Factors Associated with Oral Cancer Mortality Rates in the State of Alagoas: Decade-Long Analysis

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Fatores Associados a Taxas de Mortalidade por Câncer Oral no Estado de Alagoas: Análise de uma Década

Factores Asociados a las Tasas de Mortalidad por Cáncer Bucal en el Estado de Alagoas: Análisis de una Década

Yasmin Tenório Ferro Alencar[1]; Sâmela da Silva Ferreira[2]; Ana Clara da Silva Marinho[3]; Geovana de Santana Barreto[4]; Elisa Miranda Costa[5]; Luiz Arthur Barbosa da Silva[6]; Valéria Souza Freitas[7]; Marília de Matos Amorim[8]

ABSTRACT

Introduction: Oral cancer presents high mortality rates in Brazil, showing increasing rates in the states of the Northeast. **Objective:** To analyze the factors associated with mortality from oral cancer in the municipalities of Alagoas from 2013 to 2023. **Method:** Ecological study conducted using data from the Mortality Information System (SIM) and the Brazilian Institute of Geography and Statistics (IBGE) on deaths from mouth cancer classified according to ICD-10 codes C00-C09, by residence, in medium and large-sized municipalities of Alagoas. Socioeconomic and health service access indicators were obtained from the 2010 and 2022 censuses, E-Gestor Primary Care, and the Oncology Panel. The data was tabulated in Microsoft Excel and analyzed in STATA SE 14 using a multivariate Poisson regression model with random effects. **Results:** A total of 366 deaths were reported in medium and large-sized municipalities in the state of Alagoas between 2013 and 2023. Mortality rates ranged from 0 to 0.83 deaths per 10,000 inhabitants across different municipalities. Despite variations in mortality rates and the analyzed indicators, no statistically significant association was identified between oral cancer mortality and socioeconomic or healthcare access indicators. **Conclusion:** Although no variable showed statistical significance, the study demonstrated the persistent occurrence of oral cancer mortality throughout the analyzed decade, as well as low socioeconomic and healthcare access indicators in medium- and large-sized municipalities in the state of Alagoas.

Key words: Mouth Neoplasms/mortality; Mortality; Epidemiology/statistics & numerical data.

RESUMO

Introdução: O câncer oral apresenta altas taxas de mortalidade no Brasil, demonstrando taxas crescentes nos Estados do Nordeste. **Objetivo:** Analisar os fatores associados à mortalidade por câncer oral nos municípios de Alagoas de 2013 a 2023. **Método:** Estudo ecológico realizado a partir dos dados do Sistema de Informação sobre Mortalidade (SIM) e do Instituto Brasileiro de Geografia e Estatística (IBGE) com os óbitos por câncer oral classificados segundo a CID-10 em C00-C09, por residência, nos municípios de médio e grande portes de Alagoas. Os dados dos indicadores socioeconômicos e de acesso aos serviços de saúde foram obtidos dos Censos 2010 e 2022, E-gestor Atenção Básica e Painel Oncologia. Os dados foram tabulados no *Microsoft Excel* e analisados no STATA SE 14 utilizando o modelo multivariado de regressão de Poisson com efeitos aleatórios. **Resultados:** Um total de 366 óbitos foi notificado nos municípios de grande e médio portes no Estado de Alagoas no período de 2013 a 2023. As taxas variaram entre 0 e 0,83 óbitos por 10 mil habitantes em diferentes municípios alagoanos. Apesar da variação das taxas e dos indicadores analisados, o estudo não identificou associação estatisticamente significativa com indicadores sociais e de acesso aos serviços de saúde. **Conclusão:** Embora nenhuma variável demonstre significância estatística, o estudo demonstrou a ocorrência persistente de mortalidade por câncer oral ao longo da década analisada e baixos indicadores socioeconômicos e de acesso aos serviços de saúde nos municípios de médio e grande portes de Alagoas.

Palavras-chave: Neoplasias Bucais/mortalidade; Mortalidade; Epidemiologia/estatística & dados numéricos.

