municipality of Palhoça, Brazil. The dependent variable was the caries incidence rate in the mixed dentition. The independent variables included information regarding demographic and socioeconomic status. Multivariate analyzes were carried out using Poisson Regression with a robust estimator. Variables with $p < 0.20$ in the bivariate analysis were included in the adjusted model. Relative risks were estimated, as well as 95% confidence intervals. **Results:** Of 168 followed schoolchildren, 32 developed the disease, providing an incidence rate of 19.0%. Female children had a 10% higher risk [RR = 1.10 (95% CI 1.03; 1.18)] of developing caries than males. Also, children born from fathers with ≤ 8 years of schooling at baseline had a 9% higher risk [RR = 1.09 (95% CI 1.01; 1.16)] of developing dental caries compared to fathers with higher education. **Conclusion:** The incidence of dental caries in a four-year period was 19.0%. Females and children born from fathers with a lower level of education showed higher incidence rates.

Keywords: Dental Caries; Incidence; Schools; Age Groups.

Introduction

Dental caries was considered by the Global Burden of Disease Study [1] the most prevalent disease in the world. More than 2.3 billion individuals present the disease in permanent dentition and more than 560 million children have it in the deciduous dentition.

Studies conducted in different countries have shown that approximately 60% of children are affected by dental caries in underdeveloped [2] and developing [3,4] countries, especially among the socially and economically disadvantaged population [5,6].

Despite the improvement in oral health in recent decades, dental caries remains highly prevalent in children and adolescents [7]. In Brazil, national surveys conducted in 1986, 1996, 2003, and 2010 confirmed that residents of socioeconomically vulnerable areas had the worst rates of caries. Those studies were fundamental to tracing the epidemiological profile of oral health of the Brazilian population [8]. When comparing Brazil with countries with the same degree of development in Europe and America, the Brazilian average is in the intermediate value, with a DMF-T index of 2.1 for children aged 12 [9].

In Brazil, the association between socioeconomic conditions and higher levels of dental caries has been more evident among brown/black people, females, low-income and less educated groups [10]. Socioeconomic factors, such as income and schooling, are described as determinants in the development of dental caries [10,11].

A High prevalence of caries has been shown in Brazil. Ardengui et al. [12] conducted a study that included 177 municipalities in Brazil, with 7,217 children aged 5, showing an average prevalence of 48.2% in the deciduous dentition. Brizon et al. [13], in a review of 56 studies involving children aged between 6 and 12, observed a significant association between dental caries and low parental education and family income.

Nevertheless, incidence studies are scarce in Brazil. Cangussú et al. [14] conducted a prospective cohort study with 495 children aged 4 to 30 months in Salvador, Bahia, and observed that the mean index of decayed, missing and filled teeth (dmf-t) was 0.18 at the beginning of follow-up and 0.55 at the end of the study. The incidence of caries in the disease-free children was 18.5% and, in the total group, was 22.6%. Attending public nurseries, a child's age greater than 24 months, non-white skin color and the period of breastfeeding during sleep longer than one year were the factors that increased the risk of caries. Social vulnerability was found to be a powerful risk factor for caries in children under two years of age.

Another Brazilian study conducted in Diamantina, Minas Gerais [15] also pointed out that low mother's education, low family income, the reduction in family income, high frequency of daily sugar intake, and previous history of caries were considered risk factors for the incidence of caries in dentin.

Emmanuelli et al. [16], in a 7-year- follow-up study, concluded that individual and contextual determinants showed an important role in the incidence of caries in first permanent molars in a study carried out in Santa Maria, Rio Grande do Sul. Children living in neighborhoods with cultural community centers showed lower risk, but children from families with low income and poor parental perception of children's oral health presented a higher risk of dental caries in the first molars.

A survey conducted in the municipality of Palhoça, Santa Catarina [17] found a high incidence of caries in deciduous dentition (57.1%), with component "d" (decayed deciduous tooth) of the dmft index responsible for almost half (49.2%). The overall incidence of dental caries from zero to six years of age, including permanent and deciduous teeth, was 58.8%. The authors also aimed to analyze the influence of the first thousand days of life determinant behaviors for dental caries in 6-year-old children. They found that mothers with lower schooling at the child's birth presented a higher risk of a child's tooth brushing onset only after two years of age, brushing the teeth once a day only or not brushing and with a child not having gone to the dentist until the age of 6.

