

# Time Series of Mortality by Neoplasms in the State of Bahia between 2008 and 2018

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*Série Histórica de Mortalidade por Neoplasias no Estado da Bahia entre os Anos de 2008 e 2018*

*Serie Histórica de Mortalidad por Neoplasias en el Estado de Bahía entre los Años 2008 y 2018*

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## ABSTRACT

**Introduction:** Mortality by neoplasms in Brazil is distributed differently among the Macroregions, with the Northeast responsible for the second highest number of deaths and, within this Macroregion, Bahia is ranked first. **Objective:** To analyze the trend of mortality by neoplasms in the State of Bahia and in the nine health Macroregions between 2008 and 2018. **Method:** Ecological study based on deaths by neoplasia (C00-D48) in these Macroregions and registered in the Mortality Information System between 2008 and 2018. Mortality trends by age group were analyzed using the Joinpoint regression, with cancer death as an outcome and year of death as an independent variable. **Results:** There were 115,034 deaths related to neoplasia, 39.2% of which were recorded in the East Macroregion, 53.2% in men, 65.4% in the age group of 60 years or more, 24% with 1 to 3 years of education, 68.6% were black and 50.9% were unmarried. Trends in mortality rates per 100,000 inhabitants adjusted for the age groups of older and younger than 60 years indicated that the number of deaths grew in all Macroregions, however the increase was greater in the North Macroregion for over 60 and in the West Macroregion for under 60 years old. **Conclusion:** Cancer mortality in Bahia Macroregions has increased for both age groups, but there are differences in the profile of cancer mortality among Macroregions in the same state, indicating the need to create policies that address these regional peculiarities.

**Key words:** neoplasms/mortality; indicators of morbidity and mortality; temporal distribution; epidemiology, descriptive; mortality registries.

## RESUMO

**Introdução:** A mortalidade por neoplasias no Brasil se distribui de forma distinta entre as Macrorregiões, sendo a Nordeste responsável pelo segundo maior número de óbitos por neoplasias e, nessa Região, a Bahia ocupa a primeira posição. **Objetivo:** Analisar a tendência da mortalidade por neoplasias no Estado da Bahia e nas nove Macrorregiões de Saúde, entre 2008 e 2018. **Método:** Estudo ecológico, a partir dos óbitos por neoplasia (C00-D48) nessas Macrorregiões, registrados no Sistema de Informações sobre Mortalidade entre 2008 e 2018. As tendências de mortalidade por faixa etária foram analisadas pela regressão *Joinpoint*, tendo como desfecho morte por câncer e ano do óbito como variável independente. **Resultados:** Ocorreram 115.034 óbitos relacionados à neoplasia, sendo 39,2% registrados na Macrorregião Leste, 53,2% em homens, 65,4% na faixa etária de 60 anos ou mais, 24% com 1 a 3 anos de escolaridade, 68,6% eram negros e 50,9% eram não casados. As tendências das taxas de mortalidade por 100 mil habitantes, ajustadas para as faixas etárias de maiores e menores de 60 anos, indicaram que houve aumento dos óbitos em todas as Macrorregiões, entretanto, o incremento foi maior na Macrorregião Norte para maiores de 60 anos e na Macrorregião Oeste para menores de 60 anos. **Conclusão:** A mortalidade por câncer nas Macrorregiões baianas aumentou em ambas as faixas etárias, porém há diferenças no perfil de mortalidade por câncer entre as Macrorregiões de um mesmo Estado, indicando a necessidade de criação de políticas que levem em consideração essas peculiaridades regionais.

**Palavras-chave:** neoplasias/mortalidade; indicadores de morbimortalidade; distribuição temporal; epidemiologia descritiva; registros de mortalidade.

## RESUMEN

**Introducción:** La mortalidad por neoplasias en Brasil se distribuye de manera diferente entre las Macrorregiones, siendo la Nordeste responsable del segundo mayor número de muertes por neoplasias y, dentro de esta Macrorregión, Bahía ocupa el primer lugar. **Objetivo:** Analizar la tendencia de la mortalidad por neoplasias en el Estado de Bahía y en las nueve Macrorregiones de salud, entre 2008 y 2018. **Método:** Estudio ecológico con base en las muertes por neoplasias (C00-D48) ocurridas en las Macrorregiones de Bahía y registrados en el Sistema de Información de Mortalidad entre 2008 y 2018. Las tendencias de mortalidad por grupo de edad se analizaron mediante la regresión de *Joinpoint*, con muerte por cáncer como resultado y año de muerte como variable independiente. **Resultados:** Se registraron 115.034 defunciones relacionadas con neoplasias, de las cuales 39,2% se registraron en la Macrorregión Este, 53,2% en hombres, 65,4% en el grupo de edad de 60 años o más, 24% con 1 a 3 años de escolaridad, 68,6% eran negros y 50,9% no estaban casados. Las tendencias en las tasas de mortalidad por 100.000 habitantes ajustadas por los grupos de edad mayores y menores de 60 años indicaron que todas las Macrorregiones experimentaron un aumento en el número de muertes, sin embargo, el aumento fue mayor en la Macrorregión Norte para los mayores de 60 años y en la Macrorregión Oeste para menores de 60 años. **Conclusión:** La mortalidad por cáncer en las Macrorregiones de Bahía ha aumentado para ambos grupos de edad, pero existen diferencias en el perfil de mortalidad por cáncer entre las Macrorregiones de un mismo Estado, lo que indica la necesidad de crear políticas que tomen en cuenta estas peculiaridades regionales.

