Oral cancer mortality and factors associated in the state of Ceara, Brazil, 2009-2019: a spatial analysis

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Abstract *The study aimed to analyze the spatial distribution and factors associated with oral cancer mortality in the 2009-2019 period in the municipalities of Ceará, Brazil. This ecological study of oral cancer deaths used distribution analysis, autocorrelation, and spatial regression. The oral cancer mortality rate has spatial autocorrelation. In the geographically weighted regression analysis, a negative relationship was observed between mortality and the number of households with access to the sewage system (β = -0.001) and the mean number of people per household (β = -5.947). We observed a positive relationship between mortality and percentage of oral health coverage in Primary Health Care (β = 0.021), number of people living in the rural area of the municipality (β = 0.0001), Municipal Human Development Index (β = 40.417), and aging rate (β = 1.169). We can conclude that the influence on the mortality risk showed spatial clusters that require priority in public policies that impact oral cancer morbimortality.*

Key words *Mouth neoplasms, Socioeconomic factors, Spatial analysis*

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Introduction

The COVID-19 pandemic caused different repercussions in the context of people's lives. Millions of individuals have been affected by the new Coronavirus worldwide. Others died or were at risk of being contaminated by different predispositions. A significant increase in psychological distress and symptoms and mental disorders of various people are estimated due to the setting experienced[1]. The World Health Organization (WHO) estimates that the global prevalence of anxiety and depression increased by 25%[2] with the COVID-19 pandemic. Fear, concern, and stress are normal and understandable reactions to threats, uncertainties, or the unknown, but these behaviors were exacerbated in this context[3].

The world has been experiencing enormous, sudden transformations in the last two years since everyone's daily life has changed, and it was necessary to adapt quickly to the new way of living. Besides controlling the fear of getting sick, the trauma of losing loved ones with the new Coronavirus, and the uncertainty about the short and long-term consequences, people suffered now from unemployment, poverty, and food insecurity, triggering mental health implications[4,5]. The main measures adopted by health authorities to reduce new cases, such as distancing and social isolation, caused significant changes in people's home and work routines. They also escalated social inequalities and facilitated the emergence or the complications from other diseases due to care discontinuity[6].

Currently, the global COVID-19 epidemiological situation is losing strength. Although the Brazilian government declared the end of the Public Health Emergency of National Importance (ESPIN)[7], the WHO maintained the international health emergency related to the coronavirus due to the very heterogeneous vaccination coverage between countries and the unpredictable behavior of the virus in the global pandemic context[6]. The reflection of this setting persists, and all the damage caused by COVID-19 is still unclear. However, the increased burden of mental health problems can be considered one of the most important long-term effects of the pandemic[8].

Evidence shows that the implications for mental health may last longer and be more prevalent than the pandemic itself and that the psychosocial and economic repercussions may be unpredictable, considering their amplitude in different contexts[4,9]. Thus, we observe a possible increase in the prevalence of suspected common mental disorders (CMD) among health professionals, particularly community health workers.

In occupational health, frontline health professionals dramatically impacted their routines. Regardless of the personal risk, they were directly involved in coping with the pandemic, forced to make hard decisions and work under unprecedented pressure. COVID-19-related concerns and fears contributed to more significant psychological distress, affecting symptoms of stress, increasing anxiety and depression, and increasing the likelihood of developing mental health disorders[10,11]. From this perspective, primary health care (PHC) professionals, operationalized by the Family Health Strategy (ESF), such as community health workers (ACS), were impacted differently[12,13].

The ACS play a relevant role in healthcare, favoring access to health services, mediating in the construction of bonds between families and the ESF/PHC teams, conducting home visits, and providing guidance and support in resolving demands with health team members. The ACS performance improves health outcomes in various conditions and contexts[14], which denotes the relevance of these professionals in coping with COVID-19[13]. Mental health is essential for fully developing health promotion and care actions. However, these professionals are subject to territorial challenges, and their characteristics before and during the pandemic, such as violence, can influence their community work process and mental health[12,15].