The knowledge about the incidence of a disease is one of the main instruments for assessing the health condition and should guide the planning of prevention actions that will contribute to improving the population's health [18]. Bearing in mind that Brazil is a country with continental dimensions and profound socioeconomic inequalities and the existence of relatively few longitudinal studies involving Brazilian populations during the elementary school period, it is believed that the present study can contribute to the knowledge about determinant factors of caries incidence in the period between the first and fifth school year. Thus, the objective of this study was to estimate the incidence of dental caries and associated factors in schoolchildren aged from six/seven to ten years old in the city of Palhoça/SC, Brazil.

Material and Methods

Study Design

This is a longitudinal-designed epidemiological study carried out in the municipality of Palhoça, located in the metropolitan region of Greater Florianópolis in the southern Brazilian state of Santa Catarina.

Participants

The study population consisted of 186 children enrolled in the fifth grade of elementary school in Palhoça in 2019 and who participated in the previous phase of data collection in 2015 when they were in the first grade. The students were between 6 and 7 years old in 2015 and 10 years old in 2019. The children included in the baseline study belonged to all 56 public and private schools in the municipality. A greater detail of the baseline study has been previously published [19]. The methods of obtaining the sample can be observed in Figure 1.

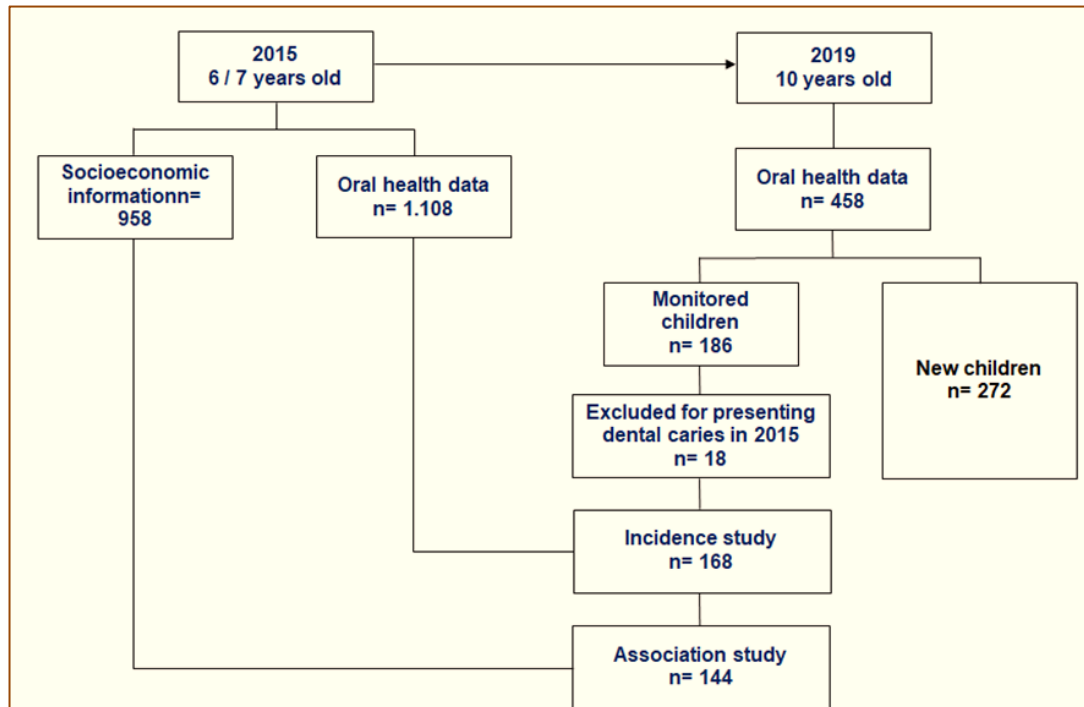


Figure 1. Sample flowchart.

