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Time trends in the incidence of cancer in the state of Mato Grosso, Brazil, from 2001 to 2016

Viviane Cardozo Modesto (https://orcid.org/0000-0001-8643-0252) [1]
Noemi Dreyer Galvão (https://orcid.org/0000-0002-8337-0669) [1,2]
Rita Adriana Gomes de Souza (https://orcid.org/0000-0002-0831-9302) [1]
Mário Ribeiro Alves (https://orcid.org/0000-0003-3665-6821) [1]
Maria Teresa Bustamante-Teixeira (https://orcid.org/0000-0003-0727-4170) [3]
Amanda Cristina de Souza Andrade (https://orcid.org/0000-0002-3366-4423) [1]

Abstract *The scope was to analyze the time-series trend in the incidence of cancer in the health macro-regions of the State of Mato Grosso from 2001 to 2016. It involved an ecological time-series study with data from the Mato Grosso Population-Based Cancer Registry. Age-standardized incidence rates, disaggregated by year, sex, macro-region and type of cancer, were calculated. For men, the trend was increasing for prostate cancer in the state and the Central-Northwest, East, West, and South macro-regions, and for colorectal cancer in the North; and decreasing for stomach cancer in the state and the Central-Northwest and North, for lung cancer in the East, and for esophageal cancer in the Central--Northwest. For women, the trend was increasing for breast cancer in the state from 2009 to 2016, for lung cancer in the state (2008 to 2016) and in the Central-North (2001 to 2016) and South (2007 to 2016) macro-regions; and decreasing for cervical cancer in the state and for all macro-regions, and for stomach cancer in the state and in the Central-Northwest. Colorectal cancer revealed a stable trend for the state and all macro-regions. Cancer surveillance, prevention and control actions should consider regional differences and variations in magnitude of the occurrence of the disease.*
Key words *Neoplasms, Incidence, Time-series studies, Information systems*

[1] Programa de Pós-Graduação em Saúde Coletiva, Universidade Federal de Mato Grosso. Av. Fernando Correa da Costa 2367. 78060-900 Cuiabá MT Brasil. csouza.amanda@gmail.com
[2] Secretaria de Estado de Saúde de Mato Grosso. Cuiabá MT Brasil.
[3] Programa de Pós-Graduação em Saúde Coletiva, Universidade Federal de Juiz de Fora. Juiz de Fora MG Brasil.

Introduction

Cancer is an important worldwide public health problem, due to high morbidity and mortality and high cost of treatment, and has shown an increasing trend in incidence rates in recent decades. This growth can be explained in part by aging, population growth, and also by the change in the distribution of cancer risk factors, especially modifiable factors, such as tobacco and alcohol consumption, physical inactivity, overweight and obesity, inadequate diet, in addition to social, environmental, political and economic conditions[1,2].

In the world, in men, the most common cancer in developing countries was prostate cancer (11.3 per 100 thousand/men), followed by lung cancer (10.3 per 100 thousand/men), and for women it was breast cancer (55.9 per 100 thousand/women), followed by colorectal cancer (20.0 per 100 thousand/women)[3]. In Brazil (2023-2025), prostate cancer (55.49 per 100 thousand/men), lung cancer (12.43 per 100 thousand/men) and colorectal cancer (12.43 per 100 thousand/men) were the most common among men, and for women breast cancer (41.89 per 100 thousand/women), cervical cancer (13.25 per 100 thousand/women) and colorectal (11.06 per 100 thousand/women), excluding non-melanoma skin cancers. In Mato Grosso, among men, the most common types of cancer were prostate, colorectal and lung cancer, and for women, breast, colorectal and cervical cancer[4]. However, there is no information on the incidence of various types of cancer in the state, broken down by geographic region.

Analyzes disaggregated into smaller geographic units allow us to better investigate the relationships and interactions between the incidence of cancer and changes in socioeconomic and demographic dimensions and the availability of health services. In addition to contributing to the identification of priorities in disease control, with support for the planning and management of health services[5].

To understand the magnitude of cancer, Population-Based Cancer Registries (RCBP) have been an important source of secondary data on all new cancer diagnoses occurring in populations within a defined geographic area[6]. In the State of Mato Grosso, the RCBP Cuiabá and Interior, despite their operational complexity, make it possible to determine, annually, the incidence and distribution of cancer in the State, and in smaller geographic units, such as health macro-regions, health regions and municipalities[7].

The state of Mato Grosso is characterized by heterogeneous geographic areas and regional inequalities[8], in addition to socioeconomic and environmental transformations, which can interfere with carcinogenesis processes, by combining different risk factors. The state's economy is based on the production of agricultural commodities (soy, cotton, sugar cane and corn) through the agribusiness production model[9], which makes it the largest consumer of pesticides in Brazil in recent years[10]. In this sense, the objective of the study was to analyze the temporal trend in the incidence of cancer in the health macro-regions of the state of Mato Grosso from 2001 to 2016.

Methods

This is an ecological time series study of the five most common types of cancer by sex, excluding non-melanoma skin cancer, in the health macro-regions of the state of Mato Grosso, from 2001 to 2016.

