

Toothache and tooth extraction as reasons for dental visits: an analysis of the 2019 National Health Survey

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Abstract: The aim of this study was to analyze the prevalence of dental visits due to toothache and tooth extraction in Brazil and its association with individual and contextual variables. This two-step cross-sectional study included persons aged 18 years and older in the 2019 National Health Survey who had visited a dentist in the 12 months prior to the interview (n = 40,369). The individual-level outcome was having a dental visit due to toothache or tooth extraction. The ecological-level outcome was the proportion of dental visits for these reasons relative to all dental visits by Brazilian state. Associations with individual – sociodemographic characteristics, number of teeth, and type of health service used – and ecological variables – HDI and dental service coverage – were assessed using Poisson regressions. The prevalence of dental visits due to toothache or extraction was higher among individuals with no formal education, household income < 25% of the minimum wage, of black and brown skin color, living in rural areas, who consulted in the public health system, with 10–19 and 1–9 teeth, and men. The proportion of dental visits due to toothache/extraction in Brazilian states was negatively associated with the HDI and the rate of dental emergency team/100,000 inhabitants and positively associated with primary dental care coverage. The prevalence of dental visits due to toothache/extraction was associated with individual and ecological characteristics, indicating inequities in reasons for dental visits in Brazil. The potential of a well-structured oral health care network to overcome these inequities is suggested and needs to be better explored.

Keywords: Toothache; Tooth Extraction; Oral Health; Healthcare Disparities.

Introduction

Oral diseases are an important global public health problem¹ and directly impact the lives of individuals by causing pain and suffering, changing food choices, and affecting speech and self-esteem.^{2,3} Moreover, dental pain and loss of function result in relevant social and psychological impacts and are associated with reduced quality of life.⁴⁻⁶

In addition to the significant financial impact on the state and individuals, oral diseases also have costs related to time lost at work and difficulties in performing daily activities.⁷ A national study with civil



servants indicated that toothache was reported as a reason for absenteeism by 23.6%, and absence from work was more frequent in individuals from a lower socioeconomic position.⁸

Estimates of toothache prevalence provide an indication of the burden it imposes on individuals and society, and its impact can be better assessed the factors involved are known.⁹ The results of the 2010 Brazilian National Survey on Oral Health showed that toothache was the most frequent reason for visiting a dentist, with a prevalence of 46% among adults.¹⁰ Previous studies suggest that toothache is socially determined and more frequently affects poorer, less educated people, and those with less access to dental care.^{8,11,12} Tooth extractions are frequently the result of toothache. Data from the 2013 National Health Survey (PNS) show that 9.6% of adults and 11.5% of older adults reported tooth extractions as the reason for seeking dental care.¹³ Difficult access to dental services and lack of financial resources are related to high rates of tooth extractions.¹⁴

Socioeconomic status, parental education level, access to health care, area of residence, and socioeconomic development are among the factors influencing oral health.¹⁵⁻¹⁷ It is well known that there is substantial discrepancy between the oral health needs of communities and the availability, location, and type of dental services offered.¹ Therefore, social inequalities in oral diseases are common irrespective of age and sex.^{11,18,19} Few studies evaluated the reasons for dental appointments due to toothache and tooth extraction, considering the different contexts in Brazil and evaluating possible related inequities.¹⁷ The aim of this study was to analyze the prevalence of dental visits due to toothache and tooth extraction in Brazil and its association with socioeconomic variables and use-of-service characteristics. Also, the proportion of dental visits in which toothache or tooth extraction was the reason was analyzed by state, and the association with HDI and provision of oral health services was assessed. This study's initial hypothesis was that dental visits due to toothache and tooth extraction is more prevalent among individuals in a less privileged socioeconomic situation and populations from more disadvantaged contexts – and with lower coverage of public oral health services.