The structural and social conditions of the territories of large urban centers are today settings of enormous social vulnerability. The provision of services and health actions must be available among PHC Units (UBS) and the different community arrangements. In these settings, this premise exposes the ACS to constant violence, food insecurity, and unemployment, among other conditions of extreme inequality experienced by the communities assisted by the Unified Health System (SUS). Thus, this whole situation of social vulnerability in the territory can adversely affect their mental health and quality of life, which may have been aggravated in the COVID-19 pandemic context[12,16].

Thus, it is strategic to investigate the repercussions of continued exposure to these factors to measure their perceptions and ability to balance and manage their emotions to support the implementation of public policies to improve health and the qualification of the ACS work process. With this prerogative, this study aimed to analyze

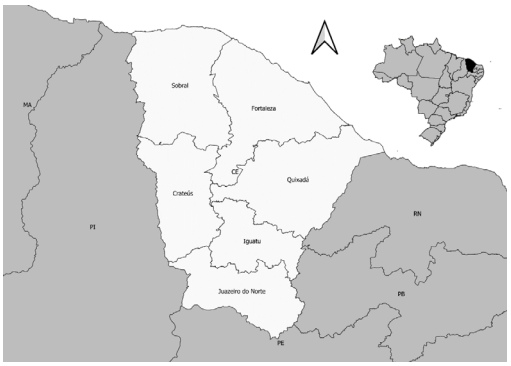

Figure 1. Location of the state of Ceará in Brazil.

Source: Authors.

the factors related to the mental health of ACS in the COVID-19 context in different settings.

Methods

This multicenter, cross-sectional study was conducted in four northeastern Brazilian capitals, namely, Fortaleza-Ceará, João Pessoa-Paraíba, Recife-Pernambuco, and Teresina-Piauí, and four cities in the inland region of Ceará, Crato, Juazeiro, Barbalha, and Sobral. The study population involved PHC workers working with community health workers (ACS). According to data from the e-manager system of the Ministry of Health, referring to 2020, 7,909 ACS were working in the municipalities[17].

The simple random sample calculation was performed for each municipality based on a sampling error of 5%, a confidence level of 95%, and homogeneous distribution (80/20) of the studied population, totaling a sample of 1,935 ACS. These professionals were drawn and invited to participate in the research, considering the following inclusion criteria: ACS active in the work process; and as exclusion criteria: ACS on vacation or sick leave. For the present study, we decided to analyze the data by capitals and inland region cities, understanding that this design helps to understand the mental health-related dynamics (measured by the Self-Reporting Questionnaire – SRQ20) in these two realities.

Data collection

A single training of the collection team was conducted to ensure standardized data collection in all cities. Initially, theoretical aspects of the research project, quantitative data collection, biosafety protocol, human research ethical aspects, data collection instrument, and finally, the definition of roles in the collection process were discussed: collector, field coordinator, and supervisor, based on the simulation technique (role play). This step was completed with the data collection planning. The process was conducted by professionals with expertise in the area, totaling 12 hours.

Previous authorization for data collection was agreed upon with the municipal managers to conduct the research. Thus, scheduling the most convenient day and time for applying the questionnaire at the family health units was facilitated. Data were collected in a private room, and the study objectives and informed consent forms were initially presented, from April to August 2021 and strictly followed all the biosafety standards determined by Technical Note GVIM/GGTES/ANVISA N° 04/202018. Then, the instrument was applied with the presence of the collector to resolve doubts.

The instrument used contained sociodemographic data; professional; SRQ-20 - Self-Reporting Questionnaire-20 (mental health); WHOQOL-Bref – World Health Organization Quality of Life Questionnaire (Quality of life), exposure to violence (saw/knew or experienced violence), Overall Self-Efficacy Score (Balsan et al. 2020), the Multidimensional Scale of Perceived Social Support-MSPSS, and COVID-19-related information, including the Coronavirus Anxiety Scale.

The WHO developed the SRQ-20 for questions related to psycho-emotional symptoms. It has been used to measure the level of suspected common mental disorders (CMD) in Brazilian studies, especially in groups of workers. It is an important screening tool for mental health, adopting a cutoff > 7[19].

The WHOQOL-Bref is an instrument used to assess the quality of life (QoL), divided into four domains: physical, psychological, social relationships, and environment[20,21]. The Coronavirus Anxiety Scale is a short scale to screen COVID-19-related anxiety[22], where higher scores refer to more significant anxiety.

