Acta Scientiarum

http://periodicos.uem.br/ojs
ISSN on-line: 1807-8648
Doi: 10.4025/actascihealthsci.v45i1.59153

Geographical distribution of dental caries in children in the southern region of Brazil

Paula Rosalen, Andressa Bulegon, Mayara Trapp Vogel and Lilian Rigo*

Faculdade de Odontologia, ATITUS Educação, Senador Pinheiro, 304, 99070-220, Passo Fundo, Rio Grande do Sul, Brazil. *Author for correspondence. E-mail: lilian.rigo@atitus.edu.br

ABSTRACT. The objective was to investigate the experience and severity of dental caries, from the medical records of children who visited the Children's Dental Clinic of a Faculty of southern Brazil, for four years. A cross-sectional study was carried out by analyzing 262 medical records containing information sociodemographic, as well as clinical oral data, to investigate dental caries. Amongst all children included in study, 226 (86.3%) had some teeth with experience of dental caries and 161 (61.5%) had three or more dental caries. The mean dental caries in children aged between 6-8 years was 5.3 ± 3.1, and the average in children aged between 9-12 years was 2.0 ± 1.9. There was association between the severity of dental caries (more than three teeth) and not using dental floss, as well as with the geographical location of residence. Older children were considered to be protected from dental caries. In this study, the experience of dental caries was high, especially in primary teeth, and variables such as the geographical location of residence, absence of flossing were related to the greater severity of dental caries.

Keywords: dental caries; determinants of health; oral hygiene; socioeconomic factors.

Received on May 10, 2021.
Accepted on March 30 2022.

Introduction

According to the World Health Organization (WHO), dental caries is still a major oral health problem in most industrialized countries, affecting 60-90% of school-age children, and is considered a public health problem (WHO, 2013). Previous studies have pointed out income inequalities play a role in various oral health indicators (Engelmann, Tomazoni, Oliveira, & Ardenghi, 2016; Stopa et al., 2017; Levy, Livny, Sgan-Cohen, & Yavnai, 2018; Kramer et al., 2019; Bastos et al., 2019). In addition to income, factors such as race, gender and education level are strongly associated with untreated caries in adults (Gupta, Vujicic, Yarbrough, & Harrison, 2018). These factors increase the risk of dental caries in the population, especially the children growing in the same environment. Caries disease it impairs the ability of the population to maintain good health, which is a trend attributed to epidemiological transition, thus affecting the children. This disease affected more than 10% of the world population in 2015, and dental caries in permanent teeth was the topmost condition in the list of diseases, highlighting that the incidence increased by 15% during 2005-2015 (Global Burden of Disease [GBD], 2016).

According to the data from the last National Oral Health Survey of 2012, a 5-year-old Brazilian child has a mean of 2.43 teeth with caries and 2.07 in children aged 12-years-old (Brazil, 2012). On comparing the results between the capital cities and the municipalities of the interior areas of each region, the mean, in general, was found to be higher in the interior areas, indicating that the location of the population directly influences the experience of dental caries (Brazil, 2012).

Public health actions such as the use of fluoridated water, fluoridated toothpaste, and table salt were implemented to reduce the occurrence of the disease in the general population (Frazão, 2012). Through initiatives such as inclusion of oral health services in the Family Health Program, Oral Health Teams were created. These teams included more activities on oral health education, held and supervised brushing programs, introduced employment of fluoride in the health units and schools, and also encouraged the practice of fluoridation of drinking water in cities (Elamin, Garemo, & Gardner, 2018). These factors led to the reduction in the occurrence of caries in Brazil. Through these initiatives, in the last three decades, the prevalence of dental caries significantly decreased in Brazil (Agnelli, 2015). However, epidemiological

investigations report that people living in some regions/cities, as well as those whose head of the family has a higher level of education, have greater access to public health services (Stopa et al., 2017), showing that disparities in accessing health services must be known and avoided. The reformulation of health policies in order to reduce disparities that should consider regional differences as well as differences among social classes (Stopa et al., 2017).

