Trend and Epidemiological Mapping of Oral Cancer in The State of Ceará from 2017 to 2023: Ecological Time-Series Study

https://doi.org/10.32635/2176-9745.RBC.2026v72n3.5579EN

Tendência e Mapeamento Epidemiológico do Câncer de Boca no Estado do Ceará nos Anos de 2017 a 2023: Estudo Ecológico de Série Temporal

Tendencia y Mapeo Epidemiológico del Cáncer Bucal en el Estado de Ceará entre los Años 2017 y 2023: Estudio Ecológico de Serie de Tiempo

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ABSTRACT

Introduction: Oral cancer is a global public health problem, characterized by high mortality rates and late diagnoses, with a negative impact on patients' quality of life. In Brazil, policies such as the National Oral Health Policy (PNSB) and the "30- and 60-Day Laws" aim to improve early diagnosis and access to treatment, but significant challenges remain. **Objective**: To analyze the epidemiological behavior and perform a georeferenced mapping of oral cancer in Ceará between 2017 and 2023, considering sociodemographic aspects, tumor staging, and geographic distribution. **Method**: Ecological time-series study using secondary data from DATASUS. Variables included sex, age, tumor stage, time to treatment, and health regions. QGIS software was applied for geospatial mapping. **Results**: A higher prevalence was observed among men over 55 years old. In 2020, there was a significant increase in treatments initiated within 30 days (43.3%), but this rate declined in subsequent years, largely due to the impact of the COVID-19 pandemic. Between 2017 and 2019, many treatments were initiated more than 60 days after diagnosis, highlighting difficulties in complying with the "60-Day Law." The Fortaleza region concentrated most diagnoses, reflecting inequalities in access to specialized care. Awareness campaigns such as "Julho Verde" (Green July) were associated with increased rates of early diagnosis. **Conclusion**: The study revealed both advances and persistent gaps in oral cancer care in Ceará, underscoring the need for a specific observatory to improve monitoring and ensure comprehensive oncological care.

Key words: Epidemiological Investigation; Mouth Neoplasms; Prevalence; Geographic Mapping.

RESUMO

Introdução: O câncer de boca é um problema de saúde pública global, com altas taxas de mortalidade e diagnósticos tardios, impactando negativamente a qualidade de vida dos pacientes. No Brasil, políticas como a Política Nacional de Saúde Bucal (PNSB) e as Leis dos 30 e 60 Dias buscam melhorar o diagnóstico precoce e o acesso ao tratamento, mas enfrentam desafios. **Objetivo:** Analisar o comportamento epidemiológico e realizar um mapeamento georreferenciado do câncer de boca no Ceará entre 2017 e 2023, considerando aspectos sociodemográficos, estadiamento tumoral e distribuição geográfica. **Método:** Estudo ecológico de série temporal com dados secundários do DATASUS. As variáveis analisadas incluíram sexo, idade, estadiamento tumoral, tempo de tratamento e Regiões de Saúde, com apoio do *software* QGIS para mapeamento geográfico. **Resultados:** Foi observada maior prevalência da doença em homens acima de 55 anos. Em 2020, houve um aumento significativo nos tratamentos iniciados em até 30 dias (43,3%), mas com redução nos anos seguintes em razão do impacto da pandemia de covid-19. Entre 2017 e 2019, muitos tratamentos foram iniciados após 60 dias do diagnóstico, evidenciando desafios no cumprimento da Lei dos 60 Dias. A Região de Fortaleza concentrou a maioria dos diagnósticos, refletindo desigualdades no acesso aos serviços especializados. Campanhas como o "Julho Verde" foram associadas ao aumento de diagnósticos precoces. **Conclusão:** O estudo destacou avanços e lacunas na assistência ao câncer de boca no Ceará, apontando a necessidade de um observatório específico para aprimorar o monitoramento e a integralidade do cuidado oncológico.

Palavras-chave: Investigação Epidemiológica; Neoplasias Bucais; Prevalência; Mapeamento Geográfico.