**Palabras clave:** neoplasias/mortalidad; indicadores de morbimortalidad; distribución temporal; epidemiología descriptiva; registros de mortalidad.

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## INTRODUCTION

Cancer is a public health problem in the whole world<sup>1</sup>. In 2018, malignant neoplasms were the second main cause of deaths in the world, one in each six deaths was disease-related, in addition to late diagnosis and inaccessible treatment, mainly in low-and-middle income countries accounting for 70% of deaths by disease<sup>2</sup>.

Brazil has similarities with the global scenario with estimates of growth of 100% of incidence and mortality by cancer from 2018 to 2040<sup>1</sup>. In 2015, according to the National Cancer Institute José Alencar Gomes da Silva (INCA)<sup>3</sup>, deaths by neoplasms responded for 16.6% of the deaths in Brazil, the second cause of death after circulatory system diseases. In 2018, 224,727 deaths by neoplasms were registered, corresponding to 17% of the total of deaths<sup>4</sup>.

Cancer is a highly complex disease, and its growth has been progressive in the country<sup>1</sup>, nevertheless, its distribution across the Brazilian regions is uneven. There is great regional distinction of incidence and mortality associated with socioeconomic factors and access to diagnostic services. Incidence and mortality are concentrated in the Southeast Region with variation of magnitude and types of cancer among Brazilian Regions and States within the same Region<sup>5</sup>. In 2018, for instance, the Northeast region was ranked second in deaths by neoplasms, corresponding to 22.2% and the State of Bahia was the leader with 25% of all deaths by cancer of the Region<sup>6</sup>.

Although Bahia has reached the highest number of deaths by neoplasm of the Northeast Region in 2018, there are few epidemiological investigations about mortality by neoplasms in the State and its Macroregions which points out the necessity of more studies. The objective of this article is to analyze the trend of mortality by neoplasms in the State of Bahia and its nine Health Macroregions from 2008 to 2018. The core concept is the importance of knowing the profile of different types of cancer and devise possible timewise scenario shifting for effective planning of cancer prevention and control in the Region<sup>7</sup>.

## METHOD

Time series ecological study through analysis of the trend of mortality by neoplasms in the State of Bahia and its nine Health Macroregions from 2008 to 2018.

Deaths by domicile, by neoplasms (codes C00 to D48) of the 10<sup>th</sup> Edition of the International Classification of Diseases and Related Health Problems (ICD-10)<sup>8</sup>, of the Mortality Information System (SIM)<sup>9</sup> plus population

estimates can be found at the website of the Computer Department of the National Health System (DATASUS)<sup>6</sup> of the Ministry of Health (MS). If available, data were obtained at DATASUS, being excluded deaths by local of occurrence and not matched to the neoplasms. The information were extracted directly from TabNet23 Win32 2.7 and saved as electronic spreadsheets in Excel<sup>®</sup> and later organized for calculation and analyzes.

The State of Bahia is divided in nine Health Macroregions whose main socioeconomic characteristics and healthcare were investigated to define the territorial context where the deaths occurred. Socioeconomic data of each Health Macroregion included: number of municipalities, resident population (total, per sex and age-range), education and proportion of low-income population extracted from “*Instituto Brasileiro de Geografia e Estatística (IBGE)*”<sup>10</sup> and the Mean Municipal Human Development Index (MHDI) acquired from Teles et al.<sup>11</sup>. To determine healthcare in the Macroregions, the proportion of territorial coverage of Primary Health Care (PHC), number of beds offered by the National Health System (SUS) per population and calculation of the indicators of offer of health services according to the population of each Macroregion the following information were evaluated: number of oncologic services, attending oncologists at SUS and equipment in use (computed tomography, magnetic resonance imaging and mammography) acquired from DATASUS<sup>6</sup>, INCA<sup>12</sup> and Brazil’s National Register of Healthcare Services (CNES)<sup>13</sup>.

Absolute (number of deaths) and relative (percentage of deaths) frequencies of deaths by neoplasms were reviewed according to: sex, age-range, education, marital status, race/color and type of neoplasm per sex in the State of Bahia. Ages were grouped per age-range from 0 to 9; 10 to 14; 15 to 19; 20 to 29; 30 to 39; 40 to 49; 50 to 59; 60 or older. The types of neoplasms were grouped per ICD codes C00 to D48.

Adjusted rates of mortality adopted in the study were based in Segi<sup>14</sup>’s world population distribution per age-range (younger than 60, 60 or older); the adjustment attempted to consider and remove the effects of the factors related to the distribution of the population interfering in the risk of death by cancer, allowing comparison at world level. The joinpoint regression method was utilized to create the time series of mortality of the historical series per age-range, having death by neoplasms as outcome and year of death as independent variable. Adjusted Permutation test was utilized to admit from 0 to 3 joinpoints and estimate the annual percent variations (APC) with confidence intervals of 95% (CI95%)<sup>15</sup>, working with mortality rates by neoplasm in the age-ranges defined for

each year and by Health Macroregions. Statistical analyzes used the software Joinpoint Regression Program, version 4.8.0.1 (2020).

