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Influence of municipal socioeconomic indices on mortality rates for oral and oropharyngeal cancer in older adults in the State of São Paulo, Brazil

Influência dos índices socioeconômicos municipais nas taxas de mortalidade por câncer de boca e orofaringe em idosos no estado de São Paulo

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ABSTRACT: ***Introduction:*** Oral and oropharyngeal cancer are diseases strongly influenced by socioeconomic factors. The risk of developing these diseases increases with age and most cases occur in the elderly, with higher mortality rates. This study aimed to analyze the influence of municipal socioeconomic indices on mortality rates for oral (OC) and oropharyngeal cancer (OPC) in elderly residents from 645 cities in the State of São Paulo, Brazil, from 2013 to 2015. ***Method:*** Secondary data on deaths were obtained in the Mortality Information System from the Brazilian Ministry of Health. The number of elderly, as well as *per capita* median income values and Human Development Index by municipality (HDI-M) values were obtained from data by the SEADE Foundation. Descriptive and exploratory analysis of data was performed, followed by negative binomial models described by the Proc Genmod procedure and evaluated by the corrected AIC (Akaike Information Criterion), the likelihood level, and the Wald test ($\alpha = 0.05$). ***Results:*** Around 30% of the cities notified deaths in 2013, 16.74% in 2014, and 18.61% in 2015. Founded mortality mean rates from OC and OPC were, respectively, 20.0 ($\pm$ 430.9) and 10.7 ($\pm$ 17.5) deaths per 100,000 inhabitants. Mean income ranged, in local currency, from 434.2 to 2,009.00. HDI-M ranged from 0.65 to 0.89. There was a significant decrease ($p < 0.05$) in mortality rates for OC and OPC in elderly with the increase in the cities' mean income and HDI-M values. ***Conclusion:*** Socioeconomic inequalities in the cities the on mortality rates for OC and OPC in elderly residents.

Keywords: Elderly. Mortality. Oral cancer. Socioeconomic factors.

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RESUMO: ***Introdução:*** O câncer de boca e o câncer de orofaringe são doenças influenciadas por fatores socioeconômicos. O risco de desenvolver essas doenças aumenta com a idade, e a maioria dos casos ocorre em idosos, com elevadas taxas de mortalidade. O objetivo deste estudo foi analisar a influência dos índices socioeconômicos municipais nas taxas de mortalidade por câncer de boca (CB) e de orofaringe (CO) em idosos nas 645 cidades do estado de São Paulo, Brasil, nos anos de 2013 a 2015. ***Método:*** Dados secundários de óbitos foram obtidos pelo Sistema de Informações sobre Mortalidade (SIM) do Ministério da Saúde. O número de idosos e os valores da renda média *per capita* e do índice de desenvolvimento humano por município (IDH-M) foram obtidos a partir dos dados da Fundação SEADE. Realizou-se a análise descritiva e exploratória dos dados, seguida de modelos binomiais negativos descritos pelo procedimento PROC GENMOD e avaliados pelo critério de informação de Akaike corrigido (AICc), pelo grau de liberdade e pelo teste de Wald ($\alpha = 0,05$). ***Resultados:*** Cerca de 30% das cidades notificaram óbitos em 2013, 16,74% em 2014 e 18,61% em 2015. As taxas médias de mortalidade por CB e CO foram, respectivamente, de 20,0 ($\pm$ 30,9) e 10,7 ($\pm$ 17,5) por 100 mil habitantes. A renda média variou de R$ 434,20 a R$ 2.009,00 e o IDH-M, de 0,65 a 0,89. Houve decréscimo significativo ($p < 0,05$) nas taxas de mortalidade por CB e CO em idosos com o aumento dos valores das rendas médias e do IDH-M. ***Conclusão:*** As desigualdades socioeconômicas das cidades influenciam nas taxas de mortalidade por CB e CO em idosos.

Palavras-chave: Idosos. Mortalidade. Câncer de boca. Fatores socioeconômicos.

INTRODUCTION

The oral cavity is a distinct region of the head and neck, with a complex functional anatomy that is related to speech, swallowing, mastication, and facial expression. Although the oropharynx is often confused with a continuous extension of the oral cavity, it is necessary to differentiate these two anatomical areas, as etiology, management, and outcomes of cancer lesions originating in these two regions are different[1]. Mouth cancer and oropharyngeal cancer are aggressive neoplasms. Its etiology is multifactorial, and chemical substances (tobacco, alcohol, areca nut, yerba mate), physical agents (mechanical traumas, ultraviolet radiation), and biological agents (human papillomavirus, immunosuppression) are considered as extrinsic risk factors, and, as intrinsic risk factors, age and sex[2].