RESUMEN

Introducción: El cáncer bucal presenta altas tasas de mortalidad en el Brasil, con un incremento sostenido en los estados del Nordeste. **Objetivo:** Analizar los factores asociados a la mortalidad por cáncer bucal en los municipios de Alagoas entre 2013 y 2023. **Método:** Estudio ecológico realizado a partir de datos del Sistema de Información sobre Mortalidad (SIM) y del Instituto Brasileño de Geografía y Estadística (IBGE), considerando los óbitos por cáncer bucal clasificados según la CIE-10 (C00–C09), por lugar de residencia, en municipios de tamaño medio y grande de Alagoas. Los indicadores socioeconómicos y de acceso a los servicios de salud fueron obtenidos de los censos (2010 y 2022), del E-Gestor Atención Básica y del Panel de Oncología. Los datos fueron tabulados en *Microsoft Excel* y analizados en STATA SE 14 mediante un modelo multivariado de regresión de Poisson con efectos aleatorios. **Resultados:** Se notificaron un total de 366 óbitos en los municipios de tamaño medio y grande del estado de Alagoas entre 2013 y 2023. Las tasas de mortalidad variaron entre 0 y 0,83 óbitos por cada 10 000 habitantes en los diferentes municipios. A pesar de la variación en las tasas y en los indicadores analizados, no se identificó asociación estadísticamente significativa entre la mortalidad por cáncer bucal y los indicadores sociales y de acceso a los servicios de salud. **Conclusión:** Aunque ninguna variable presentó significación estadística, el estudio evidenció la ocurrencia persistente de mortalidad por cáncer bucal a lo largo de la década analizada, así como bajos indicadores socioeconómicos y de acceso a los servicios de salud en los municipios de tamaño medio y grande del estado de Alagoas.

Palabras clave: Neoplasias de la Boca/mortalidad; Mortalidad; Epidemiología/estadística & datos numéricos.

[1-3,5,6,8]Universidade Federal de Alagoas (UFAL), Faculdade de Odontologia. Maceió (AL), Brasil. E-mails: yasmin.alencar@foufal.ufal.br; samela.ferreira@foufal.ufal.br; ana.marinho@foufal.ufal.br; elisa.costa@foufal.ufal.br; luiz.silva@foufal.ufal.br; marilia.amorim@foufal.ufal.br. Orcid iD: https://orcid.org/0009-0005-7304-9002; Orcid iD: https://orcid.org/0009-0002-4759-8401; Orcid iD: https://orcid.org/0009-0006-2428-2526; Orcid iD: https://orcid.org/0000-0001-5364-0384; Orcid iD: https://orcid.org/0000-0003-3390-6581; Orcid iD: https://orcid.org/0000-0002-5224-4918

[4,7]Universidade Estadual de Feira de Santana (UEFS). Feira de Santana (BA), Brasil. E-mails: santanageovana768@gmail.com; valeria.souza.freitas@gmail.com. Orcid iD: https://orcid.org/0009-0003-9719-2087; Orcid iD: https://orcid.org/0000-0002-7259-4827

Corresponding author: Marília de Matos Amorim. Rua Professora Nadyr Maia Gomes Rego, 158 – Jatiúca. Maceió (AL), Brasil. CEP 57036-760. E-mail: marilia.amorim@foufal.ufal.br

INTRODUCTION

Oral cancer, also known as oral neoplasm, is characterized by a cellular growth disorder caused by a series of mutations, promoting an excessive and autonomous proliferation[1]. This affects the oral cavity structures, including lips, gums, palate, cheeks, tongue, and mouth floor[2].

According to the National Cancer Institute (INCA), 15,100 new annual cases of oral cancer were estimated for the 2023-2025 period in Brazil, a risk of 6.99 per 100 thousand inhabitants, demonstrating high mortality rates for the disease. Moreover, this infirmity caused the death of 4,749 people in 2023 in the country, of which 1,183 were from the Northeast Region, and 77 were from the State of Alagoas, of which 56 were men and 21 were women[3]. From these data, it was possible to calculate the neoplasm mortality rate, which was 0.24 for every 10 thousand inhabitants in the State of Alagoas in 2023.

INCA's estimate, for each year of the 2026-2028 triennium, is of 17,190 new oral cavity cancer cases (C00-C10), with an estimated risk of 7.98 per 100 thousand inhabitants for Brazil[4]. Of those, 12,260 new cases will occur in men and 4,930 in women. Values that correspond to risks estimated in 11.68 new cases for each 100 thousand men and 4.46 new cases for each 100 thousand women.