This study proposes to indicate the areas of the municipality where it is necessary to expand access to dental care and reinforce education in oral health in the most vulnerable sites, by means of an investigation involving the patients' geographical location of residence. This mapping, carried out by this pioneering research, can serve as a comparative parameter for future studies and open discussion for the possible monitoring of this population in the coming years.

Thus, the objective of this study was to verify the experience and severity of dental caries and associated factors from medical records of children aged between 6 to 12 years at a Children's Dental Clinic of a Faculty in southern Brazil from 2016 to 2019.

Material and methods

The research was submitted to and approved by the Research Ethics Committee of Faculty IMED, under opinion number 2,014,434, CAAE 65086317.5.0000.5319, on April 12, 2017. This scientific article was written according to the report by Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines (Malta, Cardoso, Bastos, Magnanini, & Silva, 2015).

Study design and sample

This is a cross-sectional study, whose population was evaluated using medical records of patients aged 6-12 years, at the Children's Dental Clinic of the Faculty of Dentistry from 2016 to 2019. The total number of medical records in this period was 287; however, 25 medical records (8.7%) were excluded owing to the lack of correct data filling. Thus, the final population included in this study was 262 medical records.

The study was conducted at the Faculty of Dentistry, whose Dental Clinic aims to provide dental services to the entire population of a municipality. This municipality, Passo Fundo, is located in the north of Rio Grande do Sul and is considered the largest city in the northern region, with a population of 197,798 inhabitants (Instituto Brasileiro de Geografia e Estatística [IBGE], 2010).

Procedures for data collection

For data collection, we used the medical records from 2017 to June 2020 containing the oral clinical examination of patients registered and screened in the Children's Dental Clinic course assessed at the beginning of their treatment.

Thus, data collection for this research was carried out based on the analysis of medical records, extracting the following data: 1. anamnesis examination form - containing socio-demographic data - age, sex, race, mother's occupation and geographic location of the district and the municipality; oral hygiene data - frequency of tooth brushing, use of fluoride and use of dental floss; 2. clinical examination form - containing oral clinical evaluation describing dental caries data, which were categorized in the DMFT index codes (index that measures the experience of decayed, filled, extracted and missed teeth by caries) for permanent teeth and dmft (index that measures the experience of decayed, filled teeth, with indication of extraction by caries) for primary teeth, according to the World Health Organization (WHO, 2003).

Variables in the study

Was included all teeth with caries experience, and the outcome variable was classified into two categories, according to severity index: 1. 'Low dental caries' - up to 3 teeth with caries experience including decayed, lost due to caries and filled (0 to 3 dmft/DMFT), 2. 'High dental caries' - more than 3 teeth with caries experience (more than 3 dmft/DMFT). The frequencies are: 1. dmft/DMFT from 0 to 3 = 101 (38.5%); 2. dmft/DMFT > than 3 = 161 (61.5%)

The following independent variables were used: age (6-8 years and 9-12 years), sex (male/female), race/ethnicity (white and not white), use of floss daily (yes/no), frequency of daily tooth brushing (0 to 1 time, 2 or more times), use of fluoride (yes/no), mother's occupation (at home, domestic/cleaning services and other activities performed outside the home), and geographic location of residence by sectors of the municipality

(groups 1, 2, and 3). For geographic location of the residences, the groups were divided into three, after computing the total number of residents based on each geographical side of the city map. Thus, the central area was used as a reference, as this was the most privileged location of the city and was located in the city center and other neighborhoods with better urban infrastructure. The other two clusters were divided according to the opposite sides of the geographic map (right and left sides of the municipality map) and taking into account a population size similar to the other clusters. Thus, the groups were classified as follows, according to the size of population in the localities:

- Cluster 1 (center map) - sectors 1,4,15,18,19 - total population of 53,940.
- Cluster 2 (left side map) - sectors 2,3,8,9,10,16,17,22 - total population of 55,840.
- Cluster 3 (right side map) - sectors 5,6,7,11,12,13,14,20,21 - total population of 51,232.

