Does the school environment exert influence on quality of life related to traumatic dental injury in children?

Maritza Del Carmen QUEZADA-CONDE[(a)]
Patricia Lourdes ALVAREZ-VELASCO[(a)]
Mariela Cumanda BALSECA-IBARRA[(a)]
Raíza Dias FREITAS[(b)]
Thiago Machado ARDENGHI[(c)]
Edgard MICHEL-CROSATO[(d)]
Claudio Mendes PANNUTI[(b)]
Antonio Carlos FRIAS[(b)]
Daniela Prócida RAGGIO[(e)]
Fausto Medeiros MENDES[(e)]

(a)Universidad Central del Ecuador – UCE, School of Dentristry, Quito, Ecuador.

(b)Universidade de São Paulo – USP, School of Dentistry, Department of Stomatology, São Paulo, SP, Brazil.

(c)Universidade Federal de Santa Maria – UFSM, Faculty of Dentistry, Department of Stomatology, Santa Maria, RS, Brazil.

(d)Universidade de São Paulo – USP, School of Dentistry, Department of Community Dentistry, São Paulo, SP, Brazil.

(e)Universidade de São Paulo – USP, School of Dentistry, Department of Pediatric Dentistry, São Paulo, SP, Brazil.

Corresponding Author:
Fausto Medeiros Mendes
E-mail: fmmendes@usp.br

Abstract: The aim of this cross-sectional study was to assess whether favorable factors related to school characteristics have a positive effect on the impact of traumatic dental injury (TDI) on oral health-related quality of life (OHRQoL). An epidemiological survey of oral health was conducted with 12-year-old schoolchildren from Quito, Ecuador. Children were examined for TDI, dental caries, and malocclusion. Individual socioeconomic data were also collected. Information on the physical environment, health practices, and occurrence of negative episodes at school was collected from the school coordinators. The Child Perceptions Questionnaire 11-14 (CPQ_{11-14}) was used to evaluate the OHRQoL (outcome variable). Multilevel Poisson regression analysis was conducted. Severe TDI was associated with higher CPQ_{11-14} scores, even in the multiple model adjusted for oral health conditions, sex, individual socioeconomic variables, and school-related variables. Children from schools that had an appropriate tooth-brushing environment for their students exhibited a lower impact on OHRQoL, even after adjustment for the occurrence of TDI and other variables. A favorable school environment may exert a positive effect on OHRQoL, independent of the occurrence of TDI.

Keywords: Dental Caries; Quality of Life; Cross-sectional Studies.

Introduction

Traumatic dental injuries (TDIs) of permanent teeth are highly prevalent worldwide,[1,2] and most of these injuries occur in children and adolescents.[1-3] Therefore, since children spend a considerable part of their active time at school, a substantial proportion of these injuries may occur in the school environment.[4-6] Occurrence of TDIs has a negative impact on the quality of life of children and adolescents.[7-9] However, it is unclear whether schools with a favorable environment that promotes health practices has a positive impact on oral health-related quality of life (OHRQoL) related to TDI.

Previous studies have demonstrated that the implementation of health-promotion in schools is associated with a lower prevalence of TDI,[10,11] while episodes of bullying and vandalism are associated with a higher prevalence.[12,13] Furthermore, a negative impact on OHRQoL was

demonstrated in Brazilian children registered at public schools,[8,14] probably due to socioeconomic factors.[15]

With regard to the influence of school environmental characteristics on OHRQoL, it has been observed that children attending schools with more positive indicators had an OHRQoL that was less affected.[16,17] Moreover, the implementation of a health-promoting school model had some positive impact on children's OHRQoL.[18]

Nevertheless, none of these previous studies focused on the occurrence of TDI and its impact on schoolchildren's OHRQoL. Our working hypothesis is that factors related to school physical conditions, promotion of health practices, and the absence of negative episodes at school could have a positive impact on students' OHRQoL, regardless of the occurrence of TDI. Therefore, the aim of this cross-sectional study was to evaluate whether school environmental characteristics affect the negative impact of TDI on OHRQoL in 12-year-old schoolchildren from Quito, Ecuador.

