Temporary trend of breast cancer mortality in the state of Santa Catarina in the period from 1996 to 2019

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ABSTRACT

Introduction: Breast cancer is the most common female cancer and the leading cause of cancer death in women around the world. It has repercussions not only on human health, but also on health services due to the high incidence resulting in a large number of consultations and treatments. The disease is responsible for a large demand for hospitalizations throughout Brazil, where an increase in mortality rates is observed and Santa Catarina does not differ from the national scenario. The study aimed to analyze the temporal trend of the breast cancer mortality rate in the state of Santa Catarina from 1996 to 2019 **Methods:** This is an ecological epidemiological study of time series of breast cancer mortality in the population residing in the state according to age groups and health macro-regions. Data were obtained from the Mortality Information System and the Brazilian Institute of Geography and Statistics. Simple linear regression of standardized mortality rates according to the world standard population was performed. $p<0.05$ was considered significant. **Results:** Data showed 9,637 deaths in the period. There was a significant upward trend in mortality in the state (from 6.50 to 7.92/100,000 women). An upward trend was observed in the age groups of 30–39 years, 60–69 years, and over 80 years. All seven health macro-regions showed an upward trend in mortality. **Conclusion:** The overall mortality rate from breast cancer in Santa Catarina showed a significant upward trend. A significant increase was also observed in the age groups of 30–39 years, 60–69 years, and 80 years old or older and in all health macro-regions. Problems in public health infrastructure, lack of control of risk factors and deficiency in mammographic screening are revealed. The elaboration and strengthening of public policies to control the disease are fundamental.

KEYWORDS: breast neoplasms; mortality; time series.

INTRODUCTION

Breast cancer is the most common female cancer worldwide — except for non-melanoma skin cancer — and represents a serious public health problem. It is a disease that does not recognize borders, ethnicities, or social classes, which affects women all over the world and is the main cause of cancer mortality in the female universe[1-3]. It has a higher incidence and mortality in underdeveloped countries, mainly due to difficult access to health care and late diagnosis[1-3]. These rates show an international upward trend, especially in underdeveloped countries[3], being very different between regions depending on the lifestyle of each population and exposure to risk factors such as age, long menstrual history (early menarche and late menopause), nulliparity, late primigravidae, sedentary lifestyle, alcoholism, obesity, and use of hormone replacement therapy[2-4]. Its impact is observed not only on human health, but also on economy due to its high incidence resulting in high morbidity and mortality and high therapeutic cost[5].

In Brazil, there is also an increase in these rates[5], mainly in the North and Northeast regions[6]. Likewise, there was an increase in the mortality rate in the South of the country, mainly in the state of Rio Grande do Sul[7]. The disease is responsible for a large demand for hospitalizations, thus increasing the cost of treatment[6]. Santa Catarina does not differ from the national and international scene; the rates tend to increase, mainly due to the longevity of the state's population[8].

Early diagnosis and treatment stages are important for a favorable prognosis[2,3], therefore, prevention strategies and investment in public health are essential[2,5].

Therefore, the analysis of the behavior of breast cancer in Santa Catarina, in order to identify the epidemiological profile and establish projections, may help in providing subsidies for the

planning of public health policies, prevention, implementation and elaboration of health promotion actions and early diagnosis or palliation of the disease, to be carried out by public and private entities.

Based on these assumptions, the objective of this research was to analyze the temporal trend of the breast cancer mortality rate in the state of Santa Catarina from 1996 to 2019.

METHODS

An epidemiological study with an ecological time series design was carried out. Cases of female deaths from breast cancer in individuals residing in Santa Catarina were included from the Mortality Information System database, made available by the Department of Informatics of the Unified Health System, according to age groups and macro-regions in the period of 1996 to 2019. All cases of deaths due to malignant neoplasm of the breast, CID 10–C50, of women residing in the state of Santa Catarina during the study period were included. Population data were obtained from the Brazilian Institute of Geography and Statistics through the 1991, 2000 and 2010 censuses and intercensal estimates for the other years.

Dependent variables were general mortality rates from breast cancer and specific ones according to age range (0–19, 20–29, 30–39, 40–49, 50–59, 60–69, 70–79, and 80 years old or older) and health macro-regions (South, North and Northeast Plateau, Center-West and Serra Catarinense, Expanded West, Expanded Florianópolis, Foz do Rio Itajaí, and Alto Vale do Itajaí). The independent variable was the study period (1996 to 2019).