Low socioeconomic status has been correlated as an important determinant of oral and oropharyngeal cancer due to associated factors, such as limited access to health care, increased exposure to environmental carcinogens, malnutrition, and increased consumption of tobacco and alcohol[3]. The age group with the highest incidence of oral and oropharyngeal cancer is elderly aged over 60 years. Most of the elderly have socioeconomic disadvantages, with around 15% of them being classified as near or at the poverty line (income below two dollars/day) worldwide[4]. Disadvantaged individuals with low socioeconomic status find it difficult to obtain regular health care and often show low levels of understanding of their

role in managing their own health[3,4]. The elderly also have lower levels of awareness about oral cancer than the general population[3-5].

Several parameters can be used for the socioeconomic evaluation of a population[5]. In 2012, the United Nations Development Program (UNDP) adapted the methodology of the global human development index (HDI-G) to the Brazilian context to calculate the municipal HDI (MHDI) in the country. The Brazilian MHDI considers three dimensions: Longevity MHDI (long and healthy life), Education MHDI (access to knowledge) and Income MHDI(standard of living), which are more adequate to evaluate the development of municipalities and metropolitan regions of the country[6].

The State of São Paulo is the one that presents municipalities with the highest HDI values. The campaigns for the prevention of oral and oropharyngeal cancer in this state began in 2001, involving all regional health departments (RHDs) and municipalities[7]. All of the state's municipalities have the capacity to provide data on death rates from oral and oropharyngeal cancer[8]. Thus, this ecological study aimed to analyze the influence of municipal socioeconomic indices on oral and oropharyngeal cancer mortality rates in the elderly in the state of São Paulo, from 2013 to 2015.

METHOD

This study used secondary data on deaths from oral and oropharyngeal cancer collected in the Brazilian Ministry of Health's Mortality Information System (SIM)[9], opting for access to Tabnet/DataSUS for containing updated on the elderly (aged over 60 years) in the state of São Paulo data from 2013 to 2015. The different anatomical localization sites of the neoplasms were identified by the International Classification of Diseases (ICD-10)[10], in the following categories: C00: lip; C01: tongue; C02: other and unspecified parts of tongue; C03: gum; C04: floor of mouth; C05: palate; C06: other and unspecified parts of mouth; and CO10: oropharynx. Data on the HDI, the average income and the elderly population per municipality were obtained from the SEADE Foundation database[11] and the Atlas of Human Development in Brazil[12].

The state of São Paulo, whose capital is the city of São Paulo, is located in the southeastern region of Brazil. It consists of 645 municipalities, of which 194 (30.0%) reported deaths from oral and oropharyngeal cancer in 2013, 108 (16.74%) in 2014, and 120 (18.61%) in 2015. Associations of oral and oropharyngeal cancer rates in these municipalities were analyzed using the MHDI[11,12] and the mean *per capita* income. The other municipalities were not considered in the analysis to avoid confusion between those who reported deaths and those who had no deaths. Initially, a descriptive and exploratory analysis of the data was made in order to adjust the most appropriate model to describe the relations between the variables. Negative binomial models were then adjusted using the PROC GENMOD procedure of the SAS software (version 8.1; SAS

Institute, Inc. Cary, NC, USA). The adjustment of the model was evaluated by the corrected Akaike information criterion (CAIC), the degree of freedom, and the Wald test[13]. A significance level of 5% was considered. This study was approved by the Research Ethics Committee of the School of Dentistry of Piracicaba/Universidade Estadual de Campinas.

RESULTS

Mortality rates for oral and oropharyngeal cancer in the elderly in the state of São Paulo are presented in Table 1. In cities that reported deaths between 2013 and 2015, rates of oral cancer ranged from 0.0 to 240.8 deaths per 100,000 inhabitants, with an average rate of 20.0 (± 30.9). Mortality rates for oropharyngeal cancer ranged from 0.0 to 152.5 per 100,000 inhabitants, with an average rate of 10.7 (± 17.5). The average income varied from BRL 453.20 to BRL 2,009 and the MHDI, from 0.65 to 0.89.