The distribution of the 22 census sectors in the districts of the municipality of Passo Fundo is shown in Figure 1A. The division into 3 groups performed for analysis in this research is shown in Figure 1B.

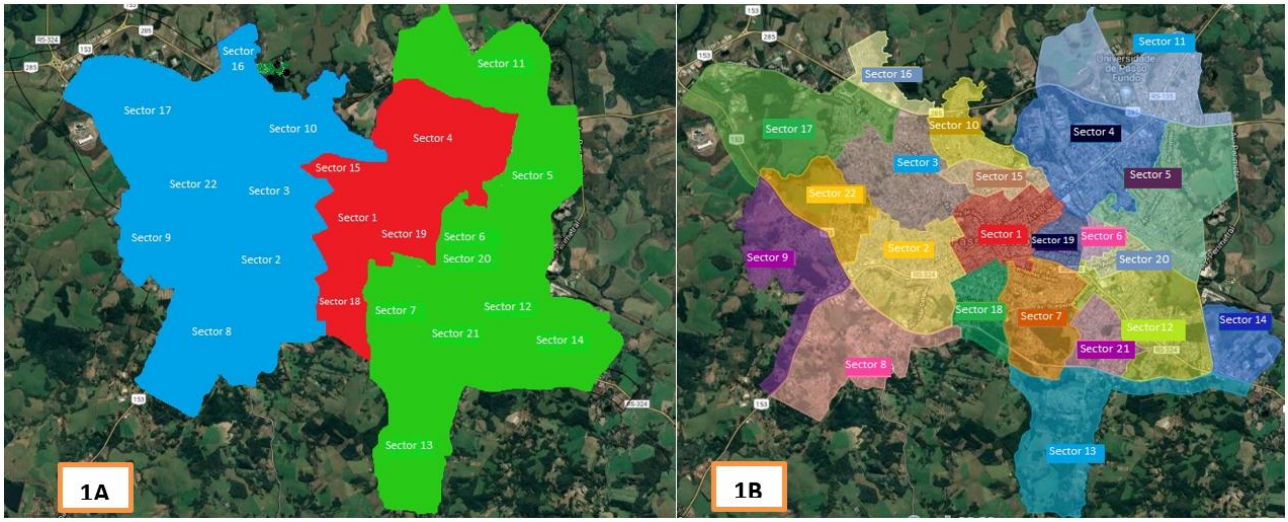

Figure 1. Distribution of the 22 census sectors in the districts of the municipality of Passo Fundo (1A) and division into 3 groups (1B).

Theoretical model for data analysis

The etiology of dental caries is multifactorial; however, some factors are already well established, for example, a high-sugar diet can be directly related to the occurrence of caries. Another factor is the oral hygiene habits such as the frequency of tooth brushing, flossing, and use of fluoride that may be inversely related to the presence of decay. It is also important to note that demographic characteristics and socioeconomic conditions can be determinants of different oral conditions. However, the exact relationship between these determinants is not fully understood, since some individuals present with dental caries despite the absence of the risk factors and others do not develop the disease even when exposed to these factors. Thus, it is possible that depending on the population and their geographic location of residence, there may be a better understanding of the presence of dental caries, which may bridge this gap. To provide an explanation for these outcomes, we chose to select a set of variables for analysis, having their entry in blocks in order (Block 1 - demographic variables: age, sex and race; Block 2 - socioeconomic variables: mother's occupation and geographical location of residence; Block 3 - oral hygiene variables: frequency of brushing teeth, use of yarn for dental flossing and use of fluoride). The final model is based on a theoretical model analysis (Figure 2).

The data obtained were organized in an Excel spreadsheet and exported to the statistical program IBM SPSS® software (Statistical Package for the Social Sciences), version 20.0, Armonk, New York.

