ORIGINAL ARTICLE

CARIES PREVALENCE AND ASSOCIATED FACTORS IN CHILDREN FROM PUBLIC VERSUS PRIVATE SCHOOLS: CROSS-SECTIONAL STUDY

Ieda Xavier Guedes[1]; Franklin Delano Soares Forte[2]; Valdelias Xavier Pereira[3]
Marcelle Matos Nascimento[4]; Gabriel Zorello Laporta[5]

Highlights:

1. Higher caries prevalence in public vs. private schools at ages 5 and 12.

2. Low-income children and public-school attendees have higher caries risk.

3. School dental care reduces caries in 5-year-old children.

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[1] Centro Universitário Faculdade de Medicina do ABC – FMABC. Santo André/ SP, Brazil. https://orcid.org/0000-0002-7276-6473

[2] Universidade Federal da Paraíba. João Pessoa/PB, Brazil. https://orcid.org/0000-0003-4237-0184

[3] Centro Universitário Faculdade de Medicina do ABC – FMABC. Santo André/ SP, Brazil. https://orcid.org/0000-0002-7700-7708

[4] University of Florida, Gainesville, FL, USA. https://orcid.org/0000-0002-9536-0038

[5] Centro Universitário Faculdade de Medicina do ABC – FMABC. Santo André/ SP, Brazil. https://orcid.org/0000-0001-7412-9390

ABSTRACT

Introduction: Childhood caries remains a major public health issue in Brazil's impoverished communities. Although government-sponsored programs have targeted improvement of oral health in children from public schools, more information is needed on the effectiveness of these programs. *Objective*: The objective was to analyze the prevalence and factors associated with caries in children aged 5 and 12 years in public versus private schools. *Methods*: This cross-sectional study included 857 children aged 5 (*n*=509) and 12 years (*n*=348) who attended public (*n*=416) or private (*n*=441) schools in Patos, PB-Brazil. Between March–September 2018 we examined caries from this study population using the DMFT/dmft index and obtained data on its demographics, toothbrushing frequency, socioeconomic status and schools' oral health program and services via questionnaires. Statistical analyses were performed using multiple logistic regression ($p<0.05$). *Results*: Among 5-years-old children from public vs private schools, untreated caries prevalence was 51.5% (*n*=117) vs 28.4% (*n*=80) and dmft index, 2.34 vs 1.04. In 12-years-old children, untreated caries prevalence of 41.3% (*n*=78) and DMFT index=0.99 in public and of 22% (*n*=35) and DMFT index=0.50 in private schools were observed. Public school children showed 2.19 (5-years-old) and 2.41 (12-years-old) higher caries odds than private school children ($p<0.01$). Among 5-years-old children, caries odds were 3.6 higher in low-income households ($p=0.025$) and 42% lower in children who received periodical dental visits at schools ($p=0.011$). *Conclusion*: Children aged 5 and 12 from public schools had higher caries odds than children from private schools. At 5 years old, households with higher incomes and access to dental care in public schools can decrease the odds of dental caries.

Keywords: dental caries, pediatric dentistry, preventive dentistry, public health practice.

PREVALÊNCIA E FATORES ASSOCIADOS À CARIE DENTÁRIA EM CRIANÇAS DE ESCOLAS PÚBLICAS E PARTICULARES: ESTUDO TRANSVERSAL

RESUMO

Introdução: A cárie infantil é problema de saúde pública nas comunidades carentes do Brasil. Embora existam programas de governo para a melhoria da saúde bucal de crianças de escolas públicas, são necessárias mais informações sobre a eficácia desses programas. *Objetivo*: O objetivo aqui foi analisar a prevalência e os fatores associados à cárie em crianças de 5 e 12