RESUMEN

Introducción: El cáncer bucal es un problema de salud pública global, caracterizado por altas tasas de mortalidad y diagnósticos tardíos, con un impacto negativo en la calidad de vida de los pacientes. En el Brasil, políticas como la Política Nacional de Salud Bucal (PNSB) y las leyes de los 30 y 60 días buscan mejorar el diagnóstico temprano y el acceso al tratamiento, pero enfrentan importantes desafíos. **Objetivo:** Analizar el comportamiento epidemiológico y realizar un mapeo georreferenciado del cáncer bucal en Ceará entre 2017 y 2023, considerando aspectos sociodemográficos, estadificación tumoral y distribución geográfica. **Método:** Estudio ecológico de serie de tiempo con datos secundarios del DATASUS. Las variables analizadas incluyeron sexo, edad, estadificación tumoral, tiempo de tratamiento y regiones de salud. Para el mapeo geoespacial se utilizó el *software* QGIS. **Resultados:** Se observó una mayor prevalencia de la enfermedad en hombres mayores de 55 años. En 2020, se registró un aumento significativo de los tratamientos iniciados en hasta 30 días (43,3%), aunque con reducción en los años posteriores debido al impacto de la pandemia de COVID-19. Entre 2017 y 2019, muchos tratamientos se iniciaron después de 60 días del diagnóstico, lo que evidencia dificultades en el cumplimiento de la ley de los 60 días. La región de Fortaleza concentró la mayoría de los diagnósticos, reflejando desigualdades en el acceso a los servicios especializados. Campañas como "Julio Verde" se asociaron con un aumento en los diagnósticos tempranos. **Conclusión:** El estudio evidenció avances y brechas en la atención al cáncer bucal en Ceará, señalando la necesidad de un observatorio específico que mejore el monitoreo y la integralidad del cuidado oncológico.

Palabras clave: Investigación Epidemiológica; Neoplasias Bucales; Prevalencia; Mapeo Geográfico.

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INTRODUCTION

Oral cancer is still seen as a relevant public health obstacle in the global scenario, since it presents high mortality rates and, mostly, late diagnosis, which leads to worse prognoses and more invasive and mutilating treatments, resulting in aesthetic, functional, and psychological damage to patients, which directly impacts their quality of life[1]. In this context, early diagnosis becomes essential and decisive for patients' survival and quality of life.

The World Health Organization (WHO) recommends preventive actions, early detection, and access to therapy for greater cancer control[2]. Preventive measures, early diagnosis, and proper treatment are still the main strategies used in actions towards cancer control, mainly regarding mortality reduction[3]. In Brazil, Ordinance N. 516, of June 17, 2015[4], issued by the Ministry of Health, establishes the diagnostic and therapeutic guidelines for head and neck cancer at a national level. It is important to emphasize that Article 3 of the same ordinance provides that it is the responsibility of municipal, district, and state managers of the National Health System (SUS) to structure the assistance network for cancer patients, defining referral services, as well as establishing care workflows at all stages of healthcare.[4].

Moreover, the National Oral Health Policy (PNSB), instituted in 2004, also known as *Brasil Sorridente* [Smiling Brazil], represents an important milestone in Brazilian oral health, since it amplified population access to dental services and care at all assistance levels of SUS[5]. One of the greatest achievements of the policy is amplifying the oral health teams in Primary Healthcare (PHC), access to Mobile Dental Units (MDU), water fluoridation, and implementation of Dental Specialties Centers (DSC), setting early diagnosis of oral cancer as a priority[5,6]. In 2023, Law 14,572/23[7] was sanctioned, instituting PNSB in the SUS organic law to include oral healthcare within the scope of SUS, which made PNSB a State policy and a mandatory component of public healthcare actions in Brazil.

Regarding care within the SUS scope, PHC is the main entryway to medical and dental assistance[5,8], having an essential and central character in identifying and following up with patients with risk factors for head and neck cancer[4], and secondary care, in oral cancer early diagnosis and quick and appropriate referral to specialized medical care[4,6]. Regarding the suspicion of malignancy and later diagnostic confirmation, the Brazilian legislation sets maximum deadlines for patients to receive oncological care. Law N. 13,896[9], of October 30, 2019, establishes that the necessary tests to confirm cancer diagnosis must be done within the maximum deadline of 30 days after the doctor requires it. Additionally, Law N. 12,732[10], of November 22, 2012, establishes that the first treatment of patients with proven malignant neoplasms must be initiated within 60 days of the signing and issuance of the anatomopathological report.

Furthermore, the National Cancer Prevention and Control Policy, through Ordinance MS N. 874/2013[11], as well as the aforementioned ordinance that establishes guidelines for head and neck cancer[4] (Ordinance-MS N. 516/2015[12]), establishes that patients with cancer diagnosis must receive comprehensive care, in a decentralized and regionalized manner, and must be preferably assisted in appropriate healthcare units, like High-Complexity Oncology Centers (Cacon) or High-Complexity Oncology Units (Unacon), which have the whole technological apparatus and specialized teams for diagnosis, treatment, and follow-up. In case patients are assisted in general hospitals, these must work with reference and contra-reference services in technical cooperation with hospitals that have oncology and radiotherapy services[4,13]. The reality of public healthcare in Brazil is still contrasting, with challenges in access to diagnostic and therapeutic services, which reduces the quality and expectation of life of patients. Among these, the low specialized assistance coverage to patients in States with fewer licensed centers or units, mainly due to the need for patients to travel long distances to receive assistance, which impairs diagnosis and treatment, in addition to low dental care coverage in PHC[5].