In compliance with Resolution 466/2012 of the National Health Council<sup>16</sup> the Institutional Review Board approval was waived because only anonymized and publicly available data were acquired.

## RESULTS

Females are predominant in all the nine health macroregions (Table 1), except in the Extreme South, mostly in the age-range of 20-39 years old, accounting for 30% of the population and at least 33% were illiterate or failed to complete until the 5<sup>th</sup> grade of elementary school. Nearly 60% of the population in each macroregion has low-income, except in the Macroregion East responding for 40%. The average MHDH varied little, it was higher, 0.631, in the Macroregion East. It was found great variation in the area (km<sup>2</sup>), population, quantity of municipalities of the macroregions and consequently in the demographic density which ranged from 6.0 population/km<sup>2</sup> in Macroregion West to 291.8 population/km<sup>2</sup> in the East.

Between 2008 and 2028, 115,034 deaths by neoplasm in Bahia were counted, 39.2% in Macroregion East with 53.2% of males. 65.4% of the deaths occurred in the age-range from 60 years of age or older, with predominance of blacks (total of who claimed to be blacks and browns), corresponding to 68.6%. 24% of the deaths in the State were of individuals with one to three years of education, but for 26.7%, this data was unknown. 50.9% were unmarried. In absolute figures, malignant neoplasms of digestive organs (19,269 deaths), malignant neoplasms of the male genital organ (12,382 deaths) and malignant neoplasms of the respiratory system and intrathoracic organs (8,438 deaths) in the male population stand out. For females, the high number of deaths occur in digestive organs (15,675 deaths), breast neoplasms (8,393 deaths) and malignant neoplasms of the genital organs (8,363 deaths) (Table 2).

It was found that the rates of mortality of all the macroregions of Bahia increased per 100 thousand population adjusted for under and over 60 years of age in the analyzes of the trends as shown in Figure 1. At state level, the increase was 21.12 in 2008 to 28.22 in 2018 for individuals younger than 60 years (APC: 2.82; AAPC: 2.8; CI95%: 2.4 to 3.2) and from 41.70 (2008) to 53.28 (2018) in individuals older than 60 years of age (APC: 1.80; AAPC: 2.4; CI95%: 1.9 to 2.8).

In the older than 60 years group, it was remarkable the increase of the trend of the adjusted mortality in the

Macroregion North which raised the adjusted mortality rate from 231.38 to 432.58 in the period investigated (APC 2008-2013: 13.03; APC 2011-2018: 3.69; AAPC: 6.4; CI95%: 3.8 to 9.1), almost 2-fold in comparison with the West Region, with the second higher increase (APC: 5.95; AAPC: 5.9; CI 3.6 to 8.3). In the population with less than 60 years, the West Region had the highest increase of the trend of mortality (APC 2008-2010: 5.42; APC 2010-2018: 8.60; AAPC: 5.6; CI95%: 3.2 to 8.1), followed by Mid-North (APC: 5.33; AAPC 3.5; CI95%: 3.0 to 7.8) and North (APC 2008-2013: 9.97; APC 2013-2018: 0.62; AAPC 5.2; CI: 1.6 to 8.9). The Regions with lower increase were East (APC 2008-2010: 6.07; APC 2010-2018: 1.30; AAPC: 2.2; CI 1.1 to 1.4) and Northeast (APC: 2.39; AAPC: 2.4; CI95%: 0.8 to 4.0) (Figure 1).

The analysis of healthcare data (Table 3) concluded that the percentage of PHC coverage in Bahia is 73.16% for 2018, however, the Macroregions have variations, the East has the lower percentage of coverage (48.2%) and Extreme South, the highest (94.6%). Macroregions East and South had similar results of attending oncologists at SUS with 0.016 oncologists for each thousand population in December 2018. Two Macroregions, Mid-North and West had no attending oncologists at SUS. Macroregion East had the best proportion of availability of mammography, computed tomography and magnetic resonance imaging for the population followed by Macroregions South and Extreme South. The ratio bed-SUS/population was 1.3 in Macroregion Northeast and 2.3 in Macroregion South.

Figure 2 reveals that the State of Bahia has 19 high complexity oncologic services approved by SUS, nine in the Macroregion East (47.36%) and three macroregions has no oncologic services (Mid-North, Northeast, West).

## DISCUSSION

Based in the results of this study, all the Health Macroregions of Bahia for both age ranges presented trends of increase of mortality rate in concurrence with the country's Northeast Region with estimated raising rates until 2030<sup>17</sup>. This growth is opposed to the perspectives for Brazil's South, Southeast and Mid-West regions because it has been estimated a general decrease of the rates of mortality by cancer between 2011 and 2030<sup>18</sup>.