anos em escolas públicas e particulares. *Métodos*: O presente estudo transversal incluiu 857 crianças de 5 (*n*=509) e 12 anos (*n*=348) que frequentavam escolas públicas (*n*=416) ou particulares (*n*=441) em Patos/PB, Brasil. Entre março e setembro de 2018 examinamos a cárie nessa população de estudo usando o índice CPOD/cedo e obtivemos dados demográficos dessas crianças, sua frequência de escovação, seu status socioeconômico e os serviços de saúde bucal de suas escolas por meio de questionários. As análises estatísticas foram realizadas por meio de regressão logística múltipla ($p<0,05$). *Resultados*: A prevalência de cárie não-tratada e o índice ceod observados em crianças de 5 anos de idade foram de 51,5% (*n*=117) e 2,34 em escolas públicas e de 28,4% (*n*=80) e 1,04 em escolas particulares. Em crianças de 12 anos, observou-se prevalência de cárie não-tratada de 41,3% (*n*=78) e índice CPOD=0,99 na rede pública e de 22% (*n*=35) e índice CPOD=0,50 na rede particular. As crianças de escolas públicas tiveram chances de cárie 2,19 (5-anos) e 2,41 (12-anos) vezes maiores ($p<0,01$), em comparação com as de escolas particulares. Entre as de 5 anos, as chances de cárie foram 3,6 vezes maiores em domicílios de baixa renda ($p=0,025$) e 42% menores se recebiam visitas de profissionais de saúde bucal na escola ($p=0,011$). *Conclusão*: Escolas públicas apresentam maiores chances de cárie dentária em crianças de ambas as idades. Crianças de 5 anos de idade possuem maiores chances de cárie em famílias de baixa renda e menores chances de cárie em escolas com acesso ao atendimento odontológico.

Palavras-chave: cárie dentária, odontopediatria, odontologia preventiva, prática de saúde pública.

INTRODUCTION

Untreated caries lesions leading to pain, chewing discomfort, sleep difficulties, and aesthetic problems can have severe consequences on children's quality of life, education, and growth[1-6]. The global prevalence of untreated dental caries among 5-years-old and 12-years-old children has declined over the last decades, with the lowest prevalence reported among 12-year-olds from high-income countries[7]. This general pattern, however, often masquerade inequalities in oral health from these countries and, particularly, from developing countries, as Brazil [4,6]. Therefore, childhood caries remains a major public health problem in low- and middle-income countries in which socioeconomic inequalities and limited access to oral health services continue[1,3].

In Brazil, the decline of caries prevalence for certain age groups has been attributed to improved access to education, income, and life expectancy[8] as well as to the implementation of oral health care programs and policies by the Brazilian government[9]. Nonetheless, the last national survey of oral health revealed that caries still affects 53.4% and 56.5% of Brazilian children aged 5 and 12 years, respectively, in 2010[10]. The 2004 Oral Health National Policy[11] and the 2007 School Health Program (SHP)[12] are public policy landmarks that were implemented by the Brazilian government to address social inequalities and promote oral health in the country. The Oral Health National Policy increased the financial resources and staff available to provide oral health care within the public health system. More specifically, this program offered educational and preventive dentistry actions to pregnant women and infants as well as group activities and home visits for children at high caries risk[11]. The SHP's main goals are to promote health and prevent diseases, and to assist schoolchildren in the public school system[12]. This program can help in the prevention of caries prevalence among public school children by improving their education on oral health and access to dental care. Whereas these nationwide programs were effective at expanding free and public access to dental care, their overall impact on caries prevalence remains to be evaluated.

There are primarily two types of schools in Brazil, public and private schools[13]. Public schools are fully funded by the Government while private schools are funded by individuals or other entities not affiliated with the Government[13]. There are key differences between these two types of schools ranging from the quality of education to the conditions of the learning facilities[13]. Private schools have a more advantaged student population, more material resources, fewer teacher shortages and better disciplinary climate than public schools[14]. The substantial higher quality of education and well-being offered by private schools[13,14] may explain why families of low income may opt to enroll their children into private schools. While the quality of education of public versus private schools has been the subject of extensive public health studies[13], there is limited information on whether the type of school system can be correlated with the prevalence of childhood caries.

It is important to note that the type of school is often a marker of the family's social condition. It is known that socioeconomically disadvantaged families have less access to health information and to dental services in general[15,16], have less health literacy[17-19] and less family cohesion[20], have unfavorable school environment and less satisfaction with the last dental appointment[21], and have increased effects from sugar intake to dental caries[22], and altogether

these factors can have a direct impact on the occurrence of dental caries. Accordingly, the objective was to analyze the prevalence and factors associated with caries in children aged 5 and 12 years in public versus private schools.