The state of Mato Grosso is located in the Central-West Region of Brazil and is made up of 141 municipalities grouped into six health macro-regions (Center North, Center Northwest, East, North, West and South)[11]. The state capital, Cuiabá, belongs to the Center North macroregion, as does Várzea Grande, which is the second municipality with the largest population[12].

Health macro-regions are marked by demographic, socioeconomic and health differences, which reflect the profile of the health regions that comprise them[8,13]. Specialized oncology care services are distributed across five healthcare macro-regions, and their provision is concentrated in the capital[14]. Table 1 presents the characteristics of the health macro-regions: a) resident population aged 60 or over (2021); b) average household income per capita (IBGE, 2010); c) illiteracy rate (IBGE, 2010); d) percentage of the population with completed 2nd primary education or more (IBGE, 2010); e) gross domestic product per capita (GDP per capita) (IBGE, 2010); f) coverage of primary care teams (2015); g) medium and high complexity outpatient procedures per 100 inhabitants (2015). The information was obtained from the Information Technology Department of the Unified Health System (DATASUS)[12,15].

Data on new cancer cases were obtained through RCBP-Interior and RCBP-Cuiabá. The period chosen for the study was defined based on updated information from the Extension

Table 1. Demographic, socioeconomic and health characteristics of the health macro-regions of the state of Mato Grosso.

Variables	Center North	Center Northwest	East	North	West	South	Mato Grosso
Number of Health Regions	1	3	4	5	2	1	16
Number of municipalities	11	24	30	35	22	19	141
Population (2021)	1,028,372	531,559	348,769	794,433	320,968	543,133	3,567,234
Resident population aged 60 or over (2021), n (%)	129,937 (12.6%)	54,226 (10.2%)	41,554 (11.9%)	81,360 (10.2%)	40,964 (12.8%)	62,265 (11.5%)	410,306 (11.5%)
Average household income per capita (IBGE, 2010)	903.6	621.0	569.1	720.1	579.6	737.6	735.3
Illiteracy rate (IBGE, 2010)	6.2	10.0	10.8	8.0	11.6	8.3	8.4
Percentage of the population with completed 2nd primary education or more (IBGE, 2010)	62.2	45.56	46.67	48.5	47.03	53.87	52.8
GDP per capita (IBGE, 2010)	19,266.2	18,539.6	13,152.5	18,382.7	13,373.5	24,991.5	18,657.3
Coverage of primary care teams (2015)	49.1	82.5	89.2	82.0	73.0	75.8	71.1
Medium complexity outpatient procedures/100 hab. (2015)	0.8	0.2	0.4	0.2	0.7	0.9	0.6
High complexity outpatient procedures/100 hab. (2015)	6.4	2.8	1.8	3.0	3.6	4.9	4.3

Soure: DATASUS.

Project "Cancer Surveillance and its associated factors: updating population-based and hospital records". The 2010 census population and the intercensal population estimates used as denominators for calculating incidence rates were extracted from the Tabnet – DATASUS[12].

The five most common types of cancer were selected, according to the distribution of data in the State, excluding non-melanoma skin cancer, according to sex and considering the International Statistical Classification of Diseases and Related Health Problems (ICD-10): (C61) prostate; (C33-C34) lung; (C18-C19-C20-C21) colorectal; (C16) stomach; and (C15) esophagus, for males and (C53) cervix; (50) breast; (C18-C19-C20-C21) colorectal; (C33-C34) lung; and (C16) stomach, for females. All cases of benign neoplasia, with uncertain or unknown behavior were excluded (D00-D48).

Age-standardized incidence rates per 100,000 inhabitants were calculated based on the global standard population proposed by Segi[16]. The direct method was used and estimates were made based on age-specific rates at 10-year intervals, disaggregated by year, sex, macro-region and cancer.

For incidence trend analysis, Joinpoint regression was used using the calendar year as a regressor variable. Joinpoint regression describes the relationship between two variables through piecewise linear regression, where pattern changes are connected by inflection points[17]. Serial autocorrelation was verified using the Durbin-Watson test. The assumption of normality was verified using the Shapiro-Wilk test and homoscedasticity using the *Breusch-Pagan* test. The choice of the analysis model was made based on checking the model's assumptions. The annual percentage change (APC) and Average Annual Percent Change (AAPC) were calculated - weighted geometric average of the different APC with weight equal to the size of the segment for each time interval[17]. Positive APC means increasing trend, negative APC means decreasing trend, and p-value>0.05 means stable trend. The Joinpoint Regression Program software, version 8.3.6.1 (Statistical Research and Applications Branch, National Cancer Institute, Bethesda, United States) was used for trend analysis and the STATA software, version 16.0 for descriptive analysis and graphs.

This project is part of a larger project entitled "Cancer and Its Associated Factors: Population and Hospital Base Registry Analyzes of Mato Grosso", sent to the UFMT Ethics and Health Research Committee with approval opinion number 4,858,521, of 07/20/2021. The project has a partnership and financing from the Public Ministry of Labor, 23rd Region, effective from July 2019 to July 2023.