The analysis of the mortality rates per Macroregion from 2008 to 2028 revealed that Macroregion East has the lowest increase of the rates where Bahia's capital, Salvador is located with the greatest population of the state, higher MHDH and more concentration of oncologic services. Macroregions North and West stand out because the rates

**Table 1.** Socioeconomic aspects of the Health Macroregions. Bahia, Brazil, 2018

Characteristics	Health Macroregions								
	Mid-East	Mid-North	Extreme South	East	Northeast	North	West	Southeast	South
	N=2,210,257	N=803,975	N=828,285	N=4,718,301	N=859,335	N=1,079,265	N=951,612	N=1,749,206	N=1,612,381
<b>Population (%)</b>									
Male	49.1	49.6	50.8	49.6	49.2	47.0	49.7	48.6	49.8
Female	50.9	50.4	49.2	50.4	50.8	53.0	50.3	51.4	50.2
<b>Number of municipalities</b>	72	38	21	48	33	28	37	73	67
<b>Area (km<sup>2</sup>)</b>	74,023.1	47,541.5	30,667.5	16,171.5	19,935.4	92,566.2	158,731.6	85,227.8	39,966.2
<b>Demographic density (population/km<sup>2</sup>)</b>	29.9	17.0	27.0	291.8	43.1	11.7	6.0	20.5	29.9
<b>Age range (%)</b>									
0 to 4 years	7.1	7.7	8.0	6.0	7.3	7.9	8.0	6.7	7.3
5 to 9 years	7.3	7.9	8.0	6.4	7.4	8.0	8.0	7.0	7.5
10 to 14 years	7.9	8.2	8.5	7.3	7.9	8.6	8.4	7.8	7.9
15 to 19 years	8.6	8.4	9.1	8.2	8.7	9.0	8.9	8.3	8.4
20 to 29 years	16.9	16.6	17.1	16.5	17.3	16.9	17.9	16.6	16.5
30 to 39 years	16.3	15.4	16.0	18.0	15.9	15.4	16.3	16.1	16.0
40 to 49 years	13.1	12.6	12.7	14.7	13.0	12.8	11.9	12.8	12.6
50 to 59 years	9.9	9.9	9.6	10.9	9.9	9.4	9.2	10.5	10.4
60 and older	13.0	13.3	11.1	11.9	12.6	12.0	11.2	14.2	13.5
<b>Proportion of low income (%) population</b>	59.7	67.0	51.6	40.8	64.9	63.0	63.2	58.2	59.0
<b>MHDI average* Education (%)</b>	0.589	0.584	0.622	0.631	0.572	0.589	0.600	0.587	0.587
No education/incomplete until 5 <sup>th</sup> grade	36.7	38.3	33.6	18.3	40.0	38.0	37.6	41.6	36.2
Complete until 5 <sup>th</sup> grade/incomplete 5 <sup>th</sup> -9 <sup>th</sup> grade	14.6	15.7	14.3	12.8	15.1	14.1	13.3	14.0	14.8
Complete elementary or more	39.0	34.8	42.4	60.5	35.1	37.4	39.5	34.8	39.6
Unknown	9.6	11.2	9.7	8.3	9.7	10.5	9.5	9.6	9.4

**Caption:** MHDI = Mean Municipal Human Development Index.

**Source:** DATASUS<sup>6</sup>.

increased significantly comparing 2008 and 2018, since the estimates indicated that the regional discrepancies of mortality rate by cancer will possibly be pronounced until 2030<sup>18</sup>.

In 2016 it has been noticed a shift in the trend detected by the joinpoint for the State of Bahia with increase of the standardized mortality rate for 60 years or older, possibly related to the efforts of expansion of oncologic

**Table 2.** Distribution (number and percentage) of the deaths by neoplasms (C00-D48) according to the characteristics of the victims. Bahia, Brazil, 2008-2018

Types of Neoplasm ICD-10	VARIABLES						
	Male	%	Female	%	Ignored	%	Total
C00-C14 Malignant neoplasms of the lip, oral cavity and pharynx	3,912	76.56	1,198	23.44	0	0	5,110
C15-C26 Malignant neoplasms of digestive organs	19,269	55.13	15,675	44.85	5	0,01	34,949
C30-C39 Malignant neoplasms of respiratory and intrathoracic organs	8,438	63.11	4,932	36.89	0	0	13,370
C40-C41 Malignant neoplasms of bone and articular cartilage	646	57.52	477	42.48	0	0	1,123
C43-C44 Melanoma and other malignant neoplasms of the skin	1,054	57.10	792	42.90	0	0	1,846
C45-C49 Malignant neoplasms and mesothelial and soft tissue	710	48.33	759	51.67	0	0	1,469
C50 Malignant neoplasm of breast	112	1.32	8,393	98.66	2	0,02	8,507
C51-C58 Malignant neoplasms of female genital organs	0	0	8,363	100.00	0	0	8,363
C60-C63 Malignant neoplasms of male genital organs	12,382	100.00	0	0	0	0	12,382
C64-C68 Malignant neoplasms of urinary tract	2,019	65.68	1,055	34.32	0	0	3,074
C69-C72 Malignant neoplasms of the eye, brain and parts of central nervous system	2,575	50.80	2,494	49.20	0	0,02	5,069
C73-C75 Malignant neoplasms of thyroid and other endocrine glands	276	38.33	444	61.67	0	0	720
C76-C80 Malignant neoplasms of ill-defined, secondary and unspecified sites	4,612	49.74	4,660	50.26	0	0	9,272
C81-C96 Other and unspecified malignant neoplasms of lymphatic, hematopoietic and related tissue	4,289	53.35	3,750	46.65	0	0	8,039
C97 Malignant neoplasms of independent multiple sites	88	59.46	60	40.54	0	0	148
D00-D09 In situ neoplasms	75	52.08	69	47.92	0	0	144
D10-D36 Bening neoplasms	125	34.25	240	65.75	0	0	365
D37-D48 Neoplasms of uncertain or unknown behavior	570	52.58	514	47.42	0	0	1,084