METHODS

Study Design and Participants

This cross-sectional is reported based on the STROBE guideline[23] and was designed to assess the following parameters in the sampled population: (1) age group (5 or 12 years-old), (2) type of school (public or private), (3) DMFT and dmft indexes, (4) associated caries factors, and (5) oral health program and services offered at schools. The selection process included all children ages 5 and 12 from the participating schools who were willing to receive an oral examination at the study visit, and whose parents or legal guardians signed the research informed consents and completed the study questionaries.

Patos is a regional economic hub for nearby counties with a population of 108,000 habitants, human development index of 0.701, and per capita income of US$187 per month[24] in which community water is not supplemented with fluoride. In Patos, the Oral Health National Policy and SHP federal programs are offered at public but not at private schools. However, a few private schools can provide certain dental care services to their students such as oral examinations and distribution of topical fluoride.

The study protocol was approved by the Research Ethics Committee of the University of Patos (CAAE 65020617.2.0000.5181, approved on April 18th, 2017). The participants' parents or legal guardians signed an informed consent form, and the participants signed an agreement consent form (Supplementary Material–Ethics Review Board Opinion).

Sampling and Sample Size

The study was initially designed to be a census study with the target accessible population composed by all children in both age groups from 100% of Patos's private schools (22 private schools) and 100% of Patos's public municipal schools (20 public municipal schools) at the time of the study.

The minimum sample size for the estimation of prevalence of caries was calculated using the following:

$$n^* = z^2_{\frac{\alpha}{2}} \frac{P(1-P)}{\epsilon^2} = 384$$

where n^* is the minimum sample size of 384, $z_{\frac{\alpha}{2}} = 1.96$ means 95% confidence interval, $P = 0.50$ is 50% prevalence of caries assumed *a priori* according to[10]; and $\epsilon = 0.05^2$ means 5% tolerated error in estimating prevalence.

In addition, the statistical power of the obtained sample was calculated for two-sided statistical testing, i.e. when two values of prevalence are compared (H_0: P_1=P_2 and H_A: $P_1 \neq P_2$) or when an odds ratio is estimated, as follows:

$$z_\beta = \frac{\frac{\sqrt{n}}{P_1 - P_2} - z_{\frac{\alpha}{2}}\sqrt{2\bar{P}(1-\bar{P})}}{\sqrt{P_1(1-P_1) + P_2(1-P_2)}}$$

$$Prob(z_\beta) = The\ test\ power$$

where $Prob(z_\beta)$ is the statistical power given the obtained sample, $z_{\frac{\alpha}{2}} = 1.96$ is 95% confidence interval, $P_1 = 50\%$ and $P_2 = 40\%$ are values of prevalence of caries assumed *a priori*, and $\bar{P} = \frac{P_1 + P_2}{2}$.

More information on the equations to estimate minimum sample sizes and statistical power of epidemiological studies can be found in the following textbook[25].

Instruments and Procedure

Clinical examination for caries diagnosis was performed by one examiner (I.X.G., the first author) using the World Health Organization (WHO) criteria[26] and the study form in all schools between March and September of 2018. To test intra-examiner concordance, a total of 15 children were examined twice within a 15-days interval. The Kappa statistic test values between the first and the second exams were above 0.90 for both age groups showing concordance and reproducibility of the criteria adopted[27]. Prior to examination, dental plaque was removed by asking the children to brush their teeth with a fluoride toothpaste. To determine caries prevalence, DMFT (number of decayed, missing, filled in permanent teeth) index was used for the 12 years-old group and the dmft (number of decayed, missing, filled in primary teeth) index was used for the 5 years-old. Parent administered questionnaires were used to collect information about the: (a) educational level of the head of household, (b) family monthly income, (c) number of residents on the student's home, and (d) child's oral health habits (frequency of brushing and use of fluoride toothpaste)[28,29]. Teachers or directors of each

participating school answered a questionnaire related to services provided by the school such as oral health education, caries prevention activities, and dental care services[10]. The research tool for caries diagnosis and questionnaires are available herein (Supplementary Material– Research Instrument).