Results

In the period from 2001 to 2016, the state of Mato Grosso reported 74,756 new cases of cancer (including non-melanoma skin cancer), 53.0% in males. The most frequent for men were prostate (22.8%), lung (6.7%), stomach (5.5%), colorectal (5.0%) and esophagus (3.2%). In women, they were breast (19.6%), cervix (13.2%), colorectal (5.6%), lung (4.0%) and stomach (3.0%).

The incidence rate among men increased for prostate (37.8 in 2001 to 44.9/100 thousand men in 2016) and colorectal (9.4 to 10.5/100 thousand men) and reduced for lung (14.8 for 11.1/100 thousand men), stomach (14.0 to 8.9/100 thousand men) and esophagus (6.9 to 5.3/100 thousand men) (Figure 1). In women, the rate increased for breast (31.1 to 39.4/100 thousand women) and colorectal (9.6 to 10.9/100 thousand women) and a small reduction for the cervix (33.5 to 17.7/100 thousand women), lung (7.9 to 7.8/100 thousand women) and stomach (6.3 to 5.1/100 thousand women) (Figure 2).

Table 2 presents the annual percentage changes in incidence rates for men. For prostate cancer, an increase of 7.1% was observed in the period from 2001 to 2016 in the East macro-region, 5.9% in the West, 4.7% in the South, 4.5% in the Central Northwest and in the state, 1.7%. For lung cancer, there was a 3.5% reduction in the incidence rate in the East macro-region from 2001 to 2016 and 4.1% in the state for the same period. For colorectal cancer, there was a 4.3% increase in the incidence rate in the North macro-region. For stomach cancer in the period from 2001 to 2016, a reduction of 2.7% was observed in the Central Northwest macro-region, 4.5% in the North and 3.3% in the state, while for the East macro-region the reduction was observed in the period from 2001 to 2009 (APC = -13.1%) and for the West in the periods from 2001 to 2008 (APC = -9.6%) and 2011 to 2016 (APC = -8.7%). For esophageal cancer, the reduction was only observed for the Central Northwest macroregion (AAPC = -4.5%).

Table 3 presents the annual percentage changes in incidence rates for women. For breast cancer, a reduction of 3.0% was observed in the period from 2001 to 2009 in the Central North macroregion and an increase of 6.8% in the period from 2009 to 2016 for the state. For cervical cancer, from 2012 to 2016, the trend was decreasing for the state (AAPC = -6.0%) and in almost all macro-regions, Central Northwest (AAPC = -5.7%), East (AAPC = -7.6), North (AAPC = -7.0%), West (AAPC = -5.2%), South (AAPC = -4.9%). The Central North macro-region showed a decreasing trend only in the period from 2003 to 2010 (APC = -11.2). For lung cancer, the Central North macro-region showed an increasing trend (AAPC = 2.6%) and the South showed a break in the series, with a decreasing trend in the period from 2001 to 2007 (APC = -8.4%) and an increasing trend in the period from 2007 to 2016 (APC = 7.9%), and for the state the trend was decreasing from 2001 to 2008 (APC = -2.9%), and increasing from 2008 to 2016 (APC = 4.8%). For colorectal cancer, stable trends were observed for all macro-regions and the state. Stomach cancer showed a reduction in the incidence trend in the Central Northwest macro-region (AAPC = -5.9%) and in the state (AAPC = -2.5%) in the period from 2001 to 2016.

Discussion

In the present study, trends in standardized incidence rates of the five most common types of cancer were presented, for both sexes, in the state of Mato Grosso, and according to health macro-regions, in the period from 2001 to 2016. Similar to the global cancer profile[3], and also in South America and the Caribbean[18], the most common cancers in the state were prostate, breast, colorectal, lung and stomach. The state's cancer burden reflects the epidemiological transition, with cancer types associated with infections and attributed to socioeconomic development, as well as unhealthy lifestyle habits[3,6,7].

For men, prostate cancer showed an increasing trend for the state and for four of the six macro-regions studied (Central Northwest, East, West and South). Study on the incidence and mortality of prostate cancer in 89 countries from 2000 to 2019, observed that the incidence increased in 65 countries, remained stable in 15 and decreased in 9, and countries with a very high Human Development Index (HDI) had an incidence rate twice as high as those in countries with a low HDI. In Brazil, the trend was increasing in the period (AAPC: 0.47), however in the periods from 2004 to 2007 and 2007 to 2017 it showed a stable and decreasing trend, respectively19. A study carried out in the municipalities of Cuiabá and Várzea Grande, from 2000 to 2016, observed a stable trend and a drop in 2006, with a decreasing trend at the end of the series[20].

