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Mortality trend of cancer and main types according to macroregion in the state of Mato Grosso, Brazil, 2000 to 2015

Tendência da mortalidade por câncer e principais tipos segundo macrorregiões do Estado de Mato Grosso, 2000 a 2015

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ABSTRACT: ***Objective***: To describe the mortality trend from all cancers and the five main ones in the state of Mato Grosso, Brazil, from 2000 to 2015. ***Methods***: This is a descriptive, ecological, time series study, with data referring to deaths of residents of Mato Grosso due to cancer (ICD-10 codes C00 to C97), from the Mortality Information System (SIM). Time trend analyses of the standardized mortality rate from all cancers and five specific cancers (lung, prostate, breast, colorectal and cervical) for the state and according to macroregion (South, West, North, East and Center-North) were performed using linear regression ($p<0.05$). ***Results***: From 2000 to 2015, 28,525 deaths from all cancers in residents of the state of Mato Grosso were recorded. An increasing trend was observed for all cancers, in addition to lung, breast and colorectal cancers. The South and North macroregions showed an increasing trend for all cancers, breast and colorectal, and Center-North for breast and colorectal. East showed an increasing trend for all cancers, prostate and colorectal, and decreasing for cervical. ***Conclusion***: In the state of Mato Grosso, there was an increasing trend in mortality for all cancers and from specific ones, with emphasis on breast and colorectal cancer in most macroregions.

Keywords: Mortality. Cancer. Health information systems. Temporal distribution.

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RESUMO: ***Objetivo***: Descrever a tendência da mortalidade por todas as causas de câncer e as cinco principais causas no Estado de Mato Grosso, Brasil, no período de 2000 a 2015. ***Métodos***: Trata-se de um estudo descritivo, ecológico, do tipo série temporal, com dados referentes aos óbitos de residentes de Mato Grosso por neoplasias (códigos C00 a C97 da Classificação Internacional de Doenças — CID-10), provenientes do Sistema de Informações sobre Mortalidade. A tendência temporal da taxa de mortalidade padronizada de todas as causas de câncer e de cinco causas específicas (pulmão, próstata, mama feminina, colorretal e colo do útero) para o Estado e segundo macrorregiões (Sul, Oeste, Norte, Leste e Centro-Norte) foi analisada por meio de regressão linear ($p<0,05$). ***Resultados***: De 2000 a 2015, ocorreram 28.525 óbitos por todas as causas de câncer em residentes do Estado de Mato Grosso. Tendência crescente foi observada para todas as causas de câncer, além dos cânceres de pulmão, mama e colorretal. As macrorregiões Sul e Norte apresentaram tendência crescente para todas as causas, mama e colorretal; Centro-Norte para mama e colorretal; Leste foi crescente para todas as causas, próstata e colorretal e decrescente para colo do útero. ***Conclusão***: No Estado de Mato Grosso, verificou-se tendência crescente de mortalidade por todas as causas de câncer e por causas específicas, com destaque para mama e colorretal na maioria das macrorregiões.

Palavras-chave: Mortalidade. Câncer. Sistemas de informação em saúde. Distribuição temporal.

INTRODUCTION

Cancer is one of the main causes of incidence and early mortality in the world, and it is increasing rapidly. According to recent worldwide estimates, 19.3 million new cases (18.1 million excluding non-melanoma skin cancer) and nearly 10.0 million cancer deaths (9.9 million excluding non-melanoma skin cancer) occurred in 2020. It is expected that by 2040, there will be an increase of almost 50% in the number of new cases [1].

In Brazil, it is estimated that, for each year of the triennium 2020-2022, there are 625,000 new cases of cancer. The most common types, except for non-melanoma skin cancer, will be breast and prostate cancer (66,000 each), followed by colorectal (41,000), lung (30,000) and stomach cancer (21,000). The distribution of incidence by geographic region shows that the Southeast region concentrates more than 60% of new cases, followed by the Northeast (27.8%) and South (23.4%). There is, therefore, great variation in the magnitude and types of cancer between the different regions of Brazil. In the South and Southeast, the pattern of incidence shows that prostate and female breast cancers, as well as lung and intestine cancers, predominate. In the Central-West, the prostate, breast, cervical and stomach types predominate[2].