Methodology

Study design, setting and ethical considerations

This cross-sectional study was part of an epidemiological survey called "QUITO Oral Health Survey" (QUITO-OH Survey). It was a population-based survey of 12-year-old children studying in public schools in the urban area of Quito, the capital city of Ecuador. The study protocol was approved by the Local Committee for Ethics in Research of the School of Dentistry of the University of São Paulo and the Central University of Ecuador (CAAE # 61903416.8.0000.0075 and # 399-CE-UCE-2016, respectively). All the subjects agreed to participate, and written informed consent was obtained from all parents or guardians. This study was carried out following the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines.

Children were examined for several oral health conditions, including TDIs, dental caries, malocclusion, gingival bleeding, presence of calculus, and fluorosis. The oral conditions were evaluated according to the recommendations of the World Health Organization (WHO).[19] The evaluations were performed by six examiners from March to May 2017. Prior to the survey, training and calibration sessions of the six examiners were conducted by two benchmark examiners.

The kappa values for interexaminer agreement ranged from 0.79 to 0.98 for evaluation of TDIs, 0.75 to 0.96 for malocclusion, and 0.92 to 0.95 for dental caries. More details on the methodology used in the survey, training and calibration of the examiners, and the observed prevalence of all oral health problems collected in the QUITO-OH survey have been previously published.[20]

In addition to oral health problems previously described, we gathered data on access to dental services, socioeconomic variables, school performance, and OHRQoL. In addition to individual variables (variables related to the children), data related to the school environment (contextual variables) were also obtained. Data related to the prevalence of TDI and association of these scholar contextual variables have been published recently.[21]

Participants and setting

The eligibility criteria were children born between April 2004 and March 2005, attending one of the randomly selected public schools in the urban area of Quito. The exclusion criteria were children whose parents did not sign the consent form or children who did not agree to participate. Children presenting with or reporting systemic diseases and children who did not attend the examinations were excluded.

From public schools (n = 156) in the urban area of Quito, we randomly selected 33 schools. Then, students who met the eligibility criteria were randomly selected, proportional to the total number of enrolled students.

The sample size was calculated based on an epidemiological survey of oral health,[20] using the software G*Power 3.1.9.7 (Universitat Kiel, Kiel, Germany). In the epidemiological survey, we obtained a minimum of 928 students. For the present study, we calculated the statistical power of this sample to achieve a statistical significance at 5% and a minimum rate ratio (RR) of 1.2 Power was calculated considering Poisson to evaluate association of a dichotomous

explanatory variable and the total CPQ_{11-14} scores. For the univariate analysis, we would have a statistical power of 99.9%, considering a ratio of 1:9 between exposed and unexposed individuals. In the multiple model, this power would be 90.7%, considering a correction factor of 0.7.

Explanatory and outcome variables

Individual and contextual explanatory variables were evaluated. The individual variables were related to socioeconomic and demographic characteristics and oral health conditions. Socioeconomic variables were obtained through a structured questionnaire sent to parents or guardians.

The following sociodemographic variables were collected: child's sex (male and female), household income, parents' level of education, and number of persons per room. Household income was calculated considering the Ecuadorian Minimum Wage (EMW), which was about $375.00 per month during the period of data collection. Children were categorized into families receiving up to one EMW and more than one EMW. Mothers' and fathers' levels of education were classified as those who finished primary school (up to 8 years of formal education) and those who received education beyond the primary level (more than 8 years of school). The number of persons per room was categorized by the median as children living in a house with up to 1.7 persons per room, and children living in a house with more than 1.7 persons per room.

TDIs and other oral health problems were evaluated by six trained and calibrated examiners. Details of the calibration procedures have been previously described.[20] Children were examined in their school environment, under artificial light, using sterilized dental mirrors and ballpoint dental probes. Gauze pads were used to dry the tooth surfaces when necessary.

TDIs were identified through the evaluation of the upper and lower incisors according to the method described by O'Brien,[22] as recommended by the WHO.[19] Children were categorized into three groups according to the most severe situation in the incisors, as follows: a) children without TDI, b) children with mild TDI (presence of enamel fractures), and c) children with severe TDI (TDI reaching the dentin, with or without pulp involvement, or avulsion).