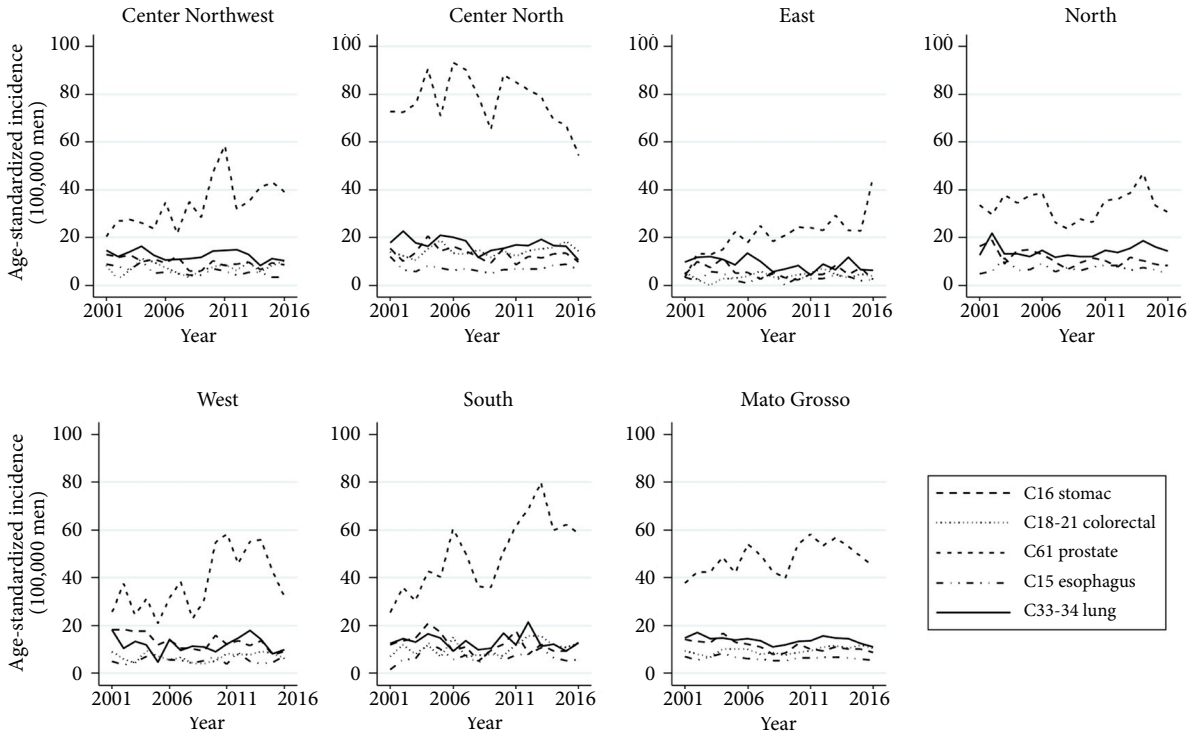

Figure 1. Age-standardized incidence rates of the five most common types of cancer in males (per 100,000 men) according to the health macro-regions of the state of Mato Grosso, 2001 to 2016.

Source: Authors.

The decreasing or stable incidence rate for prostate cancer is related to recent changes in the use of prostate-specific antigen (PSA) testing for screening. Most government regulatory agencies in countries such as Brazil, Argentina and Colombia currently oppose PSA screening[21]. The increase in the incidence of prostate cancer may be related to the occurrence of the main modifiable risk factors, which are generally related to lifestyle, such as diet and physical activity, and non-modifiable factors such as age, hormonal and genetic aspects[3] and provision of health care services[22,23].

For women, breast cancer showed an increasing trend in the period from 2009 to 2016 for the state, and a decreasing trend in the Central North macro-region in the period from 2001 to 2009, a result similar to that observed in the municipalities of Cuiabá and Várzea Grande, which showed an increase in incidence rates in the period from 2000 to 2016[20], and in developing countries, since the 2000s, both incidence and mortality have shown an increasing trend[3].

The increase in breast cancer incidence rates may reflect the occurrence of reproductive risk factors, such as delayed pregnancy, fewer children and shorter periods of exclusive breastfeeding, and lifestyle, such as alcohol intake, excess body weight, sedentary lifestyle, in addition to offering health resources and improving breast cancer screening[3]. According to the Guidelines for the Early Detection of Breast Cancer in Brazil, mammographic screening should be performed in women aged 50 to 69 once every two years[24]. However, it is necessary to consider that increased screening may indicate some degree of overdiagnosis, and that there are inequalities in the distribution of supply and use of early detection procedures for breast cancer in Brazilian regions[25]. Regions with greater inequality, measured by the Gini index, have less access to

