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SOCIOECONOMIC FACTORS ASSOCIATED WITH CLINICAL TOOTH LOSS IN CHILDREN FROM A RURAL SCHOOL IN THE ALTO SERTÃO REGION OF PARAÍBA: A CROSS-SECTIONAL STUDY

FATORES SOCIOECONÔMICOS ASSOCIADOS À PERDA DENTÁRIA CLÍNICA EM CRIANÇAS DE UMA ESCOLA RURAL DO ALTO SERTÃO DA PARAÍBA: UM ESTUDO TRANSVERSAL

FACTORES SOCIOECONÓMICOS ASOCIADOS CON LA PÉRDIDA DENTAL CLÍNICA EN NIÑOS DE UNA ESCUELA RURAL EN LA REGIÓN DEL ALTO SERTÃO DE PARAÍBA: UN ESTUDIO TRANSVERSAL

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ABSTRACT: Dental caries is a multifactorial chronic disease whose progression can compromise the quality of life of children. Socioeconomic conditions can influence oral health, as they affect access to dental care and preventive practices. This study aimed to evaluate the association between socioeconomic factors and tooth loss in children from a rural public school in Paraíba, Brazil. This is a cross-sectional, analytical study conducted with 59 children aged 6 to 12 years. Caregivers answered a questionnaire about socioeconomic conditions and oral hygiene, while the children answered about their oral health. A clinical examination was performed, and the dmft/DMFT index was used as criteria. Data were analyzed using descriptive statistics, Fisher's exact test, and Firth's penalized logistic regression as exploratory analysis. Tooth loss was identified in 5 children. In the bivariate analysis, low income was associated with tooth loss. Low education level of the caregiver, vulnerable location, and never having been to the dentist did not show a statistically significant association. In the adjusted exploratory model, low income showed a higher chance of tooth loss, although with a wide confidence interval. It is concluded that tooth loss was low, but socioeconomic vulnerability may be related to poorer oral health conditions in children.

Keywords: Socioeconomic factors. Dental caries. Tooth loss. Children. Oral health.

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RESUMO: A cárie dentária é uma doença crônica multifatorial cuja progressão pode comprometer a qualidade de vida infantil. Condições socioeconômicas podem influenciar a saúde bucal, pois afetam o acesso ao cuidado odontológico e às práticas preventivas. Este estudo teve como objetivo avaliar a associação entre fatores socioeconômicos e perda dentária em crianças de uma escola pública rural da Paraíba, Brasil. Trata-se de um estudo transversal, analítico, realizado com 59 crianças de 6 a 12 anos. Os responsáveis responderam a um questionário sobre condições socioeconômicas e higiene oral, enquanto as crianças responderam sobre a saúde bucal. Foi realizado exame clínico e utilizou como critérios ceo-d/CPO-D. Os dados foram analisados por estatística descritiva, teste Exato de Fisher e regressão logística penalizada de Firth como análise exploratória. A perda dentária foi identificada em 5 crianças. Na análise bivariada, a baixa renda esteve associada à perda dentária. Baixa escolaridade do responsável, local vulnerável e nunca ter ido ao dentista não apresentaram associação estatisticamente significativa. No modelo ajustado exploratório, a baixa renda apresentou maior chance de perda dentária, porém com amplo intervalo de confiança. Conclui-se que a perda dentária foi baixa, mas a vulnerabilidade socioeconômica pode estar relacionada a piores condições de saúde bucal infantil.

Palavras-chave: Fatores socioeconômicos. Cárie dentária. Perda dentária. Crianças. Saúde bucal.

