Oral Health Team in Primary Health Care Favors the Early Diagnosis of Oral and Oropharyngeal Cancers: A Nationwide Study

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Abstract

Background

Oral and oropharyngeal cancers are considered an important public health problem around all world. The most effective way to improve survival and reduce disease-related morbidity and mortality is the prevention of its major risk factors combined with early detection. This study aims to analyze the association between late diagnosis of oral and oropharyngeal cancers in Brazil and the contextual socioeconomic and coverage indicators of Primary Health Care (PHC), as well as to assess the temporal trend of the late diagnosis.

Methods

This observational study evaluated secondary data with a time series analysis. All Brazilian cities that reported at least one case of oral and oropharyngeal cancers each year, between 2000 and 2013 were included. These data were obtained from the National Cancer Institute José Alencar Gomes da Silva (INCA); the staging was analyzed by calculating the ratio risk for late diagnosis by municipality. The association between staging and socioeconomic variables and PHC provision was calculated using multiple linear regression. The time trend of the risk ratio for late-stage diagnosis was calculated using the Prais-Winsten method.

Results

One hundred and sixty Brazilian municipalities had at least one annual case of oral and oropharyngeal cancers notified to the INCA hospital system between 2000 and 2013. The adjusted model identified that the higher the Gini value (greater social inequality) and the lower the HDI value (less human development), the greater the number of tumors diagnosed at a late stage, considering the size of the tumor. A greater risk for late diagnosis was identified, already in the stage of lymph node involvement, when there is greater social inequality and less coverage of Oral Health Team (OHT) in PHC. The greater the social inequality, the greater the risk of late diagnosis, already in the metastasis stage.

Conclusions

Better socioeconomic indicators and greater coverage by the OHT were associated with the diagnosis of oral and oropharyngeal cancers still in the early stages. During the evaluated period, there was an increase in the number of cases diagnosed at the most advanced stage.

Background

Oral and oropharyngeal cancers are considered important public health problems in the world due to their high incidence, mortality and associated high clinical-care costs.[1–3] In Brazil, for each year of the 2020–2022 triennium, it is estimated that 11,180 new cases of oral cancer will be diagnosed in men and 4,100 in women, being respectively, the 5th and 13th most frequent types among all cancers.[4]

The prevention of the main risk factors combined with early detection are the most effective means to improve survival and reduce the morbidity and mortality associated with diseases. Therefore, the time between symptom onset, diagnosis and adequate treatment implementation directly affects the evolution and prognosis of these diseases.[5] The timely diagnosis and adequate treatment are associated, among other factors, with the organization and quality of offered health services. In this sense, Brazil has experienced an increase in population access to oral health policies [6, 7] after the creation of the Unified Health System (SUS, *Sistema Único de Saúde*), with the consolidation of Primary Health Care (PHC) and the incorporation of dental care at the three levels of care through the National Oral Health Policy (PNSB, *Política Nacional de Saúde Bucal*), created in 2004.

Thus, considering the expansion of access to services and the restructuring of oral health care, we believe that the oral and oropharyngeal cancers indicators have been positively impacted. However, there is a lack of evaluations on this association.

Considering the abovementioned facts, the aim of this study was to analyze the association between late diagnosis of oral and oropharyngeal cancers in Brazil and the contextual socioeconomic and PHC coverage indicators, as well as to assess the temporal trend of the late initial diagnosis.

Methods

Study design and population

This observational study evaluated secondary data with a time series analysis model. Data on oral and oropharyngeal cancers cases were obtained from the Hospital Registration Information System (SisRHC, *Sistema de Informações de Cadastro Hospitalar*) of the José Alencar Gomes da Silva National Cancer Institute (INCA), which gathers information from public and private health units and centers that offer cancer treatment in Brazil.[8] All information is of public domain, with no identification of patients and for that reason there was no need for project approval by the Ethics Committee for Research with human beings.

INCA considers malignant neoplasms of the lip and oral cavity to be those of which primary location is in the lips, oral cavity, salivary glands and oropharynx (C00-C10 of the 10^{th} revision of the International Classification of Diseases - ICD-10). There is some variability in the literature regarding the inclusion of salivary glands in the oral cancer category. Many authors defend the exclusion of this structure because salivary gland neoplasms show diverse etiological, histological and epidemiological behavior, but important sources of global data, such as the Global Burden of Disease Study,[9] include this anatomical site. As this work analyzes data from Brazil, the same anatomical sites used by INCA, the main authority on the subject in the country, were included as oral cancers.

