fortune Journals

Research Article

DENTAL RESEARCH AND ORAL HEALTH

ISSN: 2641-7413

Contextual and Individual Factors Associated with Dental Caries among Brazilian Adolescents: A Multilevel Study

Cíntia Levy Matos Pedroso[1]*, Luana Leal Roberto[1], Alfredo Mauricio Batista De Paula[2], Desirée Sant'ana Haikal[2]

Abstract

This study aimed to identify the contextual and individual factors associated with dental caries among Brazilian adolescents. This is a multilevel cross-sectional study with data from 5,445 participants of the 2010 National Oral Health Survey, and the contextual information was extracted from an official public database. The dependent variable was the number of decayed teeth, measured by the D component of the DMFT. We conducted a multilevel negative binomial regression and estimated the means ratio (MR). We observed a mean of 1.76 (±2.93) decayed teeth. Among the contextual variables, the mean number of decayed teeth was higher among adolescents living in municipalities with medium/low MHDI and lower among those living in municipalities with a higher proportion of dentists/inhabitants. Among individual variables, the number of decayed teeth was higher among older adults, who self-declared non-white, with lower income, who self-perceived need for treatment, reported pain, never went to the dentist, used the dental service for a longer time and whose appointment was due to oral problems. Dental caries among adolescents was associated with unfavorable contextual and individual conditions. There is a need to expand access to dental services, especially among the most vulnerable groups.

Keywords: Adolescent; Dental caries; Health inequalities; Multilevel analysis

Introduction

Oral problems are one of the leading public health problems globally [1]. We highlight dental caries, a multifactorial disease resulting from a social process including age, sex, general health conditions, and socioeconomic levels [1,2]. According to data from the latest national epidemiological surveys, dental caries showed a heterogeneous distribution, with differences between regions and social groups [3,4]. A previous study found that the disease experience was more severe in population groups most subjected to social deprivation [5]. Thus, the distribution of dental caries has been increasingly polarized, with greater severity in the socially less favored classes [6]. During adolescence, the lack of healthy lifestyle habits is a significant health risk factor in adulthood, including oral health [7]. For example, caries rates are higher in adolescents than in children [8]. Among Brazilian adolescents aged 15-19 years, a DMFT (number of decayed, missing, and filled/restored teeth) index was found with a value practically double that found at the age of 12 [4]. Thus, adolescence is an age group at risk for critical dental caries and deserves to be studied. Considering the uneven distribution of dental caries among adolescents and the scarcity of studies carried out at this life stage, this study aimed to identify the individual and contextual factors associated with the number of decayed teeth among Brazilian adolescents, adopting a multilevel

Affiliation:

[1]Postgraduate program in Health Sciences, State University of Montes Claros (Universidade Estadual de Montes Claros), Montes Claros, Minas Gerais, Brazil

[2]Departament of dentistry, State University of Montes Claros (Universidade Estadual de Montes Claros), Montes Claros, Minas Gerais, Brazil

Corresponding author:
Cíntia Levy Matos Pedroso, Postgraduate program in Health Sciences, State University of Montes Claros (Universidade Estadual de Montes Claros), Montes Claros, Minas Gerais, Brazil.

Citation: Cíntia Levy Matos Pedroso, Luana Leal Roberto, Alfredo Mauricio Batista De Paula, Desirée Sant'ana Haikal. Contextual and Individual Factors Associated with Dental Caries among Brazilian Adolescents: A Multilevel Study. Dental Research and Oral Health 5 (2022): 094-101.

Received: October 14, 2022
Accepted: October 21, 2022
Published: November 01, 2022

Pedroso CLM et al., Dent Res Oral Health 2022
DOI:10.26502/droh.0053

approach, considering the possibility of contributing to the prevention of dental caries and oral health promotion.