RESUMEN: La caries dental es una enfermedad crónica multifactorial cuya progresión puede comprometer la calidad de vida de los niños. Las condiciones socioeconómicas pueden influir en la salud bucal, ya que afectan el acceso a la atención dental y las prácticas preventivas. Este estudio tuvo como objetivo evaluar la asociación entre factores socioeconómicos y pérdida dental en niños de una escuela pública rural en Paraíba, Brasil. Este es un estudio transversal y analítico realizado con 59 niños de 6 a 12 años. Los cuidadores respondieron un cuestionario sobre condiciones socioeconómicas e higiene bucal, mientras que los niños respondieron sobre su salud bucal. Se realizó un examen clínico y se utilizó el índice dmft/DMFT como criterio. Los datos se analizaron mediante estadística descriptiva, la prueba exacta de Fisher y la regresión logística penalizada de Firth como análisis exploratorio. Se identificó pérdida dental en 5 niños. En el análisis bivariado, los bajos ingresos se asociaron con la pérdida dental. El bajo nivel educativo del cuidador, la ubicación vulnerable y no haber ido nunca al dentista no mostraron una asociación estadísticamente significativa. En el modelo exploratorio ajustado, los bajos ingresos mostraron una mayor probabilidad de pérdida dental, aunque con un amplio intervalo de confianza. Se concluye que la pérdida dental fue baja, pero la vulnerabilidad socioeconómica podría estar relacionada con peores condiciones de salud bucal en los niños.

Palabras clave: Factores socioeconómicos. Caries dental. Pérdida dental. Niños. Salud bucal.

INTRODUCTION

The socioeconomic profile corresponds to a set of population characteristics that influence living conditions, behaviors, access to health care, and health outcomes. In epidemiological studies, these factors are used to understand social and health inequalities, especially in vulnerable populations. Children living in adverse socioeconomic contexts may experience limited access to health services, reduced availability of hygiene resources, and

greater exposure to unfavorable living conditions, which may increase the risk of oral diseases, including dental caries (Martignon et al., 2021; Yousaf et al., 2022).

Dental caries is a chronic, multifactorial, noncommunicable disease and remains an important public health problem. Its development is associated with biological and social factors, including biofilm accumulation, frequent sugar intake, inadequate oral hygiene, and limited exposure to preventive measures. The caries process results from the mineral dissolution of dental tissues caused by acids produced during the metabolism of fermentable carbohydrates by bacteria. Clinically, caries may range from white spot lesions to cavitated lesions and, if untreated, may progress to extensive destruction of tooth structure (Lešić et al., 2019; Knack; Rigo, 2024; Paredes et al., 2020; Queiroz et al., 2021).

The progression of untreated dental caries may cause pain, infection, functional limitations, and tooth loss. Tooth loss in childhood may compromise occlusion, mastication, and quality of life, affecting daily activities such as eating, sleeping, attending school, and participating in recreational activities (Almahdi et al., 2022; Paredes et al., 2020).

Socioeconomic factors may influence oral health through different pathways. Low income can limit access to dental care, oral hygiene products, and healthier dietary patterns. Caregiver education may also affect oral health literacy, preventive behaviors, and the timely search for dental treatment. In addition, place of residence is relevant, since children living in rural areas may face geographic, economic, and organizational barriers to accessing health services (Chaffee et al., 2017; Franco; Lima; Giovanella, 2021; Martignon et al., 2021).

Oral health is closely related to well-being and quality of life. Oral diseases may result in pain, discomfort, impaired mastication, speech difficulties, and social limitations. Therefore, the identification of socioeconomic inequalities associated with dental caries and tooth loss can support preventive strategies and health promotion actions directed at socially vulnerable children (Albuquerque et al., 2023; Engelmann et al., 2016; Paredes et al., 2020).

Thus, this study aimed to evaluate the association between socioeconomic factors and clinical tooth loss in children from a rural public school in the Alto Sertão region of Paraíba, Brazil.

METHOD

This cross-sectional analytical study was conducted with 59 children aged 6 to 12 years enrolled in a public school located in a rural area of the Alto Sertão region of Paraíba, Brazil,

and their parents or guardians. Non-probabilistic convenience sampling was used, considering eligibility and availability of participants during the data collection period.

Children aged 6 to 12 years, of both sexes, regularly enrolled in the school, and whose participation was authorized by parents or guardians were included. Children with systemic diseases or conditions that could prevent or compromise the clinical examination, children with cognitive impairment that could interfere with questionnaire comprehension, and children undergoing orthodontic treatment were excluded.

Parents or guardians completed a structured questionnaire containing socioeconomic information, including number of household residents, type of housing, place of residence, caregiver education, monthly family income, and oral health-related habits. Children answered a questionnaire on oral habits, dental visits, and self-reported tooth loss.

