Race Disparities in Mortality by Breast Cancer from 2000 to 2017 in São Paulo, Brazil: is it a Matter of Access to Care?

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Research Article

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Abstract

Purpose To evaluate the influence of race on breast cancer mortality, this work aims to demonstrate the evolution of rates in the state of São Paulo, from 2000 to 2017, contextualizing with other causes of death.

Methods A retrospective cross-sectional time-series study using age and race as variables. Information on deaths was collected from the Ministry of Health Information System. Only white and black/brown categories were used. Mortality rates were age-adjusted by the standard method. For statistical analysis trend-tests were carried out.

Results In the period there were 60,940 deaths registered as breast cancer deaths, 46,365 in white and 10,588 in black women. The rates for 100,000 women in 2017 were 16.46 in white and 9.57 in black women, a trend to reduction in white ($p=0.002$), and to increase in black women ($p=0.010$). This effect was more significant for white women ($p<0.001$). The trend to reduction was consistent in all age-groups in white women, and the trend to increase was observed only in the 40-49 years group in black women. For ‘all-cancer causes’ the trend was to a reduction in white ($p=0.031$) and to increase in black women ($p<0.001$). For ‘ill-defined causes’ and ‘external causes’, the trend was to a reduction in both races ($p<0.001$).

Conclusion Mortality rates due to breast cancer in São Paulo were influenced by race. The divergences observed between white and black women may indicate differentiated access to health resources, contributing to the inequities that exist in the health of the black population in our setting.

Introduction

Breast cancer is the main neoplasm that affects women in Brazil and worldwide, representing about 56 new cases and 13 deaths per 100,000 Brazilian women annually [1, 2]. It is a relevant public health problem, due to the number of lives affected, the impact on potentials life-years lost and the impact of the diagnosis and treatment on the health system. The incidence of breast cancer is increasing worldwide [3]. This increase is justified by the socioeconomic improvements, causing changes in women's habits, increase exposure to risk factors, such as postmenopausal hormonal therapies and obesity, and the widespread use of mammography detecting indolent cancers [3–5].

In recent years, breast cancer mortality rates have decreased in high-income countries, while it has increased in low and middle-income countries [3, 6, 7]. Mortality from breast cancer is strongly influenced by stage and treatment [8]. The stage at diagnosis is influenced by women's access and adherence to early diagnosis programs. Mammography, when systematically applied to the target population, can reduce mortality from breast cancer [9].

In South America and the Caribbean, the ratio between mortality and incidence is greater than observed in countries of Europe and North America [6]. In Latin America, 41% of women are diagnosed in stages III

and IV, with increasing incidence and mortality [10]. In Brazil between 1980 and 2009, a country with great regional inequalities, there was a trend to reduce mortality rates in the economically favoured Southeast Region, and to increase rates in the poorest Northeast region [11]. From 2001 to 2011 the Human Development Index significantly influenced mortality rates in Brazillian states [12]. Socioeconomic differences may explain those shreds of evidence.

Blacks and browns correspond to 55% of the Brazilian population and represent the most economically disadvantaged strata [13]. In addition to social marginalization, this group also faces structural racism that can hamper access to health services and compromise the quality of care. This population has a higher degree of illiteracy, lower-income, uses health services less and is more dependent on the public health system [14]. They also have lower life expectancy and mortality rates due to external causes, drug use and homicides [14].

Mortality rates due to breast cancer increased in black and brown women in Brazil aged 50 or more between 2000 and 2010 [15]. A regional study from 2003 to 2005 found that black women with breast cancer were diagnosed at more advanced stages and had shorter survival than white women in the same stage of diagnosis: specific 10-year survival of 70% for white and 44% for black [16].

To evaluate the influence of race on breast cancer, this work aims to demonstrate the evolution of mortality rates in the state of São Paulo as a function of race, from 2000 to 2017. We also sought to contextualize the breast cancer deaths with other causes of death. It is hoped that this study may support the planning of specific public policies for cancer control and global health of black women.