Data analysis

Firstly, exploratory analysis was undertaken with Chi-squared tests for the comparison between the prevalence of caries in the public vs private schools (α = 0.05). Then, a confirmatory analysis based on generalized linear model having a dependent variable *y* as a binary event (caries = Yes, caries = No) in function of 10 independent variables $X_1 + \ldots + X_{10}$ was applied, as follows:

$$Prob(y = 1) = \frac{exp^{\beta_0+\beta_1X_1+\cdots+\beta_{10}X_{10}}}{(1 + exp^{\beta_0+\beta_1X_1+\cdots+\beta_{10}X_{10}})}, \epsilon \sim Binomial(p, N)$$

where $Prob(y = 1)$ is the probability of caries, X_1=type of institution (public vs private schools), X_2=child's sex (boys vs girls), X_3=education level of the head of household (high school vs college), X_4=education level of the head of household (middle school vs college), X_5=family monthly income (US$400-800/mo. vs >US$800/mo.), X_6=family monthly income (<US$400/mo. vs >US$800/mo.), X_7=number of residents in child's home (> 4 residents vs ≤ 4 residents), X_8=frequency of toothbrushing (1-2x daily vs 3-4x daily), X_9=oral health education at school (yes vs no), and X_{10}=periodical dental visits at school (yes vs no).

This model was run with binomial errors ϵ whose parameters *p* and *N* represents the prevalence of caries, i.e. *p*=number of children with caries and *N*=total of children examined. Dichotomization of variable was based on a cut-off that divides it in equal groups (below the median=group1; above the median=group 2).

This generalized linear model is also known as multiple logistic regression modelling because its outcome is equivalent to odds ratio:

$$Prob(y = 1) = \frac{1}{(1 + exp^{-(\beta_0+\beta_1X_1+\cdots+\beta_{10}X_{10})})}$$

where exponential of coefficient β results in an estimate of odds ratio, as follows:

$$OR(X) = \exp(\beta)$$

Accordingly, the odds ratio (*OR*) for caries (yes=1, no=0) as the response variable was estimated with 95% confidence intervals (CI) adjusted per each associated factors for dental

caries (abovementioned independent variables) with α = 0.05. If the adjusted *OR* 95% CI of caries and an associated factor exceeds 1, a reciprocal association is interpreted (more of this factor means more caries). If adjusted *OR* 95% CI <1, a protective association is interpreted. Lastly, if adjusted *OR* 95% CI contains 1, a null effect is interpreted.

Multiple logistic regression analysis and Chi-squared tests were applied using *R* v. 3.5.1 (*R* project for statistical computing; www.r-project.org).

RESULTS

A total of 857 children ages 5 (*n*=509) and 12 years (*n*=348) from the city of Patos (Paraiba State), Brazil, participated on the study. All parents or legal guardians of the children (*N*=2,492) were invited. As a result, one-third (*n*=857; 34.4%) responded and thus consented their children to participate in this study. Participation rate of public-school children (33.4%; *n*=416 vs *N*=1,247) was quantitatively alike to that of private-school children (35.4%; *n*=441 vs *N*=1,245). Participation rate of school children aged 5 years was 47.5% (*n*=509 vs *N*=1,071), whereas it was 24.5% among 12-years-old school children (*n*=348 vs *N*=1,421). Specific values of participation rate per school were provided in Table 1.

The obtained sample *n*=857 was considered sufficiently large to estimate prevalence of caries as it exceeded the minimum sample size of 384 by 2.23-fold. Both two-sided statistical testing applied in this study, Chi-squared test and multiple logistic regression, have the statistical power of 99% because $Prob(z_\beta) = 0.9865$, given the obtained sample of 857 children.

Table 1: Children's response rates per type of school and age groups, March–Sept. 2018.