The study analysis unit comprised 160 Brazilian municipalities that had at least one annual case of oral and oropharyngeal cancers notified to the RHC-INCA between the years 2000 and 2013.

Variables and data collection

The outcome variable risk ratio for late diagnosis was measured based on the breakdown of items related to the “TNM” system: “tumor size”, “lymph node involvement” and “metastasis”, found in the database as a description of the tumor characteristics at the first hospital visit.[8] “TNM” is an anatomical staging system that describes the anatomical extension of the primary tumor and the involvement of regional lymph nodes and distant metastases.[10]

The cases were classified as "0" or "1" in each variable (tumor size, lymph node involvement and metastasis): "0" meant that the tumor's staging was less severe: in this case, the diagnosis was attained early; “1” meant that the tumor staging was more severe: in this case, the diagnosis was a late one. The categories “early stage diagnosis” (0) and “late stage diagnosis” (1) were organized as follows:

- Early stage diagnosis (0): for “size” - tumors classified in the TNM T0, T1 and T2 codes; for “lymph nodes” - tumors classified in N0 code; for “metastases” - tumors classified under M0 code.
- Late diagnosis (1): for “size” - tumors classified in TNM T3 and T4 codes; for “lymph nodes” - tumors classified in N1, N2 and N3 codes; for “metastases” - tumors classified under M1 code. The detailed meaning of these codes is available in the supplementary material (Table S1).

To generate a record for each municipality, we calculated the risk ratio (RR) for late diagnosis, dividing the number of late stage diagnoses by the total number of cases with a known diagnosis, per municipality, and for each of the outcome variables separately. The RR varied from "0" to "1" - where "0" would mean that all cases in the city were diagnosed early, and "1" that all cases in the city were diagnosed late.

The means of the annual RR of each city (calculated by the arithmetic mean) were the outcome variables in our statistical analysis - the RR considering tumor size, lymph node involvement and metastasis.

The exposure variables for linear regression analysis were:

- Coverage by PHC Oral Health Teams (OHTs) - which indicates the percentage of the municipality covered by these teams.
- Coverage by family health strategy (FHS) teams.
- Coverage by community health agents (CHAs).
- Gini Index, and
- Municipal Human Development Index (M-HDI).

The number of teams in a given year was multiplied by 3,450 (ideal number of people for an OHT or FHS, according to the Ministry of Health)[11,12] and divided by the population of the municipality in the same year to calculate the annual coverage of OHT and FHS of each municipality. Then it was multiplied by 100 to obtain the coverage percentage. The calculation of the CHA coverage was practically the same, with the peculiarity that the ideal number of people for a CHA is 575, according to the Ministry of Health.[13] The mean coverage of the municipality represents the arithmetic average of the annual coverage between 2005 and 2013. The numbers of OHT, FHS and CHAs were obtained from the website of the Primary Care Department of the Ministry of Health of Brazil.

The number of inhabitants of the municipalities in each year was obtained from the portal of the Brazilian Institute of Geography and Statistics (IBGE, *Instituto Brasileiro de Geografia e Estatística*).[14]

The Municipal Human Development Index (M-HDI) was obtained from the IBGE website.[14] The M-HDI is a vital indicator created by the United Nations to assess the quality of life and economic development of a region, ranging from 0 (without human development) to 1 (full human development).

The Gini index is used to measure social inequality and ranges from 0 (without income inequality) to 1 (total income inequality). This variable for each municipality was also obtained from the IBGE website. We used data from the year 2010, as they are the only ones available for the period of interest for this study.[14]

Statistical Analysis

Linear regression models were used to analyze the association between outcomes and exposure variables, for the period of 2005 to 2013. The cut in the total period of 2000 to 2013 was necessary for association analyses, as we observed the predominance of notifications with "zeros" referring to the independent variable "OHT coverage" in the years prior to 2005, in all municipalities.

