

Public Oral Health Services Coverage and Socioeconomic Indicators' Effect on The Number of Hospitalized Cases of Oral Cancer in Brazil

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Abstract

Background: Oral cancer still representing one of the most frequent neoplasms worldwide, especially in developing countries. Socioeconomic factors and access to health services may be associated with the risk of oral cancer. This study analyzed the frequency of new hospitalized cases of oral cancer in Brazil, according to socioeconomic variables and data on oral health coverage in its public health system.

Methods: Observational study, with a retrospective cohort design, whose sampling units was composed of all Brazilian cities that registered at least one hospitalized case of oral cancer in the National Cancer Institute database, between 2002-2017. For each city included, were collected the population size, Municipal Human Development Index (M-HDI), Gini Coefficient, as well as data regarding oral health coverage in primary care and the number of Dental Specialized Center (DSC). The COX regression was used to determine the risk ratio for a city to present a new hospitalized case of oral cancer, and the effect of the predictor variables on the incidence of cases was verified by the Hazard Ratio measure. Accumulated risk curves were obtained for the adjusted model, and for each variable.

Results: All predictor variables were considered significant in the regression model ($p < 0.05$). Cities above 50 thousand inhabitants, with high or very high M-HDI, more unequal ($\text{Gini} > 0.4$), with less oral health coverage in primary care ($< 50\%$) and without the presence of DSC demonstrated a greater accumulated risk of having 1 or more hospitalized cases of oral cancer.

Conclusions: The risk of hospitalization for oral cancer in Brazil is greater in cities with a larger population size, more developed, with greater inequality of income distribution and with less availability of public oral health services.

Background

Although the incidence varies between different countries, oral cancer represents one of the most frequent neoplasms around the world, with greater prominence in developing countries^{1,2}. In Brazil, 10.70 new cases are estimated for every 100 thousand men and 3.71 for every 100 thousand women, in each year of the 2020–2022 triennium³. According to this estimate, the disease will represent the fifth most common type of cancer among men, and the thirteenth among women by 2022³.

Smoking and alcoholism are considered the main risk factors for oral cancer^{4,5}. Other aspects such as human papillomavirus infection, solar radiation and genetics are also part of its complex etiology^{2,5,6}. In addition, socioeconomic factors are strongly associated with the risk of oral cancer^{7,8}. In general, individuals with worse socioeconomic status are more exposed to behavioral risk factors (such as tobacco and alcohol consumption) and have limited access to health services throughout their lives, which contributes to less prevention⁹ and late diagnosis of oral cancer^{9,10}.

In Brazil, the public oral health services coverage has undergone a marked expansion since 2004, with the implementation of the National Oral Health Policy (NOHP)¹¹. This policy provided an increase in access to oral health in primary care, in addition to implementing specialized dental care services throughout the country, through the creation of the Dental Specialized Center (DSC)¹². NOHP prioritized oral cancer care at different levels of care, fostering prevention actions, active screening, and early diagnosis^{12,13}.

Since Brazil is a country marked by socioeconomic inequalities and with a large part of the population that depends on its public health system (Unified Health System - SUS)¹⁴, it is necessary to evaluate the indicators related to oral cancer in the country under the view of their socioeconomic determinants and the population's access to public health services. Thus, it is possible to develop evidence to encourage the implementation of public policies to combat social inequalities and to strengthen the oral health service network in Brazil and in similar populations.

This study aimed to analyze the frequency of new hospitalized cases of oral cancer in Brazil, according to socioeconomic variables of the cities and data on oral health coverage in the Unified Health System (SUS).

Methods

An observational study was carried out with a retrospective cohort design. The sample units of the study were composed of Brazilian cities that registered, between 2002 and 2017, at least one hospitalized case of oral cancer (n = 4516).

The number of hospitalized cases of oral cancer was obtained from the Hospital Cancer Registry database of the National Cancer Institute (HRC-INCA - <https://irhc.inca.gov.br/RHCNet/visualizaTabNetExterno.action>) and was extracted according to the city of residence, for each year of the study. Only new cases were considered, taking into account the year of the first diagnosis. Primary locations C00 to C06 (lip, base of tongue, tongue, gums, floor of mouth, palate, and other unspecified parts of the mouth) were considered. For these locations, 97.8% of the cases were of squamous cell carcinoma.