Analysis of the trend in mortality from all cancers in the period from 1996 to 2010, in the country, revealed a significant increasing trend in the North and Northeast regions, decreasing trend in the Southeast region and stability in the South and Central-West regions. However, estimates indicate an increase in rates for the North and Northeast and a decrease for the Central-West and other regions by 2030[3]. In the period from 1990 to 2015, there was stability

in mortality from all cancers in the country. However, a substantial decline was observed in the mortality rates for stomach cancer in women (-38.9%) and men (-37.3%), followed by a reduction for cervical cancer in women (-33.9%) and increase in colorectal cancer in men (+29.5%). In Mato Grosso, stomach cancer also showed a significant drop in women (-32.3%) and men (-42.6%), followed by cervical cancer (-32.1%) and an increase in colorectal cancer among men (+33.0%)[4].

Accordingly, the objective of this study was to analyze the temporal trend of standardized mortality rates for all cancers and for five specific cancers (lung, prostate, breast, colorectal and cervical) for the different macroregions of Mato Grosso, in the period from 2000 to 2015.

METHODS

We conducted a descriptive, ecological, time series study, in which the trend of standardized mortality rates for all cancers and the five most common cancers (lung, prostate, female breast, colorectal and cervical) was analyzed in the state of Mato Grosso, from 2000 to 2015.

Located in the Central-West region of Brazil, Mato Grosso has an estimated population of 3,526,220 inhabitants and an area of 903,207,050 km² (year 2020), with a population density of 3.36 inhabitants per km² (2010)[5]. The state is divided into five macroregions (Center-North, East, North, West and South) and 141 municipalities (Figure 1).

Data on deaths of residents of Mato Grosso, registered between 2000 and 2015, were obtained through the Mortality Information System (SIM), as part of the Extension Project "VIGICAN: Cancer Surveillance and Associated Factors: Update of Population-Based and

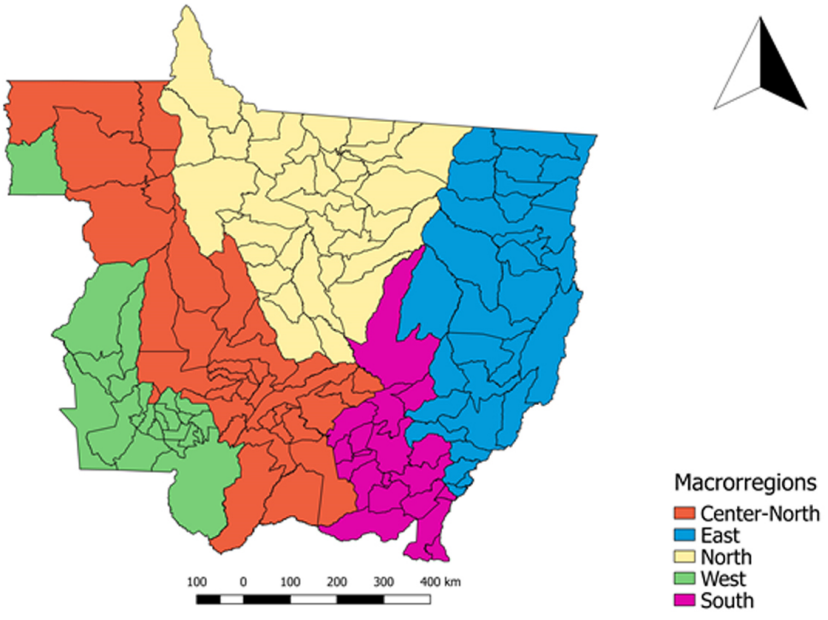

Figure 1. Macroregions of the state of Mato Grosso, Brazil.