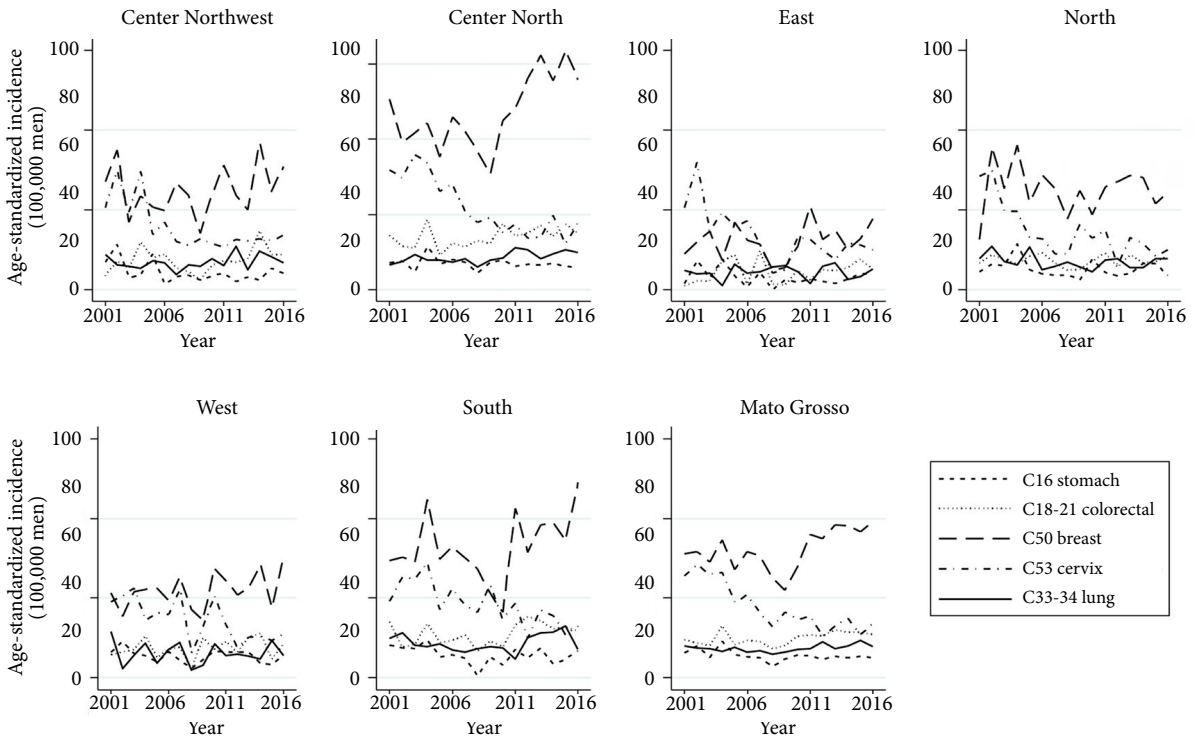

Figure 2. Age-standardized incidence rates of the five most common types of cancer in the female sex (per 100,000 women) according to the health macro-regions of the state of Mato Grosso, 2001 to 2016.

Source: Authors.

mammography exams[26], and those with higher HDI have a higher proportion of mammograms performed in the last two years[27].

Cervical cancer showed a decreasing trend for the state and almost all macro-regions in the period from 2001 to 2016, except for the Central North macro-region in which there was a stable trend from 2000 to 2003 and 2010 to 2016, and a reduction from 2003 to 2010. In the world, in recent decades, a decline in the incidence rate of cervical cancer has been observed, being higher in Latin America and Asia[28]. The trend in the incidence of cervical cancer in ten Brazilian capitals, with data from the RCBP from 1996 to 2011, showed a decrease in most of the capitals analyzed, highlighting Curitiba, São Paulo and Goiânia[29]. In a study carried out in Campinas, a reduction in the standardized incidence rate of cervical cancer was also observed, which went from 16.08 cases/100,000 women in 1991 to 1995 to 6.94 cases/100 thousand women in 2010 to 2014[30].

Improving access to health services, increasing the level of education or educational campaigns for vulnerable population groups, reducing the risk of HPV (Human Papillomavirus) infection and prevention campaigns are strategies which may contribute to reducing the incidence of cervical cancer[3,30]. In Brazil, the offer of cervical cytopathological exams for women aged 25 to 64 has been increasing since 2015[31], and this age group is recommended for screening, every three years, according to current guidelines[32]. According to data from the National Health Survey, in Mato Grosso, in 2019, the percentage of women aged 25 to 64 who underwent the last preventive exam for cervical cancer less than 3 years ago was 79.7%[33]. Carrying out cytological tests for early diagnosis of cervical cancer produces positive impacts on morbidity and mortality rates[34].

Lung cancer showed a stable trend in both sexes in the state and in almost all health macro-regions, except the East for men, which was

Table 2. Analysis of trends in the age-standardized incidence rates of the five most frequent types of cancer in males according to health macro-regions of the state of Mato Grosso, 2001 to 2016.