Name of Participating School	Type of School	Age Groups (years)	Participating Children (n)	Total of Children (N)	Participation Rate (%)
Alegria de Ler	Private	5	18	40	45
Antônio Guedes	Public	5	8	23	35
Antônio Guedes	Public	12	3	21	14
Banana de Pijamas	Private	5	20	42	48
Centro Educacional Estrela Dalva	Private	5	13	19	68
Centro Educacional Millennium	Private	12	32	94	34
Colégio Autêntico	Private	5	6	11	55
Colégio Autêntico	Private	12	3	11	27
Colégio Cristo Rei	Private	5	11	47	23
Colégio Cristo Rei	Private	12	26	71	37
Criança Feliz	Private	5	10	11	91
Dr. Dionísio da Costa	Public	12	30	86	35
Educandário Luísa Feitosa	Private	5	7	16	44
Educandário Luísa Feitosa	Private	12	8	15	53
Educandário Traços e Letras	Private	5	12	21	57
EEEF Rio Branco	Public	12	22	44	50
EMEF Aggeu de Castro	Public	5	17	25	68
EMEF Aggeu de Castro	Public	12	10	16	63
EMEF Dom Expedito Eduardo Oliveira	Public	5	18	22	82
EMEF Dom Expedito Eduardo Oliveira	Public	12	3	52	6
EMEF Manoel Roberto	Public	5	14	20	70
EMEF Manoel Roberto	Public	12	2	32	6
EMEF Monsenhor Manoel Vieira	Public	12	38	158	24
EMEF Nosso Lar Tio Juca	Public	12	3	25	12
EMEF Nosso Lar Tio Juca	Public	5	16	40	40
EMEF Sabino Ferreira	Public	5	15	27	56
EMEF Sabino Ferreira	Public	12	3	31	10
EMEF Senador Humberto Lucena	Public	5	20	28	71
EMEF Senador Humberto Lucena	Public	12	2	45	4
Gente Inocente	Private	5	11	12	92
Gente Inocente	Private	12	6	16	38
Geo	Private	5	29	164	18
Geo	Private	12	21	114	18
Instituto Educacional Branca de Neve	Private	5	14	57	25
Instituto Educacional Dentinho de Leite	Private	5	8	12	67
Instituto Educacional Diego Dantas	Private	5	14	42	33
Instituto Educacional Diego Dantas	Private	12	15	84	18
Instituto Educacional Maria do Socorro	Private	5	29	52	56
Instituto Educacional Maria do Socorro	Private	12	11	24	46
Instituto Educacional Pingo de Mel	Private	5	12	30	40
Instituto São José	Private	5	15	24	63
Instituto São José	Private	12	8	22	36
João Rodrigues	Public	12	15	64	23
Maria das Chagas	Public	5	14	28	50
Maria das Chagas	Public	12	7	47	15
Maria Nunes	Public	12	21	71	30
Nelita Rodrigues	Public	5	20	22	91
Nelita Rodrigues	Public	12	5	21	24
Paraíso do Pequeno	Private	5	5	12	42
Pequeno Gênio	Private	5	14	17	82
Radialista Paulo Porto	Public	5	9	15	60
Radialista Paulo Porto	Public	12	1	15	7
Raimunda Melo	Public	5	12	24	50
Raimunda Melo	Public	12	1	20	5

Table 1: *Continuation*

Name of Participating School	Type of School	Age Groups (years)	Participating Children (n)	Total of Children (N)	Participation Rate (%)
Renascer	Private	12	9	51	18
Rotary	Public	5	22	33	67
Rotary	Public	12	2	34	6
Sizenando Flórido	Public	5	14	28	50
Sizenando Flórido	Public	12	3	33	9
Tobias Medeiros	Public	5	17	28	61
Tobias Medeiros	Public	12	2	25	8
Turma da Mônica	Private	5	12	30	40
Vera Cruz	Private	12	20	51	39
Vera Cruz	Private	5	22	33	67
Zefinha Motta	Public	5	11	16	69
Zefinha Motta	Public	12	16	28	57

Exploratory Analysis

Tables 2 and 3 present the distribution of the study variables for the 5 years and 12 years-old study groups, respectively, according to the types of school. The dmft index for 5 years-old children was 2.34 in public vs 1.04 in private schools, whereas the DMFT index for 12 years-old children was 0.99 in public vs 0.50 in private schools. Untreated caries prevalence in all participating children was 36.2% (n=310/N=857), with higher prevalence observed in 5-years-old (38.7%) vs 12-years-old (32.5%) children, and in those attending public (46.9%) vs private (26.1%) schools. The subsequent confirmatory analysis identifies the underlying factors contributing to these differences and evaluates whether these differences can be reduced.

Table 2: Distribution of study variables in the 5 years-old group per public vs private schools, Patos, PB-Brazil, March–Sept. 2018.