Figure 1 shows the variation in the rates of oral and oropharyngeal cancer, respectively, as a function of the MHDI and the average income from 2013 to 2015. The values with the best relation are the ones closest to 1.

The multiple regression analysis of the results in this study showed a strong correlation between the covariables income and MHDI ($r = 0.97$, $p < 0.0001$), demonstrating collinearity between them. Tables 2 and 3 show the results of the regression analysis for mortality rates of oral and oropharyngeal cancer in the elderly, in relation to the MHDI and the average income, respectively. There was a significant ($p < 0.05$) decrease in mortality rates for oral and oropharyngeal cancer with the increase in the city's MHDI and average income.

Table 1. Descriptive analysis of the analyzed variables. State of São Paulo, Brazil, 2013 to 2015.

	Mean	SD	Median	Minimum	Maximum
Average income (Brazilian Reais)	767.2	204.8	732.4	434.2	2009.0
MHDI	0.73	0.04	0.73	0.65	0.89
Oral cancer rate*	20.0	30.9	10.6	0.0	240.8
Oropharyngeal cancer rate*	10.7	17.5	4.4	0.0	152.5
Total rate**	30.7	36.3	18.5	1.4	268.2

SD: standard deviation; MHDI: municipality human development index; * mortality rate due to oral or oropharyngeal cancer in the elderly per 100,000 inhabitants; **sum of mortality rates due to oral or oropharyngeal cancer in the elderly per 100,000 inhabitants.

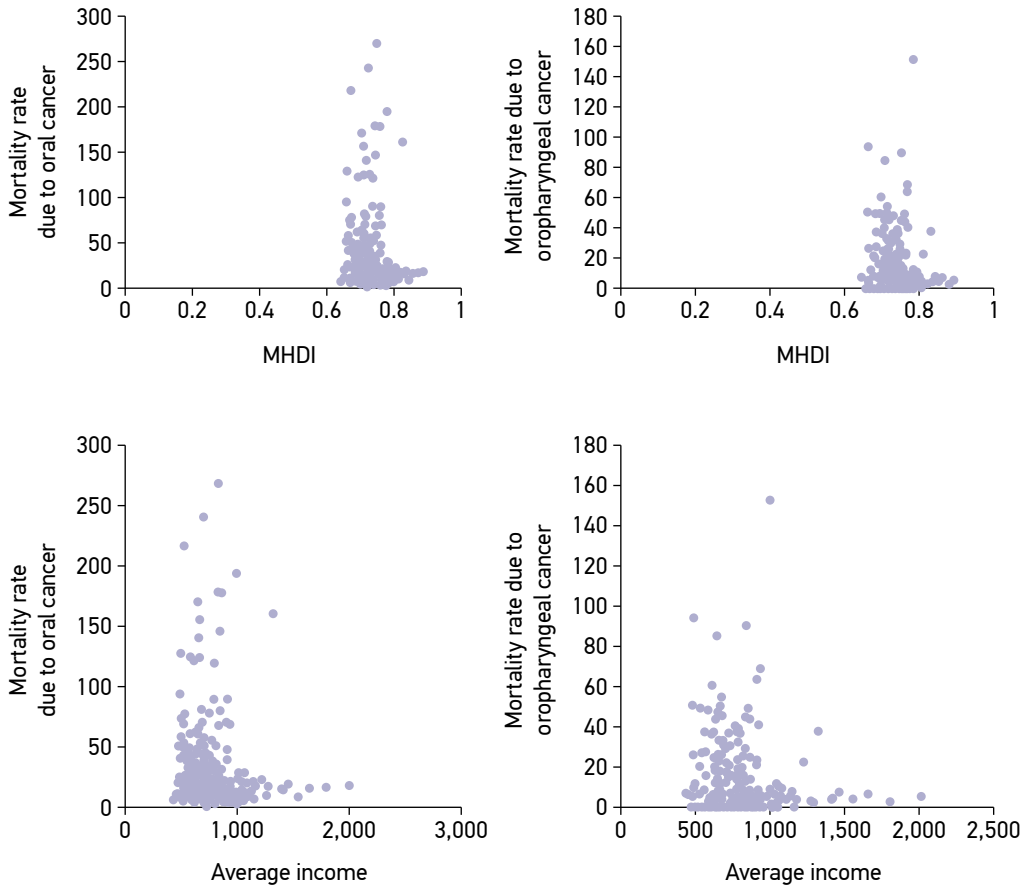

Figure 1. Variation of the mortality rate due to oral and oropharyngeal cancer in the elderly in the cities of the state of São Paulo, Brazil, from 2013 to 2015, according to the municipality human development index and the average income.