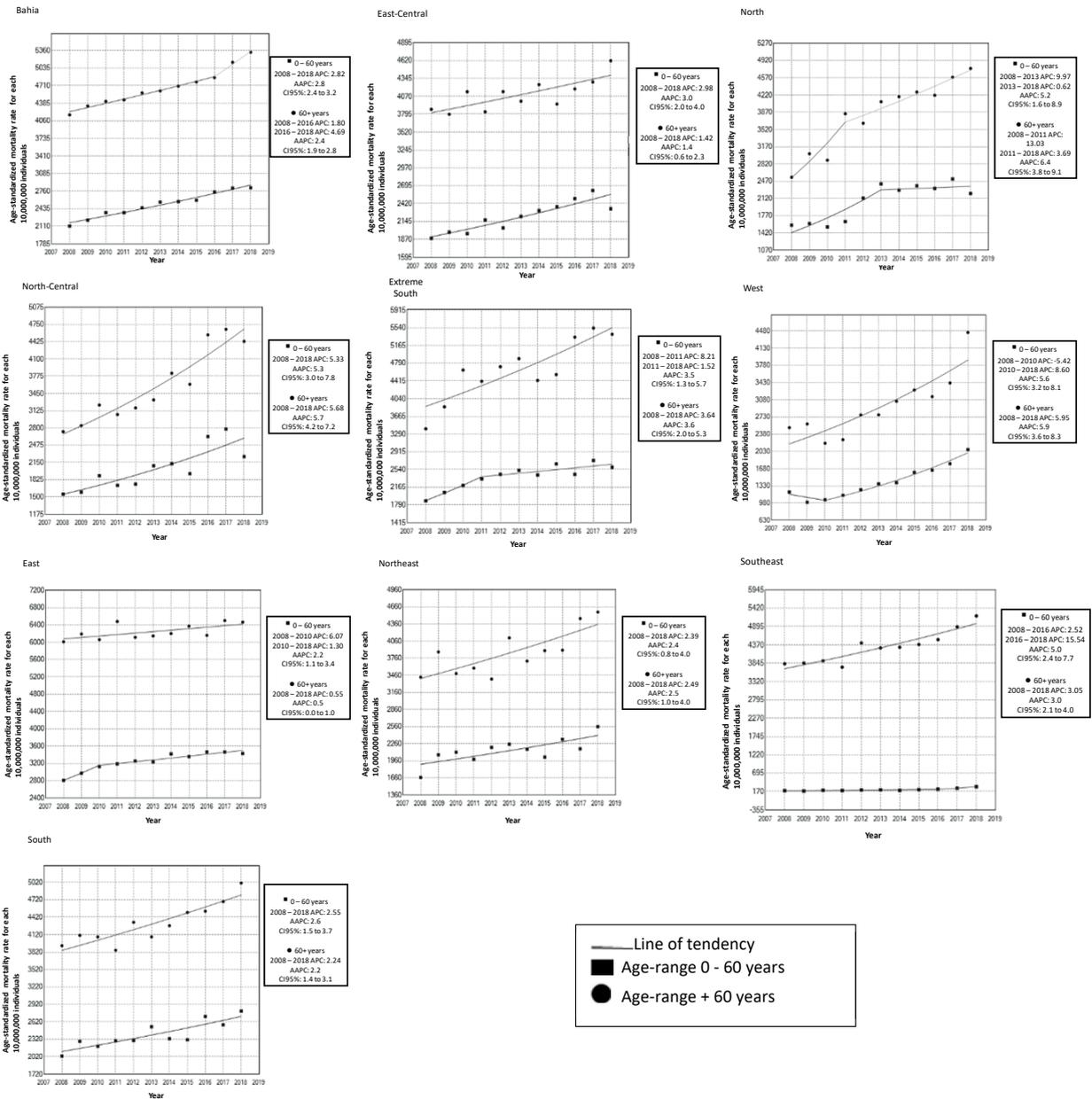
Age-range	n	%	Year	n	Education	n	%	Sex	Cases	%
0 to 9 years	995	0.9	2008	8,201	Illiterate	21,932	19.1	Male	61,152	53.2
10 to 14 years	504	0.4	2009	8,755	1 to 3 years	27,614	24	Female	53,875	46.8
15 to 19 years	694	0.6	2010	9,130	4 to 7 years	15,275	13.3	Ignored	7	0
20 to 29 years	1,893	1.6	2011	9,480	8 to 11 years	13,759	12	<b>Marital Status</b>		
30 to 39 years	4,707	4.1	2012	9,976	12 or more	5,756	5	Unmarried	58,614	50.9
40 to 49 years	10,769	9.4	2013	10,369	Ignored	30,698	26.7	Married	41,961	36.5
50 to 59 years	20,248	17.6	2014	10,731	<b>Race/Color</b>			Ignored	14,459	12.6
60 or more	75,203	65.4	2015	11,094	White	51,402	22.3			
					Black	30,848	13.4			
					Yellow	628	0.3			
					Brown	127,070	55.2			
					Indigenous	324	0.1			
Ignored	21	0.0	2018	13,103	Ignored	19,796	8.6			

**Note:** Data acquired from DATASUS<sup>6</sup> and SIM<sup>9</sup>.

care in Brazil and in Bahia in the last years, translated into an increase of the health services at SUS and oncology procedures in the State<sup>19,20</sup>.

