



Ethnic disparities in cancer mortality in the capital and northeast of the State of São Paulo, Brazil 2001–17

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Abstract

Purpose There is a paucity of studies investigating cancer disparities in groups defined by ethnicity in transitioning economies. We examined the influence of ethnicity on mortality for the leading cancer types in São Paulo, Brazil, comparing patterns in the capital and the northeast of the state.

Methods Cancer deaths were obtained from a Brazilian public government database for the Barretos region (2003–2017) and the municipality of São Paulo (2001–2015). Age-standardized rates (ASR) per 100,000 persons-years, by cancer type and sex, for five self-declared racial classifications (white, black, eastern origin (Asian), mixed ethnicity (pardo), and indigenous Brazilians), were calculated using the world standard population.

Results Black Brazilians had higher mortality rates for most common cancer types in Barretos, whereas in São Paulo, white Brazilians had higher rates of mortality from breast, colorectal, and lung cancer. In both regions, lung cancer was the leading cause of cancer death among white, black, and pardo Brazilians, with colorectal cancer deaths leading among Asian Brazilians. Black and pardo Brazilians had higher cervical cancer mortality rates than white Brazilians.

Conclusion There are substantial disparities in mortality from different cancers in São Paulo according to ethnicity, pointing to inequities in access to health care services.

Keywords Cancer · Mortality · Epidemiology · Ethnicity

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Introduction

According to current mortality estimates, cancer is the first or second leading cause of premature death in 127 of 181 countries worldwide [1]. In Brazil, the disease ranks second to cardiovascular disease, with increasing trends in cancer mortality rates reported in lower-income Brazilian regions during the last two decades [2].

Numerous studies have examined disparities in access to health resources, and in cancer survival and mortality according to ethnicity [3–6], yet there have been few investigations in transitioning economies like Brazil. This study assesses the cancer-specific mortality across five racial classifications in two diverse regions within the State of São Paulo, Brazil (the capital and the northeast region of the state) to provide insights into the tailoring of cancer policies aimed at reducing health inequalities in these populations.

Methods

Study area and population

This study was conducted in the municipalities belonging to the Regional Health Department (RHD) of Barretos and in the municipality of São Paulo (the capital of the state). The RHD of Barretos is in the northeast of the State of São Paulo and comprises 18 municipalities (Altair, Barretos, Bebedouro, Cajobi, Colina, Colômbia, Guaiúra, Guaraci, Jaborandi, Monte Azul Paulista, Olímpia, Severínia, Taiaçu, Taiúva, Taquaral, Terra Roxa, Viradouro and Vista Alegre do Alto). Collectively the municipalities occupy an area of 6,118.72 km² containing an estimated 445,216 inhabitants in the year 2021 [7]. The municipality of São Paulo, located in the southeast of the state, covers an area of 1,521.202 km² with an estimated 12,396,372 inhabitants in the year 2021 [7]. A comparative analysis in these two regions is of interest as they offer different demographic profiles, with the RHD of Barretos containing small and medium-sized cities, whereas São Paulo is a metropolis, being the largest and most populous city in Brazil. As an example related to the occupations of inhabitants, formal employment in agriculture, livestock, forestry, fisheries, and aquaculture (as a proportion of all formal employment) was 24.2% in the RHD of Barretos in 2019, whereas in the municipality of São Paulo it was 0.05% [8]. The two regions also vary in their socioeconomic profiles, with São Paulo indicated as a very high Human Development Index (HDI) city, but with wide variability in socioeconomic status (SES) within, whereas the municipalities in the RHD of Barretos are indexed with a high HDI, on average [9]. Considering health indicators, substantial differences can be found in the two regions. A contributory factor to health accessibility is the percentage of the population coverage by the Family Health Strategy, the program of primary health care in Brazil, that was higher in the RHD of Barretos (57.7) compared to São Paulo (40.3) in 2020 [10].