Dental coverage assistance in primary care, in December 2020, consisted of 56.11% oral health teams (44.95% coverage in Family Health Strategy). In the State of Ceará, data from Primary Care e-Gestor indicates approximately 70% coverage of oral health teams, a number lower than the coverage of Family Health teams in the State, which emphasizes a possible limitation in the offer of dental care at the primary care level[14].

Regarding the Family Health teams, the coverage was 76.08% (63.62% in Family Health Strategy), according to data from Primary Healthcare e-Gestor[14]. Regarding secondary care in oral healthcare, Brazil had, in 2023, 1,185 DSC distributed across the national territory[14]. In the State of Ceará, the coverage of oral health teams is approximately 70%, a number lower than the coverage of Family Health teams in the State[15].

Regarding assistance provided to oncological patients, based on a survey conducted in 2022 by the National Cancer Institute (INCA), Brazil has 317 units and centers dedicated to the care of oncology patients, with at least one oncology-enabled hospital in every Brazilian State[12]. In Ceará, there are nine specialized centers (either Cacon

or Unacon) for oncological treatment, of which seven are in Fortaleza, one in Barbalha, and another in Sobral[12,13].

Given this scenario, it is clear that there is still a disproportionate amount of dental care in primary health care, as well as low coverage of specialized dental care, which can directly impact the monitoring of risk factors and the early diagnosis of oral cancer. Additionally, there is low coverage of specialized medical assistance provided to oncological patients[6]. In this context, it is possible to visualize that, despite Brazil having amplified medical and dental care within SUS, there is still low assistance coverage, which results in people traveling farther to receive care, and consequently, barriers to cancer diagnosis and treatment, which is a very relevant factor, since late diagnoses lead to worse prognoses or mutilating treatments[10,16].

Given the complexity of oncological treatment and the relevance of the theme, it is fundamental to analyze the access of oral cancer patients to the SUS's healthcare services, since the success of oncological treatment, in addition to early detection, needs a comprehensive, transdisciplinary care network that involves several healthcare professionals and different assistance levels. In this context, the present study aims to analyze the diagnosis records and time between histopathological diagnosis and start of oral cancer treatment in the State of Ceará between 2017 and 2023, as well as describe its distribution according to sociodemographic characteristics and the State's health regions.

METHOD

Ecological time series study, based on secondary public domain data, which analyzed aggregated records of oral cancer cases in the State of Ceará between 2017 and 2023. The study's objective is to analyze the epidemiological behavior of oral cancer in the State of Ceará between 2017 and 2023, including sociodemographic variables, month of diagnosis, time to treatment start, and distribution across health regions.

Data was collected from the Oncology Panel, a public platform from the Department of Informatics of SUS (DATASUS), which gathers information from different healthcare information systems, including the SUS Ambulatory Information System (SIA[17]/SUS), the SUS Hospital Information System (SIH[18]/SUS), and the Cancer Information System (Siscan[19]). This platform was developed by the Ministry of Health to monitor access to diagnosis and oncological treatment in the country, especially regarding the enforcement of Law N. 12,732[9]/2012, which established a maximum deadline for the treatment start of patients with malignant neoplasms at SUS. Data can be consulted on the TABNET website[20].

The study included all the records of oral cavity malignant neoplasms classified according to the 10th Review of the International Classification of Diseases and Related Health Problems (ICD-10[21]) codes C00 to C06, diagnosed between January 2017 and December 2023, in individuals living in the State of Ceará and registered in the official SUS systems. The study excluded records with time inconsistencies (such as date of treatment prior to diagnosis date), duplicities identified on the base and classified out of the anatomical scope of the oral cavity.

DATASUS compiles data from procedures conducted within SUS by public or private services, representing a national base of care records. The Oncology Panel was developed to monitor the effectiveness of Law N. 12,732[9]/2012, which establishes maximum deadlines for the treatment start of proven malignant tumors. In it, the variable "diagnosis" corresponds to the date of record of the confirmed histopathological report. The variable "treatment" refers to the start date of the first recorded therapeutic modality (surgery, chemotherapy, or radiotherapy). Time to treatment start was considered the interval between these two dates, being categorized according to the current legal criteria: within 30 days, 31 to 60 days, and after 60 days.

Data extraction was conducted on the DATASUS TABNET[20] interface, with the files exported in CSV format. Then, the data was consolidated in electronic spreadsheets consistency verification, identification of duplicities, standardization of categories, and organization of variables per year and health region.

Socio-demographic variables were collected, including sex (male and female), age group (0–24 years, 25–34 years, 35–44 years, 45–54 years, 55–64 years, 65–74 years, and 75 years or older) and health regions of the State of Ceará (1st Region – Fortaleza; 2nd Region – Cariri; 3rd Region – *Sertão Central*; 4th Region – *Litoral Leste*/Jaguaribe; 5th Region – Sobral). Clinical and assistance variables related to oral cancer were also collected, including anatomical tumor site according to ICD-10 (C00 – lip; C01–C02 – tongue; C03 – gum; C04 – floor of mouth; C05 – palate; C06 – other parts of the mouth), initial therapeutic modality recorded, month of diagnosis (January through December) and time to treatment start, categorized in within 30 days, 31 to 60 days, and after 60 days.