Data on total population, Municipal Human Development Index (M-HDI) and Gini Coefficient were obtained from the panel of socioeconomic indicators of Brazilian cities, available in the Human Development Atlas of Brazil (<http://atlasbrasil.org.br>), linked to the United Nations Development Program (UNDP). The data were extracted with reference to the year 2010. The population size variable was distributed in the following categories: up to 30 thousand inhabitants, 30 to 50 thousand inhabitants, 50 to 100 thousand inhabitants and above 100 thousand inhabitants. The M-HDI was classified as: low and very low (up to 0.599), average (between 0.600 and 0.699), and high (equal to or greater than 0.700). The Gini coefficient was categorized as: less unequal (up to 0.4), and more unequal (above 0.4).

Data on oral health coverage in primary care and the number of Dental Specialized Center (DSC) were obtained from public reports from the e-Gestor portal, from the Ministry of Health's Primary Care

Secretariat, from 2002 to 2017

(<https://egestorab.saude.gov.br/paginas/acessoPublico/relatorios/relatoriosPublicos.xhtml>). Oral health coverage in primary care was categorized in up to 50% and above 50%. The cities were classified according to the presence or absence of DSC.

The data were organized and analyzed using the IBM Statistical Package for Social Sciences program (IBM SPSS, v. 24, IBM, Chicago, IL). The COX regression was used to determine the risk ratio for a city to present a new case of oral cancer, between the years 2002 and 2017. The predictive variables of the model were: population size, M-HDI, Gini coefficient, coverage of oral health in primary care and presence of DSC. The level of statistical significance was set at 5%. The model adjustment was assessed by the Omnibus test ($p < 0.05$). The effect of the predictor variables on the incidence of cases was verified by the Hazard Ratio (HR) measure, considering the 95% confidence interval. Accumulated risk curves were obtained for the adjusted model, as well as for each of the studied predictive variables.

Results

Table 1 presents the descriptive data of the number of hospitalized cases of oral cancer in Brazil, according to the year, population size, municipal human development index, Gini coefficient, oral health coverage in primary care and the presence of Dental Specialties Centers.

Table 1

– Descriptive statistics of hospitalized cases of oral cancer in Brazil, according to year, population size, Municipality's Human Development Index (M-HDI), Gini's coefficient, Oral Health coverage in primary care, and Presence of Dental Specialized Center (CEO)

Variables		Hospitalized cases of oral cancer				
		Mean	SD	Median	Max.	Min.
Year	2002	0.74	7.25	0	406	0
	2003	0.75	6.73	0	344	0
	2004	0.86	7.49	0	406	0
	2005	0.96	7.37	0	398	0
	2006	0.97	6.95	0	383	0
	2007	1.06	7.07	0	366	0
	2008	1.10	7.32	0	408	0
	2009	1.20	8.05	0	436	0
	2010	1.27	7.33	0	383	0
	2011	1.33	8.52	0	477	0
	2012	1.29	8.41	0	484	0
	2013	1.35	8.27	0	474	0
	2014	1.37	8.60	0	478	0
	2015	1.37	7.37	0	394	0
	2016	1.16	4.62	0	192	0
	2017	0.90	3.81	0	149	0
	Population Size	Up to 30 thousand inhabitants	0.38	0.75	0	30
30 to 50 thousand inhabitants		1.09	1.41	1	9	0
50 to 100 thousand inhabitants		1.99	2.13	1	19	0
Mor than 100 thousand inhabitants		10.54	29.31	5	484	0
Municipality's Human Development Index (M-HDI)	Low or very low MHDI (up to 0,59)	0.33	0.67	0	7	0

SD: standard deviation, Max.: Maximum value, Min.: Minimum value

	Average MHDHI (between 0,60 and 0,69)	0.54	1.18	0	30	0
	High or very high MHDHI (above 0,7)	2.24	12.00	0	484	0
Gini's coefficient	Less unequal (< 0.4)	0.48	1.04	0	19	0
	More unequal (> 0.4)	1.16	7.62	0	484	0
Oral Health coverage in primary care	Up to 50%	1.82	10.78	0	484	0
	Above 50%	0.53	1.37	0	50	0
Presence of Dental Specialized Center (DSC)	Without DSC	0.63	2.97	0	406	0
	With DSC	4.96	19.94	1	484	0
SD: standard deviation, Max.: Maximum value, Min.: Minimum value						