Cancer and population data sources

The cancer deaths were extracted for the 15-year period, RHD of Barretos (2003–2017) and São Paulo (2001–2015), from the Brazilian public government database entitled *Information System on Mortality*, which is part of the Informatics Department of the Unified Health System (DATASUS) [11]. The different time periods relate to consistency with previously published research using the most recent years of cancer registration in the two regions [12, 13]. We considered all deaths based on the International Statistical Classification of Diseases and

Related Health Problems 10th Revision (ICD-10), excluding nonmelanoma skin cancer (NMSC) (C44). The deaths were obtained for the RHD of Barretos and the municipality of São Paulo for all cancers combined (ICD-10 C00–C97, excluding C44) and six most frequent cancers according to cancer incidence profiles in their respective population-based cancer registries [12], namely: stomach (C16), colorectal (C18–20), lung (C33–C34, including trachea and bronchus), female breast (C50), cervix uteri (C53), and prostate (C61). Population data were available for the mid-period (2010), obtained from the 2010 Brazilian Demographic Census considering five self-declared racial classifications according to the Brazilian Institute of Geography and Statistics (IBGE): white, black, eastern origin (Asian), mixed ethnicity (“pardo”), and indigenous [14]. Of the 7,513 cancer deaths from 2003–2017 in the RHD of Barretos, 7,393 (98.4%) had information on ethnicity available and were included in the study. In the municipality of São Paulo, 187,879 (96.5%) of the 194,705 cancer deaths from 2001 to 2015 had such information.

Statistical analysis

We present age-standardized mortality rates (ASR), per 100,000 person-years based on the 1966 Segi-Doll World standard population [15], thus allowing comparisons between populations adjusted for differences in age structure. Using direct standardization, the ASR were estimated from the 10-year age-specific rates (ages 0–9, 10–19... ,60–69, ≥ 70 years) by cancer type and ethnicity, with the 95% confidence interval (95% CI) obtained from the estimated variance based on the Poisson distribution [16].

Results

Barretos region had a higher proportion of whites compared to São Paulo, the latter of which had a higher proportion of black, Asian, and pardo Brazilians (Supplementary Table 1). In Barretos, lung cancer was the leading cause of cancer death followed by colorectal and stomach cancer among both white Brazilians (corresponding to 13.9%, 9.2%, and 7.6% of total cancer deaths, respectively) and pardo Brazilians (13.6%, 8.7%, and 8.3%, respectively), whereas in black Brazilians, lung cancer deaths (11.3%) were followed by prostate (10.2%) and colorectal (7.8%) cancer. An exception was seen for Asian Brazilians, where colorectal cancer was the leading cause of cancer death in Barretos region (15.5%), followed by lung (12.7%) and stomach (11.3%) (Supplementary Table 2).

In São Paulo, lung cancer was the most common tumor among white Brazilians (13% of cancer deaths), followed by colorectal (11.2%) and female breast cancer (9.2%). Lung

cancer was also the leading cause of cancer death in black and pardo Brazilians (10.3% and 11.5%, respectively), with stomach (9.7% and 9.2%) and female breast cancer (9.6% and 8.6%) ranking in second and third place in both. As in Barretos, colorectal cancer ranked first among Asian Brazilians in São Paulo (15.8%), followed by stomach (13.7%) and lung cancer (12.8%). With few cancer deaths recorded among indigenous Brazilians, the top three cancer deaths corresponded to lung (12.9%), colorectal (11.3%), and stomach cancer (11.3%) (Supplementary Table 2).

Table 1 and Fig. 1A show the cancer mortality rates by ethnicity for both sexes. The results from Barretos region are most striking, with black Brazilians having higher mortality rates for all cancers and for each of the six cancer types. The mortality rates for black relative to white Brazilians were 18% higher for all cancers (127.4; 95% CI 116.4–138.4 vs. 103.9; 95% CI 101.2–106.7, per 100,000), 63% higher for cancers of the cervix (7.5; 95% CI 3.8–11.2 vs. 2.8; 95% CI 2.2–3.4), 51% for prostate (27.1; 95% CI 19.9–34.3 vs 13.4; 95% CI 12.0–14.8), and 18% for the female breast (15.3; 95% CI 10.1–20.4 vs. 12.6; 95% CI 11.3–13.9). There were less marked variations for colorectal, lung, and stomach cancer.