Time to treatment start was categorized into within 30 days, 31 to 60 days, and after 60 days, considering the interval between the histopathological diagnosis and oncology treatment start. Records classified as "no information' were kept in the descriptive analysis but excluded from the inferential analyses when applicable. Missing data were not input.

The data were expressed in absolute and percentage frequency and associated with the other variables using

Fisher's exact test[22] or Pearson's chi-square test[23] in the SPSS software[24] version 20.0 for Windows, adopting a 95% confidence interval.

Comparison between proportions throughout the years was conducted using Pearson's chi-square test. Fisher's exact test was applied when the frequencies expected in at least one cell of the contingency table were lower than five. A significance level of 5% was adopted (p<0.05).

Additionally, a regression model was made to correlate the number of cases with the period studied in each analyzed category.

To illustrate the number of diagnoses per health region, intensity maps were drawn in the Qgis[25] software, version 3.34 LTR. Territorial meshes of the State of Ceará were collected from the Brazilian Institute of Geography and Statistics (IBGE) website and exported to the software. Then, color grading was applied to health regions, representing the percentage value of the number of diagnoses per year and region (Figure 1), ranging from white to black, with white representing 0 and black 100%.

The information utilized comes from public databases, with unrestricted access, and no individuals are identified by name. As this is a study that used secondary data in public domain, with no identification of participants, there was no need for approval of a Research Ethics Committee, according to the National Health Council Resolution N. 510/2016[26].

RESULTS

The number of cases diagnosed in male individuals was significantly higher than those in females in every year analyzed (p=0.004). In 2021, there was a proportional alternation in the distribution of sexes, with the relative increase of female participation, when compared to other years (Table 1).

However, it was possible to observe from 2022 onwards that the number of cases diagnosed in women went back to the frequently observed threshold (Table 1). Regarding the age profile of patients, as well as the health regions assessed, no statistically significant differences were observed in the annual distribution of diagnoses (p=0.137) (Table 1).

Regarding the age profile of patients and the distribution of health regions, no statistically significant differences were observed in the annual distribution of diagnoses (p=0.137) (Tables 1 and 3). However, the 1st health region (Fortaleza) concentrated the greatest proportion of diagnoses throughout the period analyzed, representing approximately half the cases recorded in the State. On the other hand, the lower proportion was observed in the 3rd (*Sertão Central*) and 4th health regions (*Litoral Leste*/Jaguaribe) (Table 3).

There was a significant reduction in the proportion of cases classified as stage IV within the 2017–2022 period compared with 2023 (p<0.001). There was also significant variation in the distribution of time to treatment start

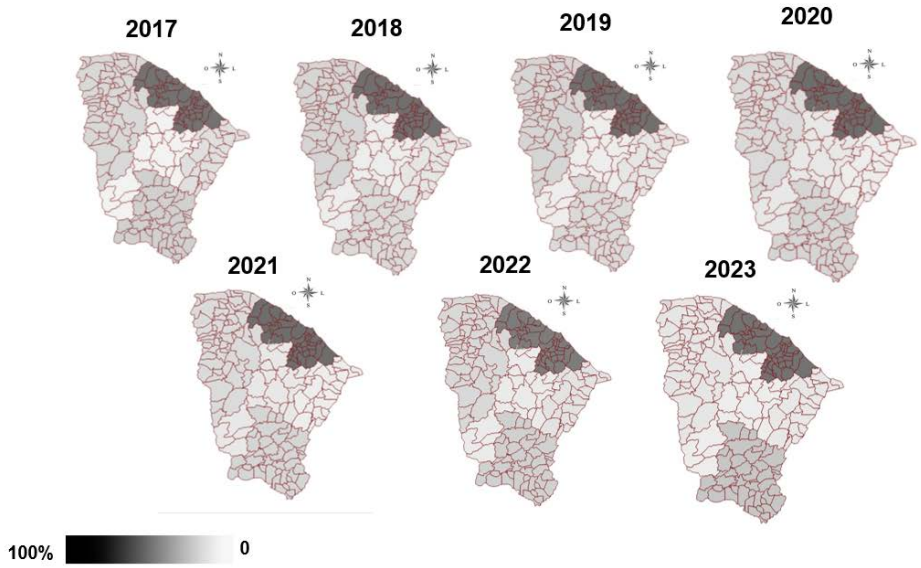

Figure 1. Percentage of oral cancer diagnoses per health regions of the State of Ceará, 2017 to 2023
Source: Oncology Panel/DATASUS.
Note: The maps represent the percentage distribution of recorded diagnoses in each health region in relation to the annual total of cases in the State. The scale ranges from 0% to 100%, with the darker tones indicating a higher relative proportion of records in the respective year. This is a descriptive cartographic representation, with no application of inferential spatial analysis. Territorial meshes obtained from the Brazilian Institute of Geography and Statistics (IBGE).

across the analyzed years (p<0.001), with an increased frequency of cases treated within 30 days in 2020 (43.3%). In the following years (2021 to 2023), this proportion presented a progressive reduction (Table 2).