Descriptive analyses of all qualitative variables were performed, describing their relative and absolute frequencies. Central tendency and dispersion measures were used to verify the mean, variance, standard deviation, minimum, maximum, and sum of teeth with experience of dental caries. After descriptive analyses, we performed further univariate and multivariate analyses, with dental caries outcome classified according to their severity. In the multiple analysis, odds ratios (OR) and their respective 95% confidence intervals (95% CI) were estimated, crude OR was adjusted for the exposure variables in a Binary Logistic Regression model ($p < 0.05$).

Thus, the statistical analysis to verify the relationship between the severity of dental carie and exposure variables resulted in a statistically significant model.

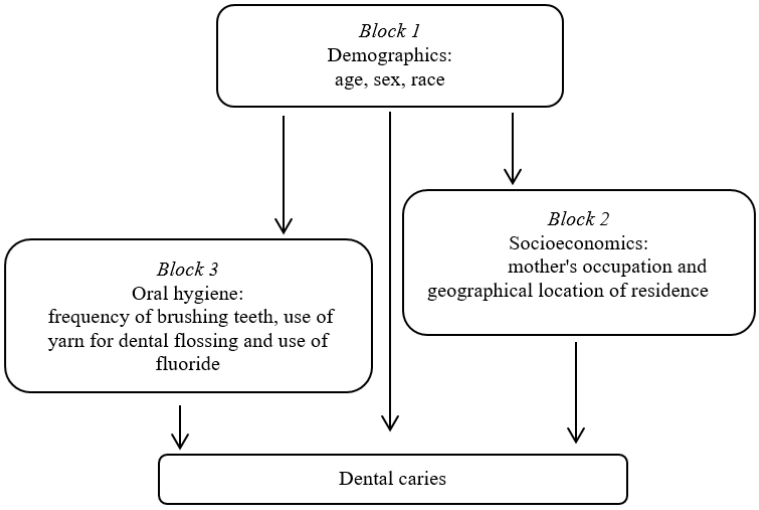

Figure 2. Model theoretical hierarchical explanation for dental caries.

Results

The mean age of the children who were at the Children's Dental Clinic described in the medical records was 9.0 (± 1.9) years. Most individuals were race white 225 (85.9%), whose mothers did not work outside home (119, 45.4%). Regarding oral hygiene, only 42.4% (111) brushed more than twice a day and 27.1% (71) used dental floss. Table 1 describes the results of the patients' socio-demographic and oral hygiene variables.

Table 1. Distribution of socio- demographic and oral hygiene variables of patients of the Children's Dental Clinic, Faculty of southern Brazil, Passo Fundo, Brazil, 2019 (n = 262).

Variables	N	%
Age		
6 to 8 years	152	58
9 to 12 years	110	42
Sex		
Male	116	44.3
Female	146	55.7
Race		
White	225	85.9
Not white	37	14.1
Tooth-brushing frequency day^{-1}		
0 to 1 time	151	57.6
2 or more times	111	42.4
Fluoride use		
Yes	69	9.9
No	193	90.1
Flossing		
Yes	71	27.1
No	191	72.9
Mother occupation		
From home	119	45.4
Household and cleaning services	59	22.5
Various activities - away from home	84	32.1
Sectors		
Cluster 1	51	19.5
Cluster 2	1 00	38.2
Cluster 3	1 11	42.4

Of the 262 survey participants, 226 (86.3%) had some teeth with experience of dental caries (decayed, restored or lost), with only 13.7% (36) of children being free of caries.

For this study, data on primary teeth for children aged 6 to 8 years (152.58%) and data on permanent teeth for children aged 9 to 12 years were analyzed (110.42%).

The mean of the dmft verified in the children's medical records was 5.3 ± 3.1 in children between 6 to 8 years old. In children aged 9 to 12 years, the mean DMFT score was 2.0 ± 1.9. The data for the dmft and DMFT indexes, as well as the elements that compose them (decayed, restored and lost) are shown in Table 2. Decayed component of dmft, which represents untreated decayed teeth, had a mean of 4.6 ± 3.2.

