



Toothache and Non-Clinical Individual and School Factors in Five-Year-Old Children: Multilevel Analysis

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The objective of the present study was to evaluate the influence of individual and contextual factors on the occurrence of toothache in five-year-old children. A cross-sectional study was conducted with 756 five-year-old children from public and private preschools in a city in the countryside of the northeast of Brazil. The sample was determined through probabilistic sampling in two stages (preschools and children). The children included could not have systematic diseases, permanent tooth or orthodontic treatment. Parents/caregivers were required to spend at least 12 hours per day with their children. The history of toothache during the life of the child was reported by parents/guardians. Socioeconomic and psychological questionnaires were completed by parents/guardians. Variables related to social context were obtained from the preschools in which the children studied and the official publications of the municipal region. Unadjusted and adjusted multilevel Poisson regression models were used to investigate the association between individual and contextual characteristics and history of toothache. The history of toothache was found for 23.8% of the children. Among the individual determinants, gender of the child, order of birth, and schooling of parent/guardian were associated with toothache in children. The individual variables remained associated with the outcome after the addition of the contextual variables to the model. The type of preschool was the contextual determinant associated with toothache in the final model. Both individual (gender, order of birth and schooling of parents/guardians) and contextual (type of preschool) determinants were associated with history of toothache in five-year-old children.

Key Words: toothache, oral health, preschool children.

Introduction

Toothache is a subjective indicator of oral health and can have an impact on oral health related quality of life (OHRQoL), causing functional and social impairment (1). In addition, having children with toothache results in greater absenteeism of parents from work (2), as well as increased financial expenses (3) and parental guilt (4). Due to the major impact that toothache can have on OHRQoL, one of the aims of the Global Goals for Oral Health 2020 is to reduce the prevalence of tooth pain and its consequences in the population (5). Thus, studies that evaluate the factors associated with the occurrence of toothache and help achieve this goal are required.

Literature describes the prevalence of toothache in five-year-old children as being between 9.4% and 25.0% (1,6-10). As cognitive ability is still developing in this age group, the evaluation of tooth pain is performed via the reports of parents (11). This data is highly reliable, as studies have shown that toothache is the most perceived symptom by parents in children at a young age (12). In terms of the psychological issues of parents, such as sense of coherence (SOC) and locus of control, previous studies have evaluated their relationship with oral health problems (13,14) but have not provided specific information about

the history of toothache.

Most studies with young children evaluate toothache in terms of clinical aspects and/or socioeconomic issues addressed at the individual level (6-8,10). These individual clinical and socioeconomic factors have therefore already been well demonstrated in literature. Dental caries and dental trauma are the main clinical conditions presented by children in this age group, and are related to toothache (8,15). Individuals with worse socioeconomic conditions at an individual level are more exposed to risk factors for oral health problems (7). However, this socioeconomic issue needs to be better addressed within a social context. In studies with adolescents and adults a direct relationship between the context in which the individual is inserted and toothache has already been demonstrated (16-18). Adolescents from areas with a low Human Development Index (HDI) had a higher prevalence of toothache than those in more developed areas, regardless of individual characteristics (16). In pre-school children, there is only one study that assesses toothache through a multilevel approach (9). This study was based on data from the national oral health survey conducted in 2010 in Brazil, and identified an association between toothache and a low level of HDI and literacy in the city (9).

New studies of this topic will allow a better understanding of the relationship between the non-clinical individual and contextual determinants of children's oral health conditions. Brazil is a country with considerable social disparities, and researchers have sought to determine factors that may explain differences in the oral health status of the population (19). Type of school can be considered a contextual determinant, since this variable is sensitive for the discrimination of different oral health conditions (20). Thus, understanding the role of the school environment in children's health is important when planning preventive strategies (21,22). To date, there are no studies that evaluate toothache in preschool children based on the school context.

The aim of the present study was therefore to evaluate non-clinical individual and school factors relating to the occurrence of toothache in five-year-old children.

Material and Methods

This study received approval from the Human Research Ethics Committee of the State University of Paraíba (38937714.0.0000.5187) and was conducted in compliance with the guidelines stipulated in the Declaration of Helsinki. All the legal guardians signed a statement of informed consent prior to the data collection process. All the preschools received clarifications regarding the study protocol and agreed to participate.