The analysis was adjusted for dental caries and malocclusion. Dental caries was assessed according to the World Health Organization (WHO) recommendation, and the number of decayed, missing, and filled teeth (DMFT) was calculated.[19] Children were categorized into groups as follows: DMFT = 0 (caries-free), DMFT ≥ 1 and ≤ 4, and DMFT > 4. Malocclusion was collected using the Dental Aesthetics Index, and children were categorized as those with normal occlusion, definite malocclusion, severe malocclusion, and handicapping malocclusion.[23]

Explanatory contextual variables were collected using a questionnaire on information regarding the physical conditions of the school, health practices promoted by the school, and occurrence of negative episodes. This questionnaire was elaborated with questions that were used in earlier studies.[10,11,13] Each question was considered separately, and the answers for most questions were dichotomous, except for the number of students per classroom and patio area.

The school coordinators answered the questionnaire, and the examiners checked the information provided. The contextual explanatory variables related to the physical conditions of the school were the average number of students per classroom (≤ 30 students per room and > 30 students per room), the patio area (≤ 600 m² and > 600 m²), and patio and court floor conditions (poor condition, with cracks and/or holes, and good condition).

Considering the health practices promoted by the school, we evaluated whether the students were allowed to brush their teeth in an adequate environment (yes or no), if the schools offered healthy meals for the students (yes or no), and if sport practice after the regular class time was allowed (yes or no). With regard to the occurrence of negative episodes, the coordinators reported whether the school experienced episodes of vandalism, theft, or physical violence among the students in the last year (yes or no). Missing data regarding explanatory variables were not imputed.

The outcome variable in our study was related to the OHRQoL. The OHRQoL was assessed using

the translated and validated Spanish version[24] of the short-form Child Perceptions Questionnaire 11-14 (CPQ_{11-14}).[25] The short form of the CPQ_{11-14} was answered by the children and it comprises 16 questions with answers that range from 0 to 4 on a Likert scale. The sum of the answers resulted in a final score ranging from 0 to 64. The higher the score, the worse the OHRQoL. The 16 questions of the instrument are divided into four domains (four items per domain): oral symptoms, functional limitations, emotional well-being, and social well-being.

The main outcome variable was obtained by considering total CPQ_{11-14} scores. The scores obtained in each separated domain were also analyzed as outcome variables in additional analyses.

To avoid selection bias, children were randomly selected before clinical examination. Dentists who were not involved in the clinical examination administered the questionnaire; hence, they were not aware of the oral health conditions of the children. Likewise, examiners who performed the clinical evaluations were unaware of the children's responses to the CPQ_{11-14}.

Statistical analysis

Descriptive statistics were performed to demonstrate the proportion of children distributed according to individual and contextual explanatory variables. The mean and standard deviation (SD) values of the total CPQ_{11-14} scores according to the explanatory variables were also calculated.

Multilevel Poisson regression was used to evaluate the association between individual and contextual explanatory variables and the main outcome variable (CPQ_{11-14} scores). The analysis was performed using robust variance to correct for possible overdispersion. Using this approach, we derived the RR and respective 95% confidence intervals (95%CI).

After univariate analysis, multiple multilevel Poisson regression analyses were performed by the gradual incorporation of explanatory variables according to the purpose of the study and adjustment of the regression model. In the first step, a null model without variables was used. The first model included only the occurrence of TDI as an independent variable, which was the main focus of this study. In the second

model, we included variables related to other oral health conditions (dental caries and malocclusion). In the third multiple model, individual demographic and socioeconomic variables were included, and contextual variables were added to the final model.

Univariate and multiple multilevel Poisson regression analyses were also used to assess the association between TDI and scores of the different domains of CPQ_{11-14}, unadjusted or adjusted for other explanatory variables. All analyses were conducted using the statistical package Stata 13.0 (Stata Corporation, College Station, USA), with a significance level of 5%.

Results

Of the 33 randomly selected schools, 31 were enrolled in this study. Two school coordinators did not allow school participation because they claimed that the examinations would disrupt the routine of the schools. From the 31 schools included, 1,100 children were randomly selected and invited to participate in the study. A total of 997 children (90.6% response rate) were examined and responded to the CPQ_{11-14}. The reasons for non-participation were non-return of the consent form (n = 96), absence on the day of examination (n = 4), refusal to be examined (n = 2), and non-response to the CPQ_{11-14} (n = 1).

The individual variables of all the children are presented in Table 1. The majority of children who experienced dental trauma had mild TDI (16.2%), while 2.2% of the children had severe TDI (Table 1). The mean (SD) of the total CPQ_{11-14} scores of the 997 participating children was 12.2 (8.7). The CPQ_{11-14} scores, according to individual explanatory variables, are presented in Table 1.