Clinical Data Collection

Clinical examinations were done in schools, in classrooms illuminated by natural and artificial lights. Information related to dental caries was collected according to the criteria of the World Health Organization

[20] and registered in clinical and epidemiological records by five dental surgeons and oral health assistants. The professionals had already undergone a training and calibration process in 2015 and underwent a new intra- and inter-examiner calibration in 2019. After theoretical and practical activities, all professionals presented a minimum tooth-by-tooth intra- and inter-examiner kappa value of at least 0.7.

The dependent variable was the incidence of dental caries (expressed as absolute and relative numbers). The independent variables were gender (male, female), child's skin color (categorized as white and non-white), school type (public; private) and socioeconomic characteristics at baseline study: father's and mother's occupation (without income, with income), mother's and father's education (categorized as ≤ 8 years, > 8 years of completed schooling meaning whether or not having completed the first degree of schooling), beneficiary of state family allowance - *bolsa família* (yes, no).

Data Analysis

Data were entered into Excel spreadsheets and exported to the IBM SPSS® - Statistical Package for the Social Sciences (SPSS) version 18.0, where statistical analysis was run. The database was submitted to the data cleaning process to detect incomplete data or other inconsistencies. Descriptive statistics of the variables were performed through distribution and frequency. Bivariate analyses were performed using the chi-square test, with a significance level of $p < 0.05$. Multivariate analyses were performed to identify any confounding variables that could be interfering with the associations, through Poisson Regression with a robust estimator. All variables with $p < 0.20$ in the bivariate analysis were included in the adjusted model. Relative risks (RR) and their respective confidence intervals at 95% were estimated.

Ethical Clearance

The project was submitted to the Research Ethics Committee of the *Universidade do Sul de Santa Catarina* and approved under CAAE 04377218.1.0000.5369. A term of free and informed consent was sent to the parents so that they knew the objective of the research, requesting authorization for their children to participate in the research. Children whose parents signed the term were invited to participate, also signing a term of free and informed assent.

Results

A total of 186 children in follow-up in the *Coorte Brasil Sul* were examined. The mean DMF-T index observed was 1.50 (SD= 2.19), and the mean dmf-t was 1.31 (SD= 2.22) (Table 1). Of the total, 168 (72.1%) were caries-free in 2015 and were followed up for a four-year-period. In total, 32 children developed the disease between 2015 and 2019, providing an incidence rate of caries of 19.0% (95% CI 13.1; 24.9). Table 2 shows the sociodemographic characteristics of the studied population.

Table 1. Indicators of caries and its components in 2019 in ten-year-old schoolchildren.

Variables	Decayed			Missing			Filled			Total		
	Mean	SD	%	Mean	SD	%	Mean	SD	%	Mean	SD	%
dmf-t	0.82	1.70	62.6	0.04	0.21	3.0	0.45	1.21	34.4	1.31	2.22	100.0
DMF-T	0.99	1.57	66.0	0.06	0.37	4.4	0.45	1.33	30.0	1.50	2.19	100.0

dmf-t = Decayed, Missing and Filled Teeth Index in the Deciduous Dentition; DMF-T = decayed, Missing and Filled Teeth Index in the Permanent Dentition; SD = Standard Deviation; % = Proportion of Each Indicator for dmf-t/DMF-T Composition.

Table 2. Sociodemographic characteristics of children from 6/7 to 10 years of age.

Variables	N	%
Child's Gender (n=168)		
Male	87	51.8
Female	81	48.2
Child's Skin Color (n=168)		
White	150	89.2
Non-white	18	10.8
School Type (n=168)		
Private	133	79.2
Public	35	20.8
Father's Occupation at Baseline (n=152)		
No income	8	5.3
With income	144	94.7
Mother's Occupation at Baseline (n=154)		
No income	65	42.2
With income	98	57.8
Father's Education at Baseline (n=139)		
≤ 8 years completed	69	49.6
> 8 years completed	70	50.4
Mother's Education at Baseline (n=154)		
≤ 8 years completed	57	37.0
> 8 years completed	97	63.0
State Family Allowance (<i>Bolsa Família</i>) (n=166)		
Yes	10	6.0
No	156	94.0

The results of the association between sociodemographic characteristics and incidence of dental caries are described in Table 3. A statistically significant association was observed with females and with lower father's education at baseline ($p=0.003$ and 0.013 , respectively).