There was predominance of deaths among 60-years or older males, consistent with the Brazilian pattern<sup>21</sup>. The analysis of mortality according to the marital status of the

patient revealed predominance of deaths in unmarried patients. Aizer et al.<sup>22</sup> showed that these patients have significantly higher risk of undertreatment and death resulting from their cancer. It stands out the potentially significant impact that social support can have on cancer detection, treatment and survival after the diagnosis<sup>22</sup>.



**Figure 1.** Temporal analysis of the trend of adjusted mortality rates per neoplasm (Chapter II, ICD-10) per Health Macroregions. Bahia, Brazil, 2008-2018

**Captions:** APC = Annual Percent Change; AAPC = Average Annual Percent Change; CI95% = Confidence Interval of 95%.

**Note:** Data acquired from DATASUS<sup>6</sup> and SIM<sup>9</sup>.

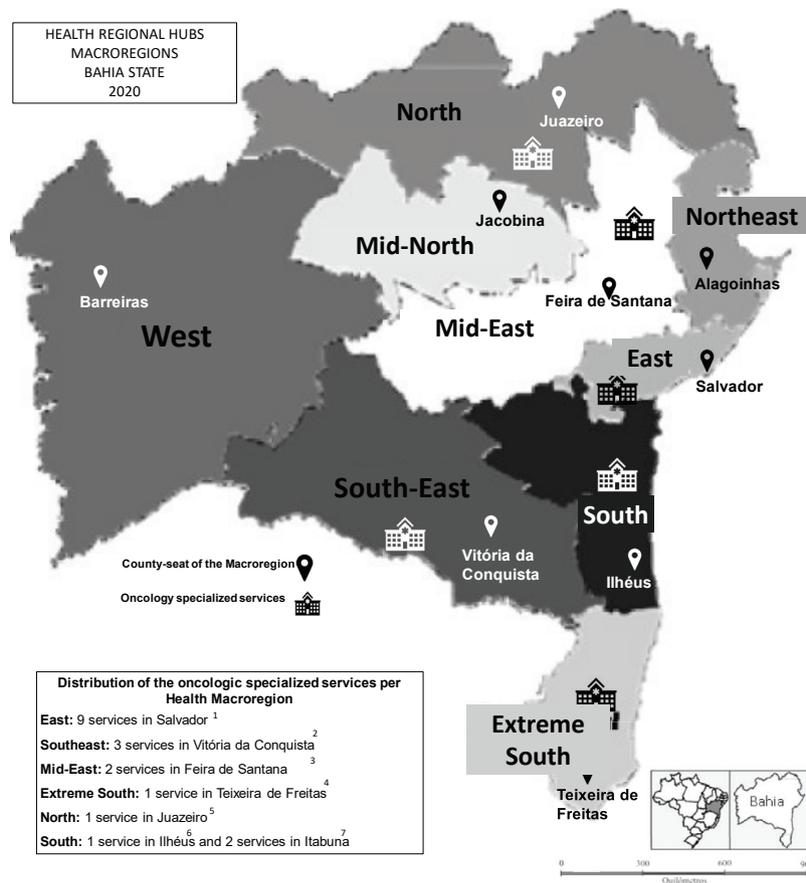
**Table 3.** Characteristics of healthcare per Health Macroregion. Bahia, Brazil, 2018

Characteristics	Health Macroregions								
	Mid-East	Mid-North	Extreme South	East	Northeast	North	West	Southeast	South
Territorial PHC coverage (%)	82.9	93.0	94.6	48.2	85.7	85.5	86.8	81.8	79.2
Number of oncologists at SUS <sup>1</sup>	0.010	0	0.002	0.016	0.002	0.002	0	0.006	0.016
Number of equipments available									
Computed tomography <sup>1</sup>	0.012	0.004	0.016	0.020	0.009	0.008	0.011	0.012	0.018
Magnetic resonance imaging <sup>1</sup>	0.007	0.003	0.010	0.014	0.004	0.003	0.006	0.008	0.007
Mammography <sup>1</sup>	0.018	0.014	0.020	0.030	0.013	0.008	0.014	0.019	0.020
Bed SUS/population	1.8	2.2	1.7	1.9	1.3	1.5	1.7	1.9	2.3

**Captions:** PHC = Primary Health Care; SUS = National Health System.

(<sup>1</sup>) For each 1,000 populations.