Sample Characteristics and Study Design

A cross-sectional study was conducted in public and private preschools in Campina Grande, a city located in the eastern part of the northeast of Brazil. This city has about 400,000 inhabitants and an HDI of 0.72. The present study was carried out to evaluate the oral health of five-year-old children and was conducted between August and December 2015. All stages of this study were performed in accordance with guidelines for cross-sectional studies.

Sample selection was performed through probabilistic sampling in two stages. A total of 263 preschools (129 public and 134 private) are registered with the Ministry of Education. The city is divided into six administrative districts and the preschools were randomly selected according to the total number of such preschool in each district in the first stage. Twenty-eight public and 20 private preschools were selected. The second phase consisted of the selection of children for the sample using a simple randomization procedure. The ratio of the total population enrolled in private and public preschools in each administrative district of the city was maintained in the sample distribution.

The sample size was calculated based on a 5% margin of error, a 95% confidence level and a correction factor of 1.6 to compensate for the design effect. A prevalence rate

of 50% for toothache was considered to increase the power and because this value gave the largest sample regardless of the actual prevalence. The required sample size was calculated to be 615 preschool children. This value was increased to compensate for possible dropouts estimated at 20% resulting in a sample of 769 five-year-old children.

Eligibility Criteria

Five-year-old children with no systematic diseases (based on the reports of parents/caregivers) enrolled at public and private preschools were included in the sample. Parents/caregivers were required to spend at least 12 hours per day with their children. The exclusion criteria were the presence of one or more erupted permanent tooth and a history of orthodontic treatment.

Pilot Study

A pilot study was conducted to test the methodology. The participants in the pilot study ($n=45$) were not included in the main sample. As there were no misunderstandings regarding the questionnaires or the methodology, no changes to the data collection process were deemed necessary.

Data Collection

Data collection was performed in preschools that were selected following contact with the principals of each school to explain the purpose of the study. Parents/guardians were previously contacted to attend a meeting at the preschool and participate in an oral health promotion activity, during which they received clarification on the study and signed an informed consent form. At the same meeting, the parents/guardians were asked to provide information related to their child's history of toothache and complete questionnaires addressing their psychological aspects and sociodemographic data. Additionally, data regarding variables related to the social context in which the children were inserted were collected. The parents/guardians who did not participate in the activity scheduled at the preschool were contacted by telephone by the researchers, who stressed the importance of the study and asked them to return the completed questionnaires.

History of toothache. This information was provided by parents/guardians and a history of toothache was recorded if this symptom was observed at some time in the child's life. The answer choices were yes or no.

Individual sociodemographic variables. The following sociodemographic variables were collected to obtain an individual profile of the child/family: child's gender, education of parents/guardians, monthly family income, order of birth and whether the child had siblings.

Psychological aspects of parents/guardians: To analyze

the psychological aspects of parents/guardians, the SOC

Table 1. Individual and contextual level characteristics of the sample

Variable	n(%) / Mean (SD)
Individual Level	
Gender	
Female	361(47.8)
Male	395(52.2)
Parent's/caregiver's schooling	
≤ 8 years of study	225(29.9)
> 8 years of study	528(70.1)
Monthly household income	
< US\$ 280.00	361(50.0)
≥ US\$ 280.00	361(50.0)
Only child	
Yes	258(34.4)
No	492(65.6)
Birth order	
Only child	258(34.5)
Youngest child	277(37.0)
Oldest child	125(16.7)
Middle child	88(11.8)
Number of children	
	2.10(1.17)
Sense of coherence	
Weak	317(41.9)
Strong	439(58.1)
Locus of control	
Internal	513(68.3)
External	238(31.7)
History of toothache	
No	576(76.2)
Yes	180(23.8)
Contextual-level variables	
Type of preschool	
Public	292(38.6)
Private	464(61.4)
Number of children in preschool	107.88(99.71)
Mean monthly income of neighborhood	1091.85(253.83)
Number of general health teams	17.50(4.60)
Number of oral health teams	8.94(2.13)

and locus of control were evaluated. The SOC of the parents/caregivers was measured using the Brazilian Sense of Coherence Scale (SOC-13), employing the version validated for use on parents of preschool children (23). This questionnaire has 13 items, each with five response options that assist in evaluating the components that compose SOC: comprehensibility, manageability and meaningfulness. The total ranges from 13 to 69 points, with higher scores indicative of a stronger SOC and greater capacity to cope with stress. For the purposes of statistical analysis, the score was dichotomized by the median, as performed in a previous study (13). Scores below the median were considered indicative of a weak SOC and scores above the median were indicative of a strong SOC.