Table 3. Association between sociodemographic characteristics and incidence of caries in children from 6/7 to 10 years of age.

Variables	Dental Caries			p-value
	Yes N(%)	RR	CI 95%	
Child's Gender				
Male	9 (10.3)	1.00		0.003
Female	23 (28.4)	1.10	1.03; 1.18	
Child's Ethnicity/Skin Color				
White	27 (18.0)	1.06	0.93; 1.20	0.386
Non-white	5 (27.8)	1.00		
School Type				
Private	5 (14.3)	0.97	0.90; 1.04	0.377
Public	27 (20.3)	1.00		
Father's Occupation at Baseline				
No income	1 (12.5)	1.00	0.91; 1.17	0.643
With income	26 (18.1)	1.03		
Mother's Occupation at Baseline				
No income	14 (21.5)	0.98	0.91; 1.05	0.512
With income	17 (17.3)	1.00		
Father's education at baseline				
≤ 8 years completed	18 (26.1)	1.09	1.02; 1.17	0.013
> 8 years completed	7 (10.0)	1.00		
Mother's education at baseline				
≤ 8 years completed	10 (17.5)	1.00		0.874
> 8 years completed	18 (18.6)	1.01	0.94; 1.08	

State Family Allowance (<i>Bolsa Família</i>)			0.953
Yes	2 (20.0)	0.99	0.86; 1.15
No	30 (19.2)	1.00	

RR= Relative Risk; 95% CI= 95% Confidence Interval; p-value: Chi-square test.

Table 4 describes the results of the multivariate analysis. Female children had a 10% higher and independent risk [RR= 1.10 (95% CI 1.03; 1.18)] (p= 0.007) of developing caries if compared to male children. Similarly, children whose fathers had completed ≤ 8 years of schooling had a 9% higher and independent risk [RR= 1.09 (95% CI 1.01; 1.16)] (p= 0.018) of developing dental caries if compared to parents with higher schooling at baseline.

Table 4. Results of multivariate analysis for incidence of caries in children from 6/7 to 10 years of age.

Variables	Dental Caries					
	RR _c	CI 95%	p-value	RR _a	CI 95%	p-value
Child's Gender			0.003			0.007
Male	1.00			1.00		
Female	1.10	1.03; 1.18		1.10	1.03; 1.18	
Child's Ethnicity/Skin Color			0.386			
White	1.06	0.93; 1.20				
Non-white	1.00					
School Type			0.377			
Private	0.97	0.90; 1.04				
Public	1.00					
Father's Occupation at Baseline			0.643			
No income	1.00	0.91; 1.17				
With income	1.03					
Mother's Occupation at Baseline			0.512			
No income	0.98	0.91; 1.05				
With income	1.00					
Father's Education at Baseline			0.013			0.018
≤ 8 years completed	1.09	1.02; 1.17		1.09	1.01; 1.16	
> 8 years completed	1.00			1.00		
Mother's Education at Baseline			0.874			
≤ 8 years completed	1.00					
> 8 years completed	1.01	0.94; 1.08				
State Family Allowance (<i>Bolsa Família</i>)			0.953			
Yes	0.99	0.86; 1.15				
No	1.00					

RR_c = Crude Relative Risk; RR_a = Adjusted Relative Risk; 95% CI = 95% Confidence Interval. p-value: Poisson regression with a robust estimator; Model: p= 0.078. Akaike= 365.9.

Discussion

The current study found an overall incidence of caries of 19.0%, independently associated with gender and father's education. Several studies [21-26] have pointed out the lack of studies about incidence rates of caries. Thus, the present study contributes to unusual epidemiological data at the local level.

In fact, although difficult to compare, there was found a relatively high incidence rate in a four-year follow-up period. This represents the need to continue prevention and health promotion measures in the school environment. The school remains an adequate environment for shaping educational activities related to oral hygiene and proper nutrition, besides establishing or reinforcing preventive measures such as access to fluoride through dentifrice or other topical applications [9].