Methods

This is a retrospective cross-sectional time-series study carried out using aggregated data on deaths from breast cancer among women living in the State of São Paulo, Southeast Region of Brazil, whose death occurred between 2000 and 2017. Population data were obtained from the Brazilian Institute of Geography and Statistics (IBGE) [13]. The available variables age and race were analyzed.

Information on deaths was collected from the Ministry of Health (MS) through the Mortality Information System (MIS) [17]. The system uses the 10th International Classification of Diseases (ICD-10) for registration. In addition to extracting “breast cancer” data (ICD-10 C50), it was decided to extract data on other mortality categories, to assist in the analysis of the hypothesis: “cancer” (filter ICD-10 C00-C97), “external causes” (filter ICD-10 S00- T99, V00-W99, Y00-Y99), “ill-defined causes” (filter “ill-defined causes”).

The MIS provides filters for age and race. For the denominator in race, were used the proportions of the race categories by age-group of the female population in the São Paulo state, according to the IBGE's National Household Sample Survey (PNAD) [13]. For years when PNAD race data were not available (years 2000, 2010 and 2017), a projection was made by time-trends. The IBGE and MIS categorize race into five classes: white, black, brown, yellow and indigenous. In this study, we included only the white and

black/brown categories (hereinafter grouped as “black”). The “ignored” race data were redistributed among the five categories according to the proportion of the total population.

Deaths in children and women under 20 were discarded due to the high chance of corresponding to errors, and those “ignored” were redistributed by age-groups. The crude rates were calculated by the quotient between the total number of deaths and the population at risk, for every 100,000 women. The adjusted rates per year were calculated considering the standard population of the World Health Organization of 2000 [18]. Then, the information on deaths by race *versus the* proportion of the population was crossed, to calculate the crude mortality rates by race, and then age-adjusted rates.

For statistical analysis of the difference on rates by race and age, the trend-tests were carried out. Three coefficients were used: B1, B2 and B3. B1 the increase or decrease over the years (the slope or year effect); B2 the difference in level between one series and another (the race effect); and B3 the difference between the slopes of the different series (the race vs year interaction term).

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Results

In the State of São Paulo from 2000 to 2017, there were 60,940 deaths registered as breast cancer deaths, 46,365 in white and 10,588 in black women. The figures of the adjusted mortality rates by years, race and age-groups, are displayed in table 1. Figure 1 shows the age-adjusted mortality rates over the years according to race. The rates for every 100,000 women in 2000 were 17.07 in white and 7.42 in black, and in 2017 16.46 in white and 9.57 in black. Over the years it was observed a significant trend to reduction in white women mortality rates [B1=(-)0.10; p=0.002], and a significant trend to increase in black women mortality rates [B1=(+)0.07; p=0.010]. This effect was more significant for white than for black women [white women with a greater inclination to fall: B3=(-)0.18; p<0.001].

The evaluation of variations in rates according to age-groups by race can be seen in figure 2. For women aged 40-49 years, mortality tended to decrease in white and to increase in black women [B1=(-)0.01; p=0.032 and B1=(+)0.02; p =0.018, respectively]. For the age-groups 50-59 years, 60-69 years and 70-79 years, the trend observed in white women was to a reduction in mortality in all age-groups [B1=(-)0.05; p<0.001, B1=(-)0.02; p =0.012 and B1=(-)0.02; p =0.004, respectively]. In black women, there was no significant variation for these age-groups [B1=(+)0.02; p =0.066, B1=(+)0.01; p=0.214 and B1=(+)0.01; p =0.435, respectively].