Data were tabulated in Windows Excel and analyzed using the Statistical Package for the Social Sciences (SPSS) 18.0 program. For each year of the period studied, overall mortality rates from breast cancer and by age groups and macro-regions per 100,000 women were calculated. The rates were standardized according to the world population for the general rate of Santa Catarina. For the analysis of temporal trends, mortality rates calculated using the simple linear regression method were used. Using the dependent variables and the years, the models estimated by equation (1) were obtained:

$$Y = b_0 + b_1 X \qquad (1)$$

Where
Y=rate;
b_0=average rate for the period;
b_1=mean annual increment; and
X=year.

For the behavior of increase, decrease or stability and the mean annual variation in the mortality rate, the positive or negative value and the statistical significance of the regression coefficient, β, were evaluated. It was considered increasing when β was positive and decreasing when β was negative. Values of p<0.05 were considered statistically significant.

The research project was submitted and approved by the Research Ethics Committee of Universidade do Sul de Santa Catarina, with CAAE number 51129621.9.0000.5369. The resources used were from the researchers themselves, without external funding. There are no conflicts of interest on the part of the researchers.

RESULTS

In the analyzed period, there were 9,637 female deaths in Santa Catarina due to malignant neoplasms of the breast. Of the total deaths that occurred in the period, 76 occurred between 20–29 years old (0.78%), 681 between 30–39 years old (7.00%), 1,782 between 40–49 years old (18.50%), 2,442 between 50–59 years old (25.33%), 2,069 between 60–69 years old (21.46%), 1,506 between 70–79 years old (15.62%), and 1,080 over 80 years old (11.20%).

An upward trend was observed in the standardized mortality rate, from 6.50/100,000 women in 1996 to 7.92/100,000 women in 2019, with an increase of 0.0506 in the rate per year (p=0.007) (Figure 1 and Table 1).

The highest mortality rates occurred in the age groups over 60 years. Significant upward trends were observed in the age groups of 30–39 years, 60–69 years, and over 80 years (p=0.041, p=0.003, and p<0.001, respectively). In the 30–39 years old range, mortality rate varied, between 1996 and 2019, from 0.29/100,000 women to 0.54/100,000 women — an increase of 0.006 in the rate per year. In the 60–69 age group, it increased from 1.26 to 1.78/100,000 women between 1996 and 2019, an increase of 0.017 per year. In the age group over 80 years old, it went from 1.05 to 1.67/100,000 women, increasing by 0.024 per year. The other age groups tended toward stable rates but did not show a significant trend (p>0.05) (Table 2).

All health macro-regions showed significant upward trends in crude breast cancer mortality rates in the state of Santa Catarina (Figure 2). The biggest increase occurred in the region of Foz do Rio Itajaí, with an increase of 0.524 per year in the period from 1996 to 2019, increasing from 4.15 to 22.27/100,000 women. The North and Northeast Plateau region increased by 0.493 per year in the period, from 7.30 to 18.83/100,000 women. The South region at the beginning of the period had a rate of 0.75/100,000 women, increasing to 17.86/100,000 women at the end of the period, an annual increase of 0.482. In Alto Vale do Itajaí, the mortality rate increased from 9.23/100,000 women in 1996 to 19.15/100,000 women in 2019, an increase of 0.388 per year. In the Center-West and Serra region, the annual increase was 0.384, going from 7.87/100,000 women to 13.21/100,000 women in the period. In Expanded Florianópolis, the mortality rate was 13.08/100,000 women to 21.85/100,000 women, an increase of 0.351 between 1996 and 2019. The Expanded West region was the one with the lowest annual increase — 0.029 per year, from 6.04/100,000 women in 1996 to 14.82/100,000 women in 2019 (Table 3).

In 1996, the lowest mortality rate was found in the Foz do Rio Itajaí region (4.15/100,000 women) and the highest in Expanded Florianópolis (13.08/100,000 women). In 2019, the lowest rate was found in the Center-West and Serra (13.21/100,000 women) and the highest mortality rate in Foz do Rio Itajaí (22.27/100,000 women).

DISCUSSION

This is a research that sought to analyze the temporal trend of the breast cancer mortality rate in the state of Santa Catarina from 1996 to 2019. The results showed an upward trend with an average annual increase of 0.05 in the rate (p=0.007).