The general self-efficacy scale[23] was adopted to measure the ACS' self-efficacy. Individuals with a higher perception of self-efficacy knowingly have a greater ability to control stressful events and determination when resolving these situations, regardless of the type of problem. Furthermore, we also employed the Multidimensional Scale of Perceived Social Support (MSPSS), developed by Zimet et al.[24]. Support or social support can be

understood as the social resources that people perceive as available or actually provided, which are related to the health outcomes of individuals.

Data analysis

Data were analyzed using the R software. The absolute and relative frequencies of nominal variables, quantitative variables' mean and standard deviation, and 95% confidence intervals were estimated to describe the sample characteristics. Statistical tests were applied, considering a significance level of 5%. With the SRQ-20 score as the outcome, multiple linear regression analyses were performed using the backward variable selection method, via the Akaike Information Criterion (AIC), as the model's exploratory character. We decided to perform three different analyses: the first considering the ACS of all cities; the second only for the capitals; and the last with the inland region municipalities of Ceará.

Ethical aspects

The Ethics Committee of the State University of Ceará approved this research under Opinion n° 4.587.955. The ACS who agreed to participate in the research signed the consent form before answering the questionnaire.

Results

A total of 1,935 Community Health Workers (ACS) answered the questionnaire in the eight cities surveyed: Fortaleza-CE (N = 364), João Pessoa-PB (N = 303), Recife-PE (N = 320), Teresina-PI (N = 309), Sobral-CE (N = 203), Juazeiro do Norte-CE (N = 215), Crato-CE (N = 127), and Barbalha-CE (N = 93).

In Table 1, we can observe the frequency analysis result for the sociodemographic variables of the participants and those related to the work performed by the ACS. In general terms, most participants are female (82.76%), with a mean age of 46 years, without a partner (58.2%), with children (81.0%), Catholic (65.8%), brown (71.8%), with high school education (47.3%), and income of up to two minimum wages. In general, participants perform an average of four different types of activities and around four types of home visits. Most worked on the frontlines during the pandemic (77.9%), despite not receiving training (84.0%). Just over half of the respondents indicated that the supply of PPE was not assured (54.6%), and they believed that the work biosafety standards needed to be revised (66.7%). In contrast, most believed they could be infected with Coronavirus at work (97.0%).

According to the participants, the service was adapted to care for patients with COVID-19 (74.94%) and working hours increased (48.41%). Furthermore, most considered themselves to be a transmission vehicle for the Coronavirus (94.5%), while 74.0% had a family member with COVID-19, and 40.4% reported having had COVID-19. A total of 78.7% of participants indicated changes in the teams' work process during the pandemic. Table 2 presents the descriptive analysis of the instruments used to assess aspects related to the perception of violence; anxiety arising from the Coronavirus; elements related to mental health, social support, and quality of life.

The final model is statistically significant [$F(24, 1{,}319) = 82.89$; $p < 0.001$; $R^2 = 0.60$; R^2 adj. $= 0.59$] compared to the model with all participants. It comprises 20 predictors, which can be observed in Table 3. When observing the predictors, we can observe variables without statistical significance but retained by the model because the presence of these variables in the model does not imply a worsening of the fit, although it is not significant[25]. When data from all municipalities were analyzed together, the predictors increasing the risk of CMD were exposure to violence and not knowing if they had COVID-19. In contrast, those that reduced the risk were the physical and psychological domains of the WHOQOL, not considering themselves COVID-19 transmitters, not having had their working hours increased by the pandemic, and not having contracted COVID-19.

In turn, regarding the analysis considering only the capitals, we identified a statistically significant model after seven steps [$F(28, 805) = 53.16$; $p < 0.001$; $R^2 = 0.65$; R^2 adj. $= 0.64$], comprised of 24 predictors, as shown in Table 4. Finally, concerning the inland region municipalities, we identified a statistically significant model after 19 steps [$F(17, 513) = 36.44$; $p < 0.001$; $R^2 = 0.55$; R^2 adj. $= 0.54$]. Table 5 shows the 12 predictors retained in the model.