Excessive alcohol intake (alcoholism) and smoking are considered the main risk factors for lip cancer and oral cavity cancer[2,5,6]. Additionally, the lack of access to healthcare services due to socioeconomic issues and a lack of symptoms in the initial stages of these types of cancer are the main reasons why oral cancer diagnoses are often delayed, with dentists being sought only at more advanced stages of the disease, which increases the mortality rate[7,8].

In this sense, the State of Alagoas presented one of the lowest Human Development Indexes (HDI) of the country, 0.68 in 2021, and the monthly family income *per capita*, in 2023, was R$ 1,100, lower than the current minimum wage, R$ 1,320 in that same year[3,9]. These data demonstrate the low socioeconomic condition of people from Alagoas, a circumstance that can influence both the occurrence and the mortality from oral cancer[10].

In this perspective, ecological studies, such as the present research, aim to assess how socioeconomic and access to healthcare services indicators, for instance, may affect the health of population groups like the risk of death from oral cancer[11]. Thus, considering the poor socioeconomic conditions and access to healthcare services in the State of Alagoas, as well as the scarcity of studies on oral neoplasms in the State, studies such as the present one, which aims to analyze socioeconomic and access to healthcare services factors and their relationship with oral cancer mortality rates, provide a geographical view of the rates in the State's municipalities across a decade, enabling us to verify the behavior of such rates across time and its associated factors. Thus, the results obtained in this study can contribute to better organizing oral cancer care in the studied municipalities, facilitating the choice of interventions and prevention strategies to combat the disease.

Thus, the objective of the present study is to analyze the factors associated with oral cancer mortality in the municipalities of Alagoas from 2013 to 2023.

METHOD

Ecological epidemiological study with panel data analysis. An ecological study using panel data is also known as longitudinal data, which consists of a time series for each cross-sectional record of the dataset and can be collected in spatial aggregates. The essential panel data characteristic is that the same cross-sectional units are followed throughout a certain period, which enables the incorporation of temporal aspects into the analysis[12].

The study was conducted in the State of Alagoas, in the Northeast Region, with a geographic area of 27,830.661 km², divided into 102 municipalities with an estimated population of 3,127,683 inhabitants[9]. The analysis unit was composed of municipalities with more than 50 thousand inhabitants according to the Brazilian Institute of Geography and Statistics (IBGE), including: Maceió, Arapiraca, Rio Largo, Palmeira dos Índios, Marechal Deodoro, União dos Palmares, Penedo, São Miguel dos Campos, Delmiro Gouveia, and Coruripe.

The object of the study was oral cancer crude mortality rate. The mortality data were obtained from the Ministry of Health's Mortality Information System (SIM)[13], and the number of inhabitants was obtained from IBGE's Census, projections, and intercensal estimates for the years 2013-2023. Oral cancer mortality rates were calculated for 10 thousand inhabitants.

All deaths due to cancer of the oral cavity and anterior oropharynx were included, from 2013 to 2023, classified according to the 10th review of the International Classification of Diseases and Related Health Problems (ICD-10[14]), codes C00, C01, C02, C03, C04, C05, C06, C07, C08, and C09.

The socioeconomic indicators selected for the present study were illiteracy rate, average family income *per capita*, and the index of people living below the poverty threshold. The indicators of access to healthcare services include coverage of family healthcare, coverage of oral healthcare, coverage of the community health agent, proportion of

oral cancer cases with a waiting time longer than 60 days (per municipality of residence), and proportion of oral cancer cases diagnosed with clinical staging III-IV (per municipality of residence).

Socioeconomic indicators were obtained from the IBGE Demographic Censuses (2010[15] and 2022[16]), due to the unavailability of annual municipal estimates for the period. Whereas the information on access to healthcare services was collected from E-gestor Primary Care and Oncology Panel.

Initially, a time series descriptive analysis of oral cancer mortality rates in different Alagoas municipalities was conducted, as well as a description of the socioeconomic and access to healthcare services indicators. Later, the Hausman test[17] was performed, which assessed whether the effects in the estimators are equal in the approach to the model with random effects in relation to the fixed effects model.