According to the World Health Organization, countries in Asia and Latin America have shown an increasing trend in mortality from breast cancer in the last three decades[4].

A study by Silva et al.[9] showed an increase of 1% in annual mortality from breast cancer in Brazil between 2004-2017 (p<0.001). Couto et al.[10] also showed an increasing trend in breast cancer mortality in Brazil between 1990 and 2010. They also revealed a significant difference in regional mortality; mortality was higher in the South region and lower in the North.

A study carried out by Rodrigues et al.[11], in the period from 2000 to 2015, pointed to an increase in the coefficients of mortality from breast cancer in Brazil, with a standardized rate of 30.15/100,000 women. The South region had the highest rate (38.55/100,000 women) and the North had the lowest (23.22/100,000 women). Lôbo et al.[12] showed an increase in mortality from breast cancer in the state of Alagoas between 2001 and 2016; the rate went from 6.4/100,000 women to 11.1/100,000 women, an increase of 4.30% per year over the period studied.

Table 1. Breast cancer mortality rates (per 100,000 women) in Santa Catarina, from 1996 to 2019.

| Year	Number of deaths	Crude mortality rate	Standardized mortality rate
1996	204	8.37	6.50
1997	239	9.64	7.74
1998	260	10.34	8.45
1999	244	9.57	7.98
2000	278	10.35	7.85
2001	264	9.66	7.44
2002	293	10.56	7.43
2003	296	10.52	7.81
2004	283	9.92	7.49
2005	324	11.00	8.47
2006	320	10.70	8.01
2007	344	11.31	7.12
2008	346	11.36	6.98
2009	400	12.99	7.81
2010	435	13.82	8.10
2011	470	14.77	8.89
2012	491	15.27	9.16
2013	518	15.53	8.02
2014	532	15.74	8.48
2015	567	16.55	8.81
2016	585	16.84	8.52
2017	617	17.53	9.11
2018	661	18.54	8.12
2019	666	18.45	7.92
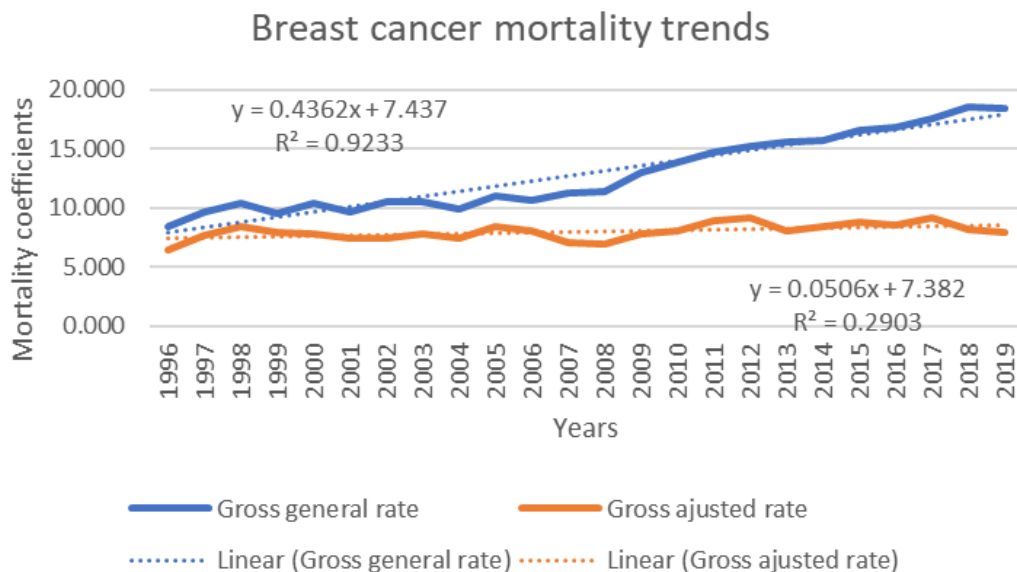
Figure 1. Trend in the crude and standardized mortality rate due to breast cancer (per 100,000 women) in Santa Catarina, from 1996 to 2019.

A study carried out by Silva et al.[13] in Santa Catarina also revealed an increase in the mortality trend; mortality rates increased from 3.78/100,000 women in 2000 to 8.38/100,000 women in 2017.