For each result, we created a crude model (result tested in association with each exposure separately). Then, according to their p-value results, we created the adjusted model (p values <0.25 in the crude model indicated the variables that were added to the adjusted model). The selection of the best model considered the goodness-of-fit measure of the “R2” model. Results with p <0.05 were considered statistically significant. The normality of the distribution in the result variables was tested by the histogram analysis.

Finally, we evaluated the temporal trend of RR for late diagnosis considering tumor size, lymph node involvement and metastasis in the period of 2000 to 2013, for all municipalities. In this analysis, a generalized linear regression was performed using the Prais-Winsten method, which allows the correction of the first-order autocorrelation in the analysis of a series of values organized over time. This procedure allowed classifying the rates as ascending (p <0.05 and positive regression coefficient), descending (p <0.05 and negative regression coefficient) or stationary (p> 0.05), and quantifying the annual averages of increase or decrease in the coefficients (annual percentage change - APC), as well as its 95% confidence interval, according to the methods employed by Antunes and Cardoso.[15] All analyses were carried out using the Stata 14.0 software.

Results

One hundred and sixty Brazilian municipalities had at least one annual case of oral and oropharyngeal cancers notified to RHC-INCA between the years 2005 and 2013. Additional information on each of the municipalities is provided in the supplementary material (Table S2). Table 1 shows the descriptive analysis of the study variables.

Table 1
Description of outcome and exposure variables, considering the 160 municipalities analyzed. Brazil, 2005–2013.

Variable	Mean(SD[a])	Median	Minimum	Maximum
Dependent variables				
Size (RR[b])	0.62(0.12)	0.62	0.25	0.90
Lymph node (RR[b])	0.55(0.10)	0.55	0.19	0.81
Metastasis (RR[b])	0.04(0.04)	0.03	0.00	0.27
Independent variables				
Gini Index	0.51(0.06)	0.50	0.37	0.64
HDI-M[c]	0.76(0.04)	0.76	0.62	0.86
OHT[d] coverage (%)	17.34(20.32)	10.17	0.00	93.77
FHS[e] coverage (%)	32.94(24.80)	25.81	0.00	95.71
CHA[f] coverage (%)	42.65(31.22)	32.32	0.00	142.21

[a]SD: Standard Deviation

[b]RR: Risk ratio for the most severe diagnosis (RR = 1) at the beginning of the treatment; obtained by dividing the number of cases with late diagnosis by the number of all cases;

[c]M-HDI: Municipal Human Development Index

[d]OHT: Oral Health Team

[e]FHS: Family Health Strategy

[f]CHA: Community Health Agents

It was identified in the adjusted model that, among the contextual variables analyzed, the Gini index was positively associated, while the HDI was negatively associated with the risk ratio for late diagnosis, considering tumor size. That is, the higher the Gini value (greater social inequality) and the lower the HDI value (less human development), the greater the number of tumors diagnosed at a late stage, considering tumor size (Table 2).

Table 2
Results of the linear regression model for the tumor size outcome of oral and oropharynx cancers. Brazil, 2005–2013.

Variables	Crude Model					Adjusted Model				
	β[a]	95%CI[b] (-)	95%CI[b] (+)	p-value	adjusted β	β[a]	95%CI[b] (-)	95%CI[b] (+)	p-value	adjusted β
Gini index	0.24	-0.07	0.56	0.132	0.11	0.34	0.02	0.66	0.037	0.16
HDI-M[c]	-0.91	-1.36	-0.46	< 0.001	-0.30	-0.98	-1.47	-0.49	< 0.001	-0.32
OHT[d] coverage	< 0.01	<-0.01	< 0.01	0.404	0.06	-	-	-	-	-
FHS[e] coverage	< 0.01	< 0.01	< 0.01	0.023	0.17	< 0.01	<-0.01	< 0.01	0.372	0.11
CHA[f] coverage	< 0.01	< 0.01	< 0.01	0.027	0.17	<-0.01	<-0.01	< 0.01	0.673	-0.05

[a]β: regression coefficient

[b]95% CI: 95% Confidence Interval

[c] M -HDI: Municipal Human Development Index

[d]OHT: Oral Health Team

[e]FHS: Family Health Strategy

[f]CHA: Community Health Agents

According to Table 3, among the contextual variables analyzed, it was observed that the greater the social inequality and the lower the proportion of OHT coverage, the greater the risk for late diagnosis, already in the lymph node involvement phase.