Table 2. Measures of central tendency of decayed, filled and missing teeth due to caries, classified by age group, of the children registered in the records of the Children's Dental Clinic, Faculty of southern Brazil, Passo Fundo, Brazil,2019 (n = 262).

	decayed teeth		filled teeth		missing teeth		experience of dental caries	
	* D	* * P	* D	* * P	* D	* * P	*dmft	** DMFT
Mean	4.6	1.8	0.7	0.2	-	0.5	5.3	2.0
Standard	3.2	1.8	1.2	0.5	-	0.4	3.1	1.9
deviation								
Maximum	15	9	6	2	-	4	15	9
Variance	10.4	3.8	1.5	0.2	-	0.1	9.9	3.7

* D – Deciduous; ** P – Permanent.

For the realization of Binary Logistic Regression, all variables that had an association with p < 0.15 were entered in the crude model: age group, race, flossing and geographic sectors. However, after multivariate adjustment, only the variables, flossing and geographic location of residence (sectors) remained significant (p < 0.05), and race lost membership in the final model adjusted to multivariate regression analysis. Children who did not use the floss had 1.98 (OR=1.98; 95% CI 1.11-3.54) were likely to have more teeth with caries experience. Children who lived in group 3 are 2.54 more likely to greater severity of dental caries (OR= 2.54; 95% CI 1.25-5.15) than the first group. The older age group was a protective factor for dental caries with 30% more chances of not having caries (OR =0.30; 95% CI, 0.17-0.53). The results are shown in Table 3.

Table 3. Univariate (crude) and multivariate (adjusted) binary logistic regression analyses for the severity of dental caries, Passo Fundo, Brazil, 2019.

	Crude OR (95% CI)	p-value *	Adjusted OR (95% CI)	p-value **
Age range				
6 to 8 years	1			
9 to 12 years	0.31 (0.18-0.55)	*< 0.001*	0.30 (0.17-0.53)	*<0.001*
Sex				
Male	1		-	
Female	1.11 (0.67-1.84)	*0.66*		
Mother's occupation				
Out of home	1			
From home	1.24 (0.75-2.06)	0.39		
Fluoride Use				
Yes	1		-	
No	0.73 (0.41-1.31)	0.30		
Frequency of tooth brushing / day				
2 or more times	1			
0 to 1 time	1.15 (0.70-1.91)	0.57	-	
Floss				
Yes	1		1	
No	1.70 (0.97-2.95)	*0.06*	1.98 (1.11-3.54)	*0.021*
Race/ethnic				
Not white	1		1	
White	1.83 (0.84-3.97)	*0.12*	2.08 (0.93-4.66)	0.073
Sectors				
Cluster 1	1		1	
Cluster 2	1.00 (0.51-1.97)	0.99	0.92 (0.46-1.85)	0.83
Cluster 3	2.40 (1.20-4.79)	*0.01*	2.54 (1.25-5.15)	*0.01*

* Adjusted for the variables: flossing, race and grouping of sectors in the municipality (p<0.15); ** Wald test (p < 0.05 - statistically significant); OR- Odds Ratio; 95%CI - 95% confidence interval

Discussion

This study aimed to investigate determinants of dental caries in pediatric patients of the Children's Dental Clinic of the Faculty of Dentistry of a Faculty of southern Brazil, in addition to providing data for future studies in the region. Therefore, we aimed to verify the experience and severity of dental caries and associated factors registered from the medical records of children 6-12 years old during the four-year period.

In the present study, a high occurrence of dental caries was observed in children who attended the Dental Clinic, with a higher prevalence in primary teeth of younger children, which is similar to other study carried out in Recife, in a community with children from 6 to 12 years old, with 81.4% prevalence of dental caries in the primary dentition (Galindo, Pereira, Feliciano, & Kovacs, 2005). A survey to verify the prevalence and severity of dental caries and risk factors in children aged 2 to 12 years identified a prevalence of 95.4% in preschool (Sutthavong et al., 2010). A survey of school children aged between 5 to 6 years and adolescents aged between 12 to 19 years, had already reported high rates of dental caries in this municipality (dmft 4.1 and DMFT 3.38) (Rigo, Souza,& Caldas Junior, 2009; Rigo, Caldas Junior,& Souza, 2011). In the present study, the younger age group had higher rates of dental caries, and older children were shown to be a protective factor for the same outcome. This was similar to the study who concluded that among 97 sample participants, when comparing the ages and results of children aged 3 to 8 years with patients aged 8 to 12 years, it was observed that older children were a protective factor for the outcome of dental caries, concluding that the higher age was considered one protective factor for the severity of the decay in the population being investigated (Goldenfum et al., 2019).