Table 2. Results of the negative binomial regression analysis in relation to the municipality human development index for the total mortality rate due to oral and oropharyngeal cancer in the elderly in the state of São Paulo, Brazil, from 2013 to 2015.

	Estimate		Standard error		95%CI		p value – Wald	
	OC	OPC	OC	OPC	OC	OPC	OC	OPC
Intercept	6.178	3.886	0.8592	1.891	4.494 – 7.862	0.180 – 7.592	< 0.0001	0.0399
MHDI	-3.777	-2.072	1.172	2.579	-6.074 – 1.479	-7.128 – 2.983	0.0013	0.4217

95%CI: 95% confidence interval; OC: oral cancer; OPC: oropharyngeal cancer; MHDI: municipality human development index

DISCUSSION

Mouth cancer and oropharyngeal cancer are diseases strongly influenced by socioeconomic factors, with high prevalence in the elderly[14], being responsible for high mortality rates in this population in Brazil[15]. The present study evaluated the mortality rates for oral and oropharyngeal cancer in the elderly in the municipalities of the state of São Paulo in relation to the average *per capita* income and the MHDI (socioeconomic variables), in the period from 2013 to 2015[11,12]. There was a significant correlation between the socioeconomic condition of the municipality and mortality rates, that is, there was a significant decrease ($p < 0.05$) in the mortality rates due to oral and oropharyngeal cancer in the elderly with an increase in the city's average income and MHDI. The municipalities with higher average per capita income and MHDI had lower mortality rates due to oral and oropharyngeal cancer in the elderly. These results differ from other national studies conducted in 1980 and 1991[15] and in the period from 1998 to 2002[6], which covered all age groups in the capitals of Brazilian states and showed that cities with high MHDI (≥ 0.80) presented higher mortality rates due to oral and oropharyngeal cancer. According to studies, the justification for this finding may be due to the fact that, in capitals with a high MHDI, the population is more susceptible to cancer risk factors, have a longer life expectancy, and has a better notification system for death records[15,16]. Compared to these data, the results of this study can be explained, firstly, by the use of a specific sample of the elderly, whose population is more vulnerable to the incidence of oral and oropharyngeal cancer[1-5,7,8], excluding other age groups of this population that could influence the results. The specific choice of more vulnerable groups in epidemiological surveys allows the development of targeted actions and policies that, over time, can reduce the prevalence of life-threatening diseases, thereby reducing their mortality rates[17]. The implementation of these specific actions may be the second and main explanation for the results. Since 2001, the state of São Paulo has developed campaigns for

Table 3. Results of the negative binomial regression analysis regarding the average income for the total mortality rate for oral and oropharyngeal cancer in the elderly in the state of São Paulo, Brazil, from 2013 to 2015.

	Estimate		Standard error		95%CI		p value – Wald	
	OC	OPC	OC	OPC	OC	OPC	OC	OPC
Intercept	3.954	2.694	0.171	0.391	3.619 – 4.289	1.928 – 3.459	< 0.0001	< 0.0001
Average income	-0.0007	-0.0004	0.0002	0.0005	-0.0011 – 0.0003	-0.0014 – 0.0005	0.0010	0.3902

95%CI: 95% confidence interval; OC: oral cancer; OPC: oropharyngeal cancer.

the prevention of oral and oropharyngeal cancer in all of its 645 municipalities[7]. Greater access to these campaigns and early and preventive action may lead to greater awareness of the search for treatment by a more vulnerable part of the elderly population, leading to a reduction in mortality rates from these types of cancer[3,7]. The third explanation may be the fact that São Paulo is the second state in the country with the highest number of municipalities and the highest MHDI values[6,11,12]. The results of the present study showed a mean MHDI of 0.74 (± 0.04), classified as high (0.70 – 0.79)[11,12], with variations from 0.65, average (0.60 – 0.69)[11,12], to 0,89, very high (0.80 – 1.0)[11,12] (Table 1). The higher the MHDI value, the higher the socioeconomic level of the population, and also the higher the components of this index, that is, income, longevity, and education in the municipality[14]. The higher the socioeconomic status of the elderly, the less difficult it is to understand their role in managing their health and obtaining regular care, preventing the occurrence of diseases with risk of death[3,4]. The fourth explanation is the fact that all municipalities in the state of São Paulo have the capacity to provide data on oral and oropharyngeal cancer mortality rates through the SIM[11,18]. In recent years, there has been a breakthrough in this system. The Brazilian mortality data, from the qualitative point of view, are accurate and reliable, similar to those of any country with a long tradition in the elaboration of these statistics[18]. However, in the past, sub-registrations and under-notifications could still be observed in the furthest regions of the country. In general, the reliability of the reporting of records in underprivileged regions is probably questionable, due to the greater difficulty of access to health services and the need to pay fees for the recording of deaths[18].