Table 3
Results of the linear regression model for the lymph node outcome of oral and oropharynx cancers. Brazil, 2005–2013.

Variables	Crude Model					Adjusted Model				
	β[a]	95%CI[b] (-)	95%CI[b] (+)	p-value	adjusted β	β[a]	95%CI[b] (-)	95%CI[b] (+)	p-value	adjusted β
Gini index	0.34	0.06	0.62	0.017	0.18	0.45	0.17	0.74	0.002	0.25
HDI-M[c]	<-0.01	-0.42	0.40	0.966	<-0.01	-	-	-	-	-
OHT[d] coverage	<-0.01	<-0.01	<-0.01	0.018	-0.18	<-0.01	<-0.01	<-0.01	0.002	-0.24
FHS[e] coverage	< 0.01	<-0.01	< 0.01	0.867	0.01	-	-	-	-	-
CHA[f] coverage	<-0.01	<-0.01	< 0.01	0.858	-0.01	-	-	-	-	-

[a]β: regression coefficient

[b]95% CI: 95% Confidence Interval

[c] M-HDI: Municipal Human Development Index

[d]OHT: Oral Health Team

[e]FHS: Family Health Strategy

[f]CHA: Community Health Agents

Among the contextual variables analyzed, it was observed that the greater the social inequality, the higher the risk of late diagnosis, already in the metastasis phase (Table 4).

Table 4
Results of the linear regression model for the metastasis outcome of oral and oropharynx cancers. Brazil, 2005–2013.

Variables	Crude Model					Adjusted Model				
	β[a]	95%CI[b] (-)	95%CI[b] (+)	p-value	adjusted β	β[a]	95%CI[b] (-)	95%CI[b] (+)	p-value	adjusted β
Gini index	0.18	0.06	0.30	0.003	0.23	0.17	0.05	0.29	0.007	0.21
HDI-M	-0.03	-0.20	0.14	0.726	-0.03	-	-	-	-	-
OHT coverage	<-0.01	<-0.01	< 0.01	0.694	-0.03	-	-	-	-	-
FHS coverage	< 0.01	<-0.01	< 0.01	0.188	0.10	< 0.01	<-0.01	< 0.01	0.453	0.05
CHA coverage	< 0.01	<-0.01	< 0.01	0.473	0.06	-	-	-	-	-

[a]β: regression coefficient

[b]95% CI: 95% Confidence Interval

[c]M-HDI: Municipal Human Development Index

[d]OHT: Oral Health Team

[e]FHS: Family Health Strategy

[f]CHA: Community Health Agents

Table 5 shows the temporal trend of the staging of malignant neoplasms of the oral cavity and oropharynx. During the evaluated period, there was an increase in the number of cases diagnosed at the most advanced stage.

Table 5
Trend in risk for advanced stage oral and oropharyngeal cancers: cases reported in the SisRHC-INCA. Brazil, 2000–2013.

Outcomes	APC[a] (%)	95% CI[b] (-)	95% CI[b] (+)	*p*-value	Trend
Tumor Size	0.46	0.05	0.87	0.030	Ascending
Lymph node	0.99	0.58	1.40	< 0.001	Ascending
Metastasis	4.42	1.14	7.81	0.012	Ascending

[a]APC: annual percent change

[b]95% CI: 95% Confidence Interval

Discussion

The findings of this study demonstrate the association between the Gini index and all outcomes, showing the significant contribution of social inequality to the diagnosis at late stages of oral and oropharyngeal cancers; moreover, there was an association between lower HDI and higher risk ratio for late diagnosis considering tumor size, which suggests the influence of contextual socioeconomic indicators in the early detection of oral and oropharyngeal cancers. The existence of an association between socioeconomic indicators and oral and oropharyngeal cancers has been well assessed in the literature.[5, 16] It is known

that socially disadvantaged groups tend to be more exposed to risk factors for oral cancers, such as tobacco and alcohol use, in addition to worse oral health conditions and underlying nutritional deficiencies.[17] This association, previously known and now corroborated by this study, requires reflection on pro-equity efforts against this disease,[18] and the assessment of existing health policies should also be part of this discussion.