The present research brought data compatible with the literature when compared with national and regional studies, as it presents an increase in mortality. The state of Santa Catarina has the highest life expectancy in the country, so an increase in breast cancer numbers is already expected due to the simple aging of women in Santa Catarina[12,14]. A change in the demographic pyramid with a decrease in the fertility rate, postponement of the first pregnancy, and income growth contribute to the increase in the rates[4,10,15]. It is also worth considering the improvement in the recording of mortality data, in addition to population growth[16].

Diverging from this study, Siegel et al.[17] found a downward trend in mortality from the disease in the United States of America (USA) in the period from 2010 to 2019. This drop was associated with early diagnosis, mammographic screening, and treatment evolution. Wojtyla et al.[18] observed a decreasing trend in mortality across the European continent between 1980 and 2017.

The international literature reveals that European countries, as well as the USA, have shown a decrease in mortality rates for years. Epidemiological data differ from those found in this research, but corroborate the fact that the state of Santa Catarina, despite its development compared to other states, is part of a developing country.

This work revealed a stationary trend in mortality in each of the age groups 0–19, 20–29, 40–49, 50–59, and 70–79 years. A significant tendency toward an increase in the rate was observed in the age groups between 30–39 years, 60–69 years, and ≥80 years. The concentration of deaths occurred between 50–69 years (46.79%).

A study carried out by Basílio et al.[15] pointed to an increase in mortality from breast cancer in the South and Southeast regions, between 1980 and 2005, in the age groups of 60–69 years, 70–79 years, and ≥80 years, corroborating the findings of this study. Carvalho et al.[19] pointed to an increase in mortality from breast cancer in women over 60 years of age in the Northeast between 2010 and 2015. The research by Rodrigues et al.[11] showed an increase in mortality rates with advancing age between 2000 and 2015 in state capitals.

Lôbo et al.[12], in a study carried out in the state of Alagoas between 2001 and 2016, showed a stationary trend in mortality from breast cancer in women aged between 20 and 39 years and an increase in mortality in other age groups, highlighting the significant increase in 9.2% per year in women over 80 years of age.

Barros et al.[16] showed that between 2005 and 2015, in Ceará, the number of deaths from breast cancer increased considerably from the age of 40, with the highest mortality rates observed in the age groups of 50–59 years and 60-69 years.

In disagreement with the present study, Silva et al.[13] observed a decreasing trend in the mortality of women from Santa Catarina in the age groups of 20–39 years, 60–69 years, and 70–79 years in the period from 2000 to 2017.

The increase in mortality with aging was already expected due to the behavior of the disease[12] and to socioeconomic development[19]; however, with the greater longevity of women from
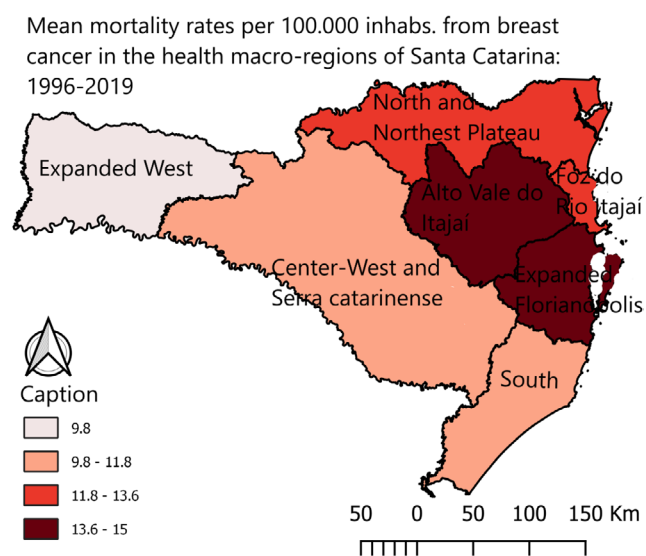

Figure 2. Mean mortality rates from breast cancer in the health macro-regions of Santa Catarina, from 1996 to 2019.

Table 2. Regression coefficients and statistical significance of the standardized breast cancer mortality trend, according to age range, in Santa Catarina, from 1996 to 2019.

Age range	Regression coefficient	95%CI	p-value	R²	Correlation coefficient
20–29 years	0.002	-0.001; 0.003	0.055	0.159	0.39
30–39 years	0.006	0.000; 0.011	0.041	0.176	0.42
40–49 years	0.000	-0.009; 0.009	0.995	0.000	0.00
50–59 years	0.001	-0.011; 0.013	0.884	0.001	0.00
60–69 years	0.017	0.007; 0.028	0.003	0.341	0.58
70–79 years	-0.001	-0.025; 0.022	0.906	0.000	0.00
≥80 years	0.024	0.012; 0.036	<0.001	0.432	0.66

Table 3. Regression coefficients and statistical significance of crude mortality trends from breast cancer, according to health macro-regions in Santa Catarina, from 1996 to 2019.