	Period	APC	95%CI	AAPC	95%CI
C61 prostate					
Center North	2001-2016	-0.2	-0.6; 0.2	-0.2	-0.6; 0.2
Center Northwest	2001-2016	**4.5***	**1.9; 7.**1	**4.5***	**1.9; 7.1**
East	2001-2016	**7.1***	**3.8; 10.**5	**7.1***	**3.8; 10.5**
North	2001-2016	0.7	-2.0; 3.5	0.7	-2.0; 3.5
West	2001-2016	**5.9***	**2.5; 9.**5	**5.9***	**2.5; 9.5**
South	2001-2016	**4.7***	**1.2; 8.**3	**4.7***	**1.2; 8.3**
Mato Grosso	2001-2016	**1.7***	**0.1; 3.4**	**1.7***	**0.1; 3.4**
C33-C34 lung					
Center North	2001-2016	-1.9	-3.8; 0.1	-1.9	-3.8; 0.1
Center Northwest	2001-2008	-5.1	-10.7; 0.9	-3.2	-9.9; 4.1
	2008-2011	12.4	-20.9; 60.0		
	2011-2016	-9.0	-19.1; 2.4		
East	2001-2016	**-3.5***	**-6.6; -0.4**	**-3.5***	**-6.6; -0.4**
North	2001-2016	0.3	-1.8; 2.5	0.3	-1.8; 2.5
West	2001-2010	-3.6	-7.3; 0.4	-3.6	-14.2; 8.3
	2010-2013	21.6	-29.9; 110.9		
	2013-2016	-23.7	-48.2; 12.5		
South	2001-2016	-0.7	-3.4; 2.0	-0.7	-3.4; 2.0
Mato Grosso	2001-2009	**-4.1***	**-6.1; -2.0**	-2.6	-6.1; 1.0
	2009-2013	7.3	-2.3; 17.9		
	2013-2016	-11.0	-24.7; 5.2		
C18-C21 colorectal					
Centro Norte	2001-2016	0.5	-1.3; 2.4	0.5	-1.3; 2.4
Center Northwest	2001-2016	-0.2	-3.5; 3.2	-0.2	-3.5; 3.2
East	2001-2016	2.5	-1.4; 6.6	2.5	-1.4; 6.6
North	2001-2016	**4.3***	**1.9; 6.**7	4.3*	1.9; 6.7
West	2001-2016	0.8	-2.4; 4.0	0.8	-2.4; 4.0
South	2001-2016	2.5	-0.9; 5.9	2.5	-0.9; 5.9
Mato Grosso	2001-2016	1.8	0.0; 3.6	1.8	0.0; 3.6
C16 stomach					
Center North	2001-2016	-1.9	-4.4; 0.6	-1.9	-4.4; 0.6
Center Northwest	2001-2016	**-2.7***	**-5.1; -0.4**	**-2.7***	**-5.1; -0.4**
East	2001-2009	**-13.1***	**-21.2; -4.0**	-2.5	-10.8; 6.6
	2009-2016	11.2	-7.3; 33.5		
North	2001-2016	**-4.5***	**-6.8; -2.2**	**-4.5***	**-6.8; -2.2**
West	2001-2008	**-9.6***	**-12.3; -6.8**	-5.2	-11.0; 1.0
	2008-2011	12.8	-19.5; 58.1		
	2011-2016	**-8.7***	**-16; -0.7**		
South	2001-2016	-2.9	-6.6; 1.0	-2.9	-6.6; 1.0
Mato Grosso	2001-2016	**-3.3***	**-5.3; -1.3**	-3.3*	-5.3; -1.3
C15 esophagus					
Center North	2001-2003	-25.3	-52.0; 16.4	-2.7	-8.0; 2.9
	2003-2016	1.4	-1.1; 3.9		
Center Northwest	2001-2016	**-4.5***	**-7.0; -2.0**	**-4.5***	**-7.0; -2.0**
East	2001-2016	-2.4	-7.3; 2.8	-2.4	-7.3; 2.8
North	2001-2016	2.2	-0.7; 5.1	2.2	-0.7; 5.1
West	2001-2016	0.6	-2.7; 4.0	0.6	-2.7; 4.0
South	2001-2016	-0.5	-5.2; 4.4	-0.5	-5.2; 4.4
Mato Grosso	2001-2016	-1.1	-3.0; 0.9	-1.1	-3.0; 0.9

APC - annual percent change; AAPC - average annual percent change; 95%CI - 95% confidence interval; * ($p < 0,05$).

Source: Authors.

Table 3. Analysis of trends in the age-standardized incidence rates of the five most frequent types of cancer in the female sex according to health macro-regions of the state of Mato Grosso, 2001 to 2016.