The figures of the adjusted mortality rates by years and the causes of death are displayed in table 2. The analysis of other causes of death according to race is presented in figure 3. In the category ‘all-cancer causes’ the trend was to a reduction in mortality rates in white women [B1=(-)0.34; p=0.031] and an increase in black women [B1=(+)0.42; p<0.001]. This effect was more significant for the reduction among

white women [B3=(-)0.75; p<0.001]. For “ill-defined causes”, the trend was to a reduction among white and black women [B1=(-)1.06; p<0.001 and B1=(-)0.75; p<0.001], respectively. For ‘external causes’ there was a reduction over the years for both races [B1=(-)0.26; P<0.001 in white and B1=(-)0.43; P<0.001black women], with an explicit difference on the races (B2=6.84; P<0.001).

Discussion

In this study of assessment of breast cancer mortality rates from 2000 to 2017 in women from São Paulo, Brazil, it was observed that, while in white women the rates tend to a reduction, in black women the rates tend to increase. The same trends were observed in cancer mortality rates in general. The woman's age in the year of death did not influence this result, as the qualification of death records and the reduction in deaths due to external or violent causes.

The reduction in breast cancer mortality is the result of improved access to early diagnosis and timely treatment. The therapeutic evolution, especially the development of new drugs and specific therapies, is considered the main factor that has had an impact on breast cancer mortality in recent decades [8, 19]. Trastuzumab, for example, is available at the universal health care system since 2013 in São Paulo state, so women carrying the HER2/neu protein would have a better prognosis since them [19].

However, inequity in access to therapeutic modalities can influence population rates in different ways. The trend observed in the reduction of mortality in white women as opposed to the increase in rates in black women indicates the clear influence of race on this issue in the Brazilian population.

The incidence rates of breast cancer are increasing in Brazil and worldwide [3]. Therefore, without adequate intervention, mortality rates are also expected to increase. The increase in mortality rates among black women may reflect delay in diagnosis, difficulty in accessing highly complex services for treatment or biological variations. In North America women, rates in black women are 21% lower for hormonal receptor (HR) and HER2 positive, 29% higher in HR negative and HER2 positive, and 93% higher for triple-negative subtypes [20]. This data may justify the rough differences observed among race, but not the opposite trends observed in the study.

The increase in cancer mortality rates in general observed in this study suggests that access to treatment should be the main factor that influenced these results. Delays in surgical treatment due to race are reported in the USA [21]. Also, racial minorities are more likely to receive more non-standardized treatments (out of standard protocols), such as less indication for surgical treatment, fewer sentinel lymph node biopsies and reconstructions, and less access to adjuvant treatment [21–24]. Regarding chemotherapy and hormone therapy, there is a greater chance of delaying its onset, which can lead to significant differences in survival [21, 25]. In Brazil, greater delays have been reported in populations with lower income, less education and non-white ethnic groups [26].

A possible explanation for these pieces of evidence is that the race factor is being influenced by socio-economic variables. However, it is necessary to consider a possible implicit bias in the health

professional behaviour, when a difference in the preference for a given social group would negatively impact communication, clinical investigation and decision in the treatment of vulnerable patients [22]. In Brazil, an assessment of satisfaction with health care and hospitalization observed 12.2% of non-satisfied among white patients and 17.4% among blacks and browns patients [14]. The probability of a black or brown person looking for a health service and not being seen is twice as high as a white person [14].

In general, international literature does not support the hypothesis of a biological plausibility that would justify these observed differences. A population-based study in the USA showed that the black population is twice as susceptible to death than the white population in tumours that express hormone receptors, with no difference between the triple-negative types [27]. Another study points out that despite hormonal subtype, socioeconomic status or access to health services, racial disparities in diagnosis, treatment and survival still persist [23].

The incidence of hormone receptor-negative tumours is higher in black than in white women [23, 28, 29]. Certain genetic factors may be associated with this fact, such as more frequent mutations in BRCA and other, although the real functional impact of these on the incidence and progression of triple-negative cancers in this population is still unknown [24]. In the specific case of tumours with negative hormone receptors, it is known that the delay in diagnosis and referral can compromise the effectiveness of the treatment [23].