The present study did not identify any relationship with the frequency of brushing of teeth in patients, but scientific evidence points out that tooth brushing skills are poor in children under 10 years old. Therefore, parental supervision is considered necessary and recommended until this age (Pujar & Subbareddy 2013). In the same way, the use of dental floss should be taught and encouraged. Therefore, in this study there was a statistical relationship between children who do not use dental floss and dental caries, revealing that participants who do not use floss are two times more likely to develop severe dental caries; and there is sufficient scientific evidence in the literature to justify only the variable floss with dental caries in children. However, a study by Bastos et al. (2019) shows the prevalence of oral health indicators related to the mean per capita family income of the participants through data from the National Health Survey, carried out in 2013, revealing that the prevalence of flossing with the use of brush and toothpaste in dental hygiene, was 2.85 times higher in the participants who have higher income, thus presenting less occurrence of caries. A study found that the chance of having untreated dental caries associated with financial conditions is 2.06 times more in the population (Gupta et al., 2018)

In this study, there was a statistical relationship among children who belonged to group 3 and dental caries, having chances more than twice of developing other diseases compared to group 1, but there was no such association in the group 2 of sectors compared to group 1. These findings are essential for mapping areas with the greatest need for treatment of dental caries. A survey analyzed the spatial distribution of dental caries in children, identifying inequalities in health (Kramer et al., 2019). Research aimed at checking the prevalence and the severity of dental caries in schoolchildren from different municipalities of the northern region of Rio Grande do Sul concluded that the size of the population of the municipality and geographical location of residence (urban/rural) were the main factors associated with experience of dental caries (Rigo, Abegg, & Bassan, 2010). In the present study, the child patients who attended the Dental Clinic in the neighborhoods of cluster 3 (right side map) showed a higher occurrence of dental caries when compared to cluster 1. Group 3 has a total population of 51,232 people, being slightly smaller than the other two sectors, however, it can be inferred that the children are most vulnerable, because the chances of developing dental caries were 2.5 times greater. We can try to address the inequalities by giving access to basic education by the residents of the areas, since there are no differences between the numbers of schools located in clusters. Group 1, in which the geographical location of residence is privileged, having a better urban infrastructure, there is currently one public school and six private schools. In cluster 2, there are twenty public schools and two private schools; already in the group 3 there is a significant reduction in the number of public and private schools, fourteen public schools and only one private school.

However, in the present study race/ethnicity of patients was associated with dental caries only in the crude model, losing the association in the adjusted analysis. In contrast, some publications in literature point out that social aspects as race / ethnicity and level of education, in addition to the location of the population and

the schools where children are enrolled, can be significantly associated with untreated caries (Jung, Kim, & Ryu, 2018). Other evidence also identify the highest occurrence of dental caries in poorer groups, less educated and of mixed race/color and black.

Elamin et al. (2018) investigated the dental caries and associations with socioeconomic factors, hygiene practices and dietary habits among children of Abu Dhabi and concluded that there is a relation between the higher mean of the dmft index with low maternal education, rural location of the patient, infrequent brushing, frequent consumption of foods with high sugar content, and nationality. A study shows that financial barriers end up resulting in higher rates of untreated caries, and frequent visits to the dentist can reduce this disease (Gupta et al., 2018).

Social inequalities have an important impact on the results of dental caries, such as children of the same age group enrolled in the private and public education have different mean of dmft when compared to each other, indicating the need for reinforcement in public oral health policies to correct this disparity (Traebert, Peres, Galesso, Zabot, & Mercenes, 2001).