	Period	APC	95%CI	AAPC	95%CI
C50 breast					
Center North	2001-2009	**-3.0***	**-5.6; -0.3**	1.7	-3.1; 6.8
	2009-2012	16.4	-10; 50.6		
	2012-2016	1.1	-6.1; 8.9		
Center Northwest	2001-2016	1.0	-2.0; 4.1	1.0	-2.0; 4.1
East	2001-2016	2.0	-2.7; 6.8	2.0	-2.7; 6.8
North	2001-2016	-0.8	-3.6; 2.0	-0.8	-3.6; 2.0
West	2001-2016	1.6	-0.8; 4.1	1.6	-0.8; 4.1
South	2001-2016	1.5	-1.0; 4.1	1.5	-1.0; 4.1
Mato Grosso	2001-2009	-2.2	-5.2; 0.8	1.9	-0.2; 3.9
	2009-2016	**6.8***	**3.3; 10.4**		
C53 cervix					
Center North	2001-2003	11.8	-31.2; 81.8	-3.9	-9.5; 2.1
	2003-2010	**-11.2***	-14.1; -8.3		
	2010-2016	0.4	-5.8; 6.9		
Center Northwest	2001-2016	**-5.7***	**-8.4; -2.9**	**-5.7***	**-8.4; -2.9**
East	2001-2016	**-7.6***	**-11.0; -4.1**	**-7.6***	**-11.0; -4.1**
North	2001-2016	-7.0*	-9.9; -4.1	-7.0*	-9.9; -4.1
West	2001-2016	**-5.2***	**-8.0; -2.4**	**-5.2***	**-8.0; -2.4**
South	2001-2016	**-4.9***	**-6.1; -3.6**	**-4.9***	**-6.1; -3.6**
Mato Grosso	2001-2008	-9.6*	-12.1; -7.0	-6.0*	-7.9; -4.1
	2008-2016	-2.8	-6.1; 0.6		
C33-C34 lung					
Center North	2001-2016	**2.6***	**0.6; 4.7**	**2.6***	**0.6; 4.**7
Center Northwest	2001-2016	1.3	-1.7; 4.5	1.3	-1.7; 4.5
East	2001-2016	0.7	-5.3; 7.0	0.7	-5.3; 7.0
North	2001-2016	-1.4	-4.2; 1.4	-1.4	-4.2; 1.4
West	2001-2016	0.6	-5.5; 6.9	0.6	-5.5; 6.9
South	2001-2007	**-8.4***	**-15.8; -0.4**	-2.6	4.8; 0.6
	2007-2016	**7.9***	**3.8; 12.1**		
Mato Grosso	2001-2008	**-2.9***	**-5.4; -0.3**	1.1	-0.3; 2.6
	2008-2016	**4.8***	**2.8; 6.8**		
C18-C21 colorectal					
Center North	2001-2016	2.0	-0.1; 4.1	2.0	-0.1; 4.1
Center Northwest	2001-2016	2.0	-2.2; 6.4	2.0	-2.2; 6.4
East	2001-2016	0.8	-6.4; 8.5	0.8	-6.4; 8.5
North	2001-2016	-0.2	-2.7; 2.4	-0.2	-2.7; 2.4
West	2001-2016	1.5	-3.1; 6.4	1.5	-3.1; 6.4
South	2001-2009	-4.9	-9.9; 0.4	-0.4	-10.7; 11
	2009-2012	23.0	-31.7;121.3		
	2012-2016	-6.9	-20.5; 9.1		
Mato Grosso	2001-2016	1.6	-0.3; 3.5	1.6	-0.3; 3.5
C16 stomach					
Center North	2001-2016	-1.6	-4.0; 0.9	-1.6	-4.0; 0.9
Center Northwest	2001-2016	**-5.9***	**-10.8; -0.7**	**-5.9***	-10.8; -0.7
East	2001-2016	-4.7	-10.4; 1.4	-4.7	-10.4; 1.4
North	2001-2016	-2.2	-6.7; 2.4	-2.2	-6.7; 2.4
West	2001-2016	-1.4	-4.5; 1.7	-1.4	-4.5; 1.7
South	2001-2016	-2.6	-6.0; 1.0	-2.6	-6.0; 1.0
Mato Grosso	2001-2016	**-2.5***	**-4.9; -0.1**	**-2.5***	**-4.9; -0.**1

APC - annual percent change; AAPC - average annual percent change; 95%CI - 95% confidence interval; * ($p < 0,05$).

Source: Authors.

decreasing, and for women, the Central North from 2001 to 2016, which was increasing, and South, which decreased from 2001 to 2007 and increased from 2007 to 2016. In relation to the state, for women there was a reduction from 2001 to 2008 and an increase from 2008 to 2016. Unlike the study that analyzed incidence trends in Cuiabá and Várzea Grande, it showed that for women there was stability in the period from 2000 to 2016 and an increase only for the age group from 50 to 79 years old, while for men it was decreasing for all the age groups[35].

At a global level, over ten years, decreasing incidence trends were identified in lung cancer among men and increasing incidence among women, which may be a reflection of patterns of adherence and cessation of smoking. For men, the countries with the most significant drop were Bahrain (AAPC: -6.53), Colombia (AAPC: -5.69) and Brazil (AAPC: -4.61). For women, there was a more dramatic increase in India (AAPC: 4.34), Brazil (AAPC: 2.43) and South Korea (AAPC: 2.35)[36].

The estimate for 2050 is that there will be around 3.8 million annual cases of lung cancer worldwide, even with current risk levels and age-specific rates[37], and greater preventive interventions are recommended for specific populations[38]. Over the last 20 years, the tobacco control policy in Brazil has resulted in a sharp drop in the prevalence of smokers, due to legislative, social and political changes that have stimulated this change in behavior in society, achieving smoking cessation rates of up to 50%[39].