Variables	Categories	5 years-old Public Schools	5 years-old Private Schools	Chi-squared test
Presence of dental caries	Yes	117 (51.5%)	80 (28.4%)	$\chi^2 = 28.50$
	No	110 (48.5%)	202 (71.6%)	$p < 0.001$
dmft[1]	7+	11 (4.8%)	1 (0.4%)	
	5–6	36 (15.8%)	24 (8.5%)	
	3–4	54 (23.8%)	32 (11.3%)	
	1–2	16 (7.1%)	23 (8.2%)	$\chi^2 = 39.26$
	0	110 (48.5%)	202 (71.6%)	$p < 0.001$
Sex	Boy	114 (50.2%)	164 (58.2%)	$\chi^2 = 3.20$
	Girl	113 (49.8%)	118 (41.8%)	$p = 0.070$
Highest educational level of the head of household	Middle school	130 (57.3%)	62 (22.0%)	
	High school	80 (35.2%)	143 (50.7%)	$\chi^2 = 75.11$
	College	17 (7.5%)	77 (27.3%)	$p < 0.001$
Family monthly income	(<US$400/mo.)	225 (99.1%)	192 (68.1%)	
	(US$400–800/mo.)	2 (0.9%)	57 (20.2%)	$\chi^2 = 81.90$
	(>US$800/mo.)	0.0%	33 (11.7%)	$p < 0.001$
N° of residents on child's home	> 4	105 (46.3%)	91 (32.3%)	$\chi^2 = 10.40$
	≤ 4	122 (53.7%)	191 (67.7%)	$p = 0.001$
Frequency of toothbrushing	1-2 times/day	146 (64.3%)	167 (59.2%)	$\chi^2 = 1.38$
	3-4 times/day	81 (35.7%)	115 (40.8%)	$p = 0.240$
Oral health education at school	Yes	129 (56.8%)	213 (75.5%)	$\chi^2 = 19.96$
	No	98 (43.2%)	69 (24.5%)	$p < 0.001$
Periodical dental visits at school	Yes	155 (68.3%)	160 (56.7%)	$\chi^2 = 7.10$
	No	72 (31.7%)	122 (42.3%)	$p = 0.007$

[1]dmft (number of decayed, missing, filled in primary teeth).

Table 3: Distribution of study variables in the 12 years-old group per public vs private schools, Patos, PB-Brazil, March–Sept. 2018.

Variables	Categories	12 years-old Public Schools	12 years-old Private Schools	Chi-squared test
Presence of dental caries	Yes	78 (41.3%)	35 (22.0%)	$\chi^2 = 14.60$
	No	111 (58.7%)	124 (78.0%)	$p < 0.001$
DMFT[1]	5	2 (1.1%)	2 (1.3%)	
	3–4	32 (16.9%)	10 (6.3%)	
	1–2	44 (23.3%)	23 (14.5%)	$\chi^2 = 16.36$
	0	111 (58.7%)	124 (77.9%)	$p < 0.001$
Sex	Boy	87 (46.0%)	77 (48.4%)	$\chi^2 = 0.20$
	Girl	102 (54.0%)	82 (51.6%)	$p = 0.660$
Highest educational level of the head of household	Middle school	121 (64.0%)	25 (15.7%)	
	High school	44 (23.3%)	69 (43.4%)	$\chi^2 = 85.59$
	College	24 (12.7%)	65 (40.9%)	$p < 0.001$
Family monthly income	(<US$400/mo.)	186 (98.4%)	85 (53.5%)	
	(US$400–800/mo.)	3 (1.6%)	58 (36.5%)	$\chi^2 = 101.40$
	(>US$800/mo.)	0.0%	16 (10.0%)	$p < 0.001$
N° of residents on child's home	> 4	97 (51.3%)	27 (17.0%)	$\chi^2 = 44.40$
	≤ 4	92 (48.7%)	132 (83.0%)	$p < 0.001$
Frequency of toothbrushing	1-2 times/day	79 (41.8%)	80 (50.3%)	$\chi^2 = 2.52$
	3-4 times/day	110 (58.2%)	79 (49.7%)	$p = 0.110$
Oral health education at school	Yes	114 (60.3%)	71 (44.7%)	$\chi^2 = 8.51$
	No	75 (39.7%)	88 (55.3%)	$p = 0.004$
Periodical dental visits at school	Yes	138 (73.0%)	36 (22.7%)	$\chi^2 = 87.65$
	No	51 (27.0%)	123 (77.3%)	$p < 0.001$

[1]DMFT (number of decayed, missing, filled in permanent teeth).