The inverse pattern was seen in the municipality of São Paulo (Table 1 and Fig. 1A), where rates in white Brazilians were 19% higher for all cancers (106.7; 95% CI 106.2–107.3 vs. 86.5; 95% CI 84.8–88.1), 41% higher for colorectal (11.6; 95% CI 11.4–11.8 vs. 6.9; 95% CI 6.4–7.4), 35% for lung (13.8; 95% CI 13.6–14.0 vs. 9.0; 95% CI 8.5–9.5) and 19% for female breast cancer (17.2; 95% CI 16.9–17.5 vs. 14.0; 95% CI 13.1–14.9), relative to black Brazilians. Asian Brazilians had similar colorectal mortality rates to white Brazilians, but elevated rates of stomach cancer. Black Brazilians in São Paulo had higher mortality rates from prostate and cervical cancer relative to white Brazilians.

The sex-specific mortality rates for colorectal, lung, and stomach cancer by ethnicity are presented in Fig. 1B and C. In Barretos region (Fig. 1B), higher mortality rates of colorectal and lung cancer were seen for black Brazilian women and white Brazilian men. Black and Asian Brazilian women had similarly higher mortality rates for stomach cancer, which were also elevated among Brazilian black and white men. White Brazilian women and men in São Paulo (Fig. 1C) had higher mortality rates for colorectal and lung cancer, with black and Asian Brazilians having higher mortality rates for stomach cancer, in both sexes.

Table 1 Race-specific mortality age-standardized rates (ASR), and confidence interval (95% CI), for all combined and six common cancer types in the Regional Health Department (RHD) of Barretos

(2003–2017) and in the municipality of São Paulo (2001–2015), Brazil, both sexes, all ages

ICD-10	Cancer site ^a	Race				
		White	Black	Asian	Pardo	Indigenous
RHD-Barretos						
C16	Stomach	7.5 (6.8–8.3)	8.5 (5.8–11.3)	5.9 (1.6–10.1)	5.0 (3.9–6.1)	–
C18-C20	Colorectal	9.4 (8.6–10.2)	9.6 (6.7–12.6)	8.2 (3.2–13.2)	5.2 (4.0–6.3)	–
C33-C34	Lung, bronchus, trachea	14.5 (13.4–15.5)	14.7 (11.0–18.5)	8.9 (2.8–15.0)	8.3 (6.9–9.8)	–
C50	Female breast	12.6 (11.3–13.9)	15.3 (10.1–20.4)	8.7 (– 0.2–17.6)	8.2 (6.3–10.1)	–
C53	Cervix uteri	2.8 (2.2–3.4)	7.5 (3.8–11.2)	1.1 (– 1.1–3.2)	3.5 (2.2–4.7)	–
C61	Prostate	13.4 (12.0–14.8)	27.1 (19.9–34.3)	10.5 (2.3–18.5)	8.1 (6.0–10.1)	–
C00-C97*	All cancers	103.9 (101.2–106.7)	127.4 (116.4–138.4)	62.3 (46.8–77.7)	59.9 (56.1–63.7)	50.0 (– 19.5–119.5)
São Paulo						
C16	Stomach	7.7 (7.5–7.8)	8.4 (7.9–8.9)	8.6 (7.9–9.2)	6.1 (5.4–5.9)	3.4 (0.9–6.0)
C18-C20	Colorectal	11.6 (11.4–11.8)	6.9 (6.4–7.4)	10.0 (9.3–10.7)	5.7 (5.4–5.9)	3.7 (0.9–6.4)
C33-C34	Lung, bronchus, trachea	13.8 (13.6–14.0)	9.0 (8.5–9.5)	8.2 (7.6–8.8)	7.8 (7.6–8.1)	4.0 (1.2–6.7)
C50	Female breast	17.2 (16.9–17.5)	14.0 (13.1–14.9)	9.0 (8.0–10.0)	8.7 (8.4–9.1)	3.8 (0.0–7.6)
C53	Cervix uteri	3.5 (3.4–3.6)	4.2 (3.7–4.6)	1.5 (1.1–1.9)	3.8 (3.5–4.0)	0.7 (–0.7–2.1)
C61	Prostate	13.6 (13.3–13.9)	18.9 (17.6–20.1)	6.8 (6.0–7.6)	10.9 (10.4–11.5)	3.0 (–1.2–7.1)
C00-C97*	All cancers	106.7 (106.2–107.3)	86.5 (84.8–88.1)	66.1 (64.1–68.0)	65.2 (64.4–66.0)	31.8 (23.8–39.9)