Methods

Study design

This multilevel, cross-sectional study employed individual and municipal data. The individual variables were derived from the National Oral Health Survey - SBBrasil 2010 [4], and the contextual variables were collected at the municipal level from official public databases. The SBBrasil 2010 is an oral health survey that covers all 27 capitals and inland municipalities of all the country's regions. Sampling was performed in different territories of state capitals, Federal District, and municipalities within the defined geopolitical macro-regions (North, Northeast, Midwest, Southeast, and South), considering 177 Brazilian municipalities. Details of the methodology used in SBBrasil 2010 are available in a previous study [4]. The 15-19 years age group is the standard group to assess oral health conditions in adolescents [9]. In this study, data from the SBBrasil 2010 were used regarding the 5,445 individuals randomly selected to represent Brazilian adolescents (15-19 years).

Dependent variable

The dependent variable "number of decayed teeth" was obtained from the decayed component of the DMFT index (number of decayed, missing, and filled/restored teeth). Information was retrieved for each of the 32 teeth examined per individual [10]. This variable was worked on per its discrete numerical nature.

Independent variables

The contextual variables were collected from public and official databases for each of the 177 municipalities participating in the SBBrasil 2010: 2010 Demographic Census of the Brazilian Institute of Geography and Statistics - IBGE [10], Atlas Brazil of the United Nations Development Program (UNDP) [11], National Basic Sanitation Survey [12], and Department of Informatics of the Unified Health System (DATASUS) [13]. The databases referring to the Atlas Brasil [11] and the National Basic Sanitation Survey [12] were generated from the 2010 demographic census, whose data were collected from August 1 to October 30, 2010, using the territorial base of 316,574 census tracts [10]. The independent contextual variables were the geographic location of the municipality (capital; inland region) [4], Municipal Human Development Index (MHDI) (very high; high; medium/low) [12], Gini coefficient, % of the population with access to toilet and piped water [12], percentage of the population covered by oral health teams [12], the proportion of dentists per 1,000 inhabitants [12] and fluoridation of public water supply (yes; no) (National Basic Sanitation Survey) [12]. Except for the variables geographic location of the municipality, MHDI, and fluoridation of public water supply, all other contextual variables were analyzed in a continuous numerical way. The coverage of oral health teams refers to the proportion of the population in the municipalities that receive coverage of oral health teams in PHC [12]. The individual independent variables were obtained from the SBBrasil 2010 [4]: sex (female, male), age (in years), self-reported skin color (white, black, yellow, brown, and indigenous), schooling (in years), income range in reais (above R$ 1,500.00; less than or equal to R$ 1,500.00), self-perceived need for treatment (no; yes), tooth and gum pain in the last six months (no; yes), previous use of dental service (yes; no), time since the last visit (less than a year; more than one year; never been to the dentist), the reason for the last visit (review/prevention; oral problems; never been to the dentist) and type of dental service used (SUS; others; never went to the dentist). Regarding the type of dental service used, those offered by the Unified Health System (SUS) were considered public services.

Analyses performed

Data referring to contextual and individual variables were initially organized in the statistical software Predictive Analytics Software (PASW/SPSS®) version 18.0 for Windows®. Data from municipalities and not individuals were used for the descriptive analysis of contextual variables. The need for adjustment was observed for the sample design effect in the descriptive analysis of the individual variables, as they derive from cluster samples. Thus, we employed the "Complex Samples" module, which considers the weights resulting from the sampling process. We estimated central tendency and variability measures for independent numerical variables and simple (n) and relative frequencies (%) for categorical independent variables. We identified the bivariate association between the dependent variable and individual characteristics by employing Pearson's Correlation (r) for independent numerical variables, Student's t-test for dichotomous categorical variables, and Analysis of Variance (ANOVA) for polytomous variables. The data were exported to the STATA® 14.0 program and the Multilevel Negative Binomial Regression model (stepwise backward method), using contextual and individual data to obtain the multiple models. This model is appropriate when the dependent variable is quantitative and with integer and non-negative values (count data) and with data overdispersion (variance of the dependent variable greater than the mean) [14]. The adequacy of the dependent variable for this type of regression was verified and confirmed before starting the modeling. We adopted the mixed effect scheme (fixed effect and random intercept) [15] to estimate the adjustment between the outcome (number of decayed teeth) and independent variables of the first (contextual) and second (individual) levels of analysis. A priori, we considered an empty model (only with