In the present study, there was a variation in the number of municipalities in the state that reported deaths from oral and oropharyngeal cancer in the elderly during the period evaluated. In 2013, 194 (30.0%); in 2014, 108 (16.74%); and, in 2015, 120 (18.61%). This fact can be explained by the possible non-occurrence of deaths by these types of cancer in the elderly in the studied years, by the underreporting of deaths, by delays in the collection and processing of data by the municipalities, and by difficulties or errors in coding the cause of death. Limitations in data processing can occur due to difficulties in the transfer of data from the municipality to the state or by work overload, a situation in which the processing of deaths becomes only secondary, as already observed by another study[19], characterizing a possible failure in this notification system. The use of secondary data may also be considered a limitation of the present study. Even with criticism, since its inception, mortality statistics have always been, and continue to be, the main source of data to obtain knowledge on the epidemiological profile of a type of disease, an area, and a population group, to analyze trends, indicate priorities, evaluate programs, among other purposes[18]. The SIM implemented in the state of São Paulo has been evaluated as having good quality and reliability[20], minimizing the biases of the presented data.

The mean oral cancer mortality rate in the elderly in the state of São Paulo was 20.0 (± 30.9) for each 100,000 inhabitants per municipality, ranging from 0.0 to 240.8; for

oropharyngeal cancer, the mean mortality rate was 10.7 (± 17.5) for every 100,000 inhabitants per municipality, ranging from 0.0 to 152.5. The total mortality rate for these two types of cancer was 30.7 (± 36.3) (Table 1). The latter figure is higher than that observed in the elderly by a study with data from the state capitals of Brazil in 2009, which was 14.11[21]. The comparison of this data with that of other studies is difficult due to the lack of methodological standardization. However, in the state of Minas Gerais, a study evaluating the trend of oral cancer mortality rates from 2009 to 2013, showed a predominance of higher values in the elderly and a trend towards stability in high values due to the population's aging process[22]. When this trend is evaluated in relation to sex and race, a study conducted in the city of São Paulo, the largest in South America, from 2003 to 2009, showed that the mortality due to oral cancer among women increased more than between men and doubled among black individuals. According to the study, the rationales are the increased exposure to risk factors for oral cancer in women, especially tobacco use, and social inequalities, which stimulate alcohol and tobacco consumption and hinder access to health services for black individuals[23].

Compared to data from other countries, the death rate from these types of cancer in the elderly in the State of São Paulo was higher. In the 40 countries of Europe, in 2012, the age-adjusted mortality rate for oral and oropharyngeal cancer was 10.0 for every 100,000 inhabitants, ranging from 3.4 to 26.8[24].

The strong relationship of socioeconomic factors with the mortality rate due to oral and oropharyngeal cancer in the elderly can also be observed in other countries. In Japan, the age-adjusted mortality rate had a strong correlation with the socioeconomic variables of the municipalities[25]. In France, it was observed that socioeconomic inequity in males influenced the mortality pattern due to oral cancer[5]. Review study in 164 countries found higher rates of mortality due to oral cancer among men in countries with lower HDI[26]. One limitation of these studies, as well as this study, was the use of socioeconomic data from the municipality rather than individual characteristics of each individual. To eliminate this limitation, future studies using multilevel analysis simultaneously assessing individual and contextual socioeconomic characteristics will be needed.

CONCLUSIONS

The mean rates of oral cancer mortality in the elderly in the state of São Paulo, from 2013 to 2015, were 20.0 and, for oropharyngeal cancer, 10.7 per 100,000 inhabitants per municipality. There was a decrease in mortality rates due to oral and oropharyngeal cancer in the elderly with an increase in the average *per capita* income and MHDI values. Socioeconomic inequalities in cities influence mortality rates for oral and oropharyngeal cancer in the elderly.

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