In this study, data on stage and molecular subtypes were not available. It is known that more aggressive tumours tend to affect younger populations [30, 31]. In the group of women aged 40 to 49, mortality decreased significantly among white women and increased significantly among black women. It is not possible to determine whether tumours in black women were more aggressive than those in white women, but this data also reinforces the hypothesis of less access to treatment faced by black women. Survival studies can elucidate this issue.

The hypothesis that mortality rates may have been influenced by an improvement in the quality of filling out death certificates among black women in the period was investigated. The analysis of mortality rates due to ill-defined causes revealed that the tendency towards reduction was observed for both white and black women, with a more important fall among white women, which could have influenced the results in an inverse way to the hypothesis made. Another interesting fact is that in the period, there was a significant reduction in mortality from external causes in the population in general, more significant among white women, which should not have influenced the results either.

This is a population-based study in a region that concentrates about 1/5 of the Brazillian population, being quite representative of other large urban centres in middle-income countries. It is also important to note that the data from the death registry information system in the State of São Paulo are of high quality, considered as the best in the country. In this way, we consider that this is the best information that might be obtained for the analyzes to be carried out. The main limitations of the study are the lack of

data on the stage and molecular subtypes of breast cancers. We believe that future survival analyzes from population-based cancer registries can support the evidence generated in this study.

Conclusions

Mortality rates due to breast cancer in São Paulo were influenced by the declared race. The divergences observed between white and black women may indicate differentiated access to health resources, contributing to the inequities that exist in the health of the black population in our setting.

Declarations

Funding

This study was performed during the tenure of the research funding of the “Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP)”, registered under the number 2017/21908-1. The study sponsors had no involvement in the study other than funding.

Conflict of interests/Competing interests

None to declare.

Availability of data and material

The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

Code availability

Not applicable.

Authors´ contributions

ACM, BG and DBV conceived and designed the work. BG acquired data and HM analysed it. CCF and LCZ made substantial contribution interpreting data. ACM and DBV drafted the work and revised it critically for important intellectual content. All authors approved the version to be published and agree to be accountable for all aspects of the work.

Ethics approval

This study was approved by the Unicamp Research and Ethics Committee, registered at ‘Plataforma Brasil’ under the number CAAE 89399018.2.0000.5404.

Consent to participate

Due to the retrospective nature of the study, the Unicamp Research and Ethics Committee waived the need for the consent form.

Consent for publication

Authors consent the publication of the content to the publisher.

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Conflict of interest

The authors declare that they have no conflict of interest.

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Tables

Table 1. Breast cancer adjusted mortality rates in São Paulo, Brazil, by race and age-groups.

Years	40-49		50-59		60-69		70-79		Total	
	White	Black	White	Black	White	Black	White	Black	White	Black
2000	2.6	1.7	3.9	1.9	3.9	1.7	3.5	1.0	17.1	7.4
2001	2.7	1.7	4.2	2.4	4.3	1.6	3.6	1.0	18.1	7.9
2002	2.6	1.4	4.6	2.3	4.4	2.0	3.2	0.9	18.4	7.9
2003	2.7	1.7	4.2	2.3	4.0	1.6	3.4	1.0	17.8	8.3
2004	2.7	1.8	4.2	2.3	4.3	1.7	3.3	1.4	17.9	8.6
2005	2.8	1.9	4.7	2.0	4.4	2.1	3.5	1.2	19.1	8.2
2006	2.4	1.4	3.7	2.1	4.1	1.6	3.5	0.8	16.8	7.0
2007	2.4	1.5	3.8	2.1	3.8	1.6	3.2	1.5	16.7	8.0
2008	2.7	1.6	4.0	1.9	4.0	1.6	3.3	1.2	17.6	7.4
2009	2.5	1.5	3.9	2.1	3.9	1.5	3.1	1.1	16.9	7.6
2010	2.4	1.6	3.9	2.4	4.0	1.7	3.2	1.3	16.7	8.4
2011	2.5	1.7	3.8	2.2	4.1	1.7	3.2	0.8	17.2	7.8
2012	2.4	1.8	3.8	2.2	3.9	1.6	2.9	1.1	16.3	8.2
2013	2.4	1.7	3.7	2.3	3.8	1.7	3.4	1.1	16.5	8.1
2014	2.5	2.1	3.6	2.4	3.7	2.0	3.0	1.2	16.0	9.3
2015	2.4	1.8	3.7	2.4	3.8	1.7	3.3	0.9	16.8	8.4
2016	2.7	2.1	3.7	2.2	3.9	1.9	3.3	1.2	17.0	9.1
2017	2.4	1.8	3.6	2.6	4.0	2.1	3.0	1.4	16.5	9.6
B1	-0.01	0.02	-0.05	0.02	0.02	0.01	-0.02	0.01	-0.10	0.07
B2	1.14		2.24		2.57		2.42		10.50	
B3	-0.03		-0.06		-0.03		-0.03		-0.18	