Hospital-Based Cancer Registries". Carried out in partnership with and with funding from the Mato Grosso State Health Department (SES-MT), the project ran from April 2016 to March 2021. To carry out the analyses and publish the results, SES-MT authorized the use of the data and the research project titled "Cancer and its associated factors: analysis of population-based and hospital-based registries".

To identify the underlying cause of death from cancers, the 10th edition of the International Classification of Diseases (ICD-10) was used, and the following codes were considered: C53 (cervical), C18 to C21 (colorectal), C50 (breast), C61 (prostate) and C34 (bronchi and lungs). Population data were obtained from the 2000 and 2010 Demographic Census, and for the intercensal periods, population estimates prepared by the Ministry of Health and made available through the Information Technology Department of the Unified Health System (DATASUS) were used[6]. The number of cancer deaths was divided by the population over the period, multiplied by 100,000 inhabitants. Crude rates were calculated and then standardized by the direct method, considering the standard world population proposed by Segi[7] and modified by Doll et al.[8].

A simple linear regression model was fitted that explored the relationship between two variables; in this case, the response variable was the standardized rate, and the explanatory variable was the year. The model has the following form:

$$Y = \alpha + \beta x + \varepsilon_i$$

Where: Y is the response variable (dependent); α is the intercept; β is the slope in relation to the explanatory variable (independent variable); and ε_i is the random component, which represents residual factors and possible measurement errors.

To visualize the trend in mortality rates by means of a percentage, the annual percent change (APC) was used. Its calculation was performed through the ratio between the regression coefficient and the mortality rate at the beginning of the analyzed period, in this case the rate referring to the year 2000, followed by multiplication by 100. The trend of the rates was interpreted as increasing (positive APC and $p<0.05$), decreasing (negative APC and $p<0.05$) or stable ($p\geq0.05$). Data analysis was performed using Excel for Windows, Stata version 12.0 and R version 3.6.2 for Windows.

This study was approved by the Ethics Committee of Hospital Universitário Júlio Muller (CEP-HUJM), under approval No. 3.048.183, of November 20, 2018, and by the Research Ethics Committee of the Mato Grosso State Health Department (SES-MT), under approval No. 3.263.744, of April 12, 2019.

RESULTS

In the period from 2000 to 2015, there were 28,525 cancer deaths among residents of the state of Mato Grosso. Among the five cancers selected, the most frequent was lung

Table 1. Temporal trend of standardized mortality rates for all cancers and five specific cancers (lung, prostate, female breast, colorectal and cervical). Mato Grosso, 2000 to 2015.

Cause	B*	p	APC†	Trend
All	0.061	0.001	0.81%	Increasing
Lung	0.007	0.049	0.79%	Increasing
Prostate	0.003	0.440	0.44%	Stable
Breast	0.018	<0.01	5.47%	Increasing
Colorectal	0.022	<0.01	8.06%	Increasing
Cervical	0.001	0.729	0.31%	Stable

*Slope, †annual percent change.

cancer (12.0%), followed by prostate (8.7%), female breast (5.7%), colorectal (5.5%) and cervical (3.9%) cancer.

Regarding the temporal trend of standardized mortality rates in Mato Grosso, an increasing trend was observed for all cancers and lung, breast and colorectal cancer. For prostate and cervical, the trend was stable (Table 1).

When considering all cancers, the South, North and East macroregions showed an increasing trend and the West and Center-North macroregions, a stable trend. The lung cancer trend was stable for all macroregions. In the case of prostate cancer, there was a growing trend in the East microregion, and in all the others, the trend was stable. Breast cancer showed an increasing trend in the South, North and Center-North macroregions and a stable trend in the West and East. Colorectal cancer showed a stable trend in the West macroregion and an increasing trend in all others. Cervical cancer had a stable trend in all macroregions, with the exception of the East, where it showed a decreasing trend. (Table 2).