Thus, the statistical analysis for verifying the association between the mortality rate and indicators was conducted using the multivariate Poisson regression model with random effects. This model was the most suitable as per the outcome classification, due to it being an outcome with rates derived from death count, characterizing discrete and non-negative data. The Hausman test[17] was conducted to assess the suitability of the model specification, indicating the choice of random effects.

The Microsoft Office Excel 2007 for Windows and STATA/SE 14[18] softwares were used to build databases and statistical analysis.

Since this is a study that used public domain and secondary database data, with no violation to the confidentiality of information and the details of the individuals involved, there was no need for approval of a Research Ethics Committee, in agreement with Resolution N. 510/2016[19] of the National Health Council.

RESULTS

A total of 366 deaths were reported in the ten medium- and large-sized municipalities in the state of Alagoas between 2013 and 2023. Table 1 demonstrates the average deaths by year and the crude mortality rates in each of the studied municipalities. The highest average rate across time was perceived in the municipality of Palmeira dos Índios (0.27 deaths for every 10 thousand inhabitants), and the lowest average was found in the municipality of Marechal Deodoro (0.14 deaths for every 10 thousand inhabitants). Furthermore, the highest mortality rate (0.83 deaths for every 10 thousand inhabitants) was also seen in Palmeira dos Índios, in 2014.

Graph 1 shows the municipalities' rate time series. In addition to the greater stability in Maceió, there were mortality rates equal to 0 in every municipality, except for Maceió and Arapiraca.

In Table 2, it is possible to verify data obtained from socioeconomic and access to healthcare services indicators, in the years 2013 and 2023, and each indicator's average during the assessed decade.

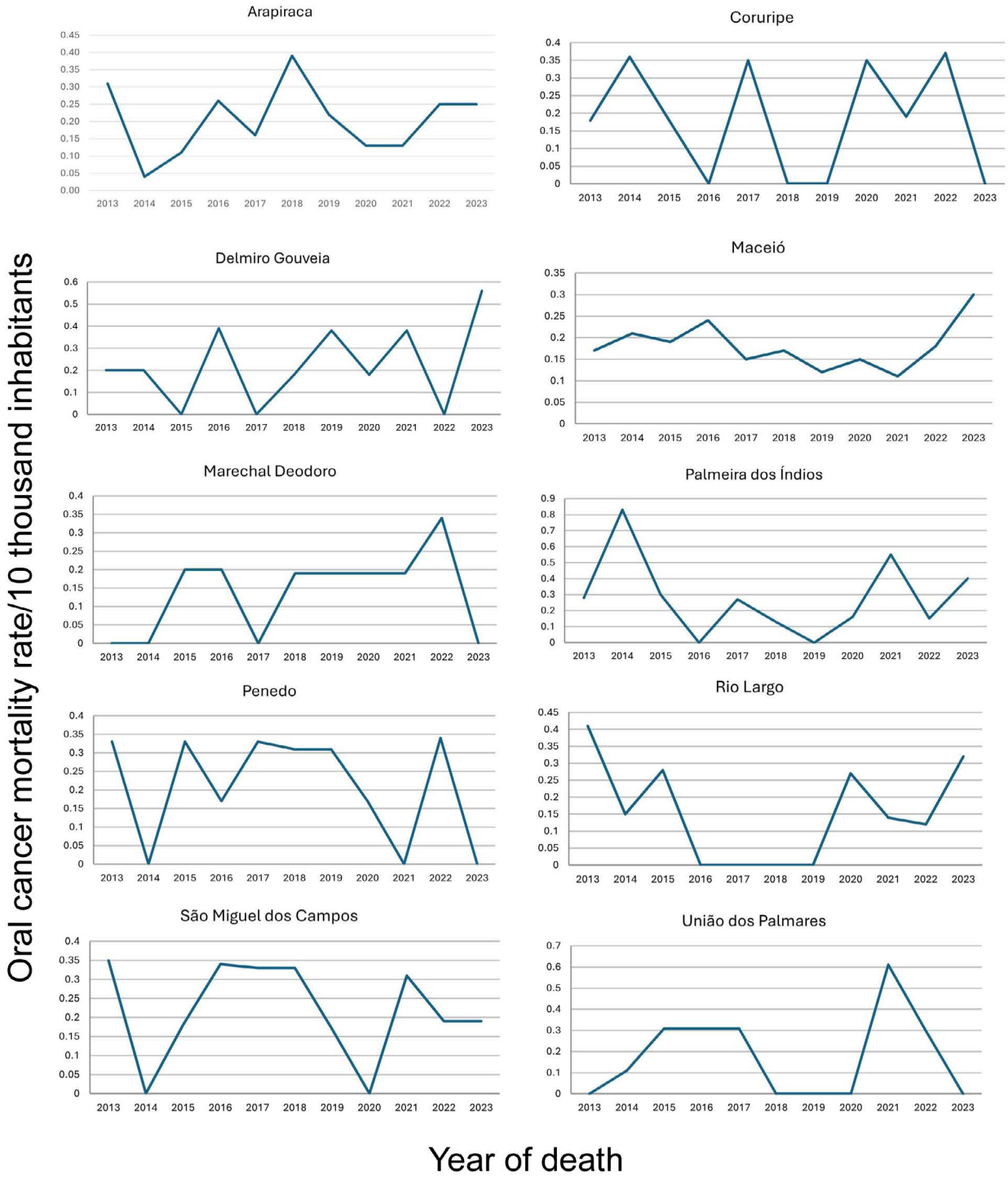
Regarding the illiteracy rate, the highest average was observed in the municipality of União dos Palmares (28.5), which presented the lowest average in family income *per capita* (R$ 313.92). The municipality of Maceió obtained an inversely proportional relationship, with the lowest average being illiteracy (10.61) and the highest average being family income *per capita* (R$ 792.54).