Regarding the frequency of treatments initiated after 60 days of diagnosis, it was possible to observe that, between 2017 and 2019, there was a higher proportion of cases with treatment starting after 60 days, when compared to 2020. In the years 2022 and 2023, there was a new proportional increase in treatments started after 60 days (Table 2).

There was variation in the monthly distribution of diagnoses throughout the analyzed period (p<0.001). In August 2017 (31 cases – 12%), in May 2018 (32 cases – 10.4%), and in February 2019 (39 cases – 12.6%), single peaks were recorded in the number of diagnoses. Between 2020 and 2023, there was a higher proportional concentration of cases in September when compared to the same period between 2017 and 2019 (Table 3).

In 2017, the number of diagnoses with unspecified locations was not proportionally higher in comparison to the other years. In 2018, there was an increase in the number of diagnoses classified as other parts of tongue, unspecified. Regarding the number of cases whose location was the floor of mouth, there was a proportional increase between 2020 and 2023 (Table 4).

There was a significant positive correlation between the number of cases in the period with patients aged 35-44 years (p=0.037). Sex and other age groups did not show a significant increase (Table 1). There was a significant positive correlation between the number of cases in the period and stage 0 (p=0.021) and time to treatment start longer than 60 days (p=0.041) (Table 2). The month of diagnosis and region did not individually show a significant positive correlation with the number of cases in the period (Table 4), but the palate cases demonstrated a significant negative correlation throughout the studied period (p=0.001).

DISCUSSION

The present study analyzed the epidemiological and spatial distribution of oral cancer in the State of Ceará between 2017 and 2023, showing a predominance of cases in the male sex, higher concentration in individuals aged 55 years or older, high frequency of diagnoses in advanced stages, and temporal variations in the interval between histopathological diagnosis and oncological treatment start.

The male predominance observed throughout the period is in line with the national literature, which points to a greater historical exposure of men to risk factors, such as smoking and alcohol intake, in addition to lower adherence to preventive actions and seeking out healthcare services[27]. The maintenance of this pattern across the historical series suggests stability in the disease's epidemiological profile in the State, with no structural changes observed in the distribution by sex in the studied period.

Regarding tumoral staging, there was a high proportion of cases diagnosed in stages III and IV, reinforcing previously described findings from Brazilian studies[10,27]. Although a proportional reduction of cases in stage IV has been identified in 2023, such a finding must be interpreted with caution, since annual oscillations may reflect variations in the information recording or in the reorganization of care flows, especially in the post-pandemic context.

It must be considered that, from 2018 onwards, including the ICD-10 code in anatomopathological reports became mandatory in Brazil, which may have contributed to improvements in the standardization and recording of anatomical tumor sites throughout the analyzed time series.

Regarding the interval between diagnosis and treatment start, there was significant variation across the analyzed period, with an increase in the proportion of cases treated within 30 days in 2020 and a subsequent increase in the treatments initiated after 60 days of diagnosis in 2022 and 2023. França et al. demonstrated that, after the implementation of Law N. 12,732/2012[9], there was a progressive increase in the proportion of cases treated within the legal deadline in Brazil[27]. The results of the present study partially align with this trend but reveal a temporal instability that might reflect specific organizational and contextual factors of the analyzed period.

It must be noted that the data consulted refers exclusively to the interval between the histopathological diagnosis date recorded in the system and the oncological treatment start. Thus, it was not possible to assess the time elapsed between the initial clinical suspicion and diagnostic confirmation, which impairs inferring about the diagnosis delay itself. This distinction is essential to the appropriate interpretation of the findings.

It must also be considered that the information referring to tumoral staging available at the Oncology Panel is mainly associated with cases treated with chemotherapy and radiotherapy. Therefore, these records tend to include a higher proportion of patients with more advanced disease stages, since tumors in initial stages are often exclusively treated with surgery and may not be fully represented in the consulted database. Thus, the results related to staging must be interpreted with caution, due to the possible selection bias inherent in the information system.