Methodology

This study analyzed data from the 2019 PNS, a representative, population-based cross-sectional national survey. The target population of the 2019 PNS were individuals aged 15 years or older living in permanent private households. This survey used a conglomerate random sampling, and collected data through interviews, carried out in households by 1.200 trained interviewers. The primary units (UPA, in Portuguese) were census tracts or sets of tracts, the secondary units were private households (selected by simple random sampling), and the tertiary units were residents aged 15 years or older that were selected from each household by simple random sampling in. Due to the complex sample design and different selection probabilities, it was necessary to apply sample weights – for households and selected residents. The analyses of this study included the final weights that the Brazilian Institute of Geography and Statistics (IBGE) provided for the 2019 PNS. More information about the 2019 PNS methodology can be found in a previous publication.²⁰

This study included data from participants aged 18 years and older who reported having visited a dentist in the 12 months before the interview (assessed using the following question: “When was the last time you had a dental appointment?”, $n = 40,369$).

This study comprised two different sets of analysis, one at the individual level and one at the ecological level. The first assessed the relationship between individual exposures and outcome. The outcome variable was defined as “visit to the dentist in the year prior to data collection for toothache or tooth extraction”. Answers to the question “What was the main reason you visited the dentist last time?” were organized into two groups: “toothache and/or extraction” (analysis category) and “other reasons” (reference category), which included the answers “cleaning, prevention or checkup”, “dental treatment”, “gum problems”, “treatment of mouth sores”, “dental implant”, “placement/maintenance of braces”, “placement/maintenance of prosthesis” and “others”.

The following exposures were analyzed: “sex” (male; female), “age” (18–39; 40–59; 60 and more),

“race/skin color” (white; black; brown), “education” (no formal education; incomplete elementary school; complete elementary school; incomplete high school; complete high school; incomplete university; complete university), “area of residence” (urban; rural), “household income” (up to ¼ of minimum wage – MW –per person; from ¼ up to ½ MW; from ½ up to 1 MW; 1 up to 2 MW; 2 up to 3 MW; 3 up to 5 MW; more than 5 MW - considering that the Brazilian MW was US\$ 241 in 2019), “number of teeth” (20–32 teeth; 10–19; 1–9; edentulous), “type of healthcare system used in the last dental visit” (private; public), and “type of service used in the last dental visit” (primary dental care service; public clinic; public emergency services; specialized dental care center; public hospital outpatient clinic; private dental care service; private emergency services; other type of service). These variables were selected based on Andersen’s behavioral model, which seeks to identify the determinants of health service use, which include predisposing factors, enabling factors, health behaviors, and health needs. In this study, sex, age group, skin color, and education were considered predisposing factors; zone of residence, household income, and type of service/health system were considered enabling factors – as they act as organizational or financial factors related to the use of services; and, finally, the variable “number of teeth” represented the dimension of health care needs.²¹

Individuals whose reason for last dental visit was toothache or extraction were compared with individuals who had other reasons for the last dental visit. Chi-square tests were applied to assess differences in outcome distribution. Associations between exposures and the outcome were modeled using Poisson regressions. Prevalence ratios (PR) were provided with 95% confidence intervals (95%CI). The adjusted model included all variables with $p < 0.20$ in the crude model.

The ecological sub-study used Brazilian states as the units of analysis. The proportion of dental visits due to toothache or extraction relative to all dental visits was estimated for each of the 26 states and the federal district and used as the outcome. The states’ Human Development Index (HDI), primary dental care coverage, rate of Dental Specialty Centers (DSC) per 100,000 inhabitants, and rate of dental emergency teams (DET) per 100,000 inhabitants were the exposures used in the analyses. Table 1 describes the sources and organization of these variables. Associations between exposures and the outcome were modeled using Poisson regressions with robust variance. The adjusted model included all variables with $p < 0.20$ in the crude model.

All analyses were carried out using Stata 14.0 software. All data used are available anonymously in public databases. The 2019 edition of the PNS

Table 1. Exposure variables: year, data sources, and calculation methods.