The association between the individual explanatory variables and OHRQoL measured through the CPQ_{11-14} scores is shown in Table 1. Children with severe TDI presented significantly higher CPQ_{11-14} scores than children with no signs of TDI. Likewise, children with DMFT > 4 and children with severe or handicapping malocclusion exhibited higher CPQ_{11-14} scores (Table 1). On the other hand, male children and children of fathers with higher education levels were significantly associated with lower CPQ_{11-14}

scores. Additionally, children living in houses with more persons per room exhibited a more negative impact on OHRQoL (Table 1).

Table 2 shows the distribution and mean of the total CPQ_{11-14} scores according to the schools and the contextual variables evaluated in our study. Children from schools that provided an adequate environment for tooth brushing were associated with a significantly

lower impact on OHRQoL (Table 2). Moreover, children from schools with episodes of vandalism during the last year presented significantly higher total CPQ_{11-14} scores than children from schools that did not experience these events (Table 2).

The multiple regression analyses are presented in Table 3. Children with severe TDI exhibited a mean CPQ_{11-14} score approximately 37% higher than that of

Table 1. Descriptive analysis of all participants (n = 997) according to the individual explanatory variables and Child Perceptions Questionnaire 11-14 (CPQ_{11-14}) scores.

Explanatory variables	n (%)	CPQ_{11-14} Mean (SD)	Unadjusted RR (95%CI)
Traumatic dental injuries (TDI)			
Without TDI	814 (81.6)	12.2 (8.7)	1.00
Mild TDI	161 (16.2)	11.4 (8.2)	0.92 (0.81–1.07)
Severe TDI	22 (2.2)	18.4 (10.5)	1.37 (1.04–1.78)*
DMFT			
Without caries	413 (41.4)	11.9 (8.9)	1.00
DMFT between 1 and 4	523 (52.5)	12.3 (8.4)	1.00 (0.96–1.04)
DMFT higher than 4	61 (6.1)	14.7 (10.6)	1.25 (1.16–1.35)*
Dental Aesthetics Index			
Normal occlusion	390 (39.1)	11.3 (7.7)	1.00
Definite malocclusion	352 (35.3)	11.8 (8.7)	1.04 (0.95–1.13)
Severe malocclusion	175 (17.6)	13.8 (9.9)	1.22 (1.11–1.34)*
Handicapping malocclusion	80 (8.0)	14.6 (9.6)	1.31 (1.12–1.52)*
Sex			
Female	554 (55.6)	13.3 (9.3)	1.00
Male	443 (44.4)	11.1 (7.8)	0.85 (0.75–0.96)*
Household income**			
≤ 1 EMW	433 (45.2)	12.9 (9.3)	1.00
> EMW	526 (54.8)	11.8 (8.2)	0.94 (0.83–1.06)
Mother's education level**			
≤ Primary school	342 (34.3)	13.0 (9.1)	1.00
> Primary school	654 (65.7)	12.0 (8.6)	0.93 (0.85–1.03)
Father's education level**			
≤ Primary school	342 (34.5)	13.8 (9.8)	1.00
> Primary school	650 (65.5)	11.5 (8.1)	0.85 (0.77–0.95)*
Number of persons per room**			
≤ 1.7 persons per room	602 (60.8)	11.5 (8.4)	1.00
> 1.7 persons per room	389 (39.2)	13.6 (9.1)	1.14 (1.05–1.24)*

DMFT: number of decayed, missing and filled permanent teeth; EMW: Ecuador's minimum wage at the time of data gathering (U$ 375.00); SD: standard deviation; RR: rate ratio; 95%CI: 95% confidence interval; *statistically significant at 5%; **variables did not sum 997 participants due to missing data.

children with no TDI, as observed in model 1 (Table 3). In model 2, this association remained significant even after adjustment for other variables related to oral health conditions (Table 3). With the inclusion of demographic and socioeconomic variables, children with severe TDI had a significantly higher impact on OHRQoL. Other variables significantly associated with OHRQoL were the presence of

Table 2. Descriptive analysis of all participants (n=997) enrolled at the 31 participating schools, according to the contextual explanatory variables and Child Perceptions Questionnaire 11-14 (CPQ$_{11-14}$) scores.