In the index of people who live below the poverty threshold, Delmiro Gouveia presented the highest figure, 16.76, while Maceió had the lowest figure, 5.29.

In the access to healthcare services indicator, Coruripe, Marechal Deodoro, Palmeira dos Índios, Penedo, Rio Largo, and São Miguel dos Campos had 100% coverage of family health for at least 3 years. It is worth mentioning

Table 1. Distribution of oral cancer deaths and mortality rates in the municipalities of Alagoas, 2013-2023

Municipality	Total number of deaths	Average deaths per year	Average mortality rate
Arapiraca	53	4.82	0.21
Coruripe	11	1.00	0.18
Delmiro Gouveia	13	1.18	0.23
Maceió	205	18.64	0.19
Marechal Deodoro	8	0.73	0.14
Palmeira dos Índios	22	2.00	0.27
Penedo	14	1.27	0.20
Rio Largo	13	1.18	0.15
São Miguel dos Campos	14	1.27	0.22
União dos Palmares	13	1.18	0.18



Graph 1. Oral cancer mortality rate in municipalities, 2013-2023

that the municipality with coverage lower than 35% on every year was the capital, Maceió. Moreover, the remaining municipalities, except Delmiro Gouveia, presented a higher than 50% coverage during the ten years analyzed.

Therefore, the highest average family health coverage was verified in Palmeira dos Índios and Marechal Deodoro, 100%, and the lowest mean was found in Maceió, 27.49%.

Regarding oral healthcare coverage, Maceió and Delmiro Gouveia were the only municipalities to present rates lower than 50% in some years. It must be noted that the capital of Alagoas remained with coverage below 50% on every year. Thus, the highest average oral healthcare coverage was verified in the municipalities of Palmeira dos Índios and Marechal Deodoro (100%), and the lowest average was found in Maceió (16.63%).

Table 2. Characterization of socioeconomic and access to healthcare services indicators in the medium- and large-sized municipalities of Alagoas, 2013-2023