Variable	Year	Data Source	Calculation
Human Development Index	2010 ^a	United Nations Development Program	This variable was collected directly from the data source ^b , by State.
Coverage by primary dental care teams	2019	Information System on Primary Health Care	This variable was collected directly from the data source ^c , by State. It considered the percentage of the State’s population covered by this type of health care.
Rate of Dental Specialty Centers/100,000 inhabitants	2019	National Program for the Improvement of Access and Quality of Primary Care (PMAQ-CEO)	The number of DSCs per State was collected from the PMAQ-CEO dataset. This number was divided by the population of each State in 2019 and multiplied by 100,000 ^d .
Rate of dental emergency services/100,000 inhabitants	2019	National Register of Health Establishments	The number of dental emergency services per State was collected from the National Register of health care services. Only public services were included. This amount was divided by the population of each State in 2019 and multiplied by 100,000 ^d .

^aThe most recent year with available data; ^b<http://www.atlasbrasil.org.br/>; ^c<https://egestorab.saude.gov.br/>; ^dData on the population residing in each State in 2019 were collected from the inter census projection of the IBGE.

was approved by the National Research Ethics Commission (3.529.376).

Results

A total of 40,369 individuals 18 years and older reported having visited a dentist in the year prior to data collection. The characteristics of the population are shown in Table 2. Considering sample weight, 16.5% (95%CI: 15.8–17.1) of these individuals visited a dentist for toothache or tooth extraction. The results showed a statistically significant difference in the distribution of reasons for dental visits between the variables, except for sex and age (Table 2). A higher percentage of people of black and brown skin color, from lower education and income categories, and rural residents had toothache or extraction as reasons for dental visit. Individuals with fewer teeth and that used the public health system in their last dental visit also visited the dentist more for those reason.

The results of bi- and multivariate analysis are shown in Table 3. The multivariate model indicated that the prevalence of dental visits due to toothache and/or extraction was higher in people of black and brown skin color [PR = 1.3 (95%CI: 1.2–1.5) and PR = 1.2 (1.1–1.3), respectively], living in rural areas [PR=1.1 (1.0–1.2)], and who were treated in the public health system [PR = 1.6 (1.4–1.7)]. Dental visits due to toothache or tooth extraction were more frequent in people from lower education and income categories. The outcome was more prevalent in individuals with 10 to 19 teeth and 1 to 9 teeth: [PR = 1.4 (1.3–1.6) and PR = 1.6 (1.4–2.0), respectively]. Finally, the prevalence of dental visits due to toothache or extraction was lower among women than among men [PR = 0.9 (0.9–1.0)].

The average proportion of dental visits due to toothache and extraction in Brazilian states was 18.9% (Table 4). Figure shows that this proportion was higher in the North and Northeast regions. Results of bi- and multivariate regressions are presented in Table 5. The adjusted model showed a negative and statistically significant association between HDI and the outcome and “DET per 100,000 inhabitants” and the outcome. In contrast, primary oral health care coverage had a positive and statistically significant

association with the proportion of dental visits due to toothache and extraction.

Discussion

The findings showed that the prevalence of dental visits due to pain or extractions was higher in people of black and brown skin color, residents of rural areas, and among those who used the public health system. There were important gradients in education and income, indicating that oral health inequities affect all Brazilian society. The present study demonstrates that despite the progress made by the National Oral Health Policy in Brazil since 2004, there are still significant oral health inequalities in pain and suffering and tooth loss.