DISCUSSION

In Mato Grosso, from 2000 to 2015, there was an increasing trend in mortality from all cancers. Among the specific cancers, lung, female breast and colorectal also showed an increasing mortality trend in the state. For breast and colorectal cancer, the trend was increasing in most macroregions.

Chronic non-communicable diseases (NCDs) were responsible for 54.7% of deaths in Brazil in 2018. In part, these statistics are due to the demographic transition that the country has been going through, which go hand in hand with the aging of the population and the improvement in the quality of life and access to health services. In 2020, there were 717,939 deaths from NCDs in Brazil, of which 30.5% were due to cancer (ICD C00-C97). In Mato Grosso, 8,898 deaths from NCDs were recorded in the same year, with cancer being

Table 2. Temporal trend of standardized mortality rates for all cancers and five specific cancers (lung, prostate, female breast, colorectal and cervical) according to macroregion. Mato Grosso, 2000 to 2015.

Cause	Macroregion	B*	p	APC†	Trend
All	South	0.09	0.01	1.12%	Increasing
All	West	0.03	0.44	0.51%	Stable
All	North	0.10	0.01	1.51%	Increasing
All	East	0.08	0.01	1.82%	Increasing
All	Center-North	0.04	0.12	0.46%	Stable
Lung	South	0.01	0.31	1.17%	Stable
Lung	West	0.01	0.55	1.08%	Stable
Lung	North	0.01	0.31	1.34%	Stable
Lung	East	-0.02	0.13	-1.76%	Stable
Lung	Center-North	0.01	0.07	1.11%	Stable
Prostate	South	0.01	0.84	0.18%	Stable
Prostate	West	-0.01	0.42	-1.31%	Stable
Prostate	North	-0.01	0.87	-0.27%	Stable
Prostate	East	0.05	0.01	7.25%	Increasing
Prostate	Center-North	0.02	0.19	1.15%	Stable
Breast	South	0.04	0.01	4.59%	Increasing
Breast	West	0.03	0.11	5.18%	Stable
Breast	North	0.04	0.00	9.13%	Increasing
Breast	East	0.01	0.56	1.52%	Stable
Breast	Center-North	0.04	<0.01	4.68%	Increasing
Colorectal	South	0.03	<0.01	25.12%	Increasing
Colorectal	West	0.01	0.06	5.43%	Stable
Colorectal	North	0.02	0.01	3.94%	Increasing
Colorectal	East	0.01	0.04	2.90%	Increasing
Colorectal	Center-North	0.03	<0.01	10.63%	Increasing
Cervical	South	0.01	0.38	1.52%	Stable
Cervical	West	0.03	0.05	43.72%	Stable
Cervical	North	-0.01	0.26	-1.58%	Stable
Cervical	East	-0.03	0.02	-4.40%	Decreasing
Cervical	Center-North	0.01	0.93	0.10%	Stable

*Slope, †Annual percent change.

responsible for 29.93% of deaths; that is, the state follows the national trend of proportionality of deaths from cancer in relation to those from NCDs[9].

A study that evaluated mortality from chronic diseases in Brazil and its regions, between 2000 and 2011, showed that there was an average decline of 2.5% per year in the age group 30 to 69 years, in the set of the four main NCDs — which is in accordance with the Action Plan to Confront NCDs in Brazil, 2011–2022. However, cancer was the cause that showed the smallest decline (annual drop of 0.9%), falling behind cardiovascular causes, chronic respiratory diseases and diabetes and, therefore, not reaching the goals of the plan, which aims for annual reduction of 2%[10].

Corroborating these findings, another study evaluated all states between 2000 and 2011 and classified them as lacking with regard to cancer; that is, none of them achieved a 2% reduction in mortality for NCDs in the age group 30 to 69 years old, as recommended by the National Plan[11]. In the present study, an unfavorable scenario was also observed, with an increasing trend in mortality from all cancers.