Municipalities	Illiteracy rate (%)			Average family income per capita			Index of people living below the poverty threshold			Family healthcare coverage		
	2013	2023	x̄	2013	2023	x̄	2013	2023	x̄	2013	2023	x̄
Municipalities with higher rates												
Palmeira dos Índios	24.41	18.83	22.38	391.37	391.37	391.37	15.3	15.3	15.3	100	100	100
Delmiro Gouveia	23.35	17.48	21.22	332.13	332.13	332.13	16.76	16.76	16.76	56.47	99.49	68.51
São Miguel dos Campos	21.28	15.88	19.32	360.82	360.82	360.82	10.11	10.11	10.11	85.76	100	97.65
Arapiraca	22.45	15.26	19.84	423.28	423.28	423.28	11.15	11.15	11.15	83.82	96.77	93.05
Penedo	22.83	17.95	21.06	339.15	339.15	339.15	15.87	15.87	15.87	100	100	98.28
Municipalities with lower rates												
Maceió	11.86	8.42	10.61	792.54	792.54	792.54	5.29	5.29	5.29	30.76	25.06	27.49
Coruripe	23.9	18.23	21.84	315.85	315.85	315.85	16	16	16	100	90.9	95.93
União dos Palmares	31.62	23.23	28.57	313.92	313.92	313.92	15.38	15.38	15.38	76.76	73.62	78.47
Rio Largo	18.28	13.14	16.41	369.11	369.11	369.11	7.86	7.86	7.86	100	100	96.98
Marechal Deodoro	21.9	13.47	18.83	431.43	431.43	431.43	13.34	13.34	13.34	100	100	100

	Oral healthcare coverage			Community health agent coverage			Proportion of oral cancer cases with a waiting time longer than 60 days			Proportion of oral cancer cases diagnosed in clinical staging III-IV		
	2013	2023	x̄	2013	2023	x̄	2013	2023	x̄	2013	2023	x̄
Municipalities with higher rates												
Palmeira dos Índios	100	100	100	100	100	100	100	0	34.82	0	0	44.82
Delmiro Gouveia	49.41	100	61.76	100	100	100	0	-	37.91	100	-	59.73
São Miguel dos Campos	61.26	100	75.89	86.78	100	98.80	33	40	53.55	100	60	65.09
Arapiraca	66.43	77.9	69.84	100	100	100	69	17	41.18	77	20	52.27
Penedo	100	100	98.77	100	100	100	100	100	63.64	0	100	54.55
Municipalities with lower rates												
Maceió	25.69	13.68	16.63	28.65	22.12	24.95	68	24	52.91	71	27	50.09
Coruripe	100	100	99.24	100	100	100	100	50	71.18	100	50	42.45
União dos Palmares	76.76	93.11	83.05	100	100	100	100	20	58.45	50	20	50.45
Rio Largo	60.04	100	76.70	85.89	100	92.99	100	43	39.73	0	36	40.18
Marechal Deodoro	100	100	100	100	100	100	0	40	30.91	100	40	58.18

Source: Mortality Information System; 2010 and 2022 Census – Brazilian Institute of Geography and Statistics; E-gestor – Primary Care Information System, Oncology Panel/DATASUS.

Regarding the coverage of community healthcare agents, seven municipalities presented 100% coverage at some point. Like with other indicators, Maceió showed the worst rates, with coverages below 30% during the whole assessed decade. Thus, the capital of Alagoas presented the lowest average coverage in the assessed decade (24.95%). Furthermore, all the other municipalities presented averages higher than 95% for the community health agents coverage indicator.

In the proportion of oral cancer cases with a waiting time longer than 60 days, the municipalities of Coruripe, Delmiro Gouveia, Marechal Deodoro, Palmeira dos Índios, Penedo, Rio Largo, São Miguel dos Campos, and União dos Palmares presented at least one year with a 0 proportion, and a 100% proportion in some years. The only municipalities that did not present 0% and/or 100% proportions were Arapiraca and Maceió — Maceió presented results between 10% and 86%, having the lower proportion in the year 2019, and Arapiraca, a variation between 10% and 73%.

The higher mean ratio of oral cancer cases with a waiting time longer than 60 days was seen in Coruripe (71.18%), and the lowest mean was in Marechal Deodoro (30.91%).

In terms of the proportion of oral cancer cases diagnosed in clinical stage III-IV, the highest average was 65.09% in the municipality of São Miguel dos Campos, and the lowest average was 40.18% in the municipality of Rio Largo. The highest proportion presented was 100% in the municipalities of Coruripe, Delmiro Gouveia, Marechal Deodoro, Palmeira dos Índios, Penedo, Rio Largo, São Miguel dos Campos, and União dos Palmares, and the lower proportion, 0%, was verified in the municipalities of Coruripe, Marechal Deodoro, Palmeira dos Índios, Penedo, Rio Largo, and União dos Palmares. Moreover, proportions between 5% and 10% were verified in the municipalities of Arapiraca, Maceió, São Miguel dos Campos, and Delmiro Gouveia.