The results of the adjusted model showed a negative and statistically significant association between the HDI and the proportion of dental visits due to toothache or tooth extraction – which is also evident in the regional distribution of the outcome, with a higher proportion in the less developed regions of Brazil: North and Northeast. A study in Colombia found that a low HDI was associated with a higher prevalence of toothache.¹⁸ In Brazil, a study evaluated racial inequities in oral health and found correlations between oral health outcomes and HDI. The results showed racial oral health inequities in Brazil in the analyzed indicators (cavities, tooth loss, toothache, and need for prosthesis), with greater vulnerability of black and brown people compared to white people.²²

Differences in the prevalence of the outcome concerning race persisted after adjustments. In the literature, inequities in oral health are mainly attributed to the lower socioeconomic status of non-white individuals. Nevertheless, our results reinforce recent conceptions that racial inequities in oral health are more complex. They stem from historical and multidimensional processes and are likely influenced by racism and structural racism.²³ A Brazilian study showed that the dentist’s decision to extract or retain a decayed tooth varies significantly depending on the race of the patient: black patients are more likely to have a tooth extracted than white patients.²⁴

Table 2. Distribution (%) of dental visits in the year prior to the data collection due to toothache or tooth extraction compared with dental visits due to other reasons. National Health Survey (PNS), 2019.

Variable	All dental visits ^a	Dental visits due to toothache or extraction	Dental visits due to other reasons	p-value ^c
	%	% (CI _{95%} ^b)	% (CI _{95%} ^b)	
Total	100	16.46 (15.82–17.12)	83.54 (82.88–84.18)	-
Sex				
Male	43.05	44.28 (42.3–46.29)	42.8 (41.87–43.74)	0.19
Female	56.95	55.72 (53.71–57.70)	57.2 (56.26–58.13)	
Age group				
18–39	48.47	46.78 (44.79–48.79)	48.8 (47.77–49.84)	0.08
40–59	36.21	38.12 (36.23–40.05)	35.84 (34.92–36.76)	
60 and older	15.32	15.10 (13.96–16.31)	15.36 (14.64–16.11)	
Skin color^d				
White	47.95	35.69 (33.69–37.74)	50.36 (49.21–51.51)	< 0.01
Black	10.40	13.65 (12.41–15.00)	9.76 (9.19–10.36)	
Brown	40.27	49.23 (47.20–51.26)	38.51 (37.45–39.58)	
Education				
No formal education	2.49	6.60 (5.83–7.47)	1.68 (1.51–1.88)	< 0.01
Incomplete elementary school	20.10	32.27 (30.44–34.15)	17.71 (16.96–18.48)	
Complete elementary school	7.45	8.54 (7.48–9.73)	7.24 (6.77–7.75)	
Incomplete high school	6.62	7.97 (6.90–9.18)	6.35 (5.88–6.86)	
Complete high school	33.55	29.07 (27.24–30.97)	34.43 (33.52–35.36)	
Incomplete university education	6.64	3.79 (2.98–4.82)	7.21 (6.69–7.75)	
Complete university education	23.14	11.76 (10.49–13.17)	25.38 (24.35–26.44)	
Zone				
Urban	89.41	82.10 (80.80–83.32)	90.84 (90.36–91.31)	< 0.01
Rural	10.59	17.90 (16.68–19.20)	9.16 (8.69–9.64)	
Household income (per capita)				
Up to ¼ of (MW ^e)	5.70	11.37 (10.33–12.51)	4.58 (4.26–4.93)	< 0.01
More than ¼ up to ½	11.39	18.23 (16.82–19.72)	10.04 (9.46–10.65)	
More than ½ up to 1	25.34	31.50 (29.71–33.35)	24.13 (23.2–25.08)	
More than 1 up to 2	29.21	24.51 (22.76–26.36)	30.13 (29.19–31.09)	
More than 2 up to 3	11.66	7.58 (6.51–8.81)	12.46 (11.82–13.12)	
More than 3 up to 5	8.86	4.35 (3.50–5.39)	9.75 (9.14–10.39)	
More than 5	7.85	2.46 (1.94–3.12)	8.91 (8.22–9.65)	
Number of teeth				
20–32	94.56	90.10 (89.02–91.09)	95.44 (95.01–95.83)	< 0.01
10–19	3.89	7.10 (6.25–8.06)	3.25 (2.94–3.60)	
1–9	1.06	2.23 (1.80–2.76)	0.82 (0.63–1.08)	
Edentulous	0.50	0.56 (0.35–0.90)	0.48 (0.37–0.64)	