*Excluding nonmelanoma skin cancer (C44)

^a Mortality Information System (SIM-DATASUS)

– Not available

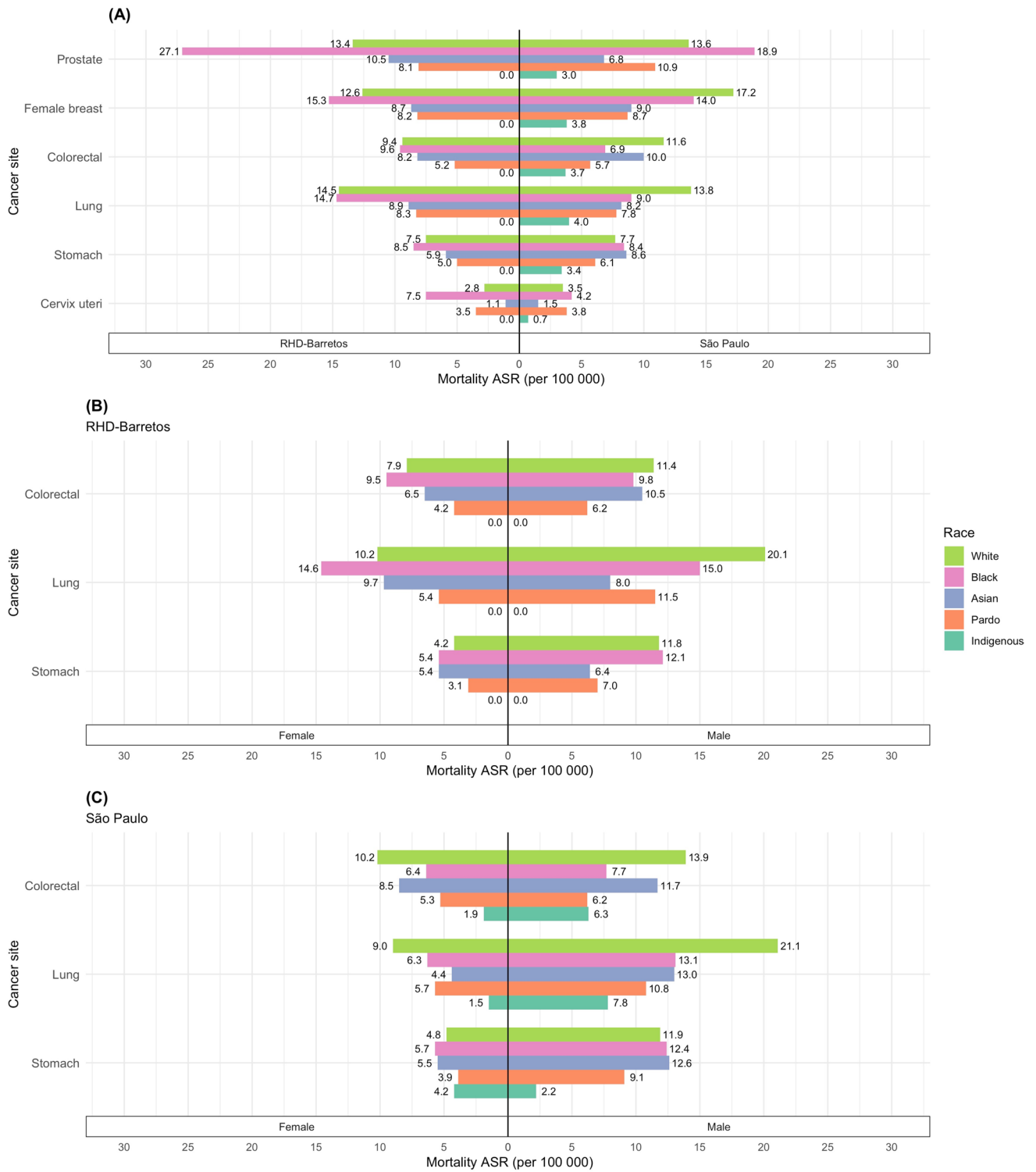


Fig. 1 Age-standardized cancer mortality rates (ASR) for six common cancer types by ethnicity in the Regional Health Department (RHD) of Barretos (2003–2017) and the municipality of São Paulo (2001–2015), Brazil, both sexes (A), sex-specific (B and C), all ages

Discussion

This analysis of cancer mortality in two regions of the State of São Paulo reveals substantial variations in the disease profiles by region as well as ethnicity. Within defined municipalities of Barretos' RHD, black Brazilians had higher mortality rates for each of the six common cancers studied and for all cancers combined, whilst in the capital, white Brazilians had the highest rates of all cancers, female breast, colorectal, and lung. In our previous study [13], we identified elevated incidence and mortality rates of female breast, colorectal and lung cancer among more affluent population in the municipality of São Paulo, which may provide an explanation for the relatively higher mortality rates of these cancers among white Brazilians compared with the black population. It is well-established that historically, the black population in Brazil, including in the State of São Paulo, has faced greater socioeconomic vulnerability [17] and may contribute to the unfavorable mortality profile of black Brazilians as observed in the Barretos region in this and previous studies [18, 19].

This study aims to contribute to a better understanding of cancer mortality within the State of São Paulo, and the direct impact of ethnicity on the burden and suffering at the community level. Such findings can provide information for cancer prevention and control and, in so doing, minimize the differentials in the uptake screening, early diagnosis, and curative services to reduce inequities in cancer between ethnic groups.

While few studies have assessed cancer mortality by ethnic group in Brazil, our results broadly align with recent assessments of breast [5] and colorectal cancer [20] in the country. The former study reported higher breast cancer mortality rates in white compared to black women in the State of São Paulo, although the authors also observed contrasting trends, with declining rates in