Smoking is, by far, the most significant risk factor for lung cancer, not only in Brazil but also around the world[39,40]. Despite the decrease in tobacco consumption, the country spends more than three times what it earns on tobacco use, with R$17.5 billion on indirect costs per year and R$39.4 billion on medical costs per year[41]. Since 2014, electronic cigarettes (a mixture of flavorings, solvents, and liquid nicotine) have gained ground in the consumer market around the world[42]. The current electronic cigarette market presents significant challenges for the formulation of regulatory policies, considering that electronic cigarettes are not regulated and with high levels of commercialization via the internet, facilitating substantial access to the product[36]. However, the components present in the particles in e-cigarette vapor can cause inflammatory damage to the airways and lungs, and long-term damage[43].

For colorectal cancer, in both sexes, the state and macro-regions showed a stable trend, except in the North for males, where the trend was increasing. A different result from that observed in São Paulo, which showed an increase in the incidence of colorectal cancer among women, up to the age of 60 and among men, the trend in the incidence rate was increasing up to 29 years and in age groups from 40 years was stable for the total[44]. In low- and middle-income countries the incidence of colorectal cancer has increased, and in high-income countries it has decreased or stabilized[40].

Colorectal cancer is considered a marker of socioeconomic development in low- and middle-income countries[45]. However, in high-income countries, incidence rates show different behavior, especially for individuals over the age of 50, with stability and/or reduction[40,46]. The recommendations to be adopted to control colorectal cancer imply specialized care, combined with the implementation of measures and continuous efforts to monitor trends in the incidence of the disease[40].

Stomach cancer in the state of Mato Grosso showed a decreasing trend in both sexes and also in the Central Northwest and North macroregions for males and Central Northwest for females. Worldwide, the decline in stomach cancer incidence rates began in the mid-20th century, starting in North America and Europe, and in many other countries, including those in Asia and Latin America[47]. In the municipalities of Cuiabá and Várzea Grande, from 2000 to 2016, a decreasing trend in the incidence rate was observed for men and stability for women[20]. In Fortaleza, between 1990 and 2002, stomach cancer showed a decreasing trend for men (APC = -1.9%) and an increase for women (APC = 8.5%)[48].

Esophageal cancer showed a stable trend in the state in almost all health macro-regions, except for the Central Northwest macro-region, which saw a downward trend. In Brazil, the majority of cases are found in men, and increased from 69% in 2005 to 78% in 2015, with an increase in incidence from 12.8 to 19.1/100,000 men in the same period, while rates for women remained stable during the period. It is noteworthy that new cases presented higher concentrations in the southern regions of Brazil[49].

Despite the presence of risk factors such as smoking, physical inactivity, inadequate food consumption and excess weight, on the other hand, there was also a reduction in tobacco consumption and H. Pylori infection, access to better foods (raw vegetables, citrus fruits), being a protective factor for stomach and esoph-

ageal cancer[50-52]. With the rise of new therapeutic technologies and early diagnosis, additional clarification on risk factors helps identify multiple prevention opportunities and reduce the impact of gastrointestinal cancers[52-54].

This study provided information on the temporal trend of the five main types of cancer in Mato Grosso, disaggregated by health macro-regions, demonstrating the importance of RCBP for cancer surveillance in the state. The analysis of time series of cancer incidence is important to assist in the planning and evaluation of public policies for the prevention and control of the disease. This study advanced by analyzing an updated historical series with good representation of cancer in the state of Mato Grosso. Regarding the quality of RCBP data, for the period from 2001 to 2016, it was observed for RCBP Cuiabá, a percentage of cases registered only by death certificate (%SDO) lower than 20% (10.5% for males and 8.7% for females), while for RCBP Interior it was 25.8% for males and 19.4% for females. The percentage of microscopic verification was greater than 70% for registration in the capital and interior[55]. As it is secondary data, it may present problems of underreporting, filling and coding errors, which were minimized by improving the quality of information over time[6].

The most common cancer among men was prostate cancer and showed an increasing trend for the state and four macro-regions, Central Northwest, East, West and South, and for women it was breast cancer with an increasing trend for the state and the Central North macro-region. Also noteworthy is the growing trend of lung cancer for the state in the period from 2008 to 2016 and the Central North and South macro-regions among women and colorectal cancer in the North macro-region among men. For cervical cancer, stomach cancer for both sexes and esophageal cancer for men, there was a reduction in incidence rates during the study period.

Differences in the incidence trends of the five types of cancer between the state's macro-regions may reflect different stages of the demographic and epidemiological transition[8], as well as the socioeconomic profile and the supply of health resources[9,11]. The results reinforce the need for specific cancer surveillance, prevention, control and assistance actions throughout the state, to guarantee the line of care and access to diagnosis and cancer care by strengthening and expanding the cancer treatment network in the Unified Health System. It is relevant to highlight the importance of actions to increase access to primary prevention, early diagnosis, treatment and rehabilitation, taking into account the social disparities that exist in the health macro-regions in the state of Mato Grosso.

Contributions

All authors participated sufficiently in the conception and design of this work and in the analysis of the data, as well as in the writing of the manuscript, to assume public responsibility for it.

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