Continue

Continuation

Type of health system ^f				
Private	75.6	57.04 (55.16–58.91)	79.25 (78.33–80.14)	< 0.01
Public	24.4	42.96 (41.09–44.84)	20.75 (19.86–21.67)	
Type of service ^f				
Primary dental care service	19.12	33.88 (32.12–35.69)	16.21 (15.46–17.00)	< 0.01
Public clinic	1.97	2.99 (2.44–3.65)	1.77 (1.51–2.06)	
Public emergency services	0.83	2.27 (1.67–3.09)	0.54 (0.43–0.69)	
Specialized dental care center	1.27	2.01 (1.43–2.81)	1.12 (0.93–1.36)	
Public hospital outpatient clinic	1.21	1.80 (1.30–2.49)	1.1 (0.85–1.42)	
Private dental care service	74.66	56.17 (54.26–58.05)	78.3 (77.35–79.23)	
Private emergency services	0.37	0.31 (0.18–0.54)	0.38 (0.31–0.48)	
Other type of service	0.57	0.57 (0.37–0.87)	0.57 (0.44–0.73)	

^aAll individuals ≥ 18 years who had dental visits in the last year; ^b95% confidence interval; ^cResulting of chi-square to assess the difference in the distribution of dental visits due to toothache or tooth extraction and dental visits for other reasons; ^d“Indigenous” and “yellow” skin color categories not shown due to insufficient number of interviews in the PNS 2019; ^eMinimum wage; ^fIn the last dental visit.

Oral health care in the country still depends on private services and the urban population has easier access and greater availability of dental services.²⁵ This is confirmed in the present study, where the prevalence of toothache and extraction as a reason for consultation was higher in individuals who lived in rural areas and who consulted in the public health service. The poor socioeconomic conditions and the scarcity of dental services that offer comprehensive dental care lead to seeking dental care only when there is a problem or discomfort (problem-oriented behavior), which can help explain these findings.¹⁴

The lack of access to preventive measures and care may make extraction the only technically feasible procedure given the severity of the disease, or as an indication for pain relief given the lack of access to other types of treatment.^{14,26} In oral health, the expansion of services through the public health system and the change in the model of care have led to quite heterogeneous scenarios. At the extremes, there are services whose organization is based solely on free demand, where surgical and restorative interventions predominate, and where restrictions on access persist.²⁷ Previous findings showed that the expansion of primary dental care in some municipalities does not guarantee better access to public oral health services.²⁸

The greater proportion of dental visits due to pain or extraction in the North and especially in the Northeast regions is compatible with the results of another study based on the 2019 PNS data, which identified that these two regions have the lowest proportion of individuals who consulted a dentist in the previous year. In addition, the study showed that residents of the North and Northeast regions were more likely to use public services at their last dental appointment than people in other regions of the country and had lower coverage under private dental health insurance.²⁹ Given the greater dependence on public oral health care in the North and Northeast regions, which does not ensure comprehensive health care to the population due to insufficient coverage and/or an ineffective care model, the demand for more complex dental care is an expected consequence.

Primary care is the first contact with the healthcare system when a new health problem arises. However, infrastructure and access problems are still reasons for users to migrate to other healthcare providers.^{27,30,31} Failures in dental care networks can make it difficult for users to access preventive care that could avoid a toothache or tooth extraction. With the associations found in the current study between the proportion of consultations due to pain and tooth extraction and

Table 3. Association between dental visits in the year prior to the data collection due to toothache or tooth extraction and exposures: prevalence ratio and its 95%CI. National Health Survey (PNS), 2019. All analysis were adjusted for the sample's weight.