Confirmatory Analysis

Table 4 shows the multiple logistic regression analysis of the presence of caries in 5 years-old children and in 12 years-old children as a function of the study variables.

In the 5 years-old group, the adjusted *OR* of caries was 2.19 higher in public vs private-school children (95%CI=1.4-3.43; $p<0.001$). The analysis further shows that family income of less than US$400 per month was a significant contributor to caries (adjusted *OR*=3.56;

95%CI=1.17-10.85; *p*=0.025). Moreover, dental care visits at schools significantly decreased the likelihood of caries (adjusted *OR*=0.58; 95%CI=0.39-0.88; *p*=0.011).

As for the 12-years-old group the only predictor of caries was the type of school with the adjusted odds ratio of caries being 2.41 higher in children from public vs private schools (*OR*=2.41; 95%CI=1.22-4.75; *p*=0.012).

Table 4: Multiple logistic regression analysis of presence of dental caries in the 5 years-old group and 12-years-old group as a function of the study variables, Patos, PB-Brazil, March–Sept. 2018.

Explanatory variables of caries (yes vs no)	**5 years-old**		**12 years-old**	
	Adj *OR* (95%CI)	***P***	**Adj *OR* (95%CI)**	***P***
Type of institution:				
public vs private schools	2.19 (1.4-3.43)	< 0.001*	2.41 (1.22-4.75)	0.012*
Sex:				
boys vs girls	0.84 (0.57-1.25)	0.393	0.72 (0.45-1.15)	0.172
Education level of the head of household:				
High school vs College	1.08 (0.62-1.91)	0.780	0.9 (0.47-1.72)	0.750
Middle school vs College	1.05 (0.57-1.93)	0.870	1.11 (0.57-2.17)	0.760
Family monthly income:				
(US$400-800/mo.) vs (>US$800/mo.)	1.78 (0.51-6.22)	0.364	0.51 (0.15-1.78)	0.289
(<US$400/mo.) vs (>US$800/mo.)	3.56 (1.17-10.85)	0.025*	0.52 (0.15-1.73)	0.285
Number of residents in child's home:				
> 4 residents vs ≤ 4 residents	1.02 (0.69-1.51)	0.936	0.84 (0.5-1.41)	0.510
Frequency of toothbrushing:				
1-2x daily vs 3-4x daily	0.85 (0.57-1.25)	0.400	0.98 (0.61-1.57)	0.934
Oral health education at school:				
yes vs no	0.74 (0.48-1.12)	0.154	0.9 (0.49-1.65)	0.732
Periodical dental visits at school:				
yes vs no	0.58 (0.39-0.88)	0.011*	1.22 (0.61-2.46)	0.569

Adj *OR*: odds ratios adjusted from a multiple logistic regression model; CI: confidence intervals; and *: statistically significant explanatory variable (*p*=Wald's *p*; < 0.05).

DISCUSSION

One of the most significant findings of this study was the higher prevalence of caries observed in public school children as compared to private school children ages 5 and 12 years from Patos, PB-Brazil. Children enrolled in public schools exhibited twice the likelihood of developing cavities when accounting for other relevant factors, in contrast to those attending private schools.

Another important finding was the significant association between caries experience and low family income among 5 years-old children attending either public or private schools. In this study, nearly all the kids in public schools come from low-income families. Among private school children, two-thirds of 5-year-olds and half of 12-year-olds are from low-income backgrounds. Our findings substantiate the current evidence that low socioeconomic status is associated with increased chances for caries development[30,31]. A metanalysis suggested that individuals who were socioeconomically deprived has higher caries experience, and this association is stronger in developed countries, including Brazil[30]. Socioeconomic inequalities continue as a major driver of poor access to dental care in Brazil[32]. Children with poor oral hygiene habits and lacking access to dental care and fluoridated-water are the most affected by caries disease[33]. Previous studies have suggested potential reasons for the association between low family income and caries experience[30,34,35]. Parental educational levels frequently determine the level of family income[36], which has a direct impact on access to dental care as well as to home or professional preventive means such as toothpastes, dental floss, and low-sugar diets[37]. Educational levels also impact health literacy and behavior, including dietary and oral hygiene habits, as well as frequency and patterns of utilization of health service such as dental sealants[36]. Importantly, socioeconomic status and access to health care are interrelated drivers of health and part of a complex "eco-social" framework of macroenvironmental (political, economic, social), community-level, and individual-level factors[30].