Cox's multivariate regression (Table 2) demonstrated that all variables that were studied had a significant effect on the number of hospitalized cases of oral cancer in Brazil. Cities above 50 thousand inhabitants, with high or very high M-HDI, more unequal (Gini > 0.4), with less oral health coverage in primary care (< 50%) and without the presence of DSC had a greater accumulated risk of having 1 or more hospitalized cases of oral cancer, in the period between 2002 and 2017. Cumulative risk curves for each variable under study are shown in Fig. 1.

Table 2

– Multivariate Cox regression that determined cumulative risk of each explanatory variable on the frequency of hospitalized cases of oral cancer in Brazil, between 2002 and 2017.

Variables	B	p-value	HR	95% CI	
				Lower	Upper
Population size		< 0.001			
Up to 30 thousand inhabitants			Reference		
30 to 50 thousand inhabitants	0,000	0,998	1,000	0,972	1,029
50 to 100 thousand inhabitants	0,223	< 0.001	1,250	1,215	1,287
More than 100 thousand inhabitants	0,369	< 0.001	1,446	1,400	1,492
Municipality's Human Development Index (MHDI)		< 0.001			
Low or very low MHDI			Reference		
Average MHDI	0,017	0,064	1,017	0,999	1,036
High or very high MHDI	0,166	< 0.001	1,180	1,158	1,203
Gini's coefficient		< 0.001			
Less unequal (< 0.4)			Reference		
More unequal (> 0.4)	0,071	< 0.001	1,074	1,048	1,101
Oral Health coverage in primary care		< 0.001			
Up to 50%	0,260	< 0.001	1,296	1,278	1,315
Above 50%			Reference		
Presence of Dental Specialized Center (DSC)		< 0.001			
Without DSC	0,142	< 0.001	1,153	1,132	1,174
With DSC			Reference		
B: regression coefficient, p-value: statistical significance, HR: hazard ratio, 95% CI: 95% confidence interval.					

Discussion

The findings of this investigation demonstrated that the population size of the cities, the socioeconomic status of the population and the availability of public dental services influence the risk of hospitalization due to oral cancer in Brazil. Two previous studies have developed similar analyses of oral cancer rates, involving socioeconomic characteristics and dental coverage in the SUS among the regions and states of

Brazil^{13,15}. However, the present study considered for analysis a more comprehensive period and all cities in the country as sample units.

It was shown that cities with large populations and high M-HDI had a higher frequency of hospitalized cases of oral cancer. In general, larger, and more developed cities have a better structured health service network, with greater encouragement and training of professionals for active disease tracking^{15,16}. In addition, the population of those cities has higher life expectancy, which increases the proportion of the risk group for advanced age, in addition to greater access to diagnosis and hospitalization^{17,18}. Inverse associations between HDI and oral cancer were found in studies that evaluated mortality rates^{9,10,18}. These findings show that the largest number of oral cancer cases is concentrated in more developed regions. However, mortality is higher in less developed areas, revealing the impact of social inequalities on the prognosis of the disease¹⁹.

This analysis revealed that cities with strong inequality in the income distribution have a higher risk of presenting hospitalized cases of oral cancer. Socioeconomically disadvantaged individuals are often diagnosed with lesions in advanced clinical stages and with cervical metastases, which require complex treatments performed in the hospital setting⁸. Previous studies that used regions and states as sample units found no association between the Gini coefficient and oral cancer rates^{13,15}. However, other studies with more specific and similar populations, considering cities and neighborhoods, were able to detect a positive association between income inequality and oral cancer, like the present study^{20,21}.

The average number of hospitalized cases of oral cancer increased as of 2004, coinciding with the implementation of the NOHP in Brazil. This relation is explained by the increase in the frequency of diagnoses in the SUS, as well as referral to hospital units and registration of cases in the information systems²². The scenario observed before this policy was characterized by a curative and individualized dental care model, centered on private services²³. With its implementation, prevention started guiding oral health care, and procedures for detecting changes in the oral mucosa and biopsies started to be recommended in primary care and in the DSC²⁴.