Explanatory variables	Schools	Children	CPQ$_{11-14}$ scores	Unadjusted RR
	n	n (%)	Mean (SD)	(95%CI)
Physical conditions of the school				
Nº of students per classroom				
≤ 30 students/classroom	17	400 (40.1)	11.8 (8.8)	1.00
> 30 students/classroom	14	597 (59.9)	12.4 (8.6)	1.09 (0.91–1.31)
Patio area				
≤ 600 m2	23	581 (58.3)	12.1 (8.5)	1
> 600 m²	8	416 (41.7)	12.3 (9.0)	0.94 (0.77–1.14)
Patio floor conditions				
Poor condition	5	130 (13,0)	14.0 (9.2)	1
Good condition	26	867 (87,0)	11.9 (8.6)	0.83 (0.62–1.09)
Sports court floor conditions				
Poor condition	4	92 (9.2)	14.1 (9.8)	1.00
Good condition	27	905 (90.8)	12.0 (8.6)	0.80 (0.59–1.09)
Health practices promoted by the school				
Appropriate tooth brushing environment				
No	27	861 (86.4)	12.6 (8.8)	1.00
Yes	4	136 (13.6)	9.8 (7.8)	0.78 (0.66–0.93)*
School offers healthy meals				
No	5	110 (11.0)	11.8 (8.4)	1.00
Yes	26	887 (89.0)	12.2 (8.7)	1.01 (0.89–1.14)
Sports Activities after regular class time				
No	22	638 (64.0)	11.9 (8.9)	1.00
Yes	9	359 (36.0)	12.7 (8.4)	1.16 (0.94–1.43)
Occurrence of negative episodes				
Episodes of vandalism				
No	12	499 (50.1)	11.3 (7.9)	1.00
Yes	19	498 (49.9)	13.3 (9.4)	1.20 (1.01–1.42)*
Theft episodes				
No	9	249 (25.0)	11.1 (7.5)	1.00
Yes	22	748 (75.0)	12.6 (9.0)	1.19 (0.99–1.41)
Physical violence among the students				
No	7	245 (24.6)	12.0 (8.5)	1.00
Yes	24	752 (75.4)	12.4 (8.8)	1.13 (0.91–1.40)

SD: standard deviation; RR: rate ratio; 95%CI: 95% confidence interval; *statistically significant at 5%.

severe or handicapping malocclusion, children's sex, father's level of education, and number of persons per room (model 3, Table 3). In the final model, this association remained significant despite the incorporation of contextual variables related to the school environment. Moreover, besides the same associations with individual explanatory variables found in model 3, we observed that children studying

Table 3. Multiple regression analyses for the association of individual and contextual exposure variables and the mean of the Child Perceptions Questionnaire 11-14 (CPQ$_{11-14}$) total scores.

Independent variables	Null model	Model 1	Model 2	Model 3	Model 4
		Adjusted RR (95%CI)			
Fixed effects					
Intercept	2.48 (0.05)	2.49 (0.05)	2.40 (0.05)	2.50 (0.07)	2.52 (0.07)
Coefficient (SE)					
TDI (ref.: without TDI)					
Mild TDI		0.92	0.94	0.95	0.95
		(0.80–1.06)	(0.82–1.09)	(0.82–1.09)	(0.82–1.09)
Severe TDI		1.37*	1.36*	1.34*	1.34*
		(1.05 to 1.78)	(1.03–1.78)	(1.04–1.74)	(1.04–1.74)
DMFT (ref.: with no caries)					
DMFT between 1 and 4			0.99	0.98	0.98
			(0.95–1.02)	(0.89–1.07)	(0.89–1.07)
DMFT higher than 4			1.11*	1.03	1.03
			(1.03–1.21)	(0.79–1.34)	(0.79–1.34)
DAI (ref.: normal occlusion)					
Definite malocclusion			1.04	1.05	1.05
			(0.96–1.14)	(0.97–1.14)	(0.9–1.14)
Severe malocclusion			1.23*	1.21*	1.21*
			(1.12–1.34)	(1.11–1.33)	(1.11–1.32)
Handicapping malocclusion			1.30*	1.33*	1.33 *
			(1.12–1.52)	(1.14 –1.56)	(1.13–1.56)
Sex (ref.: Female)					
Male				0.85*	0.85 *
				(0.76–0.96)	(0.76–0.96)
Father's education level (ref.: ≤ primary school)					
> Primary school				0.89 *	0.89 *
				(0.81–0.98)	(0.81–0.98)
Number of persons per room (ref.: ≤ 1,7 persons per room)					
> 1,7 persons per room				1.13 *	1.13*
				(1.04–1.22)	(1.04–1.22)
Appropriate tooth brushing environment (ref.: no)					
Yes					0.81*
					(0.69–0.96)
Random effects					
Variance of intercept (SE)	0.065 (0.016)	0.063 (0.015)	0.063 (0.016)	0.058 (0.014)	0.053 (0.014)
-2 log likelihood	9159.3	9113.8	9006.0	8778.5	8776.0