**Note:** Data acquired from DATASUS<sup>6</sup> and CNES<sup>13</sup>.



**Figure 2.** Map of distribution of approved hospitals for oncologic treatment per Health Macroregion. Bahia, Brazil, 2020

(<sup>1</sup>) Centro Estadual de Oncologia/Cican (Unacon – High Complexity Oncology Service); Hospital Aristidez Maltez/Liga Baiana contra o Câncer (Cacon with Pediatric Oncology); Hospital Geral Roberto Santos/SES (Unacon with radiotherapy); Hospital Martagão Gesteira/Liga Álvaro Bahia contra a Mortalidade Infantil (Unacon only with Pediatric Oncology); Hospital Português/Real Sociedade Portuguesa de Beneficência (Radiotherapy single service); Hospital Professor Edgard Santos/Hospital Universitário MEC - Universidade Federal da Bahia/Fapex (Unacon with hematology); Hospital São Rafael/Fundação Monte Bator (Unacon with radiotherapy); Hospital Santa Isabel/Santa Casa de Misericórdia da Bahia (Unacon with radiotherapy and hematology); Hospital Santo Antônio/Obras Sociais Irmã Dulce (Unacon with radiotherapy).

(<sup>2</sup>) Conquista Assistência Médica Ltda/Onco-Med Rac (Radiotherapy Service); Hospital Geral de Vitória da Conquista (Unacon); Serviço de Assistência Médica de Urgência - Samur (Unacon with radiotherapy).

(<sup>3</sup>) Hospital Dom Pedro de Alcântara/Santa Casa de Misericórdia de Feira de Santana (Unacon with radiotherapy and hematology); Hospital Estadual da Criança (Unacon only with Pediatric Oncology).

(<sup>4</sup>) Hospital Estadual da Criança (Unacon only with Pediatric Oncology).

(<sup>5</sup>) Hospital Regional de Juazeiro (Unacon).

(<sup>6</sup>) Hospital São José Maternidade Santa Helena/Santa Casa de Misericórdia (Unacon).

(<sup>7</sup>) Hospital Calixto Midlej Filho (Unacon with Radiotherapy); Hospital Manoel Novaes (general hospital with oncologic surgery and radiotherapy).

**Note:** Data acquired from DATASUS<sup>6</sup> and INCA<sup>17</sup>.

Data from Bahia's macroregions have also shown that individuals who have completed until three years of education account for 44.1% of deaths by neoplasm, concurring with the literature which indicated higher life expectancy and better health conditions among those with more years of education and better economic status in addition to higher mortality in individuals with poor education level<sup>25-27</sup>.

The number of deaths per race/color as described in the literature revealed that blacks were affected the most, which is clearly associated with socioeconomic, demographic characteristics and access to health services. In a population-based study, Zeng et al.<sup>28</sup> noticed that Afro

descendants had worse survival than whites for all types of cancer. Additionally, Virnig et al.<sup>29</sup> concluded as well that whites were diagnosed at earlier stages in 31 of the 34 tumor sites when compared with blacks.

The socioeconomic characteristics indicated that the MHDl of all Macroregions of Bahia is within the intermediate category of development, from 0.500 to 0.799. Bray et al.<sup>30</sup> analyzed 27 types of neoplasms in 187 countries and found higher incidence of lung, stomach, liver, colon and esophagus cancers in regions of low or intermediate MHDl, possibly reaching until 62% of the total cases of neoplasms. The same study revealed that the mortality rates are higher for lung, stomach, esophagus,

liver and colorectal neoplasms in these areas<sup>30</sup>. These data concur with the results of the Health Macroregions of Bahia where most common cancers investigated causing death were malignant neoplasms of digestive organ, malignant neoplasms of respiratory system and intrathoracic organs and malignant neoplasms of male genitals.

The elevated number of deaths by malignant neoplasms of digestive organs may suggest important collaboration of environmental and behavioral factors typical of the region and help to increase risk factors for this cancer. Mostly, it is a low socioeconomic level population with more propensity to infection by *Helicobacter pylori*<sup>31</sup>, tobacco use, intake of salty and smoked food and low intake of fruits and vegetables which increase the risk for these neoplasms<sup>32</sup>. The number of deaths by malignant neoplasms of the respiratory system and intrathoracic organs can be related to the continuation of tobacco use as an important problem for this region because although it had reduced significantly in the last years, the Northeast Region had the third higher proportion of smokers with 18 years or more in the country accounting for 14.2% of its population<sup>33</sup>. The profile of mortality may still be associated with tobacco use in the past as the latency period of this pathology may last for nearly 30 years<sup>34</sup>.

Clearly, socioeconomic level is also an important predictor of neoplasms morbimortality, specifically in regard to access to health services, historically poor for underserved population, impeding early screening, a major survival factor for oncologic patients<sup>35</sup>. The peculiarities of each macroregion such as the inequalities in accessing diagnostic and treatment, the impact of tobacco control programs, health centers, among others coexisting in the same State should be analyzed<sup>36</sup>. The justification is grounded in the necessity of understanding the structuring role of PHC coverage and healthcare data for actions of neoplasm control<sup>37</sup>.

The diagnosis and treatment of cancer, as highlighted in article 8 of Directive 1,399 dated December 17, 2019<sup>38</sup>, hypothesize an actual liaison between the macroregional attention including PHC, outpatient and hospital diagnostic services and approved hospitals in providing high complexity oncologic services. Activities involving the promotion of health, risk reduction or ensuring low risk, early detection and diseases screening although not all types of cancer are subject to these actions stand out in the initiatives conducted by Brazilian PHC. Screening and diagnosis or early detection are relevant in the practice, especially for breast and cervical cancers because according to the guidelines, screening should be offered in this context. PHC actions, it should be brought up, are not limited to early diagnosis and cancer prevention<sup>39</sup>.