The lower coverage of oral health in primary care and the absence of DSC are related to the higher risk of hospitalization for oral cancer, according to the findings of this investigation. Studies have also found similar impacts of these variables on oral cancer mortality rates in Brazil in recent decades^{13,15}. The lack of access to health services is one of the main factors related to the delay in the diagnosis of oral cancer, which often results in the need for more aggressive and mutilating treatments, reducing the individual's survival²⁵.

Since the dentist in primary care acts as the entrance to the health system and the longitudinal character of this assistance in the SUS, it is able to develop educational actions to combat behavioral risk factors and self-detection of lesions through oral self-examination²⁶. The DSC complement the assistance offered in primary care, representing the reference unit for suspected cases²⁷. The relation between a

greater number of DSC and a lower number of hospitalized cancer cases may indicate advances in terms of problem-solving, suggesting a higher frequency of cases detected in early stages, and reducing demand in hospital units. Additional studies should be conducted to verify the effects of the organization of the oral cancer care network in the country.

Despite the advances observed, some barriers still make it difficult to face oral cancer in Brazil. Some problems are inherent to the health system as a whole, which refer to insufficient coverage, unequal distribution of health care units and a decrease in government investments in health in recent years, with the advance of austerity policies^{14,15}. The lack of training and insecurity of professionals in relation to the diagnosis of malignant lesions and biopsies should also be highlighted²⁴. Furthermore, the global pandemic of Covid-19, in 2020, which required measures of social distance, as well as its long-term impacts can contribute to the increase of cases that are diagnosed later²⁸.

The present study has some limitations. The use of secondary data reduces the researchers' control over the registration of information systems, which may represent a bias. Due to its observational design, this study suggests associations, but it is not the most appropriate for establishing cause and effect relationships. The study considered population data, and the phenomenon of ecological fallacy may occur if its findings are interpreted at individual levels. Oral cancer is a complex disease, strongly influenced by behavioral risk factors, which are not fully explained by individuals' socioeconomic characteristics. Future studies must be developed considering these aspects as well. The use of official information systems, analysis at a city level throughout Brazil, the large sample size used, and the long period of analysis are strengths of this investigation. In addition, the survival analysis verified by the Hazard Ratio measure also characterizes the pioneer nature of this study.

Taking this into account, the expansion of oral health coverage in primary and specialized care, especially in the sense of equity, prioritizing populations in socioeconomic vulnerability, are essential strategies for improving the epidemiological scenario of oral cancer in Brazil^{13,24}. In this sense, some urgent measures are highlighted, such as the increase in government investments in health, the implementation of public policies to combat social inequalities, the control of behavioral risk factors for oral cancer, the training of oral health professionals in the early identification of precancerous lesions and the expansion of health education measures for the general population.

Conclusions

The number of new hospitalized cases of oral cancer in Brazil was influenced by the cities' population size, the population's socioeconomic status and the availability of public dental services. Cities with 50 thousand inhabitants or more, high M-HDI, greater inequality in the distribution of income, with less oral health coverage in primary care and without the presence of a DSC had a greater cumulative risk of having 1 or more hospitalized cases of oral cancer.

List Of Abbreviations

Municipal Human Development Index (M-HDI)

Dental Specialized Center (DSC)

National Oral Health Policy (NOHP)

Unified Health System (SUS)

Hospital Cancer Registry database of the National Cancer Institute (HRC-INCA)

United Nations Development Program (UNDP)

IBM Statistical Package for Social Sciences program (IBM-SPSS)

Hazard Ratio (HR)

Confidence Interval (CI)

Declarations

Ethics approval and consent to participate

Not applicable (Public aggregates data were used).

Consent for publication

Not applicable.

Availability of data and materials

The datasets generated and/or analyzed during the current study are available in the repositories below:

Hospital Cancer Registry database of the National Cancer Institute (HRC-INCA):

<https://irhc.inca.gov.br/RHCNet/visualizaTabNetExterno.action>

Human Development Atlas of Brazil:

<http://atlasbrasil.org.br>

E-Manager Basic Care portal (Ministry of Health's Primary Care Secretariat of Brazil):

<https://egestorab.saude.gov.br/paginas/acessoPublico/relatorios/relatoriosPublicos.xhtml>

Competing interests

The authors declare that they have no competing interests.

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Not applicable.