Variable	Crude	Adjusted ^a
	PR (CI _{95%}) ^b	PR (CI _{95%}) ^b
Sex		
Male	1 (ref.)	1 (ref.)
Female	0.95 (0.88–1.02)	0.92 (0.86–0.99)
Age group		
18–39	1 (ref.)	1 (ref.)
40–59	1.09 (1.00–1.18)	1.04 (0.95–1.13)
60 and older	1.02 (0.93–1.12)	0.97 (0.87–1.09)
Skin color^c		
White	1 (ref.)	1 (ref.)
Black	1.76 (1.58–1.97)	1.34 (1.20–1.50)
Brown	1.64 (1.51–1.79)	1.23 (1.13–1.34)
Education		
Complete university education	1 (ref.)	1 (ref.)
Incomplete university education	1.12 (0.87–1.45)	0.90 (0.70–1.15)
Complete high school	1.70 (1.49–1.94)	1.14 (1.00–1.30)
Incomplete high school	2.37 (2.00–2.81)	1.35 (1.13–1.61)
Complete elementary school	2.25 (1.91–2.66)	1.34 (1.12–1.59)
Incomplete elementary school	3.16 (2.78–3.59)	1.68 (1.45–1.94)
No formal education	5.21 (4.51–6.03)	2.38 (2.02–2.80)
Zone		
Urban	1 (ref.)	1 (ref.)
Rural	1.84 (1.71–1.98)	1.12 (1.04–1.21)
Household income (per capita)		
More than 5 (MW) ^d	1 (ref.)	1 (ref.)
More than 3 up to 5	1.57 (1.18–2.08)	1.41 (1.06–1.89)
More than 2 up to 3	2.08 (1.58–2.73)	1.70 (1.28–2.26)
More than 1 up to 2	2.68 (2.10–3.42)	1.88 (1.45–2.45)
More than ½ up to 1	3.97 (3.13–5.03)	2.33 (1.79–3.03)
More than ¼ up to ½	5.11 (4.02–6.50)	2.60 (1.98–3.42)
Up to ¼	6.37 (4.99–8.12)	2.84 (2.15–3.76)
Number of teeth		
20–32	1 (ref.)	1 (ref.)
10–19	1.92 (1.70–2.16)	1.42 (1.25–1.61)
1–9	2.22 (1.78–2.76)	1.63 (1.36–1.96)
Edentulous	1.19 (0.83–1.71)	0.94 (0.67–1.32)
Type of health system^e		
Private	1 (ref.)	1 (ref.)
Public	2.33 (2.17–2.50)	1.56 (1.43–1.69)

^aAdjusted for all variables with $p < 0.20$ in the bivariate analysis; ^bPrevalence ratio and its 95%CI; ^c“Indigenous” and “yellow” skin color categories not shown due to insufficient number of interviews in the PNS 2019; ^dMinimum wage; ^eIn the last dental visit.

Table 4. Proportion of dental visits due to toothache or tooth extraction and description of exposure variables – results for Brazil, based on the data of the states. National Health Survey (PNS), 2019.

Contextual variables	Mean	Median	sd ^b
Proportion of dental visit due to toothache or extraction ^a (%)	18.89	19.48	5.08
Human Development Index	0.70	0.70	0.05
Primary dental care coverage (% of the population)	60.43	59.66	18.45
Dental specialty centers (per 100 000 inhabitants)	0.56	0.46	0.35
Dental emergency team (per 100 000 inhabitants)	0.39	0.34	0.25

^aThe proportion of dental visits due to toothache or extraction concerning all dental visits in the year prior to the data collection – considering the adjustment for the sample’s weight; ^bstandard deviation.

Table 5. Association between the proportion of dental visits in the year prior to the data collection due to toothache or tooth extraction and socioeconomic and dental services provision variables. National Health Survey (PNS), 2019.