Regarding the five specific cancers, the Brazilian mortality scenario in 2019 was: among men, cancer of trachea, bronchi and lungs occupied first place with 13.8%, followed by prostate (13.1%) and colorectal (8.4%); among women, breast cancer was first with 16.4%, followed by trachea, bronchi and lungs (11.4%), colorectal (9.4%) and cervical (6%). In Mato Grosso, between 2000 and 2015, the five most common cancers, in descending order, were lung, prostate, breast, colorectal and cervical[12].

In this state, an increasing trend in the standardized mortality rate for all cancers was found, with an increase in the East macroregion, which showed the highest APC, in contrast to the Center-North macroregion, with a small non-significant change, indicating stability. This fact follows the scenario of developing countries, in which mortality trends have also been increasing in recent decades, and differs from developed countries, such as Canada and the United States, in which, despite the high incidence rates for all cancers, the mortality trend is in decline[13]. This is thanks to extensive cancer screening, which favors early detection and effective treatment[1,14].

In the Brazilian context, in a study that analyzed cancer mortality trends in Brazilian capitals, from 1980 to 2004[15], a decreasing or stable trend was found for the most frequent cancers. It was also observed that the Southeast and South regions had a decrease in mortality rates when compared to the Northeast and North, which showed an increase, and with the Central-West, which showed an increase followed by stability — rates associated with patterns related to poverty and sedentary lifestyle[16].

The literature is conflicting regarding these findings, but there seems to be a higher incidence trend in developed areas, while those in development account for the higher mortality, probably due to unfavorable socioeconomic factors, delay in diagnosis and insufficient access to adequate therapy. This trend seems to follow the course of Latin America, where there was an increase in cancer mortality between 1979 and 2010, which demonstrates the influence of socioeconomic factors on the epidemiology of the disease[17]. In Brazil, studies indicate regional variations in cancer mortality indicators. In a study that evaluated the

trend in cancer mortality in Brazil between 1980 and 2006, higher mortality was identified in the countryside compared to capitals, and the general trends in mortality in the country did not indicate a reduction in that period[18].

Variations in mortality rates for different types of cancer have been observed in national studies, such as increasing trends for cervical cancer between 2012 and 2016, with a greater number of deaths in the range between 50 and 54 years[15]. However, in the present investigation, this type was the only one to show a decreasing trend in the East macroregion, when compared to the other types and macroregions of the state.

In the Central-West region, lung cancer in a more recent period (1995-2017) showed a decrease in the capitals and an increase in the countryside, tending to decrease in intensity throughout the period, among men. In women, there was an increase in both areas, also with a decrease in intensity[16]. In the period 1990–2015, there was an increase of 20.7% in females and a reduction of 12% in males[4]. Similar results were found by Malta et al.[19] between 1996 and 2011, despite the fact that absolute mortality was higher in men. In the present study, although a non-significant increase between 1 and 2% was observed in almost all macroregions, classifying trends as stable, a small significant increase was observed in the state. It is worth mentioning that, despite the reduction in the prevalence of current smokers having been verified in Brazil and regions thanks to the success of the programs and the continuous monitoring of this risk factor, no significant reduction was observed among women in Mato Grosso[20].

For breast cancer, stable[4,21] and increasing trends were observed in the country[22]. In the present study, an increasing trend was also observed in the state, as well as an increase in three of the five macroregions (South, Center-North and North) and stability for the others. The difficulty in accessing early diagnosis services, delay in diagnosis and time interval between diagnostic tests and adequate treatment of breast cancer can promote disease progression[22].

It is noteworthy that there are barriers to screening and early detection of different types of cancer. With regard to breast cancer, despite the recommendation of a routine mammogram for women between 50 and 69 years old once every two years, the lack of resources to acquire state-of-the-art equipment and hire specialists trained to handle the instrumentation and read the imaging results can compromise the mammogram coverage[23,24].