Authors' contributions

YW and EH were responsible for the study concept and statistical analysis of the data, and participated in the interpretation of results and final review of the manuscript. AR, EC e DE participated in data collection, interpretation of results, preparation, editing and final review of the manuscript.

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Figures

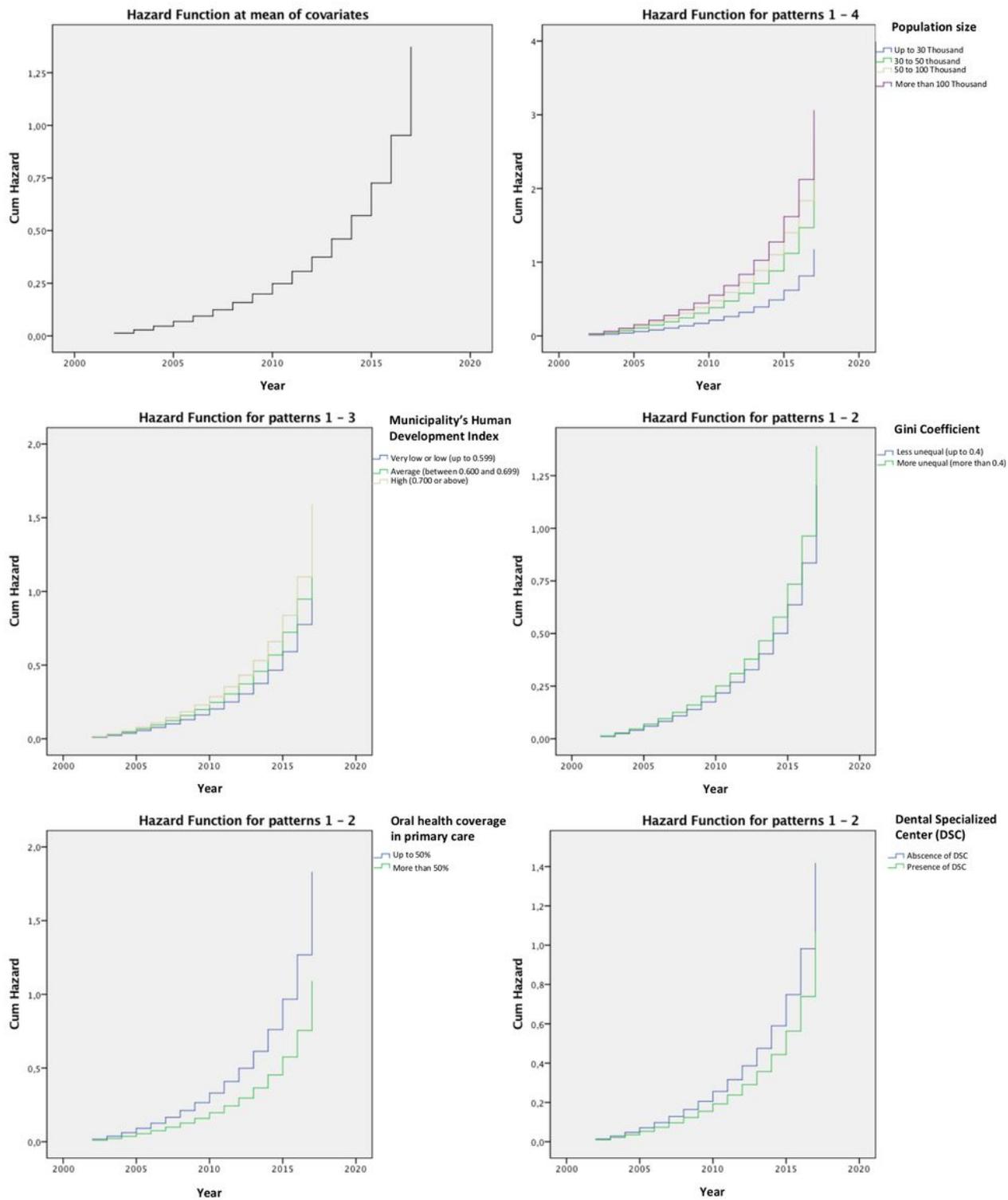


Figure 1

Cumulative risk curves of the mean effect of all variables (A) and for each category of each the independent variables.