The data the current study disclosed about PHC coverage per macroregion of Bahia suggest that the actions developed, given the high coverage in most of the macroregions can be successful if professional ability is in place for early detection of neoplasms and liaison among other services of the State Cancer Attention Network<sup>40</sup>.

The Northeast region accounts for 27% of the Brazilian population and 17.8% of the doctors, with a ratio of 1.41 doctors per thousand population, well below the national ratio of 2.18 and ahead only of the North region when compared to other country's regions. The region has also only 18.33% of oncologists and 50% of the doctors are concentrated in the capitals in the same State, another important discrepancy<sup>41</sup>.

Macroregion East concentrated the attending oncologists at SUS, a data also confirmed by Scheffer<sup>41</sup>, with a rate of 1.35 physicians per population while the rate in the State capital is 4.14, accounting for 59.1% of the State's physicians.

Directive GM 1101 dated June 12, 2002 defined the parameters for the number of computed tomography, magnetic resonance imaging and mammography equipment: 0.42 mammography per 100 thousand population, 0.2 magnetic resonance imaging per 100 thousand population and one computed tomography per 100 thousand population<sup>42</sup>. It was found great concentration of these equipment in Macroregion East, above the recommended by the Directive and other macroregions were below these parameters. The uneven distribution of these equipment, although the analysis is limited, shows the inequality of access to the exams, possibly delaying the diagnosis of cancer.

Timing and geographical variations detected in the offer of hospital beds by SUS allows the understanding and identification of inequalities. Similar results of the distribution of beds SUS/population were found in all the State's Macroregions with little variation. The distribution of high complexity oncology services in Bahia guided by Directive 458 dated February 24, 2017<sup>43</sup> and Directive 1399, dated December 17, 2019<sup>38</sup> reveals the regional concentrations, standing out the regions where none of these services is found; this scenario reduces the coverage, access to diagnosis in addition to delayed care to the patients<sup>40</sup>.

Macroregion East has the highest density and concentration of oncology services, number of attending oncologists at SUS and number of equipment; these findings corroborate the literature about the concentration of healthcare in the Brazilian capitals and the conclusions by Goldman et al.<sup>44</sup> on national gaps also found regionally, which clearly contribute for the poor quality of the care

offered to the community. Historically, this Macroregion, where the State's capital is located, concentrates the offer of healthcare, particularly High Complexity Oncology Services<sup>40</sup>.

The guiding question of the 2011 Operational Auditing Report of the Federal Audit Court to evaluate the Policy of Oncologic Attention was: *Has the oncologic care network ensured to patients with cancer the timely and egalitarian access to diagnosis and treatment?*<sup>45</sup>.

Typically in the State of Bahia, the diagnosis occurs at advanced cancer staging which reveals difficulties for early diagnosis associated with poor offer of services, inadequate performance of PHC and early screening, further to inefficiency of Medium Complexity Attention<sup>40</sup>. Geographical barriers, delay of consultation with expert physicians and difficult in scheduling exams impact the diagnosis and early cancer treatment as the current study concluded.

The study limitations include the quality of the data of the national information systems, the uneven macro and microregional coverage, mainly in low socioeconomic areas, correction of the mortality data with redistribution according to sex and age-range, completeness of the death certificate and deaths by ill-defined causes, and potential inconsistent socioeconomic and oncology services data per Health Macroregion acquired for 2018 and 2020.

Studies of trends of mortality have flaws, mainly due to the quality of the mortality data along the time and the conclusions should be reached cautiously because of inconsistencies. Regardless of the limitations, the results may help the local epidemiological surveillance, planning and organization of the oncologic care to improve the approach to neoplasms considering the inequalities within the Health Macroregions of Bahia.

## CONCLUSION

The analysis of the trend of mortality by neoplasms in Bahia and its nine Health Macroregions from 2008 to 2018 revealed that the number of deaths by neoplasm increased for all Macroregions, but it was higher in the Macroregion North for older than 60 years of age and in the Macroregion West for 60 years or less. These results reveal the regional differences within the State and the necessity of creating policies addressing this issue.

All the State's macroregions in the period investigated presented raising trend of mortality by cancer notwithstanding the efforts of decentralization of health services. The findings may indicate that the prevention and treatment-centered public policies have not been effective or appropriate; each region of the State needs different approaches because of regional inequalities in

socioeconomic conditions, access and accessibility to health services for timely diagnosis and correct treatment.

The analysis of several variables related to mortality by cancer is important for the endorsement of screening policies and care to oncologic patients according to the State Plan of Attention to Cancer. This was the first study analyzing the profile of mortality by neoplasms in the State of Bahia due to the relevance of providing epidemiological information and hospital care.

## CONTRIBUTIONS

All the authors contributed substantially for the study design, acquisition, analysis and/or interpretation of the data, wording, critical review and approved the final version to be published.

## DECLARATION OF CONFLICT OF INTERESTS

There is no conflict of interests to declare.

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