Regarding the demographic factors associated with dental caries incidence, this study found that female children had a 10% higher risk for the disease. Bortolo et al. [27] found higher averages of DMF-T in female

schoolchildren in Vitória/ES but in a prevalence study. Also, Farghaly et al. [28] found that girls had a higher dental caries index compared to boys. The authors pointed out boys present salivary differences with higher total protein concentration, lower salivary flow and peroxidase activity, suggesting that gender can influence the children's susceptibility to dental caries and salivary parameters. Fleissig et al. [29] found a reduction in salivary flow in total saliva, parotid and smaller salivary glands in females.

Although socioeconomic status has been considered a determinant of children's oral health, this study showed a significant association only with lower father's education. Peres et al. [30] found that the instruction of fathers and mothers who worked during pregnancy were the socioeconomic variables significantly associated with higher caries index. Huew et al. [31] found an association between dental caries and family income and also with the child's father's education. Piovesan et al. [32] also found that lower father's instruction was associated with dental caries in children. A study with 12-year-old schoolchildren showed that family income, lower education of the father and of the mother, housing condition, and socioeconomic class were factors statistically associated with dental caries [33]. Barroso et al. [34] investigated the level of education of the children's guardians and found that the mean DMF-T was higher in children whose guardians had a lower level of education. Deichsel et al. [35] showed that the highest prevalence and incidence rates of dental caries were found in children with poor living conditions.

However, it is important to notice the opposite is also possible. According to Branden et al. [36], children with parents with a higher level of education may also have a high prevalence of caries, which can be explained by the monitoring given to the child. Parents with higher levels of education generally have more demanding jobs, and children's caregivers may not have adequate oral health knowledge, increasing the risk of dental caries.

Studies [6,37] point out that the type of parents' occupation can provide answers about the children's socioeconomic status since parents with higher educational level and income can have greater access to dental services. Higher education is believed to create better conditions of access to health information [37]. Furthermore, those children who live with parents with higher educational level are subject to healthier oral health habits [6].




The explanatory hypothesis for the association found in this study may be that less-educated parents are less concerned about children's education on oral hygiene [38]. However, according to Corrêa-Faria et al. [39], even if caregivers have been properly instructed about the importance of controlling risk factors for dental caries, as well as the measures they must adopt to prevent and control it, the incidence of dental caries may be high. It can be difficult for parents or caregivers to understand such measures and consequently give low priority to oral health care.

The results of this study should be interpreted carefully due to some limitations. First, the absence of association with other socioeconomic conditions could be related to the small sample size, making it difficult to identify differences in the incidence of dental caries in children with higher or lower socioeconomic status. Second, the inclusion of only a few variables, such as schooling and parental occupation, may have contributed to underestimating the impact of socioeconomic conditions on dental caries risk. Another important limitation was the use of sociodemographic information related to the year of the baseline study. Parents' education level and occupations may have changed over the four-year period, which could represent measurement bias. Nevertheless, studies on the incidence of dental caries in municipalities can contribute to the evaluation and planning local actions. The current study sought to fill a gap in oral health knowledge since there are few population-based cohort epidemiological studies investigating the incidence of dental caries.

Conclusion

The incidence rate of 19.0% in the four-year school period, in which children were aged 6/7 to 10 years, was observed. There was found a statistical difference with higher incidence rates in females and children with lower father's education.

Authors' Contributions

ACN	 https://orcid.org/0000-0002-6913-0167	Conceptualization, Methodology, Investigation, Writing - Original Draft and Writing - Review and Editing.
JT	 https://orcid.org/0000-0002-7389-985X	Conceptualization, Methodology, Formal Analysis, Investigation, Writing - Original Draft, Writing - Review and Editing and Funding Acquisition.
ET	 https://orcid.org/0000-0001-9667-7216	Conceptualization, Methodology, Formal Analysis, Writing - Original Draft, Writing - Review and Editing and Project Administration.
All authors declare that they contributed to critical review of intellectual content and approval of the final version to be published.		

Financial Support

Fundação de Amparo à Pesquisa e Inovação do Estado de Santa Catarina – Grant number 06/2017.

Conflict of Interest

The authors declare no conflicts of interest.

Data Availability

The data used to support the findings of this study can be made available upon request to the corresponding author.

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