The global burden of childhood caries is evident[3,38]. Also evident is the impact of government policies on the provision of oral health care to populations[32]. The outcomes of public health measures and oral health community strategies across different countries can certainly support the implementation of new strategies to be adopted at a national level by other countries, or at a global level, as a systemwide reform of the global oral health care system[3]. The urgent need for a more robust oral healthcare system is more evident under the COVID-19 epidemic with oral health service being among the most disrupted essential health services.

Caries prevention associated with the periodical dental care services offered at public schools is a remarkable achievement from the oral health programs sponsored by the Brazilian government as periodical visits from dentists tend to stimulate students to achieve improved oral hygiene[39]. Dental health services provided in both public or private schools were basically aimed at prevention of dental caries, including fluoride application and oral hygiene instructions. At the time of this study, two-thirds of 5-year-old children in public schools and half in private schools were getting dental care at their schools. The likelihood of developing cavities significantly reduced by this school-based intervention, which somewhat offset the strong influence of low family income on cavity formation. Interestingly, neither receiving oral health services at school nor the family's monthly income had any impact on the likelihood of cavities in 12-year-old children who participated in our study. The most critical factor influencing cavities among these children was simply the type of school they attended. Simply attending a public school significantly raised the risk of developing cavities, even after accounting for all other factors in the study. It is not to say the public school itself promotes caries among these pre-teenagers, but perhaps the contextual low socioeconomic status seen in students from public schools might support higher odds of caries[40-42]. A recent study conducted with 12 years-old Brazilian children highlighted the importance of considering the school environment, socioeconomic status, and oral health literacy when planning school-based caries preventive programs[21]. Despite the expanded coverage of oral health policies across the country, there remains considerable room for improvement in childhood oral health care access in Brazil[43]. Clearly, sustainable positive changes in Brazilian children can only be achieved by reducing socioeconomic inequalities and improving people's overall quality of life.

A notable finding of this study lies in the favorable consequences stemming from enhanced dental care accessibility, facilitated through regular visits by dentists within both the public and private school systems. This accessible approach, which has significantly curtailed the likelihood of dental caries among 5-year-old children, is an encouraging outcome. In the realm of caries prevention, various support mechanisms exist, including privately funded initiatives within private schools and government-sponsored programs such as the National Oral Health Policy[11] and the School Health Program[12], which cater to public school settings.

Notwithstanding these efforts, there persists an exigent demand for the development and implementation of more efficacious strategies aimed at preventing caries and fostering oral health, particularly in the context of public schools[10-12]. The urgency for such strategies extends

to encompass children from lower socioeconomic backgrounds attending private schools in Brazil. This highlights the necessity for a comprehensive approach to tackle oral health disparities, ensuring that all segments of the population, regardless of their socioeconomic status, have access to the tools and resources essential for maintaining good oral health.

The observable pattern of expected answers on toothbrushing frequency differing from other studies in the same region[24] underscores the questionnaire's notable limitation. This may explain why the study's high toothbrushing frequency did not correlate with decreased caries prevalence. Alternatively, if the observed high toothbrushing frequency is true, it may be followed by the lack of fluoride-based pastes, which can modulate the association of caries and sugar intake in low-income settings[22].

CONCLUSION

Our findings revealed that children ages 5 and 12 attending public schools present nearly double the prevalence of dental caries as compared to those attending private schools in Patos, PB-Brazil. In addition, low family income and social inequality remain as the main factors associated with poor oral health conditions among schoolchildren.

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Ieda Xavier Guedes: Conceptualization, Data curation, Investigation, Methodology, Project administration, Resources, Writing – original draft.

Franklin Delano Soares Forte: Formal analysis, Validation, Writing – review & editing.

Valdelias Xavier Pereira: Conceptualization, Validation.

Marcelle Matos Nascimento: Formal analysis, Validation, Visualization, Writing – original draft, Writing – review & editing.

Gabriel Zorello Laporta: Formal analysis, Supervision, Visualization, Writing – original draft, Writing – review & editing

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Corresponding author:

Gabriel Zorello Laporta

Centro Universitário Faculdade de Medicina do ABC – FMABC

Santo André/ SP, Brazil

E-mail: gabriel.laporta@fmabc.br

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