A limitation of this study was the use of secondary data collected from dental records, as the clinical examination for research was not possible to be conducted by the researcher himself, during the period of data collection. However, clinical assessments were performed by dental students always monitored by trained teachers to observe and correct completion of the charts. Another limitation of the study was the cross-sectional design without temporality, that is, the data of the current exposure may not represent the past exposure, since the temporality cannot be established.

This epidemiological survey identified the most vulnerable sectors of the municipality in relation to dental caries, in the patients who attended the Children's Dental Clinic of the Faculty of Brazil. Thus, the relevant and unprecedented findings presented in this research can be useful in the planning and development of public health activities and initiatives of the Higher Education Institution itself in partnership with the municipal sectors.

Conclusion

From the analysis of study results, it was possible to verify that the experience of dental caries was high. The geographical location of residence in the city had a strong relationship with the severity of dental caries, because the children residing in group 3 of the sectors showed greater chance of having more than three decayed teeth compared with the other two groups. Regarding oral hygiene, children who do not floss have twice more chances of developing dental caries and have higher rates of dental caries.

References

Agnelli, P.B. (2015). Variation of Brazilian CPOD index during the 1980 to 2010 period. *Revista Brasileira de Odontologia*, *72*(1-2), 10-15. DOI: http://dx.doi.org/10.18363/rbo.v72i1/2.549

Bastos, T.F., Medina, L.P.B., Sousa, N.F.S., Lima, M.G., Malta, D.C., & Barros, M.B.A. (2019). Income inequalities in oral health and access to dental services in the Brazilian population: National Health Survey, 2013. *Revista Brasileira de Epidemiologia*, *22*(2), 190015. DOI: https://doi.org/10.1590/1980-549720190015.supl.2

Brazil,Secretaria de Atenção à Saúde, Secretaria de Vigilância em Saúde. (2012). *Pesquisa Nacional de Saúde Bucal: resultados principais.* Brasília, DF: Ministério da Saúde.

Elamin, A., Garemo, M., & Gardner, A. (2018). Dental caries and their association with socioeconomic characteristics, oral hygiene practices and eating habits among preschool children in Abu Dhabi, United Arab Emirates - the NOPLAS project. *BMC Oral Health*, *18*(104), 1-9. DOI: https://doi.org/10.1186/s12903-018-0557-8

Engelmann, J.L., Tomazoni, F., Oliveira, M.D.M., & Ardenghi, T.M. (2016). Association between Dental Caries and Socioeconomic Factors in Schoolchildren - A Multilevel Analysis. *Brazilian Dental Journal*, *27*, 72-78. DOI: https://10.1590/0103-6440201600435

Frazão, P. (2012). Epidemiology of dental caries: when structure and context matter. *Brazilian Oral Research*, *26*(1), 108-114. DOI: https://doi.org/10.1590/S1806-83242012000700016

Galindo, E.M.V., Pereira, J.A.C., Feliciano, K.V.O., & Kovacs, M.H. (2005).Prevalence of caries and associated factors in children of the Vietnã Community, Recife. *Revista Brasileira de Saúde Materno Infantil*, *5*(2), 199-208. DOI: https://doi.org/10.1590/S1519-38292005000200009

Global Burden of Disease [GBD]. (2016). Regional, and national incidence, prevalence, and years lived with disability for 310 diseases and injuries, 1990-2015: a systematic analysis for the Global Burden of Disease Study 2015. *The Lance*, *388*(10053), 1545-602.