Discussion

This is one of the first studies to assess mental health and related factors in ACS in Northeast Brazil during the COVID-19 pandemic. We identified a significant portion of ACS with a relatively high prevalence of mental distress (about 40%, higher for ACS in the capitals). Previous studies[26-29] also observed this demand for mental

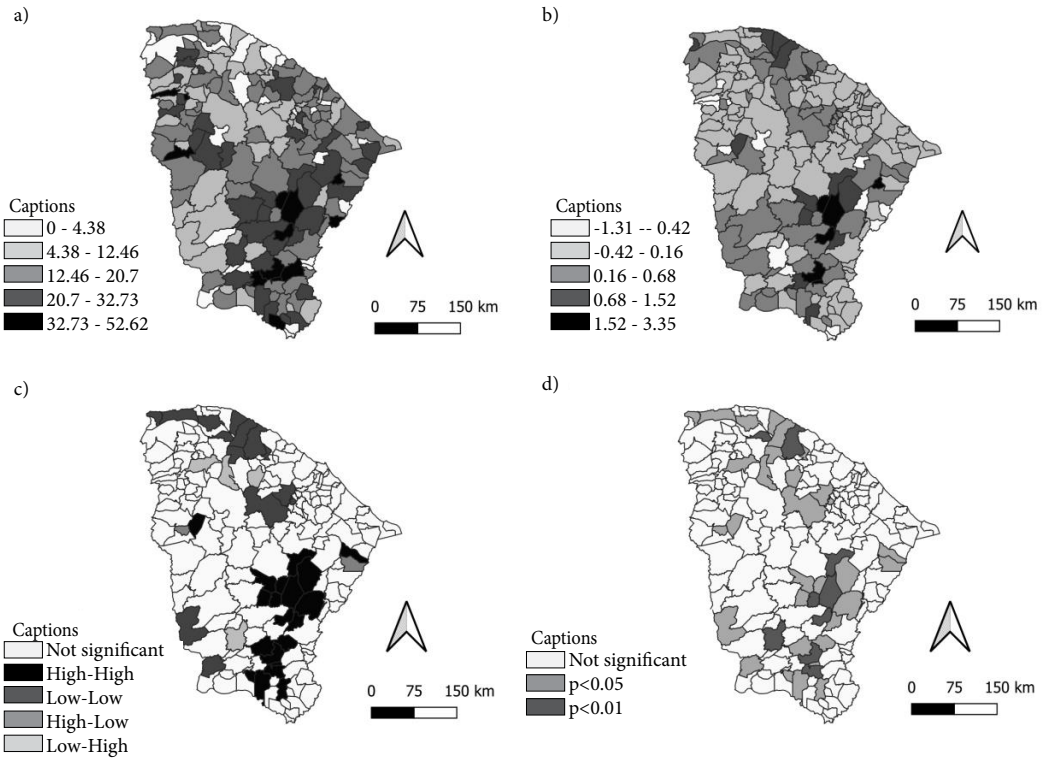

Figure 2. Spatial distribution of mouth cancer mortality coefficient (2a); local Moran index distribution (2b); distribution of spatial autocorrelation clusters (2c); and significance of spatial autocorrelation clusters (2d), Ceará, Brazil, 2009-2019.

Source: Authors.

Table 1. Final OLS and GWR regression model for mouth cancer mortality in Ceará, Brazil, 2009-2019.

Variables	OLS Regression			GWR Regression	
Indicators	Coefficient (β)	Standard error	p-value	Coefficient (β)	Standard error
Intercept	-10.639	17.751		1.018	46.495
Percentage of oral health coverage in primary health care	0.032	0.013	0.01	0.021	0.022
Number of houses with access to the sewage system	-0.001	0.005	p<0.001	-0.001	0.009
Number of people living in the rural area of the municipality	0.0001	0.0005	0.02	0.0001	0.0002
Mean of people per home	-6.876	2.487	p<0.001	-5.947	6.764
Municipal Human Development Index	60.554	14.704	p<0.001	40.417	31.155
Aging rate	1.357	0.351	p<0.001	1.169	0.691

OLS regression: $R^2 = 0.3911$; adjusted $R^2 = 0.37045$; GWR regression: $R^2 = 0.60666$; adjusted $R^2 = 0.53076$.