The locus of control of the parents/caregivers was evaluated using the Multidimensional Health Locus of Control index (14), which has 18 items distributed among three subdivisions (internal/external/chance) for the evaluation of the respondent's perception of who or what determines health/illness events: the individual himself/herself (internal) or other forces (external/chance). Each item has five response options (1= fully agree; 2=agree in part; 3=neither agree nor disagree; 4=disagree in part; 5=fully disagree). The scores of the items on each subscale are totaled and can range from 6 to 30 points, with higher scores on the subscale indicating a lower degree of each factor (internal and external/chance). An internal LOC is considered when the lowest score is on the subscale of internal factors and an external LOC is considered when the lowest score is on the subscale of external or chance factors.

Contextual variables. Five variables of the children preschools were investigated to assess the influence of contextual aspects on children's toothache: type of preschool in which the child was enrolled, number of children in the preschool, average monthly income of the neighborhood in which the preschool was located and number of general and oral health teams in the administrative district where the school was located. Information on the average income of the city's districts was obtained from the Brazilian Institute of Geography and Statistics and the number of general and oral health teams from the administrative districts was obtained from the city's Department of Health. Data on pre-schools were recorded during the first visit to each preschool.

Statistical Analysis

The STATA 12.0 program (Stata Corporation, College Station, TX, USA) was used for data analysis. Descriptive statistics were used for the characterization of the sample. Unadjusted and adjusted multilevel Poisson regression models were created to describe the associations between the outcomes and predictors. Multilevel Poisson regression

analysis involved a fixed effects model with random intercepts to evaluate associations between the history of toothache of the children (primary outcome) and both individual and contextual covariates. This strategy enabled the estimation of prevalence ratio (PR) between comparison groups and respective 95% confidence intervals (CI). In the first step, an unconditional (null) model was used to estimate variability in the data before the individual and contextual characteristics were taken into account. The individual covariates were incorporated into model 2 and both the individual and contextual covariates were incorporated into model 3. Individual variables that achieved a p-value < 0.20 in the univariate multilevel Poisson regression analysis were incorporated into model 2 and those with a p-value < 0.05 in the adjusted analysis remained in the model. Next, contextual variables that achieved a p-value < 0.20 in the univariate multilevel Poisson regression analysis were incorporated into model 3 and those with a p-value < 0.05 in the adjusted analysis remained in the final model. The goodness-of-fit of the models was calculated based on deviance values (-2 log likelihood).

Results

A total of 756 pairs of children/parents were included in the present study, representing a response rate of 98.3%. Thirteen children were considered losses due to incomplete questionnaires. Table 1 shows the main characteristics of the sample. A history of toothache during the child's lifetime was reported in 23.8% of cases, and the majority of children were male (52.2%), had parents/guardians with more than eight years of schooling (70.1%), and attended private preschools (61.4%).

In bivariate analysis of multilevel Poisson regression, the history of toothache was significantly associated with parents'/guardians'

schooling, monthly family income, presence of siblings, order of birth, number of children, locus of control and type of pre-school (p < 0.05) (Table 2).

Table 2. Unadjusted assessment of the association of history of toothache among preschool children with individual and contextual-level variables