Goldenfum, G.M., Silva, N.C, Almeida, I. A, Moura, M.S., Silva, B.B., Jardim, J.J., & Rodrigues, J.A. (2019). Risk indicators of caries lesion activity in children. *European Journal of Paediatric Dentistry*, *20*(3), 179-182. DOI: https://doi.org/10.23804/ejpd.2019.20.03.02

Gupta, N., Vujicic, M., Yarbrough, C., & Harrison, B. (2018). Disparities in untreated caries among children and adults in the U.S., 2011-2014.*BMC Oral Health*, *18*(30), 1-9. DOI: https://doi.org/10.1186/s12903-018-0493-7

Instituto Brasileiro de Geografia e Estatística [IBGE]. (2010). *Get to know Brazil City*. Passo Fundo. Retrieved fromhttps://cidades.ibge.gov.br/brasil/rs/passofundo/panorama

Jung, S.H.,Kim, M.H., &Ryu, J. I. (2018). Inequalities in oral health among adolescents in Gangneung, South Korea. *BMC Oral Health*,*18*, 68. DOI: https://doi.org/10.1186/s12903-018-0533-3

Kramer, P.F., Priesnitz, M.C., Celeste, R.K., Pereira, M.J., Benelli, K.G., & Feldens, C. A. (2019). Spatial distribution of dental caries among preschool children in Canoas, Southern Brazil. *Acta odontológica Latinoamericana*, *32*, 3-9.

Levy, D.H., Livny, A., Sgan-Cohen, H., & Yavnai N. (2018). The association between caries related treatment needs and socio-demographic variables among young Israeli adults: a record based cross sectional study. *IsraelJournal of Health Policy Research*, *7*(24), 1-6. DOI: https://doi.org/10.1186/s13584-018-0222-3

Malta, M., Cardoso, L.O., Bastos, F.I., Magnanini, M.M.F., & Silva, C.M.F.P. (2015). Iniciativa STROBE: subsídios para a comunicação de estudos observacionais. *Revista Saúde Pública*, *44*(3), 559-565. DOI: https://doi.org/10.1590/S0034-89102010000300021

Pujar, P., & Subbareddy, V. (2013). Evaluation of the tooth brushing skills in children aged 6-12 years. *EuropeanAcademy of Paediatric Dentistry*, *14*(4), 213-219.DOI: https://doi.org/10.1007/s40368-013-0046-3

Rigo, L., Souza, E.A., &Caldas Junior, A.F. (2009). The prevalence of dental caries in milk teeth in a municipality with fluorinated water. *Revista Brasileira Saúde Materno Infantil*, *9*(4), 435-442. DOI: https://doi.org/10.1590/S1519-38292009000400008

Rigo, L., Abegg, C., & Bassan, D.G. (2010). Dental caries in schoolchildren living in cities of Rio Grande do Sul, Brazil, with and without water fluoridation. *Revista Sul-Brasileira de Odontologia*, *7*, 57-65.

Rigo, L., Caldas Junior, A. F., & Souza, E. A. (2011). Dental Caries Experience and Associated Factors in Students from a city withfluoridation in water supplies. *Pesquisa Brasileira de Odontopediatria Clinica Integrada*, *11*(3), 407-415.

Stopa, S.R., Malta, D.C, Monteiroa, C.N., Szwarcwald, C.L., Goldbaum, M., & Galvão Cesar, C. L. (2017). Use of and access to health services in Brazil, 2013 National Health Survey. *Revista de Saúde Pública*, *51*(1), 1-11s. DOI: https://doi.org/10.1590/S1518-8787.2017051000074

Sutthavong, S., Taebanpakul, S., Kuruchitkosol,C., Na-Ayudhya, T.I., Chantveerawong, T., & Fuangroong, S. (2010). Caries Risk Factors of the Children of Public Kindergarten and Schools in Phranakornsriayudhya, Thailand. Oral Health Status, Dental. *Journal of the Medical Association of Thailand*, *93*(6), 71-78.

Traebert, J.L., Peres, M.A., Galesso, E.R., Zabot, N. E., &Mercenes,W. (2001). Prevalence and severity of dental caries among schoolchildren aged six and twelve. *Revista Saúde Pública*, *35*(3), 283-288. DOI: https://doi.org/10.1590/S0034-89102001000300011

World Health Organization [WHO]. (2003). *The world oral health report*. Geneva: WHO.

World Health Organization [WHO]. (2013). *Oral health surveys: basic*(5th). Geneva: WHO.