Table 1. Number of oral cancer cases diagnosed per year related to sex and age

	Year								Correlation with the period		
	2017	2018	2019	2020	2021	2022	2023	*p*	*p*	r	95% CI
Sex											
Masc.	**185 (71.4%)**	**234 (75.2%)**	**217 (70.2%)**	**263 (72.5%)**	74 (56.9%)	**249 (73.0%)**	**225 (76.0%)**	**0.004**	0.986	0.008	-0.7495 to 0.7568
Fem.	74 (28.6%)	77 (24.8%)	92 (29.8%)	100 (27.5%)	**56 (43.1%)**	92 (27.0%)	71 (24.0%)		0.871	-0.076	-0.7843 to 0.7183
Age											
0-24	0 (0.0%)	3 (1.0%)	2 (0.6%)	4 (1.1%)	1 (0.3%)	0 (0.0%)	4 (1.4%)	0.137	0.631	0.223	-0.6374 to 0.8357
25-34	3 (1.2%)	6 (1.9%)	7 (2.3%)	3 (0.8%)	10 (2.7%)	12 (3.5%)	10 (3.4%)		**0.037**	**0.783**	**0.07362 to 0.9664**
35-44	19 (7.3%)	23 (7.4%)	26 (8.4%)	32 (8.8%)	19 (5.1%)	23 (6.7%)	24 (8.1%)		0.767	0.138	-0.6863 to 0.8074
45-54	60 (23.2%)	55 (17.7%)	49 (15.9%)	66 (18.2%)	81 (21.8%)	66 (19.4%)	43 (14.5%)		0.969	0.018	-0.7451 to 0.7610
55-64	80 (30.9%)	110 (35.4%)	96 (31.1%)	101 (27.8%)	102 (27.4%)	113 (33.1%)	91 (30.7%)		0.502	0.308	-0.5799 to 0.8613
65-74	56 (21.6%)	59 (19.0%)	77 (24.9%)	86 (23.7%)	98 (26.3%)	70 (20.5%)	65 (22.0%)		0.431	0.358	-0.5413 to 0.8751
75+	41 (15.8%)	55 (17.7%)	52 (16.8%)	71 (19.6%)	61 (16.4%)	57 (16.7%)	59 (19.9%)		0.185	0.566	-0.3257 to 0.9250

Captions: **p*<0.05, Pearson's Chi-square test (n, %); 95% CI = 95% confidence interval.

Table 2. Tumoral staging and time of treatment (year)

	Year								Correlation with the period		
	2017	2018	2019	2020	2021	2022	2023	*p*	*p*	r	95% CI
Staging											
Stage 0	1 (0.4%)	1 (0.4%)	7 (3.1%)	13 (5.4%)	13 (5.0%)	10 (4.3%)	12 (5.6%)	**<0.001**	**0.021**	**0.829**	**0.2018 to 0.9740**
Stage 1	5 (2.0%)	5 (2.0%)	6 (2.6%)	15 (6.3%)	8 (3.1%)	12 (5.2%)	11 (5.1%)		0.097	0.674	-0.1606 to 0.9466
Stage 2	44 (17.5%)	28 (11.4%)	30 (13.1%)	16 (6.7%)	23 (8.9%)	28 (12.1%)	23 (10.6%)		0.136	-0.622	-0.9365 to 0.2461
Stage 3	82 (32.5%)	98 (39.8%)	89 (38.9%)	88 (36.7%)	94 (36.3%)	85 (36.8%)	**95 (44.0%)**		0.602	0.241	-0.6256 to 0.8415
Stage 4	**120 (47.6%)**	**114 (46.3%)**	**97 (42.4%)**	**108 (45.0%)**	**121 (46.7%)**	**96 (41.6%)**	75 (34.7%)		0.085	-0.692	-0.9499 to 0.1286
Time to treatment start											
Within 30 days	42 (16.2%)	97 (31.2%)	98 (31.7%)	**157 (43.3%)**	**129 (34.7%)**	**121 (35.5%)**	**85 (28.7%)**	**<0.001**	0.324	0.439	-0.4692 to 0.8960
31 to 60 days	71 (27.4%)	56 (18.0%)	56 (18.1%)	67 (18.5%)	69 (18.5%)	45 (13.2%)	28 (9.5%)		0.085	-0.692	-0.9500 to 0.1276
After 60 days	**146 (56.4%)**	**158 (50.8%)**	**155 (50.2%)**	139 (38.3%)	174 (46.8%)	175 (51.3%)	183 (61.8%)		**0.041**	**0.774**	**0.05099 to 0.9648**

Captions: **p*<0.05, Pearson's Chi-square test (n, %); 95% CI = 95% confidence interval.