Legend: B1, the slope or year effect; B2, the race effect; B3, the race vs year interaction term; (-) indicates trend to a reduction in rates.

Table 2

Adjusted mortality rates in São Paulo, Brazil, by race and causes of death.

Years	40–49		50–59		60–69		70–79		Total	
	White	Black	White	Black	White	Black	White	Black	White	Black
2000	2.6	1.7	3.9	1.9	3.9	1.7	3.5	1.0	17.1	7.4
2001	2.7	1.7	4.2	2.4	4.3	1.6	3.6	1.0	18.1	7.9
2002	2.6	1.4	4.6	2.3	4.4	2.0	3.2	0.9	18.4	7.9
2003	2.7	1.7	4.2	2.3	4.0	1.6	3.4	1.0	17.8	8.3
2004	2.7	1.8	4.2	2.3	4.3	1.7	3.3	1.4	17.9	8.6
2005	2.8	1.9	4.7	2.0	4.4	2.1	3.5	1.2	19.1	8.2
2006	2.4	1.4	3.7	2.1	4.1	1.6	3.5	0.8	16.8	7.0
2007	2.4	1.5	3.8	2.1	3.8	1.6	3.2	1.5	16.7	8.0
2008	2.7	1.6	4.0	1.9	4.0	1.6	3.3	1.2	17.6	7.4
2009	2.5	1.5	3.9	2.1	3.9	1.5	3.1	1.1	16.9	7.6
2010	2.4	1.6	3.9	2.4	4.0	1.7	3.2	1.3	16.7	8.4
2011	2.5	1.7	3.8	2.2	4.1	1.7	3.2	0.8	17.2	7.8
2012	2.4	1.8	3.8	2.2	3.9	1.6	2.9	1.1	16.3	8.2
2013	2.4	1.7	3.7	2.3	3.8	1.7	3.4	1.1	16.5	8.1
2014	2.5	2.1	3.6	2.4	3.7	2.0	3.0	1.2	16.0	9.3
2015	2.4	1.8	3.7	2.4	3.8	1.7	3.3	0.9	16.8	8.4
2016	2.7	2.1	3.7	2.2	3.9	1.9	3.3	1.2	17.0	9.1
2017	2.4	1.8	3.6	2.6	4.0	2.1	3.0	1.4	16.5	9.6
B1	-0.01	0.02	-0.05	0.02	0.02	0.01	-0.02	0.01	-0.10	0.07
B2	1.14		2.24		2.57		2.42		10.50	
B3	-0.03		-0.06		-0.03		-0.03		-0.18	

Legend: B1, the slope or year effect; B2, the race effect; B3, the race vs year interaction term; (-) indicates trend to a reduction in rates.