Pedroso CLM et al., Dent Res Oral Health 2022
DOI:10.26502/droh.0053

random intercept and the dependent variable, without the other variables). Subsequently, we included the first level variables, promoting model adjustment. Then, the second-level variables were introduced, adjusting the model again. The *menbreg*, *irr* function was used to obtain the Mean Ratio (MR) and 95% confidence interval (95% CI) measurements, keeping only the variables associated with a level less than or equal to 0.05 ($p \leq 0.05$) in the final models. We analyzed the fit of models employing *deviance*, obtained through the Log-Likelihood multiplied by (-2), where significant differences are expected between the models [16]. Moreover, we tested multicollinearity, verifying the correlations between the independent variables using Pearson's Correlation (r), and we did not identify values above 0.7.

Ethical issues

The SBBrasil 2010 was conducted to meet the ethical principles of Resolution n° 196/96 of the National Health Council (CNS) on human research. It was approved by the Research Ethics Committee of the Ministry of Health and registered at the National Research Ethics Committee (CONEP), of the CNS, under N° 15.498/2009. Participants were duly informed about the research and agreed to participate by signing the Informed Consent Term [17].

Results

Seventy-eight (1.43%) people from the sample evaluated by the SBBrasil 2010 were excluded because they did not have information related to the dependent variable under analysis. Thus, this study considered 5,367 Brazilian adolescents. The mean number of decayed teeth was 1.76 (± 2.93). The descriptive analysis of the contextual variables is shown in table 1. One-third of the 177 Brazilian municipalities considered did not have fluoridated water, and most had a high MHDI (66%). In the descriptive analysis of individual variables, most adolescents were female (51.7%) and self-declared black/yellow/brown/indigenous (55%). The mean age of the adolescents was 16.86 years (±1.46), and they had, on average, 9.36 years of schooling (±2.44). Furthermore, most adolescents self-perceived the need for dental treatment, and 13.8% reported never having gone to the dentist (table 2). The bivariate analysis can also be seen in table 2. The multilevel negative binomial regression analysis results are shown in table 3. Considering the contextual variables, the mean number of decayed teeth was higher among residents of municipalities with medium/low MHDI (MR=1.78; CI=1.19 -2.65). Living in cities with a higher proportion of dentists per inhabitant was associated with a lower mean number of decayed teeth (MR=0.76; CI= 0.59-0.97). Among the individual variables, the mean number of decayed teeth was higher among older adolescents (MR=1.07; CI=1.03-1.09) who self-declared black, yellow, brown, or indigenous (MR=1 0.13; CI=1.04-1.24) and had a household income less than or equal to R$ 1,500.00 (MR=1.30; CI= 1.18-1.42). However, the mean number of decayed teeth was lower among adolescents with higher schooling (MR=0.92; CI= 0.90-0.93). Additionally, the number of decayed teeth was higher among individuals who self-perceived the need for dental treatment (MR=2.02; CI= 1.83-2.24), who reported tooth and gum pain in the last six months (MR= 1.51; CI=1.39-1.65), who never went to the dentist (MR=1.62; CI=1.40-1.88), who used the dental service for more than one year (MR=1.20; CI=1.10-1.30) and whose reason for the visit was oral problems (MR=1.67; CI=1.50-1.83). The use of non-public dental services was a protective factor for the number of decayed teeth compared to adolescents who used dental services offered by the SUS (MR=0.75; CI= 0.67-0.82). A significant decline in *deviance* was observed with the adjustment of the models.

Discussion

This study identified the influence of contextual variables MHDI and proportion of dentists per inhabitant on the number of decayed teeth in Brazilian adolescents, even after adjusting for critical individual variables knowingly associated with dental caries. The presence of contextual variables among the determinants of dental caries reinforces the fact that the geographic space (territory) reflects human, social, economic,

Table 1: Characterization of the Brazilian municipalities (n=177) regarding contextual variables in absolute numbers (n) and percentages (%), mean ($\bar{x}$) and standard deviation (SD). Brazil, 2010.