Table 3. Number of cases diagnosed per month/year and region

	Year								Correlation with the period		
	2017	2018	2019	2020	2021	2022	2023	*p*	*p*	r	95% CI
Month of diagnosis											
January	21 (8.1%)	12 (3.9%)	31 (10.0%)	28 (7.7%)	27 (7.3%)	30 (8.9%)	32 (10.8%)	**<0.001**	0.076	0.706	-0.1010 to 0.9526
February	17 (6.6%)	24 (7.8%)	**39 (12.6%)**	24 (6.6%)	21 (5.6%)	20 (5.9%)	28 (9.5%)		0.873	0.075	-0.7188 to 0.7839
March	16 (6.2%)	28 (9.1%)	17 (5.5%)	35 (9.6%)	30 (8.1%)	36 (10.7%)	29 (9.8%)		0.107	0.660	-0.1857 to 0.9439
April	24 (9.3%)	15 (4.9%)	26 (8.4%)	18 (5.0%)	20 (5.4%)	24 (7.1%)	28 (9.5%)		0.375	0.400	-0.5058 to 0.8861
May	24 (9.3%)	**32 (10.4%)**	19 (6.1%)	16 (4.4%)	31 (8.3%)	27 (8.0%)	27 (9.1%)		0.759	0.143	-0.6837 to 0.8091
June	24 (9.3%)	26 (8.5%)	18 (5.8%)	30 (8.3%)	25 (6.7%)	34 (10.1%)	21 (7.1%)		0.664	0.202	-0.6501 to 0.8290
July	14 (5.4%)	39 (12.7%)	21 (6.8%)	40 (11.0%)	44 (11.8%)	26 (7.7%)	17 (5.7%)		0.935	0.038	-0.7362 to 0.7692
August	**31 (12.0%)**	33 (10.7%)	35 (11.3%)	33 (9.1%)	46 (12.4%)	24 (7.1%)	27 (9.1%)		0.652	-0.210	-0.8315 to 0.6454
September	22 (8.5%)	19 (6.2%)	22 (7.1%)	38 (10.5%)	34 (9.1%)	34 (10.1%)	24 (8.1%)		0.262	0.492	-0.4147 to 0.9085
October	25 (9.7%)	30 (9.8%)	37 (12.0%)	38 (10.5%)	29 (7.8%)	30 (8.9%)	15 (5.1%)		0.402	-0.379	-0.8808 to 0.5236
November	18 (7.0%)	20 (6.5%)	24 (7.8%)	32 (8.8%)	36 (9.7%)	27 (8.0%)	29 (9.8%)		0.075	0.708	-0.09590 to 0.9531
December	22 (0.0%)	29 (0.0%)	20 (0.0%)	31 (0.0%)	29 (0.0%)	26 (0.0%)	19 (0.0%)		0.837	-0.096	-0.7920 to 0.7083
Region											
1st HR Fortaleza	142 (54.8%)	172 (55.3%)	155 (50.2%)	205 (56.5%)	208 (55.9%)	133 (50.6%)	162 (54.7%)	0.297	0.843	0.093	-0.7100 to 0.7907
2nd HR Cariri	45 (17.4%)	42 (13.5%)	59 (19.1%)	55 (15.2%)	61 (16.4%)	46 (17.5%)	63 (21.3%)		0.174	0.578	-0.3103 to 0.9274
3rd HR Sertão Central	15 (5.8%)	20 (6.4%)	27 (8.7%)	31 (8.5%)	34 (9.1%)	19 (7.2%)	20 (6.8%)		0.636	0.220	-0.6391 to 0.8348
4th HR Litoral Leste/Jaguaribe	18 (6.9%)	29 (9.3%)	20 (6.5%)	24 (6.6%)	22 (5.9%)	28 (10.6%)	24 (8.1%)		0.445	0.348	-0.5493 to 0.8724
5th HR Sobral	39 (15.1%)	48 (15.4%)	48 (15.5%)	48 (13.2%)	47 (12.6%)	37 (14.1%)	27 (9.1%)		0.188	-0.563	-0.9243 to 0.3300

Captions: **p*<0.05, Pearson's Chi-square test (n, %); 95% CI = 95% confidence interval; HR = Health Region.

Table 4. Diagnoses of oral cavity neoplasms per anatomical site, across different years

	Year								Correlation with the period		
	2017	2018	2019	2020	2021	2022	2023	*p*	*p*	r	95% CI
Anatomical site											
C00 - Lip	7 (2.7%)	12 (3.9%)	37 (12.0%)	53 (14.6%)	49 (13.2%)	40 (11.7%)	25 (8.4%)	**<0.001**	0.221	0.530	-0.3715 to 0.9171
C01 - Base of tongue	47 (18.1%)	58 (18.8%)	51 (16.5%)	64 (17.6%)	84 (22.6%)	67 (19.6%)	69 (23.3%)		0.063	0.729	-0.05267 to 0.9569
C02 - Other and unspecified parts of tongue	73 (28.2%)	**111 (35.9%)**	96 (31.1%)	103 (28.4%)	99 (26.6%)	105 (30.8%)	77 (26.0%)		0.973	0.016	-0.7461 to 0.7600
C03 - Gum	3 (1.2%)	9 (2.9%)	12 (3.9%)	19 (5.2%)	8 (2.2%)	9 (2.6%)	7 (2.4%)		0.791	0.124	-0.6938 to 0.8024
C04 - Floor of mouth	33 (12.7%)	38 (14.7%)	39 (15.1%)	**50 (19.3%)**	**50 (19.3%)**	**48 (18.5%)**	**41 (15.8%)**		0.125	0.636	-0.2255 to 0.9392
C05 - Neoplasm of palate	42 (16.2%)	40 (12.9%)	34 (11.0%)	31 (8.5%)	32 (8.6%)	21 (6.2%)	22 (7.4%)		0.001	-0.958	-0.9939 to -0.7336
C06 - Other and unspecified parts of mouth	**54 (20.8%)**	41 (13.3%)	40 (12.9%)	43 (11.8%)	50 (13.4%)	51 (15.0%)	55 (18.6%)		0.366	0.406	-0.4997 to 0.8878