Table 3 shows the multivariate Poisson model with random effects for the association between mortality rates and social indicators. The estimated coefficients indicate there was no statistically significant association between mortality rate and the analyzed social indicators. Data regarding the association between indicators of access to health services and the oral cancer mortality rate are shown in Table 4. Likewise, the model demonstrated that no access indicator was statistically significant (p>0.005).

Table 3. Multivariate Poisson model (random effects) for the association between oral cancer mortality rates and social indicators in the medium- and large-sized municipalities of Alagoas, from 2013 to 2023

Indicators	Random effects			
	Coefficient	Coefficient exponential (relative risk)	Standard error	*p*
Illiteracy rate	-.0038233	.996184	.0185953	0.837
Average family income	.0002934	1.000293	.0007073	0.678
Poverty index	.0303276	1.030792	.033958	0.372

Note: N = 10; T = 11.

Table 4. Multivariate Poisson model (random effects) for the association between oral cancer mortality rates and access to healthcare service indicators in the medium- and large-sized municipalities of Alagoas, from 2013 to 2023

Indicators	Random effects			
	Coefficient	Coefficient exponential (relative risk)	Standard error	*p*
Family healthcare coverage	.0005922	1.000592	.0081521	0.942
Community health agent coverage	-.0007439	.9992563	.0063697	0.907
Oral healthcare coverage	.0015513	1.001552	.0058308	0.907
Proportion of cases treated after more than 60 days	-.0001502	.9998498	.0020001	0.940
Proportion of cases diagnosed in stages III and IV	.0000139	1.000014	.0021211	0.995

Note: N = 10; T = 11.

Despite not presenting significance, the indicators that demonstrate some coherences are community health agent coverage, showing a negative coefficient, and the proportion of cases diagnosed in stages III and IV, showing a positive coefficient.

DISCUSSION

Brazil presents high oral cancer mortality rates, varying across its different regions and States. The latest data presented by SIM demonstrated 4,749 deaths in the country, of which 24% were in the Northeast Region[4].

Oral cancer mortality is attributed mainly to late diagnosis, which is related to macrodeterminants like the organization of care, barriers of access to healthcare services, and socioeconomic indicators[7,8].

The results demonstrate a higher time series rate, in addition to higher averages in the municipality of Palmeira dos Índios. A lack of high-complexity oncology services in the municipality must be noted, in addition to the geographic distance between the cities and reference services with which the municipality holds agreements — Arapiraca, which has two High-Complexity Oncology Units (Unacon). Thus, a geographic barrier of access to the service is suggested, which can affect early diagnosis and treatment of oral cancer[20].

Moreover, the obtained results also point to a greater stability of rates in the capital Maceió. The presence of specialized services for diagnosis and treatment in the municipality may contribute to that stability, since a greater availability of healthcare resources tends to facilitate the assistance pathways, maintaining death rates stable[20,21]. Additionally, the concentration of healthcare services in the capital favors a more complete and systematic report of deaths from oral cancer, reducing artificial fluctuations in the rates across the years. This scenario, in addition to the fact that Maceió has the largest population among the assessed municipalities, can explain the higher absolute number of deaths (205) in this municipality during the studied decade[20,21].

In this perspective, socioeconomic indicators are considered macrodeterminants for several health aggravations. Regarding oral cancer, some studies point to indicators such as HDI, illiteracy rate, average family income, poverty index, among others[7,21].

Alagoas generally presents low socioeconomic indicators, which vary across its municipalities. Regarding HDI, the State presents one of the lowest in the country, 0.68, ranking 26th out of 27, which implicates and explains the low education rates of the Alagoas population and the low income *per capita* in its municipalities[9,22]. The situation described may increase vulnerability of the population and contribute to the oral cancer mortality rate, since low education levels promote a lack of knowledge on healthcare, and precarious life conditions can increase the risk of developing these diseases[22,23].