Context Variables	n	%
Geographical location of the municipality		
Capital	27	15.3
Inland	150	84.7
MHDI		
Extremely high	33	18.5
High	117	66
Medium/low	27	15.5
Gini coefficient§	$\bar{x}$ (SD) = 0.62 (0.12)	
% of the population with access to toilets and running water §	μ (SE) = 95.36 (7.39)	
Oral health team coverage§*	$\bar{x}$ (SD) = 31.0 (27.55)	
Proportion of dentists per 1,000 inhabitants§	$\bar{x}$ (SD) = 0.90 (0.45)	
Public water supply fluoridation		
Yes	118	66.7
No	59	33.3

Source: SBBrasil 2010, UNSD, DATASUS, and IBGE.
§ Numerical variables.
* Data not available for 15 municipalities.

Citation: Cíntia Levy Matos Pedroso, Luana Leal Roberto, Alfredo Mauricio Batista De Paula, Desirée Sant'ana Haikal. Contextual and Individual Factors Associated with Dental Caries among Brazilian Adolescents: A Multilevel Study. Dental Research and Oral Health 5 (2022): 094-101.

Pedroso CLM et al., Dent Res Oral Health 2022
DOI:10.26502/droh.0053

Table 2: Characterization of Brazilian adolescents (n=5,367) regarding individual variables in absolute numbers (n) and percentages (%), and their bivariate association with the number of decayed teeth. Brazil, 2010.

Individual Variables	n	%	Number of decayed teeth $\bar{x}$ (SD)	p-value
Sex				
Female	2915	51.7	1.93 (2.81)	0.679**
Male	2452	48.3	1.96 (3.06)	
Age (in years)§	$\bar{x}$ (SD) = 16.86 (1.46)			0.070#
Self-declared ethnicity/skin color				
White	2177	45	1.41 (2.59)	<0.001**
Black/Yellow/Brown/Indigenous	3190	55	2.31 (3.09)	
Schooling (in years)§*	$\bar{x}$ (SD) = 9.36 (2.44)			<0.001#
Household income (in reais)*				
Up to R$ 1,500.00	1585	32.3	2.31 (3.17)	<0.001**
Above R$ 1,500.00	3467	67.7	1.21 (2.28)	
Self-perceived need for dental treatment*				
No	1603	32.6	0.90 (2.30)	<0.001**
Yes	3569	67.4	2.44 (3.09)	
Toothache*				
No	4048	75.7	1.54 (2.60)	<0.001**
Yes	1305	24.3	3.16 (3.48)	
Previous use of dental service*				
Yes	4625	86.3	1.84 (2.71)	<0.001**
No	716	13.7	2.59 (3.99)	
Time since last visit*				
Less than 1 year	2665	47	1.60 (2.59)	<0.001†
More than 1 year	1905	39.1	2.17 (2.85)	
Never went to the dentist	716	13.9	2.59 (4.00)	
Reason for visit*				
Check-up/prevention	1598	30.9	0.93 (1.80)	<0.001†
Oral problems	2986	55.3	2.32 (2.95)	
Never went to the dentist	716	13.8	2.59 (4.00)	
Type of dental service used *				
SUS	2176	40.2	2.50 (3.11)	<0.001†
Other	2418	46.1	1.25 (2.13)	
Never went to the dentist	716	13.8	2.59 (4.00)	

Source: SBBrasil 2010.
§ Numerical variables.
* N variation due to loss of information.
** *Student's* t-test
# *Pearson's* correlation
†ANOVA

and historical relationships. It can, in fact, influence people's living conditions and health. The context can be understood as a reflection of the conditions of its inhabitants that positively or negatively affect the living conditions of its occupants. Contextual and individual conditions are interrelated and often seem to feed back [18]. Adolescents living in cities with medium/low MHDI had, on average, 1.78 more decayed teeth than those living in cities with very high MHDI. The MHDI had already been identified as a contextual determinant of untreated caries among adolescents [22]. A previous multilevel study observed a more significant number of missing teeth among adults living in municipalities with lower MHDI [24]. This conception aligns with features found in municipalities, where worse contextual indicators and worse oral health conditions are simultaneously identified since essential aspects for maintaining dentition, such as higher education, better eating habits, greater access to information, and provision of health services are generally

Pedroso CLM et al., Dent Res Oral Health 2022
DOI:10.26502/droh.0053

Table 3: Multilevel negative binomial regression analysis on the number of decayed teeth among Brazilian adolescents (n = 4,750). Brazil, 2010.