Figures

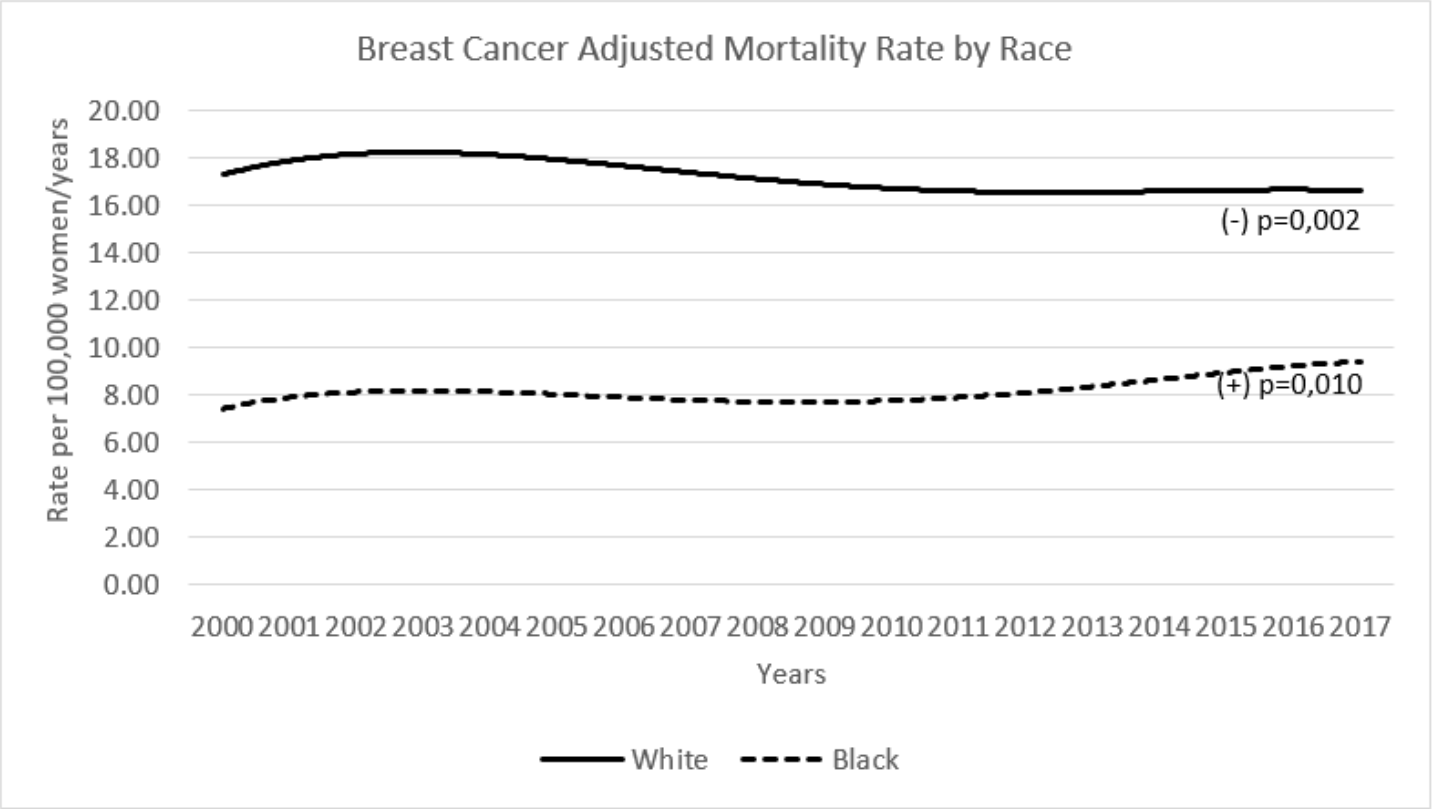

Figure 1

Breast cancer mortality rates in São Paulo State, Brazil, from 2000 to 2017, as a function of race. Legend: P-value refers to year-effect (B1). (+) indicates trend to increase and (-) trend to decrease rates.