TDI: traumatic dental injuries; SE: standard error; DMFT: number of decayed, missing and filled teeth; DAI: dental aesthetics index; RR: rate ratio; 95%CI: 95% confidence interval; *statistically significant at 5%;

in schools with an appropriate environment for tooth brushing had lower total CPQ$_{11-14}$ scores than children from schools that did not favor tooth brushing (model 4, Table 3).

As regards the impact of TDI on the different domains of CPQ$_{11-14}$, children presenting severe TDI had significantly higher CPQ$_{11-14}$ scores than those with no TDI in the domains "functional limitations," "emotional well-being," and "social well-being" in both univariate and multiple analyses (Table 4). The exception was the domain "oral symptoms," where no significant association with the occurrence of TDI

was observed. Moreover, children who had mild TDI presented similar scores to those who had not experienced TDI for all domains (Table 4).

Discussion

The present study, nested in an epidemiological survey conducted with a representative sample of children from Quito, Ecuador, was designed to evaluate whether factors related to the school environment influenced the negative impact of TDIs on schoolchildren's OHRQoL. We found that children

Table 4. Association of occurrence of Traumatic Dental Injuries (TDI) and the mean of the different domains of Child Perceptions Questionnaire 11-14 (CPQ$_{11-14}$) scores using multiple multilevel Poisson regression.

CPQ$_{11-14}$ domains	Without TDI	Mild TDI	Severe TDI
Oral symptoms			
Mean (SD)	4.9 (2.7)	4.7 (2.5)	5.6 (2.8)
Unadjusted RR (95%CI)	1.00	0.95 (0.86–1.05)	1.10 (0.93–1.30)
Adjusted RR (95%CI)**	1.00	0.96 (0.87–1.06)	1.10 (0.93–1.30)
Functional limitations			
Mean (SD)	3.3 (2.8)	3.3 (2.7)	5.2 (3.3)
Unadjusted RR (95%CI)	1.00	0.96 (0.80–1.16)	1.43 * (1.12–1.83)
Adjusted RR (95%CI)**	1.00	1.00 (0.83–1.19)	1.44 * (1.12–1.85)
Emotional well-being			
Mean (SD)	2.3 (3.4)	1.9 (3.1)	4.3 (5.2)
Unadjusted RR (95%CI)	1.00	0.83 (0.64–1.08)	1.60* (0.73–0.94)
Adjusted RR (95%CI)***	1.00	0.84 (0.64–1.11)	1.55 (1.25–1.93)
Social well-being			
Mean (SD)	1.6 (2.5)	1.5 (2.2)	3.2 (3.3)
Unadjusted RR (95%CI)	1.00	0.92 (0.68–1.25)	1.74* (1.36–2.23)
Adjusted RR (95%CI)****	1.00	0.97 (0.84–1.12)	1.61* (1.25–2.06)

SD: standard deviation; RR: rate ratio; 95%CI: 95% confidence interval; *statistically significant at 5%; **adjusted by number of decayed, missing and filled teeth (DMFT), Dental Aesthetics Index (DAI), sex, number of persons per room, appropriate tooth brushing environment, and patio floor conditions; ***adjusted by DMFT, DAI, sex, number of persons per room, father's education level, and appropriate tooth brushing environment; **** adjusted by DMFT, DAI, sex, number of persons per room, father's education level, and promotion of sports activities after regular class time.

from schools that experienced vandalism episodes in the previous year had a more negative impact on OHRQoL. Furthermore, this trend was also observed for children studying in schools that did not provide an adequate environment for tooth brushing to their students, and this variable remained significant even when the model was adjusted for TDI and other individual variables. Therefore, the positive characteristics of the school environment had a lower impact on OHRQoL, regardless of the occurrence of TDI and oral health disorders, supporting our working hypothesis.