Variable	N	History of toothache		
		n%	p value	PR(95%CI)
Individual-level variable				
Gender				
Female	361	97(26.9)	0,098	1.29(0.95-1.73)
Male	395	83(21.0)		1.00
Parent's/caregiver's schooling				
≤ 8 years of study	225	92(40.9)	p<0.001	2.45(1.83-3.29)
> 8 years of study	528	88(16.7)		1.00
Monthly household income				
< US\$ 280.00	361	115(31.9)	p<0.001	1.92(1.40-2.62)
≥ US\$ 280.00	361	60(16.6)		1.00
Only child				
Yes	258	41(15.9)	0.007	0.61(0.43-0.88)
No	492	135(27.4)		1.00
Order of birth				
Only child	258	41(15.9)		1.00
Youngest child	277	68(24.5)	0.055	1,47(0,99-2,19)
Oldest child	125	33(26.4)	0.040	1.62(1.02-2.58)
Middle child	88	35(39.8)	0.001	2.25(1.41-3.61)
Number of children	-	-	0.013	1.15(1.03-1,29)
Sense of coherence				
Weak	317	91(28.7)		1.00
Strong	439	89(20.3)	0.072	0.76(0.56-1.03)
Locus of control				
Internal	513	106(20.7)	0.031	0.71(0.53-0.97)
External	238	73(30.7)		1.00
Contextual-level variables				
Type of preschool				
Public	292	108(37.0)	p<0.001	2.38(1.77-3.21)
Private	464	72(15.5)		1.00
Number of children in preschool	-	-	0.025	0.99(0.99-1.00)
Mean monthly income of neighborhood	-	-	0.220	0,99(0,99-1.00)
Number of general health teams	-	-	0.535	0.95(0.87-1.04)
Number of oral health teams	-	-	0.288	0.99(0.95-1.03)

Table 3 shows the results of the multivariate Poisson regression model. In model 2, with the inclusion of individual determinants, the variables associated with the history of toothache were lower levels of schooling of parents/guardians (PR= 2.24; CI95%: 1.64-3.06), being a middle child (PR= 1.87; CI95%: 1.17-2.99) and the female gender (PR= 1.36; CI95%: 1.01-1.82). Following adjustment for the contextual determinants, the individual variables remained associated with the result (Model 3). Attending private preschools was a protective factor in relation to the history of toothache at some time in the child's life (PR=0.61; CI95%: 0.42-0.88).

Discussion

A history of toothache was more prevalent among children living in an unfavorable social context. The schooling of parents/guardians and the type of preschool can be used as a means of intervention to improve the oral health of children and consequently decrease the

prevalence of toothache. The results of the present study are therefore valid for the support of oral health policies.

According to parents/guardians, 23.8% of children had a history of toothache. This prevalence agrees with other studies conducted in the same age group (6,9). However, other reports of toothache in preschool children have found a lower prevalence (1,7,8,10). Caution should be exercised when performing comparisons with these studies, as they are based on different methodologies, especially in relation to the time considered for the reporting of toothache (7) and feature age groups, involving children under 5 years of age (1,8,10). These factors may result in a less frequent reporting of toothache.

Toothache was reported more frequently among female children. Possible, parents may tend to be more careful with their daughters, and thus, they are more attentive to the reported pain of female children. In addition to the child's gender, birth order also influenced this problem. Middle children were associated with a more prevalent history of

toothache. An earlier study with preschool children revealed that being a middle child led to an approximately ten times greater chance of suffering an impact on OHRQoL (1). Based on this, it is possible to assume that the prevalence of oral health problems, including toothache, tends to be greater among such children. One possible explanation for this relationship is the fact that when there are more than 2 children, parents tend to pay more attention to their older and younger children, while the middle children are less remembered.

A lower level of schooling of parents/guardians was an individual socioeconomic predictor that influenced the history of toothache in five-year-old children. However, the psychological aspects of the parents/guardians evaluated (SOC and control locus) were not associated with a history of toothache. This result confirms the significant influence of social inequality on the oral health of the Brazilian population. Parents/guardians with a lower educational level may have lower oral health knowledge and reduced financial conditions (24). Moreover, parents with lowest education only take

Table 3 Multilevel Adjusted Assessment of cavitation of toothache among preschool children associating individual and contextual variables

Fixed effects	Model 1 ("null")	Model 2	Model 3
		PR (CI 95%)	PR (CI 95%)
Intercept	0.24(0.21-0.27)	0.11(0.08-0.17)	0.18(0.11-0.27)
Individual level			
Parent's/caregiver's schooling			
≤ 8 years of study		2.24(1.64-3.06)	1.65(1.14-2.39)
> 8 years of study		1.00	1.00
Order of birth			
Only child		1.00	1.00
Youngest child		1.19(0.79-1.77)	1.16(0.78-1.74)
Oldest child		1.50(0.95-2.38)	1.50(0.95-2.38)
Middle child		1.87(1.17-2.99)	1.73(1.08-2.77)
Gender			
Male		1.00	1.00
Female		1.36(1.01-1.82)	1.37(1.02-1.85)
Contextual level: Preschool			
Type of preschool			
Public			1.00
Private			0.58(0.40-0.84)
Random effects			
Deviance (-2loglikelihood)	870.0276	817.2961	809.1280

Model 1 ("null"): represents the unconditional model; Model 2: represents individual covariates; Model 3: represents subject and contextual-level covariates.

their children to the dentist when problems arise (25). These factors can result in poorer oral health conditions for children. It is worth mentioning that this individual determinant remained associated with a history of toothache even after adjustment with the contextual variables. There is therefore a need for public health programs that educate parents to seek preventive oral health care on an ongoing basis, rather than in response to oral problems.