For cervical cancer, the existing national screening policy recommends a Pap smear test for women between 25 and 64 years old, who have been or are sexually active. The application of this method by health professionals has proven to be effective; however, there is the possibility of false-negative and false-positive results in the tests performed; and due to the manifestation of symptoms only in advanced stages, cervical cancer may have its screening impaired[25,26]. Despite showing a stable trend in Mato Grosso and in most macroregions, it was the only type that showed a reduction in mortality trend. One of the goals of the National Plan is to increase the coverage of this preventive examination. According to data from VIGITEL 2016, in 27 cities examined, 81% of women between 25 and 64 had a Pap smear in the last three years. Cuiabá reached 78%, ranking 15th[27].

Colorectal cancer is the third most common type in the world and the second in terms of mortality[1]. In Brazil, it is the second in incidence and third in mortality[2]. In developed countries, there are screening programs, accompanied by early diagnosis and effective treatment, which contribute to reducing mortality trends of this cancer[28]. Such programs are not fully implemented in Brazil or Mato Grosso. The disease has a much better prognosis when its lesions are detected at an early stage, and the main screening tests are fecal occult blood tests and endoscopic examinations (colonoscopy or rectosigmoidoscopy). The World Health Organization (WHO) advises that all people over 50 years of age undergo a fecal occult blood test, if the country has conditions for diagnostic confirmation, referral and adequate treatment[29].

Colorectal cancer screening is justified for several reasons: the incidence of the disease is high and its preclinical stage is long[30]. Furthermore, it can start as an easily treatable adenoma, whose progression to a malignant lesion takes between five and ten years[31]. It is also worth mentioning that the five-year survival rates for patients whose lesion is detected at an early stage are approximately 90%, while, if the cancer is detected at an advanced stage, they are around 10%[32]. Finally, as the follow-up of the disease and its treatment are very expensive, screening can save public resources[33]. However, this is not the reality in Brazil. The Ministry of Health prioritizes early diagnosis actions for patients with clinical suspicion of colorectal cancer; and screening for high-risk patients with a family history of colorectal cancer or suspected Lynch syndrome or familial adenomatous polyposis[34].

In Mato Grosso, the highest annual percent increase was found for colorectal cancer. The disease affects both sexes, but especially among men (variations of 29.5% in males and 12.5% in females) and for all age groups, except women over 70 years of age because of the lack of public tracking policies[35].

In the present study, the types of cancer that stood out showed an increasing mortality trend in the South, North and Center-North macroregions. These are marked by having high mortality rates, expressed through the socioeconomic indicators of the municipalities that integrate them, as well as inequalities in established capacity and in public and private investments, such as lower availability of primary care services, low health expenditures, low availability of specialized care establishments and low outpatient care, per inhabitant, of medium and high complexity[36-38]. Another characteristic of the state is that agriculture is the economic base of practically all municipalities. Therefore, there is intensive use of chemical fertilizers and pesticides and biotechnology. It should be noted that the macroregions mentioned include municipalities close to BR-163, a federal highway used to transport agricultural production to other countries, so the regional population, in turn, is exposed to pesticides through the environment, food and water contamination[38].

As this was an ecological study, possible limitations due to the occurrence of bias or confounders cannot be ruled out. The underreporting of deaths stands out as a potential bias, observed in studies that used secondary data[39-41].

Analyzing cancer mortality can contribute to future epidemiological research on the issue, not only for Mato Grosso but also on the country level. Although there are studies

on the subject, they are still scarce, and there is a need to expand our knowledge to identify priority areas (aimed at reducing mortality).

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ETHICAL APPROVAL

The study was assessed and approved by the Ethics Committee of Hospital Universitário Júlio Muller (CEP-HUJM) under CAAE No. 98150718.1.0000.8124, approval No. 3.048.183, of November 20, 2018, and by the Research Ethics Committee of the Mato Grosso State Health Department (SES-MT), CAAE No. 98150718.1.3003.5164, approval No. 3.263.744, of April 12, 2019.

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