A potential explanation for these findings is that children studying in schools with a more negative environment are probably from families with low socioeconomic status. Socioeconomic conditions can partially explain the higher prevalence of dental caries,[13] although these factors were not usually associated with the occurrence of TDI.[26] On the other hand, socioeconomic conditions have been associated with OHRQoL.[17] In the multiple model adjusted for the socioeconomic indicators and the occurrence of TDI and other oral health problems, the variable "vandalism episodes" did not achieve statistical significance. Thus, this suggests the influence of individual socioeconomic characteristics on our findings.

In addition to the decrease in the prevalence of health problems, a positive school environment may favor higher resilience among their students.[27] This effect can be observed with variables that were not directly associated with the prevention of TDIs. In our study, another contextual variable significantly associated with lower CPQ_{11-14} scores was the promotion of an appropriate tooth-brushing environment at the schools. The mean of the total CPQ_{11-14} scores in children attending these schools was approximately 20% lower than that in children studying in other schools that did not provide time and an environment for tooth brushing. However, unlike the occurrence of vandalism, this variable remained significant even in the adjusted model, including oral health conditions and socioeconomic indicators. Thus, even though the prevalence of TDI in schools that promote a safe tooth brushing environment was lower (11.0% and 0.8% for mild and severe TDI, respectively) than that

in schools without this routine (17.0% and 2.4% for minor and severe TDI, respectively), multiple analyses suggest that the lower impact on OHRQoL was also associated with the promotion of these healthy habits.

Therefore, promotion of tooth brushing among students, as well as other contextual variables related to health promotion measures (offering healthy meals and sport practice after regular class time), may be part of a general concept of health promotion for students. The concept of "Health-Promoting Schools" comprises the fact that broader health promotion measures are more effective than individual care.[11,28] Previous studies have found a lower prevalence of oral health conditions in health-promoting schools.[10,11,29,30] Moreover, positive effects on OHRQoL related to health-promoting schools have been observed.[18] Thus, in the present study, a possible explanation for the lower impact on OHRQoL in children from health-promoting schools, even in the adjusted model that incorporated the occurrence of TDI and other health conditions, may be the promotion of favorable healthy habits in these schools. These actions may favor healthier conditions,[10,11,28-30] resilience,[27] better quality of life,[18] and other positive aspects.[28]

However, this study had some limitations. First, we analyzed contextual variables independently. With this approach, the notion of a 'school environment' could be lost. Further studies should conduct an analysis to create latent variables related to school characteristics. Moreover, because of the nature of the study, it was not possible to determine where or how the TDIs occurred. Therefore, the direct relationship between the physical structure or occurrence of negative episodes in schools and occurrence of TDIs could not be evaluated. Nevertheless, researchers have observed that many TDI episodes in students occur in the school environment.[4-6] In addition, the occurrence of negative episodes could have been underreported by school coordinators.

Another limitation is that other variables related to the promotion of healthy habits were not associated with lower CPQ_{11-14} scores. Furthermore, there were only four schools promoting a tooth-brushing-friendly environment, and the sample was restricted exclusively to public schools in the urban area of

Quito. Thus, studies in other cities and countries that preferentially involve public and private schools are necessary to corroborate our findings.

Despite these limitations, our study has some strengths. This is the first study to evaluate the influence of contextual school environmental characteristics, as well as health promotion measures, on the impact of TDI on children's OHRQoL. The occurrence of TDI, especially in the more severe stages, has been commonly associated with a negative impact on the OHRQoL of schoolchildren in primary studies,[8,9] as well as in a recent systematic review.[7] Despite the low prevalence of children with severe TDI, this impact was confirmed in the present study, since children with severe TDI exhibited a greater impact on quality of life, even after adjustment for other variables.

In addition, this study demonstrated that even with the occurrence of TDI, schools that promote health practices were associated with a lower impact on OHRQoL. These findings favor the implementation of supportive environments in schools that promote health measures. This effort could facilitate a reduction in the prevalence of oral health conditions and an improvement in OHRQoL. In addition, health-promoting schools may favor other health conditions, as well as an improvement of the well-being and general quality of life of the students, teachers, and staff of these schools.[28] However, the effect of these health-promoting schools on reducing health problems and improving health-related quality of life should be tested in cohort studies or cluster randomized clinical trials.

Conclusion

A positive social environment and promotion of health practices in schools may reduce the impact of TDI on OHRQoL.

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