Health macro-region	Regression coefficient	95%CI	p-value	R^2	Correlation coefficient
Expanded West	0.029	0.129; 0.462	0.001	0.381	0.62
Center-West and Serra	0.384	0.267; 0.501	<0.001	0.679	0.82
Alto Vale do Itajaí	0.388	0.280; 0.490	<0.001	0.738	0.86
Foz do Rio Itajaí	0.524	0.360; 0.680	<0.001	0.670	0.82
Expanded Florianópolis	0.351	0.200; 0.490	<0.001	0.528	0.73
South	0.482	0.380; 0.570	<0.001	0.828	0.91
North and Northeast Plateau	0.493	0.380; 0.590	<0.001	0.814	0.90

Santa Catarina, a higher concentration of deaths was observed from the age of 50, and 46,79% of deaths in the studied period occurred between 50 and 69 years. 26.28% of deaths occurred between 20–49 years of age, and 26.82% over 70 years of age. These data draw attention to the fact that 53.10% of the deaths shown in this study occurred outside the screening age expected by the Ministry of Health[20].

With regard to breast cancer mortality rates in the health macro-regions of Santa Catarina, all seven macro-regions showed an increasing trend in the mortality rate during the study period. The highest crude mortality rates, at the end of the period, were observed in the coastal regions: Foz do Rio Itajaí (22.27/100,000 women), Expanded Florianópolis (21.85/100,000 women), and Alto Vale do Itajaí (19.15/100,000 women). The highest annual increases during the study period were observed in the regions of Foz do Rio Itajaí (0.524), North and Northeast Plateau (0.493), and South (0.482).

In this context, Silva et al.[9] observed a greater increase in mortality from breast cancer in the capitals of the South region than in other regions between 1980 and 2017. Couto et al.[10], in turn, showed higher mortality rates from breast cancer in Brazilian municipalities with a population greater than 500,000 inhabitants or smaller than 5,000 inhabitants, associating the fact with less access to health in small municipalities and displacement to large urban centers for medical care.

The results of this study should be interpreted with caution. All research carried out using secondary data is subject to bias arising from possible delays and errors in recording deaths and population estimates, despite the fact that the research was carried out based on available official data. Another important limitation lies in the fact that the standardization of mortality rates by health macro-region was not possible due to the difficulty in obtaining population data by region. Thus, the upward trends in gross rates in the macro-regions can, in part, be attributed to demographic dynamics with an aging population in the period studied.

The upward trend in mortality from breast cancer in the state suggests the need to review public policies for coping with the disease. Considering the severity of the disease, the impact generated for the woman and her family, and the social and economic cost, it is necessary to review and strengthen public policies for prevention and early diagnosis — behavioral measures to control exposure to risk factors such as smoking, alcoholism, and obesity, for example. In addition, it is important to improve access to mammographic screening and to carry out studies on the suitability of expanding the screening age, since its positive predictive value depends on the prevalence of the disease and a significant portion of deaths occur outside the current screening range recommended by the Ministry of Health. All of these are essential measures for controlling breast cancer.

CONCLUSIONS

The overall mortality rate from breast cancer in Santa Catarina showed a significant upward trend. There was also a significant increase in the age groups 30–39 years, 60–69 years, and 80 years or more and in the seven health macro-regions of the state.

Based on the results presented, it is possible to determine the importance of breast cancer in the state of Santa Catarina and the damage caused to women in this region. The results contribute to the knowledge of the general panorama of female mortality and help to provide knowledge for the elaboration of public policies, whether for prevention or diagnosis.

It is extremely important to monitor the disease, as it causes damage to women's health in the state of Santa Catarina. Despite the high numbers of mortality, with the improvement of indicators and investments in the health area, it is expected that mortality will be controlled and that, in the future, the rates will begin to decrease.

AUTHORS' CONTRIBUTION

GAOA: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Supervision, Visualization, Writing – original draft, Writing – review & editing. ESAT: Formal analysis, Methodology, Supervision, Writing – review & editing. GOCP: Formal analysis, Software.

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