The type of preschool was the only contextual variable that presented an association with the history of toothache in children. Children in private preschools had a lower prevalence of history of toothache than children in public preschools. In Brazil, the type of preschool reflects the socioeconomic condition, and thus may possibly reflect inequalities associated with oral conditions, such as dental caries and the use of the health service. Thus, public health policies should prioritize the incorporation of measures that encourage healthy habits and the creation of healthy environments in public schools to promote health among this population (20), because on that socioeconomic context, these children are more vulnerable to oral health problems. The other contextual variables analyzed in the present study did not exhibit an association with a history of toothache, perhaps because they did not reflect the contextual differences between the environments in which the children were inserted. The results of the present study suggest that, in Brazil, type of school better represents the socioeconomic environment in which children are inserted than monthly income of the neighborhood of the school that they attend, as children often live in a different neighborhood and the income of the neighborhood in which the school is located may not reflect their actual socioeconomic status. With regard to the number of health professionals, this information only referred to those at public services, which could be considered a limitation of the present study. Moreover, for the population of the study, socioeconomic status probably had greater importance than access to healthcare services with regard to the outcome of toothache in the children.

One limitation of this research is that it is a cross-sectional study that prevents causal inferences. However, it includes a representative sample of the population, followed the norms established for cross-sectional studies, and performs differentiated analyzes to evaluate the social context. Although the history of toothache was reported by proxy measure, this is a reliable alternative for the evaluation of this condition in young children. Further studies should aim to establish the influence of the school context, such as structure, methods of teaching children, as well as the existence of health promotion actions, on the child's oral health conditions.

The results found in the present study can help to identify the individual and contextual characteristics that should be explored further, and support interventions to improve oral health. Some characteristics associated with the history of toothache are immutable factors such as gender and birth order. However, public health policies that address social inequalities can be elaborated. Especially, the present study warns of the importance of establishing healthy measures and changes in behavior in public preschools, as children in this context had a higher prevalence of toothache.

Resumo

O objetivo do presente estudo foi avaliar a influência de fatores individuais e contextuais na ocorrência de dor de dente em crianças de cinco anos de idade. Um estudo transversal foi realizado com 756 crianças de cinco anos de idade de pré-escolas públicas e privadas em uma cidade no interior do Nordeste do Brasil. A seleção da amostra foi realizada por meio de amostragem probabilística em duas etapas (pré-escolas e crianças). As crianças incluídas não poderiam ter doenças sistêmicas, dentes permanentes ou tratamento ortodôntico. Foram incluídos apenas pais/responsáveis que passavam pelo menos 12 horas por dia com seus filhos. O histórico de dor de dente durante a vida da criança foi relatado pelos pais/responsáveis. Os questionários socioeconômicos e psicológicos foram preenchidos pelos pais/responsáveis. As variáveis relacionadas ao contexto social foram obtidas na pré-escola em que as crianças estudaram e nas publicações oficiais da região municipal. Os modelos de regressão de Poisson multinível não ajustados e ajustados foram utilizados para investigar a associação entre características individuais e contextuais e histórico de dor de dente. O histórico de dor de dente foi encontrado em 23,8% das crianças. Entre os determinantes individuais, gênero da criança, ordem de nascimento e escolaridade dos pais/responsáveis foram associados com dor de dente em crianças. As variáveis individuais permaneceram associadas ao resultado após a adição das variáveis contextuais ao modelo. O tipo de pré-escola foi o determinante contextual associado ao histórico de dor de dente no modelo final. Tanto o indivíduo (gênero, ordem de nascimento e escolaridade dos pais/responsáveis) quanto os determinantes contextuais (tipo de pré-escolar) foram associados com o histórico de dor de dente em crianças de cinco anos de idade.

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