It is noteworthy that coverage by the OHT and the staging of the assessed cancer cases are associated, which indicates that patients in municipalities with greater access to OHT assistance are less likely to receive a diagnosis at advanced stages, when lymph node involvement is considered. Additionally, it has been observed that the risk of receiving a diagnosis at advanced stages of the tumor points to an increase between the years 2000 and 2013 in Brazil. It should be noted that epidemiological studies on the staging of oral and oropharyngeal cancers are scarce in the Brazilian scientific literature. Academic works that analyze the indicators of these diseases associated with the availability of health services in the country are even scarcer.

Regarding oral health care in the Unified Health System, PHC is primarily represented by the OHT of the FHS.[19] Our findings indicate the importance of primary care for oral health and its attributes, such as population health responsibility, formation of bonds, working with priority groups and in a health care network.[20, 21] These characteristics favor preventive actions over risk factors. Additionally, it is understood that the expansion of access to dental care for a historically unassisted population, experienced in Brazil since the implementation of the National Oral Health Policy (PNSB) and put into practice through the OHT, may have impacted on the more timely identification of lesions. The association between OHT coverage and the outcome "lymph nodes", even after adjusting for socioeconomic variables, suggests the offer of this service is a factor that influences the diagnosis at earlier stages of the lesions.

Although little explored, some evidence supports the hypothesis that the restructuring of oral health care in SUS may have a positive impact on oral cancer. This evidence points to access to information about the disease, the demand for dental care and the possibility of identifying tumors at earlier stages, especially in risk groups, all of which are improved by the presence of OHTs. In line with this fact, people living in municipalities with greater PHC coverage are more likely to receive care in advanced health centers.[22, 23] Therefore, it is plausible to establish that the adequate interconnection of health network services (coordinated by PHC), is essential for an effective approach to oral or oropharyngeal cancers.

Our results did not indicate that the greater coverage of Family Health Teams, defined as the priority strategy for PHC expansion and qualification and as the main gateway to SUS,[24] contributes to the early diagnosis of oral and oropharyngeal cancers. Therefore, the importance of the need and expansion of OHT in the country is reinforced. After the publication of the new Primary Care policy in 2017, a movement was observed indicating a reduction in the number of OHTs in Brazil, particularly in the most unequal municipalities in terms of income distribution and larger populations.[25] In this sense, it is worth mentioning the political-economic moment presently experienced by Brazil, of which current government, with the justification of the need for austere measures, has promoted the dismantling and precariousness of SUS, also regarding oral health care, deactivating health units that make up the health network attention (particularly the Dental Specialty Centers). This may imply a weakening of the opportunity for early diagnosis of the neoplasms assessed in this study, which would be a perverse reflection of irresponsible political attitudes, given that the most affected population will be precisely the one who lives in the most disadvantaged places. Extrapolating the attention to oral health, in this context, knowing that these measures affect SUS as a whole, it is worth considering the potential they have to weaken, undermine and, in a very close situation, annihilate the greatest social achievement of the Brazilian population – SUS.

However, it is essential to consider the natural history of oral or oropharyngeal cancers. Both result from the accumulation of genetic mutations throughout life, which means that it takes many years for it to develop, even in cases of massive exposure to risk factors. Emerging evidence data shows that, although alcohol and tobacco consumption is the main risk factor for these diseases, the role played by other factors such as socioeconomic disadvantage, genetics, oral health and human papillomavirus (the latter only for oropharyngeal cancer) has become more evident.[5, 16] Therefore, it is understood that the cases analyzed in this study are due to exposure in previous decades, and, therefore, our findings highlight the role of PHC OHTs in the diagnosis and treatment and not in their prevention role.

Regarding the trend analysis, our study showed that the risk of being diagnosed at more advanced stages was upward for all outcomes. Few possible interpretive dimensions are available to understand this result. The first corroborates a finding that reflects the improved access to the health care network: the tertiary health centers started to treat patients who would previously not have access to the public health system and died after going untreated, consequently, without hospital records. During a similar period, it was observed that the mortality rates from oral and oropharyngeal cancers showed a stable or decreasing trend in almost all regions of the country,[26] which contributes to this interpretation.