Context Variables	Model 1		Model 2	
	MR (95% CI)	p-value	MR (95% CI)	p-value
MHDI				
Extremely high	Ref.		Ref.	
High	1.50 (1.07-2.11)	0.018	1.29 (0.91-1.84)	0.149
Medium/low	2.28 (1.55-3.36)	<0.001	1.78 (1.19-2.65)	0.005
Oral health team coverage	0.99 (0.99-1.00)	0.006	--------	--------
Proportion of dentists per 1,000 inhabitants	0.70 (0.54-0.89)	0.004	0.76 (0.59-0.97)	0.028
Indiviadual Variables				
Age (in years)			1.07(1.03-1.09)	<0.001
Self-declared ethnicity/skin color				
White			Ref.	
Black/Yellow/Brown/Indigenous			1.13 (1.04-1.24)	0.003
Schooling (in years)			0.92 (0.90-0.93)	<0.001
Household income (in reais)				
Above R$ 1,500.00			Ref.	
Less than or equal to R$ 1,500.00			1.30 (1.18-1.42)	<0.001
Self-perceived need for dental treatment				
No			Ref.	

more available in more developed areas [19,20]. Thus, the results of this study reinforce the finding that dental caries is a "social disease" whose unequal impact results from unavoidable individual variations and the social disparities in which they are inserted [21-23]. The main finding of this analysis refers to the association between the number of dentists per inhabitant of the municipalities and the number of decayed teeth observed among adolescents, even after adjusting for the other blocks of variables. Adolescents living in municipalities with a higher proportion of dentists per inhabitant showed a lower mean number of decayed teeth than adolescents living in municipalities with a lower dentist per inhabitant ratio. This finding emphasizes the importance of the availability of dental surgeons in the municipalities in adequate numbers, referring to the reflection of the need for an equitable, nationwide distribution of these professionals to ensure a more significant transfer of information and access to oral health care for the population. The WHO recommends one dentist per 1,500 inhabitants [9]. In 2020, Brazil had a ratio of one dentist to 626 inhabitants [26,27], exceeding the recommended by more than twice. However, our study found that the proportion of dentists per inhabitant was considerably lower in the Northern regions, with one dentist for every 2,631 inhabitants, and in the Northeast, one dentist for every 1,818, when compared to the South regions (one dentist for every 1,149 inhabitants) and Southeast (one dentist for every 1,111 inhabitants). Thus, the distribution of these professionals by Brazilian region shows great disparity, with greater concentration in the most populous and developed regions. The issue of polarized and heterogeneous distribution of dental services in the country is more related to market laws than the profile of needs [17]. This problem is repeated worldwide, with more than one million dentists duly qualified to provide oral health care. However, they are not evenly distributed and as per the populations' needs, many of which are from the most impoverished, underprivileged regions with a higher need for this type of care, with less than one dentist for every 300,000 inhabitants [28]. Other studies also report that the proportion of dentists per inhabitant is one of the leading contextual factors associated with tooth loss [29,30] and other oral diseases [31,32] among adolescents. Unfortunately, despite the relevance of this variable (dentist/inhabitant ratio) in dental caries or other oral problems, this issue has not been widely explored in the scientific literature, especially considering a multilevel approach. Thus, further investigations are recommended considering this vital variable for oral health outcomes. Regarding individual variables, a previous study found that younger adolescents had a better oral health pattern [17], which corroborates the findings of this study, possibly due to the shorter exposure time of dental elements to the oral environment. We found that black/yellow/brown/indigenous individuals had a higher mean number of decayed teeth than white individuals. Inequalities associated with dental caries related to skin color