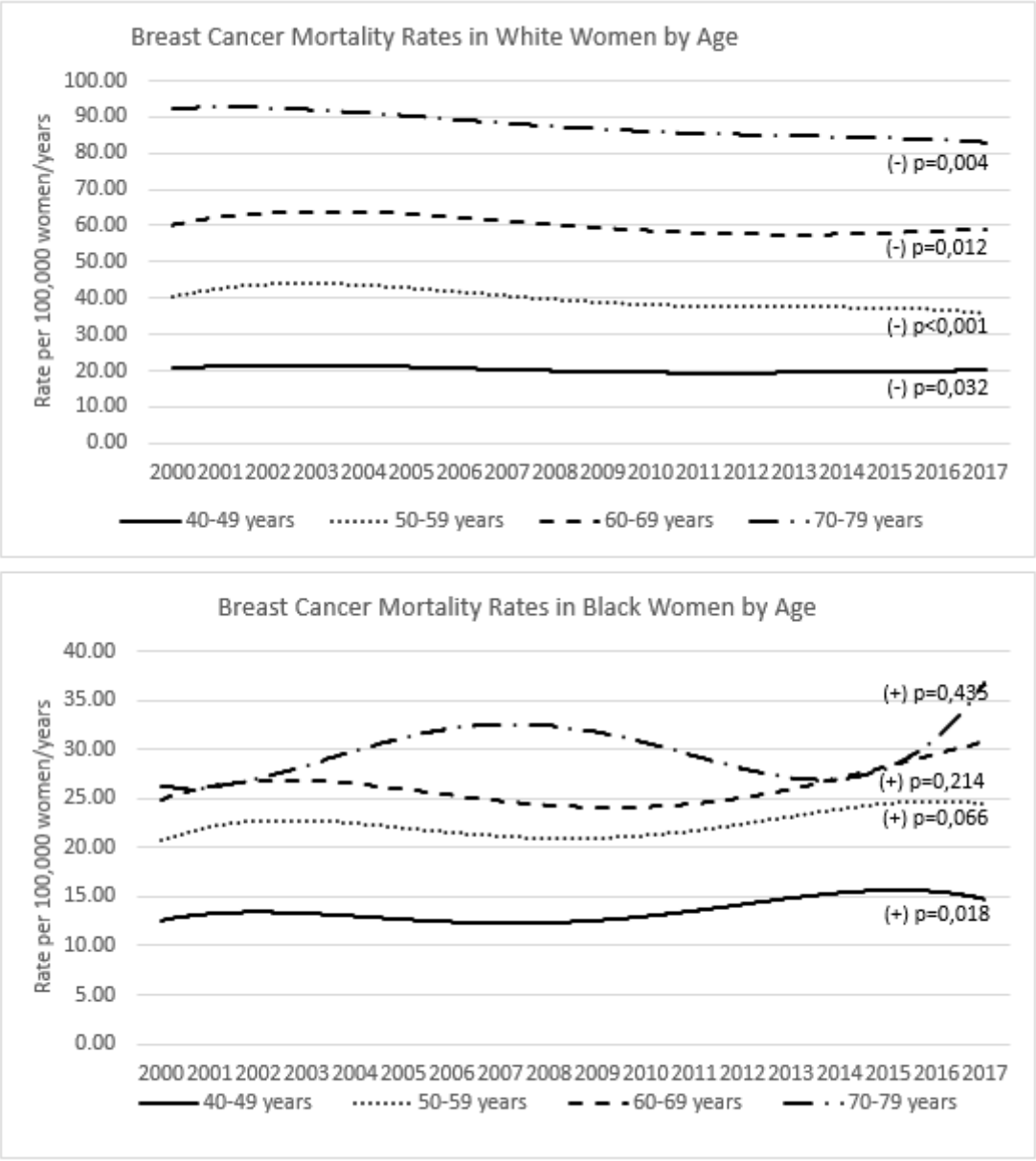

Figure 2

Breast cancer mortality rates in São Paulo State, Brazil, from 2000 to 2017, by age-groups, as a function of race. Legend: P-value refers to year-effect (B1). (+) indicates trend to increase and (-) trend to decrease rates.