Source: Authors.

health in the COVID-19 context among health professionals. The characteristics and contexts of the ACS in the capitals and inland region cities showed differences in some variables, confirming the relevance of studies involving different realities. In general, the capitals are more extensive,

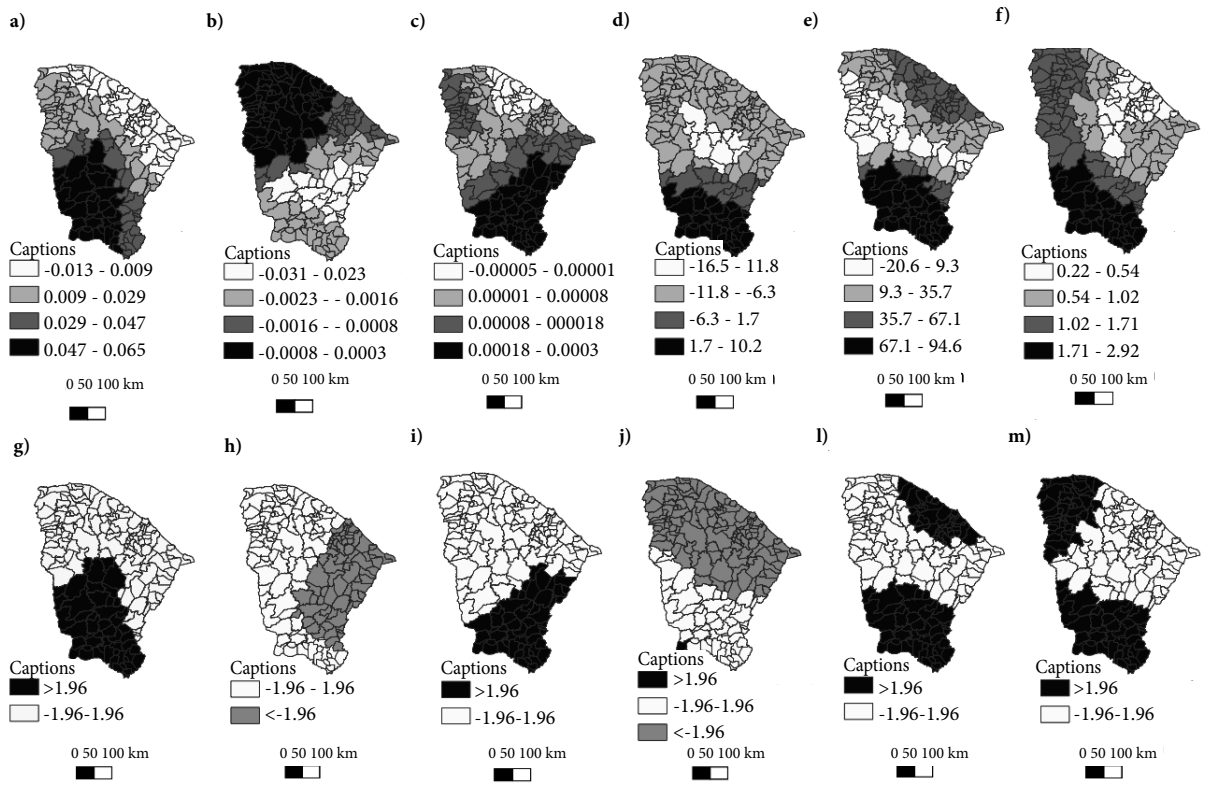

Figure 3. Distribution map of the regression coefficient (β) and significance of the t-test according to the GWR model for the variables oral health coverage in primary health care (3a and 3g), number of households with access to the sewage network (3b and 3h), number of people living in the rural area of the municipality (3c and 3i), the mean number of people per household (3d and 3j), Municipal Human Development Index (3e and 3l), and aging rate (3f and 3m), Ceará, Brazil, 2009-2019.

Source: Authors.

have a higher violence level, lower ESF coverage, and were initially more affected by COVID-19. Capitals Fortaleza and Recife, for example, which have a larger population and international air hubs, were more affected (cases and deaths) than other municipalities at the onset of the pandemic.