Pedroso CLM et al., Dent Res Oral Health 2022
DOI:10.26502/droh.0053

were also observed in previous studies on Brazilian adolescents [22,33]. On the other hand, fewer decayed teeth were observed among adolescents with higher education (MR=0.92; CI= 0.90-0.93). Higher education levels are protective factors for dental caries [22]. Adolescents with a lower household income had a higher mean number of decayed teeth than those with higher household income (MR=1.30; CI= 1.18-1.42), evidencing the socioeconomic condition as one of the determining factors for dental caries. Subjective oral health conditions were also associated with dental caries among adolescents. A higher mean number of decayed teeth was found among individuals who self-perceived the need for dental treatment and reported tooth and gum pain in the last six months. The conception of quality of life and general aspects of health, including oral health, has been much discussed. This relationship plays an essential role in people's perception, characterizing a subjective factor linked to self-image, understanding of needs, and searching for dental care [34-36]. Regarding the use of dental services, we found that the mean number of decayed teeth was higher among adolescents who had never used these services, who had used these services for more than a year, and whose reason for the visit was oral problems. Research conducted among Brazilian adolescents also found a higher likelihood of caries in adolescents who did not visit the dentist regularly or never went to the dentist [33]. The regular use of dental services possibly ensures greater access to oral health maintenance procedures, disease prevention, and early treatment. Preventive use/review of dental services is an indicator of oral health, with a higher presence of dental caries observed among individuals who used dental services due to oral problems [37]. Moreover, fewer decayed teeth were observed among adolescents who used non-public dental services than those who used the SUS. National and international studies have already identified the association between the use of dental services in the last year and less tooth loss. Adults who routinely used dental services had better oral health levels, with fewer decayed and missing teeth [24,38]. These results show that regular access to dental services can reduce the number of decayed and missing teeth and, consequently, ensure oral health as a whole. The results of this study are expected to be helpful for the implementation of national and regional policies by oral health care providers. Considerable progress in reducing inequalities in access and increasing the use of dental services has been observed in Brazil from 1998 to 2008 [40]. However, inequalities among social groups are still significant. Adolescents' context and individual factors associated with dental caries reveal health disparities, highlighting the importance of eliminating inequality in accessing dental services. Oral health system managers and legislators must immediately allocate resources and reduce barriers to this end, assuring the principle of equity. As for the limitations of this work, we should consider that it is a cross-sectional study, where causes and effects are measured simultaneously, thus hindering the inference of causality. Furthermore, secondary data were analyzed, and, consequently, some risk factors for dental caries, such as habits and lifestyle, were not evaluated since the SBBrasil 2010 did not address such characteristics. It is worth mentioning the data's temporal limitation, collected in 2020, although they are the most recent national approach data currently available. We recognize that the descriptive results should be interpreted with some caution, as the last decade was marked by changes in the oral health policy adopted in the country, which may have impacted the prevalence of caries lesions in the population. However, we believe that the verified associations are current and relevant. Also, it is worth noting the representativeness of the investigated sample and the multilevel approach of the variables, which allowed assessing the importance of contextual and individual factors in the investigated outcome. Another strength is that the dependent variable adopted was worked on in its discrete numerical nature (without categorizations), thus allowing us to verify the impact by the mean number of decayed teeth.

Conclusion

The contextual variables MHDI and proportion of dentists per population remained associated with the highest number of decayed teeth among adolescents, even after adjusting for critical individual variables knowingly associated with dental caries. A more significant number of decayed teeth was associated with unfavorable contextual and individual factors, such as lower MHDI, a lower proportion of dentists per inhabitant, lower schooling, low household income, reports of pain, absence, and more prolonged use of dental services. The relationship between the proportion of dentists per inhabitant in the municipalities seems to play a role in social inequalities in dental caries among adolescents. It should be further explored in the scientific literature. Thus, the results of this study reinforce the importance of public policies in increasing adolescents' access to dental care. Additionally, we emphasize that such policies should be guided by implementing coordinated actions to promote health and social justice, prioritizing the population segments with the highest needs.