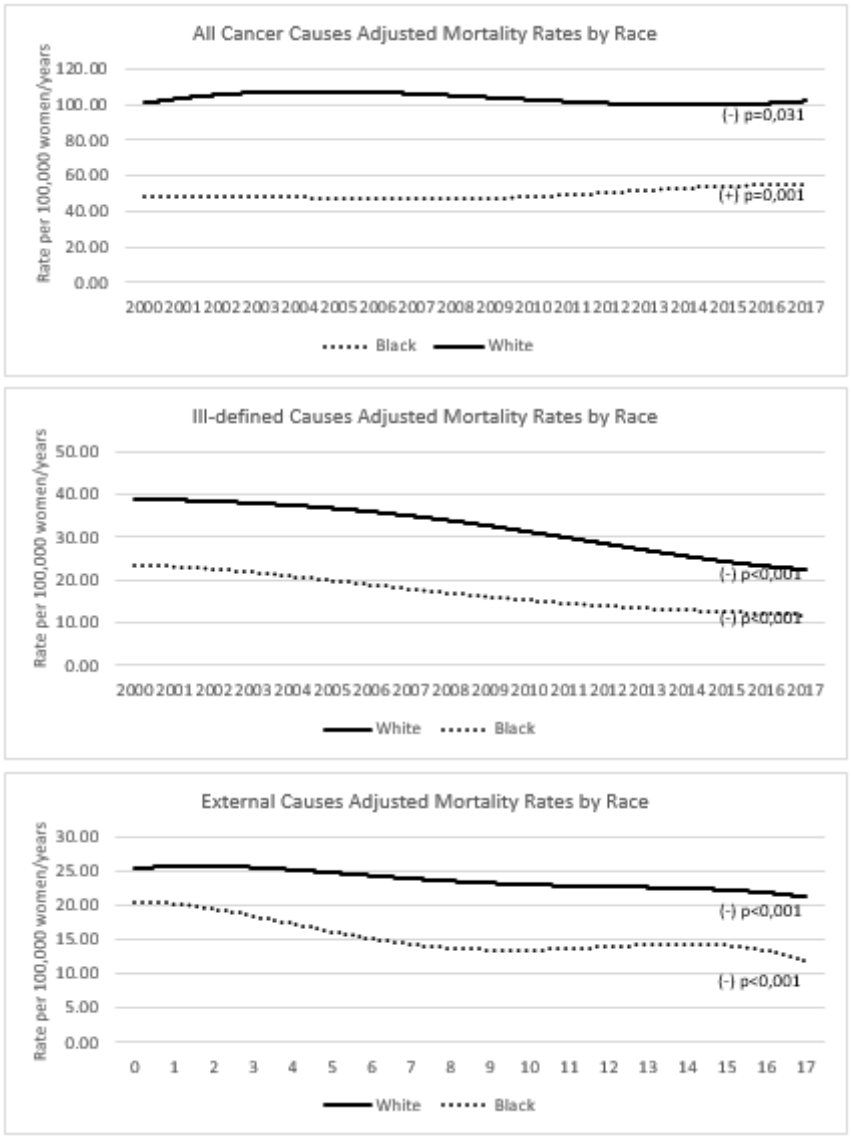

Figure 3

Breast cancer mortality rates in São Paulo State, Brazil, from 2000 to 2017, by causes of death and race. Legend: P-value refers to year-effect (B1). (+) indicates trend to increase and (-) trend to decrease rates.