Captions: **p*<0.05, Pearson's Chi-square test (n, %); 95% CI = 95% confidence interval.

De-Carli[12] et al. identified an increase in the waiting time for biopsies at the DSCs, in addition to structural limitations related to the working hours of professionals and organization of services. These findings suggest that assistance gaps may occur in steps before the record is entered into the oncological system, reinforcing the need for caution when interpreting indicators of time to treatment start based exclusively on aggregated secondary data.

Regarding regional distribution, there was a higher proportional concentration of diagnoses in the Fortaleza region, with no statistically significant differences between Health Regions. This concentration may be associated with the greater offer of specialized services in the capital or centralization of assistance records; however, the aggregated data may not distinguish between patients' place of residence and treatment location, limiting conclusions on the possible incidence of regional inequalities.

The monthly analysis showed individualized variations in the frequency of diagnoses throughout the time series, with no consistent seasonal pattern identified. Although awareness campaigns may influence the search for healthcare services, it is not possible to establish a statistically significant association between specific actions and an increase in diagnoses based on the available data.

Regarding anatomical location, there was a predominance of records classified as other parts of tongue, unspecified, in addition to a proportional increase of diagnoses in the floor of mouth from 2020 onwards. The national literature suggests tongue as the main anatomical site afflicted by oral cancer[27], which is in line with the findings from this study. However, the high frequency of unspecified classifications may indicate limitations in record completion, which must be considered in data interpretation.

This study presents limitations inherent in the use of aggregated secondary data from DATASUS, subject to record inconsistencies, under-reporting, and a lack of detailed clinical variables. Moreover, due to its ecological nature, it is not possible to establish causal relationships or make inferences at an individual level. The lack of specific statistical methods for a formal time trend analysis limits the robustness of conclusions about the changes throughout the analyzed period.

Despite its limitations, the results contribute to understanding the epidemiological profile of oral cancer in the State of Ceará and provide subsidies for regional planning of cancer care and for monitoring healthcare indicators within the SUS.

CONCLUSION

The present study showed a predominance of oral cancer cases in men and individuals aged 55 years or older, a high frequency of diagnoses at advanced stages, and variations in the interval between the histopathological diagnosis and treatment start in the State of Ceará between 2017 and 2023. The observed instability in time to treatment start reinforces the need for continuous monitoring of assistance indicators, especially regarding compliance with the legal deadlines established for oncology treatment start.

The findings reveal the importance of strengthening early diagnosis strategies and improving systematic follow-up of care pathways within SUS, integrating primary care, specialized services, and state regulation. The implementation of structured surveillance mechanisms, based on official information systems, may contribute to the regional planning of cancer care, as long as it is based on a standardized, temporal, and spatial analysis methodology.

Given the ecological nature of the present study and its use of aggregated secondary data, it was not possible to make causal inferences or assess the individual care journeys, for which further analytical studies are necessary to deepen the understanding of the observed temporal variations.

CONTRIBUTIONS

Janderson Fernando da Silva, Weslley Nilson Oliveira de Sousa, Lucas de Farias Gomes, and Jennifer Vianna Barbosa have substantially contributed to the study design and planning; data collection, analysis, and interpretation; and wording. Ana Mirian da Silva Cavalcante and Maria Clara Holanda Delfino Aragão have substantially contributed to the study design and planning; data collection, analysis, and interpretation. Thinali Sousa Dantas, Fabrício Bitu Sousa, and Paulo Goberlânio de Barros Silva have substantially contributed to study design and planning; 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

Data was collected from the SUS Ambulatory Information System (SIA), through the Individualized Ambulatorial Production Report (BPA-I) and the High-Complexity Procedure Authorization; Hospital Information System (SIH); Cancer Information System (SISCAN), through access to the Oncology Panel of the Department of Informatics of SUS (DATASUS), and

may be consulted on the website: <http://tabnet.datasus.gov.br/cgi/dhdat.exe?PAINEL_ONCO/PAINEL_ONCOLOGIABR.def>.

FUNDING SOURCES

None.

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Recebido em 3/12/2025
Aprovado em 23/3/2026

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Scientific-editor: Anke Bergmann. Orcid iD: https://orcid.org/0000-0002-1972-8777