References

1. Bragamian RA, Garcia-Godoy F, Volpe, A. The global increase in dental caries. A pending public health crisis. American Journal of Dentistry 21 (2009): 129-135

2. Assunção LRDS, Vilella KD, Rocha DP, et al. Epidemiologia da cárie dentária em crianças da primeira infância no município de Belém, PA. Rev Assoc Paul Cir Dent 69 (2015): 74-79.

3. Brasil. Ministério da Saúde, Coordenação Nacional de

Pedroso CLM et al., Dent Res Oral Health 2022
DOI:10.26502/droh.0053

Saúde Bucal. Projeto SB Brasil 2003: condições de saúde bucal da população brasileira, 2002-2003, resultados principais. Brasília: Ministério da Saúde; 2004.

4. Brasil. Ministério da Saúde. Departamento de Atenção Básica. SBBrasil 2010. Pesquisa nacional de saúde bucal: Resultados principais. Brasília: Ministério da Saúde (2012).
5. Narvai PC, Frazão P, Roncalli AG, et al. Cárie dentária no Brasil: declínio, iniqüidade e exclusão social. Rev Panam Salud Publica 19 (2006): 385-393.
6. Mota JC, Valente, JGV, Schramm JMA, et al. Study of the overall burden of oral disease in the state of Minas Gerais, Brazil: 2004-2006. Ciência & Saúde Coletiva; Rio de Janeiro 19 (2014): 639-648.
7. Curi DSC, Figueiredo ACL, Jamelli SR. Fatores associados à utilização dos serviços de saúde bucal pela população pediátrica: uma revisão integrativa. Ciência & Saúde Coletiva 23 (2018): 1561-1576.
8. Almeida TFD, Cangussu MCT, Chaves SCL, et al. Condições de saúde bucal em crianças, adolescentes e adultos cadastrados em unidades de Saúde da Família do município de Salvador, estado da Bahia, Brasil, em 2005. Epidemiol. Serv. Saúde 21 (2012): 109-118.
9. World Health Organization (WHO). Oral health surveys: basic methods. 4th Ed. Geneva: WHO (1997).
10. Instituto Brasileiro De Geografia E Estatística (IBGE). Síntese de indicadores sociais: uma análise das condições de vida da população brasileira. Estudos e Pesquisas 27 (2011): 1-4.
11. Brasil. Atlas do Desenvolvimento Humano no Brasil (2010).
12. Instituto Brasileiro de Geografia e Estatística. Pesquisa Nacional de Saneamento Básico (2012).
13. Brasil. Ministério da Saúde. Informações de saúde. Informação de saúde: cadernos de informação de saúde (2010).
14. Fávero LP. Análise de Dados: Modelos de Regressão Com Excel®, Stata® e Spss®. Rio de Janeiro: Editora Elsevier (2015): 520.
15. Snijders TAB. Multilevel analysis. Springer Berlin Heidelberg 12 (2011): 879-882.
16. Carle AC. Fitting multilevel models in complex survey data with design weights: Recommendations. BMC Medical Research Methodology 9 (2009): 49.
17. Roncalli AG, Silva NND, Nascimento AC, et al. Aspectos metodológicos do Projeto SBBrasil 2010 de interesse para inquéritos nacionais de saúde. Cad Saúde Pública 28 (2012): 40-57.
18. Moreira RS, Nico LS, Tomita NE. A relação entre o espaço e a saúde bucal coletiva: por uma epidemiologia georreferenciada. Ciênc. saúde coletiva 12 (2007): 275-284.
19. Franco M, Diez-Roux AV, Glass TA, et al. Neighborhood characteristics and availability of healthy foods in Baltimore. Am J Prev Med 35 (2008): 561-567.
20. Brasil. Ministério da Saúde. Secretaria de Atenção à Saúde. Departamento de Atenção Básica. A saúde bucal no Sistema Único de Saúde [recurso eletrônico] / Ministério da Saúde, Secretaria de Atenção à Saúde, Departamento de Atenção Básica. Brasília: Ministério da Saúde (2018).
21. Freitas SFT. História social da cárie dentária. Monografia em Português | LILACS, BBO - Odontologia. Bauru: EDUSC (2001).
22. Frias AC, Antunes JLF, Junqueira SR, et al. Determinantes individuais e contextuais da prevalência de cárie dentária não tratada no Brasil. Rev Panam Salud Publica 22 (2007): 279-285.
23. Silva MAM, Souza MCA, Rodrigues CRT, et al. Condições de saúde bucal em escolares de Vassouras/RJ: uma pesquisa epidemiológica. Rev Brasil Pesq Saúde 12 (2010): 52-56.
24. Roberto L, Silveira M, De Paula AM et al. Contextual and individual determinants of tooth loss in adults: a multilevel study. BMC Oral Health 73 (2020) 20-29.
25. Chalub LLFH, Martins CC, Ferreira RC, et al. Functional dentition in Brazilian adults: an investigation of social determinants of health (SDH) using a multilevel approach. PLoS One 11 (2016): e0148859.
26. San Martin AS, Chisini LA, Martelli S, et al. Distribuição dos cursos de Odontologia e de cirurgiões-dentistas no Brasil: uma visão do mercado de trabalho. Revista da Abeno 18 (2018): 63-73.
27. Brasil. Conselho Federal de Odontologia. Quantidade Geral de Profissionais e Entidades Ativas (2021).
28. Federação Dentária Internacional (FDI) High risk of oral diseases and low access to care condemns developing countries to sub-standard oral health. Switzerland: FDI (2014).
29. Natto ZS, Aladmawya, M, Alasqaha M, et al. Factors contributing to tooth loss among the elderly: a cross sectional study. Singapore Dental Journal 35 (2014): 17-22.
30. Silva Junior MF, Batista MJ, De Sousa MDLR. Risk factors for tooth loss in adults: a population-based prospective cohort study. PLoS One 14 (2019): 1-14.
31. Bulgareli JV, Faria ETD, Cortellazzi KL, et al. Fatores que influenciam o impacto da saúde bucal nas atividades