Our study showed an association of the following variables in the regression model for all cities: violence (seen or knew) in the territories; rising coronavirus anxiety index; increase in the working time in the family health strategy, and receiving more than four minimum wages with an increase in the SRQ-20 (worst mental health indicator). Worse quality of life in the physical and psychological dimensions and increasing age were also associated with increased SRQ-20. Despite some differences between the regression model when the ACS from all municipalities are analyzed together against the models when the ACS is divided into municipalities in the inland region and capital, these findings show mental health's multidimensional dynamics. As a result, they help uncover the relationship between community violence, COVID-19, quality of life, age, and time working in the ESF with the ACS mental health. It is interesting to observe that, while age seems to be a protective factor, time as an ACS is positively related to common mental disorders, indicating that the ACS practice is a risk indicator for mental health. The intense daily work in primary care during COVID-19, the change in the work routine, precarious work, and life changes such as social distancing can be risk factors for mental health[30]. These findings are significant and deserve to be considered in developing public policies.

COVID-19 has generally affected the population. In Brazil, a study by Barros et al.[32] noted that 40.4% of participants often felt sad or depressed, and 52.6% frequently anxious or nervous. Health

workers who were facing COVID-19 were also affected[29,33-36].

Common mental disorders (CMD) measured by SRQ-20 may be related to the work context, manifesting by a set of symptoms, including fatigue, irritability, insomnia, difficult concentration, forgetfulness, and somatic complaints. However, they do not fully meet the diagnostic criteria of anxiety or depression but cause intense psychic distress, which may result in significant functional loss and psychosocial harm[37,38].

Thus, it is not surprising to find reports of an increasing number of health professionals with anxiety symptoms, which may precede depression and, in turn, can reverberate (or relate to) the quality of life[29,39-41]. Among possible stressors in the studied group, we can cite the lack of ACS training; the lack of PPE; the biosafety rules established are perceived as insufficient; and the work process change.

Furthermore, most ACS believe they are a COVID-19 transmitting vehicle, and many have had COVID-19 cases in the family, which can also be considered stressors. One study noted that the risk and fear of virus infection, along with social distancing (some feelings of loneliness), family life, and economic and uncertainty issues with the future, cause physical and mental fatigue[33].

This research also indicated a negative association between self-efficacy and greater SRQ in the ACS. In the COVID-19 context, having greater self-efficacy is essential, as it would mean having a greater ability to cope with the consequences of this disease in the living condition and lead to more coherent problem-solving and decision-making[42,43].

A study by Xiong et al.[44] observed the association between lower self-efficacy and anxiety in nurses during the COVID-19 pandemic. Thus, self-efficacy can support mental health toward the well-being of health professionals during the pandemic[42,46], as it is related to motivation and accomplishment. Subjects with high self-efficacy do not easily give up. On the contrary, they increase the effort to overcome challenges[47]. Compromised mental health, quality of life, and self-efficacy reduce work performance (delays and errors) and are a risk factor for accidents at work, conflicts between team members, and a higher likelihood of engaging in drug abuse[48,49].

The present study also revealed the importance of early identification of mental health problems, which can affect other areas of life, including work. Knowledge about individual and contextual factors associated with ACS mental health is essential. It can contribute to this population's most effective mental and occupational policies, especially those in high social vulnerability and violent areas. Thus, establishing a caregiver care policy can support the ACS in exercising their craft, improving their work process, and offering decent working conditions to improve their quality of life and effectiveness, thus qualifying healthcare provided to the population.

This study did not occur without limitations, and its cross-sectional design is one of them as it prevents establishing a cause and effect between the analyzed variables. However, analysis was performed at various levels and assessed contextual factors related to the mental health of ACS.

We can conclude that, although the ACS operated in northeastern cities with different peculiarities, about 40% of them had SRQ above 7, signaling high levels of CMD/mental health problems during the COVID-19 pandemic. This fact may have compromised the quality and continuity of health care for families admitted to the ESF territories.

The findings showed the multidimensional dynamics of mental health. They helped to understand the relationship between community violence, COVID-19, quality of life, age, and time working in the ESF with the mental health of ACS. The results of this study are expected to subsidize strategic actions that seek to promote the mental health and quality of life of the ACS so that these professionals can overcome the emotional sequelae suffered throughout the COVID-19 pandemic and fully develop their activities.

Collaborations

JC Siqueira contributed to the design, study planning, collection, analysis and interpretation of data. AO Costa, DHIP Oliveira, II Castro-Silva and JAC Maciel collaborated in the preparation and review of the manuscript.

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