The State of Alagoas has barriers regarding access to healthcare services, especially in the capital, Maceió, which has the lowest coverage averages. Due to having a larger resident population, there may be difficulties in expanding healthcare services coverage to the entire population, a situation that is easier in municipalities with smaller populations. Access to healthcare services, perceived through coverage indicators, enables early diagnosis and treatment, optimized care pathways, leading to better prognoses, better survival, and lower mortality rates. Thus, higher coverages tend to generate better oral cancer control[24,25].

It must be underscored that primary care, in oral healthcare, is essential to control risk factors, promote early diagnosis and care to oncological patients, given that the association between oral cancer mortality rates and health promotion and prevention in primary care, based on the construction of an interdisciplinary team, has already been presented in the literature[25,26].

Some studies conducted in Brazil indicate controversial results, like the present study, in which the regions with better social indicators presented higher mortality rates. Despite that, studies demonstrate an association between worse social indicators and mortality rate[27-29]. Due to its limitations, the present study did not reveal statistical significance between the studied indicators.

Despite not presenting statistical significance, the poverty index presented a positive coefficient, consistent with the hypothesis that poverty increase may be related to increased mortality from oral cancer. Thus, this result is coherent with the social determination theory of the health-sickness process, in which macrodeterminants can interfere with the population's health conditions[23].

Regarding access to healthcare, the indicators community health agent and proportion of cases diagnosed in stages III and IV deserve attention. Therefore, it is suggestive, despite not being statistically significant, that a decrease in oral cancer mortality rate follows health community agent coverage increase, in agreement with the relationship between oral cancer mortality rates and healthcare promotion and prevention in primary care[26]. Analyzing the described hypothesis, it is worth highlighting that the community health agent plays an essential role in the family healthcare strategy, enabling early oral cancer diagnosis and referral to dentists who can provide treatment[25].

Moreover, the literature shows that a high proportion of cases diagnosed in stages III and IV may have a direct influence on the increase in oral cancer mortality rates.

These advanced stages reflect a more aggressive disease, greater tumor extension, and a higher probability of local metastases, substantially reducing the possibilities of healing treatment and therapeutic response. On the individual level, several studies highlight that late diagnosis is among the main determinants for the high lethality of oral cancer, since patients in advanced stages present lower survival and a higher risk of death when compared to those diagnosed early. Thus, the predominance of stages III and IV suggests fragilities in timely detection and care pathways, contributing to higher mortality rates in the analyzed municipalities[30,31].

It is important to consider that the present study presented limitations, given its ecological nature, and cannot be considered individually. Furthermore, secondary data were analyzed, making the research dependent on the quality and reliability of the sources, which could lead to information bias. The study also presented a lack of data variability across time, considering the non-availability of annual data for the social indicators and the use of Census data instead — which impairs the verification of association — and a short evaluation window, limited to ten years.

Another relevant aspect refers to the lack of standardized rates by age and sex. We acknowledge that age structure and sex distribution can significantly influence oral cancer mortality, as the disease occurs more frequently in older age groups and in males. However, standardization may cause statistical instability in the estimates, especially in municipalities with a low absolute number of deaths, and reduce the analytical power of the model before the limited number of analysis units. However, the lack of standardization limits direct comparability with other studies and may have influenced the magnitude of the observed associations and data generalization.

CONCLUSION

The study showed the persistent occurrence of oral cancer mortality throughout the analyzed decade in medium- and large-sized municipalities in the State of Alagoas. The factors studied did not present statistical significance, a situation caused by limitations in the data available for the State. Thus, we suggest that further studies are conducted on the theme to verify the relationship between socioeconomic indicators and healthcare services access indicators with oral cancer mortality rates in the State of Alagoas.

CONTRIBUTIONS

Yasmin Tenório Ferro Alencar and Marília de Matos Amorim have substantially contributed to the study design, acquisition, analysis and interpretation of the data, wording, and critical review. Sâmela da Silva Ferreira, Ana Clara da Silva Marinho, Geovana de Santana Barreto, Elisa Miranda Costa, Luiz Arthur Barbosa da Silva, and Valéria Souza Freitas substantially contributed to wording and critical review. All the authors approved the final version for publication.

DECLARATION OF CONFLICT OF INTERESTS

There is no conflict of interest to declare.

DATA AVAILABILITY STATEMENT

The database used in this study was built from data available at the Mortality Information System, Census, intercensal estimates, E-gestor - Primary Care, and Oncology Panel.

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