Pedroso CLM et al., Dent Res Oral Health 2022
DOI:10.26502/droh.0053

diárias de adolescentes, adultos e idosos. Revista de Saúde Pública 52 (2018): 1-9.

32. Peres MA, Macpherson LMD, Weyant RJ, et al. Oral diseases: a global public health challenge. The Lancet 394 (2019): 249-260.

33. Silveira MF, Freire RS, Nepomuceno MO, et al. Cárie dentária e fatores associados a adolescentes no norte de Minas Gerais, Brasil: uma análise hierárquica. Ciência e Saúde Coletiva 20 (2015): 3351-3364.

34. Locker D, Gibson B. Discrepancies between self-ratings of and satisfaction with oral health in two older adult populations. Community Dent Oral Epidemiol 33 (2005): 280-288.

35. Walter MH, Woronuk JI, Tan HK, et al. Oral health related quality of life and its association with sociodemographic and clinical findings in 3 northern out.

36. Cohen-Carneiro F, Souza-Santos R, Rebelo MA. Quality of life related to oral health: contribution from social factors. Cien Saude Colet. 16 (2011): 1007-1015.

37. Camargo MBJ, Barros AJD, Frazão P, et al. Preditores da realização de consultas odontológicas de rotina e por problemas em pré-escolares. Rev Saude Publica 46 (2012): 87-97.

38. Koltermann AP, Giordani MA, Pattussi MA. The association between individual and contextual factors and functional dentition status among adults in Rio Grande do Sul state, Brazil: a multilevel study. Cad Saude Publica 27 (2011): 173-182.

39. Thomson WM, Williams SM, Broadbent JM, et al. Long-term dental visiting patterns and adult oral health. J Dent Res 89 (2010): 307-311.

40. Ghasemianpour M, Bakhshandeh S, Shirvani A. et al. Experiência de cárie dentária e status socioeconômico entre crianças iranianas: uma análise multinível. BMC Public Health 19 (2019): 1569.