A clinical oral examination was performed in the school environment to identify dental caries and tooth loss using the dmft/DMFT criteria. For the present analysis, the outcome variable was clinical tooth loss (yes/no), defined by the presence of a tooth coded as lost in the odontogram. The independent variables were child sex, caregiver education, family income, place of residence, and history of dental visits.

Caregiver education was dichotomized into low education and medium/high education. Family income was dichotomized into low income and higher income. Place of residence was categorized as vulnerable area or other areas, and dental visits were categorized as never having been to the dentist or having already been to the dentist. Missing or noninformative responses were excluded from each specific analysis; therefore, denominators may vary across variables.

Data were organized in a spreadsheet and analyzed using statistical software. Descriptive analysis was performed using absolute and relative frequencies for categorical variables and mean and standard deviation for age. Fisher's exact test was used to assess bivariate associations between independent variables and clinical tooth loss, considering the low frequency of the outcome and reduced expected cell counts. A significance level of 5% was adopted.

As an exploratory analysis, a parsimonious Firth penalized logistic regression model was fitted to estimate adjusted odds ratios (OR) and 95% confidence intervals (95% CI) for the association between socioeconomic factors and clinical tooth loss. Due to the small number of events, this adjusted model was interpreted as hypothesis-generating rather than confirmatory.

The study was approved by the Research Ethics Committee of Centro Universitário Santa Maria under protocol number 7.944.810. Parents or guardians signed the informed consent form, and children signed the assent form.

RESULTS

The sample consisted of 59 children, with a mean age of 8.5 years (standard deviation = 1.35). Males predominated, representing 61.0% of the sample. Clinical tooth loss was identified in 5 children, corresponding to 8.5% of the sample (Table 1).

Table 1 – Sample characterization and prevalence of clinical tooth loss

Variable	n (%) or mean ± SD
Age	8.5 ± 1.35
Female	23 (39.0%)
Male	36 (61.0%)
No clinical tooth loss	54 (91.5%)
Clinical tooth loss	5 (8.5%)

Fonte: Autores (2026).

In the bivariate analysis, low family income was statistically associated with clinical tooth loss (p=0.024). Caregiver education, sex, place of residence, and history of dental visits were not statistically associated with tooth loss. However, all cases with complete information for dental visits occurred among children who had never been to the dentist, and all cases with complete information for place of residence occurred among children living in vulnerable areas (Table 2).

Table 2 – Bivariate association between socioeconomic variables and clinical tooth loss

Variable	Category	No loss n (%)	With loss n (%)	p*
Sex	Female	21 (91.3)	2 (8.7)	1.000
	Male	33 (91.7)	3 (8.3)	
Caregiver education	Low	30 (90.9)	3 (9.1)	1.000
	Medium/high	17 (94.4)	1 (5.6)	
Family income	Low	17 (81.0)	4 (19.0)	0.024
	Higher income	30 (100.0)	0 (0.0)	
Place of residence	Vulnerable area	45 (91.8)	4 (8.2)	1.000
	Other areas	2 (100.0)	0 (0.0)	
Dental visits	Never been	46 (90.2)	5 (9.8)	1.000
	Already been	8 (100.0)	0 (0.0)	

*Two-tailed Fisher's exact test.

Fonte: Autores (2026).

Note: Differences in totals between variables are due to missing or noninformative responses in some categories.

In the exploratory Firth penalized logistic regression model, low family income showed increased odds of clinical tooth loss, although the association did not reach conventional statistical significance after adjustment and presented a wide confidence interval (OR=15.73; 95% CI: 0.86–286.73; p=0.063). Low caregiver education was not associated with clinical tooth loss in the adjusted exploratory model (Table 3).

Table 3 – Exploratory Firth penalized logistic regression model for clinical tooth loss

Variable	Adjusted OR	95% CI	p*
Low caregiver education	1.63	0.20–13.57	0.649
Low family income	15.73	0.86–286.73	0.063

*Parsimonious Firth penalized logistic regression. Complete-case exploratory analysis (n=51; events=4).

Fonte: Autores (2026).