The second point of view concerns the quality of health records in recent years: the correct classification of the most severe cases by primary location is a challenge. Therefore, in previous periods, they could have been poorly classified and recorded as due to unclear causes, being better identified and recorded in the analyzed historical series. This might explain the increase in the number of cases with advanced staging found in this study, mainly when we consider that it was only in 2004 that dental surgeons were included in the FHS teams through the implementation of the National Oral Health Policy (PNSB).

The consolidation of the Brazilian primary oral health care has to face many obstacles, mainly regarding the practical application of its principles and guidelines. While the PNSB advocates a new model of care that emphasizes prevention and health promotion in families and communities, individual and curative treatment remains the hegemonic practice in our health system.[18, 21, 27] Coverage, management, structure and vulnerabilities of the work process have been described in the scientific literature.[7, 21, 28] However, we must emphasize that the increased access to dental care observed in the last decades is unprecedented in the history of the country and that, despite some limitations, its pro-equity core seems to prevail.[6] Thus, studies related to the influence of this policy on an outcome as serious as oral and oropharyngeal cancers become, in addition to being necessary, critical for the planning and management of these diseases in the communities.

As limitations of this study, we point out the vulnerability of the database with low completeness of information at the beginning of the series, or the delay in making information available throughout the country at the end of the historical series. Therefore, we chose to perform an ecological study. However, the original internal operational control database validates the data to avoid duplication of records, among others.[8] It is important to note that the analyzed cases do not correspond to all cases of oral and oropharyngeal cancers treated in the hospital environment in Brazil, as the database we use includes only the records sent to SisRHC-INCA. Additionally, the coverage is calculated considering the number of people living in the region and are registered, and not the people using the services. Nevertheless, it is the best and most complete national database available on the evaluated pathologies, since cancer is not a mandatory notification disease in Brazil. The other limitations are intrinsic to its methodological design. They have been widely discussed in the literature,[26] such as the impediments in the processing of aggregated data and the lack of individual data, which are necessary for a more detailed investigation.

Conclusions

We conclude that the greater coverage of OHT services seems to be associated with the diagnosis of oral and oropharyngeal cancers at the early stages. This suggests a potential increase in the chances of treatment and cure. Moreover, it should be noted that, although it has been more than 15 years since the implementation of the PNSB, the OHT coverage in the Brazilian territory is less than 50%. It is necessary to strengthen the growing qualification of this strategy and evaluate its effects, aiming to enable well-directed and effective efforts against oral and oropharyngeal cancers.

The association between greater social inequalities and an increase in the proportion of late diagnosis of oral and oropharyngeal cancers observed in this study reinforces the need to discuss the reduction of inequalities in different social groups. This process requires the creation of public health policies that aim not only at the prevention of individual behaviors related to oral or oropharyngeal cancers, but also address the socioeconomic and cultural determinants that are at the origin of such behaviors. Only through adequate planning and investment will it be possible to reverse the upward trend in the number of cases diagnosed at advanced stages found in this study.

List Of Abbreviations

CHA

community health agents
FHS
family health strategy
IBGE
Brazilian Institute of Geography and Statistics (
INCA
National Cancer Institute José Alencar Gomes da Silva
M-HDI
Municipal Human Development Index
OHT
Oral Health Team
PHC
Primary Health Care
PNSB
National Oral Health Policy
RR
Risk ratio
SD
Standard Deviation
SUS
Unified Health System

Declarations

Ethics approval and consent to participate

All information is of public domain, with no identification of patients and for that reason there was no need for project approval by the Ethics Committee for Research with human beings. The exemption was taken by the Ethics Committee in Human Beings of the Federal University of Mato Grosso do Sul.

Consent for publication

Not applicable.

Availability of data and materials

All data generated or analysed during this study are included in this published article [and its supplementary information files].

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

Conceptualization: ADDC, DGMV.

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Supporting Information Captions

Table S1. Meaning of TNM codes and their distribution according to the staging categories used in the study.

Table S2. Sample of 160 municipalities, risk medium relative to the most serious outcome in relation to less serious ("T" represents tumor size, "N" represents lymph node involvement and "M" represents the presence of distant metastasis).

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