Exposure variables	Crude	Adjusted ^a
	β (CI _{95%}) ^b	β (CI _{95%}) ^b
HDI ^{cd}	-4.61 (-5.72;-3.49)	-3.75 (-4.99;-2.51)
Primary oral health care coverage (% of the population) ^d	0.01 (0.01;0.01)	0.00 (0.00;0.01)
Public specialized dental care center (per 100,000 inhab.) ^d	0.17 (0.04;0.31)	-0.08(-0.19;0.02)
Dental emergency team (per 100,000 inhab.) ^d	-0.27 (-0.59;0.04)	-0.21(-0.34;-0.07)

^aAdjusted for all variables with $p < 0.20$ in the bivariate analysis; ^bRegression coefficient and its 95%CI; ^cHuman Development Index; ^dAt the states level.

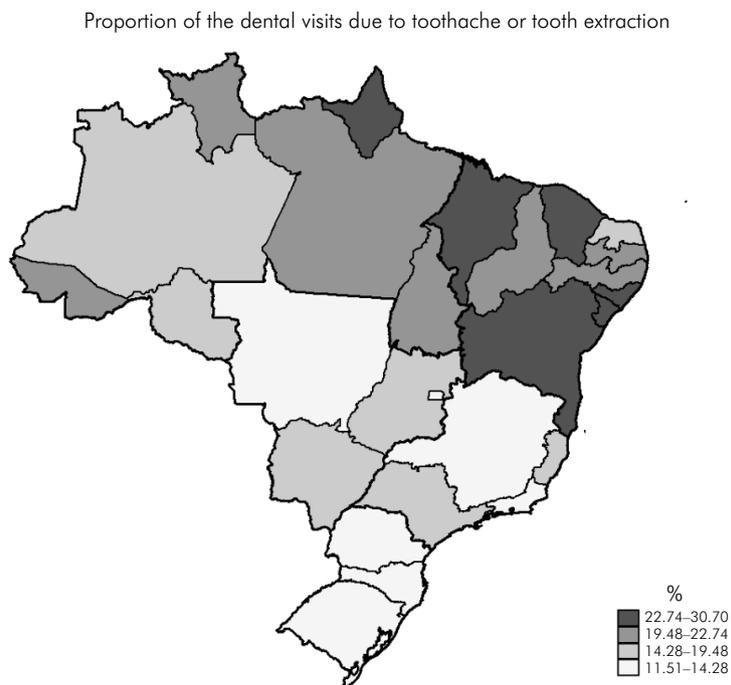


Figure. Proportion of the dental visits due to toothache or tooth extraction in the year prior to the data collection in Brazil, by states. Data was collected from the 2019 National Health Survey (PNS). Footnote: Proportion of dental visits due to toothache or tooth extraction relative to all dental visits in the year prior to the data collection after adjustment for the sample’s weight.

coverage by different types of services, at least two hypotheses arise: a) almost twenty years after the implementation of the National Oral Health Policy, primary healthcare services continue to represent a vital reference for the repressed oral health demands; b) the negative associations between the outcome and provision of dental emergency teams – and with the provision of Dental Specialty Centers, but without significance – may indicate the potential of a well-structured oral health network. This hypothesis needs to be further investigated.

The findings of this study must be interpreted accounting for some limitations. The information collected in the PNS 2019 is not representative of indigenous and yellow people due to the insufficient number of interviews. In addition, the cross-sectional design does not provide a temporal relationship between variables, so we cannot infer causality. In the ecological-level analysis, the use of states as units of analysis does not account for critical within-state variations. Despite these limitations, we used data from a nationally representative sample with a data

collection that was carried out with high quality control measures.

Conclusions

Important contextual and individual inequalities, as well as gradients in income and education, related to dental visits for toothache and extractions were identified in Brazil. The results of this study reinforce the importance of analyzing information collected in population health surveys as a strategy to support policy formulation. Understanding the factors related with dental service utilization in Brazil can help reduce unfair access to health resources and reduce inequalities. The results suggest that the existence of a well-structured oral health care network can help overcome oral health inequities.

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