Note: The model was interpreted as hypothesis-generating due to the small number of events.

DISCUSSION

The present study found a low frequency of clinical tooth loss among children from a rural public school in the Alto Sertão region of Paraíba. In the bivariate analysis, low family income was associated with tooth loss. In the exploratory adjusted analysis, low income showed increased odds of tooth loss, although with wide uncertainty and without conventional statistical significance. These findings suggest that socioeconomic vulnerability may be related to poorer oral health conditions in children, but the results should be interpreted cautiously due to the small number of events.

Family income is an important social determinant of oral health. Low income may limit access to dental services, oral hygiene products, preventive care, and healthier dietary patterns. These conditions may contribute to delayed diagnosis and treatment of dental caries, increasing the risk of complications such as tooth loss. Previous studies have reported that socioeconomic inequalities are associated with higher caries experience, poorer oral health-related quality of life, and greater vulnerability to untreated oral diseases (Chaffee et al., 2017; Costa et al., 2013; Melo et al., 2019; Yousaf et al., 2022).

Caregiver education was not statistically associated with clinical tooth loss in this analysis. Nevertheless, this variable remains relevant from a public health perspective because education may influence oral health literacy, preventive behaviors, and decisions regarding

dental care. Children often reproduce family habits, including oral hygiene practices and patterns of dental service use, which may affect their oral health over time. Previous studies also indicate that oral health knowledge, family structure, maternal or caregiver education, and sociodemographic conditions are related to caries experience and oral health behaviors in children and adolescents (Bastianini et al., 2019; Brito et al., 2020; Corrêa et al., 2020; Dag et al., 2021; Engelmann et al., 2016; Lopes et al., 2021; Nembhwani; Varkey, 2022).

The rural context of the study should also be considered. Although place of residence was not statistically associated with tooth loss, all cases with complete information occurred among children living in vulnerable areas. Children in rural settings may face geographic, economic, and organizational barriers to accessing dental care. These barriers can delay diagnosis and treatment and reinforce inequalities in oral health. The concentration of specialized services in urban areas may also hinder continuous follow-up of children from remote communities, increasing the importance of school-based and collective health promotion actions (Akinyamoju et al., 2018; Arrais; Roncalli; Rosendo, 2021; Franco; Lima; Giovanella, 2021).

The history of dental visits was not statistically associated with clinical tooth loss. However, all tooth loss cases occurred among children who had never been to the dentist. This pattern may indicate that lack of regular dental care can contribute to disease progression, although the small number of events prevents stronger conclusions. Preventive dental visits, early diagnosis, and timely treatment are essential to avoid the progression of caries lesions and their consequences, especially in primary care and school-based contexts (Jardim et al., 2020).

These results reinforce that oral health in childhood should not be understood only as a biological condition. Tooth loss and dental caries are influenced by social, economic, behavioral, and contextual factors. Therefore, prevention should combine clinical strategies, such as early diagnosis and minimally invasive treatment, with health education and actions aimed at reducing social inequalities.

This study has limitations. Its cross-sectional design does not allow causal inference. The sample was selected by convenience from a single rural school, limiting generalizability. The small number of clinical tooth loss cases reduced statistical power and produced wide confidence intervals, especially in the adjusted model. In addition, some socioeconomic

variables had missing or noninformative responses, resulting in different denominators across analyses.

Despite these limitations, the study has clinical and social relevance because it integrates clinical oral health assessment with socioeconomic information in a rural and socially vulnerable school population. The use of Fisher's exact test was appropriate for sparse data, and the Firth penalized model was used only as an exploratory approach to reduce small-sample bias. The findings may support local oral health promotion strategies focused on vulnerable children and their families.

FINAL CONSIDERATIONS

Clinical tooth loss was infrequent among the children evaluated. However, low family income was associated with tooth loss in the bivariate analysis and showed increased odds in the exploratory adjusted model, although with wide uncertainty. These findings reinforce the role of socioeconomic vulnerability in children's oral health and highlight the need for preventive strategies, oral health education, and improved access to dental services, especially in rural and socially vulnerable populations. Early identification of oral problems and school-based health promotion actions may contribute to reducing inequalities and improving children's quality of life.

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