white women, but rising rates among black women [5]. Another study found lower breast cancer survival among pardo and black women in two Brazilian capitals, from the south and northeast of the country, highlighting the likelihood of regional inequalities in access to health care [18]. A retrospective cohort study in Brazil from 2002 to 2012 identified a higher likelihood with a late-stage breast cancer diagnosis among pardo and black women, compared to white women, suggesting lower breast cancer survival in this ethnic group, and aligning with our results among black women in Barretos region [21]. An analysis of the determinants of late diagnosis of cervical cancer in Brazil, reported black women having a 20% risk of a higher clinical stage relative to other ethnic groups [19]. As a direct marker of mortality, later stage at presentation may in part explain the elevated cervical cancer mortality rates seen among black women in both regions in our study.

Evidence from the U.S. supports our observation of elevated cancer mortality rates among blacks in Barretos region and for some sites in São Paulo [6], with one study estimating the odds of presenting with metastatic prostate cancer to be 47% higher in U.S. blacks compared to whites [3]; another reported cervical cancer mortality to be 41% higher in black compared with white women [4]. Black ethnicity has also been shown to be a predictor of increased time to treatment initiation in the U.S. for breast, prostate and lung cancer [22]. With respect to prostate cancer, evidence from Brazil is in line with our observation of higher rates in black Brazilians in Barretos region and São Paulo, with one study showing a prevalence of prostate cancer of 9.6% in black vs. 5.6% in white men [23] and another indicating a 300% increased risk of metastasis at diagnosis in black Brazilians [24].

Our results for stomach cancer indicate a higher mortality rate in Asian Brazilians in São Paulo compared to other ethnic groups. There is a scarcity of epidemiological studies in Brazil evaluating stomach cancer by race, but our results at least align with the GLOBOCAN estimates from the International Agency for Research on Cancer (IARC) for 2020, where elevated mortality rates of stomach cancer are commonplace in many Asian countries [25]. The proportion of Asian Brazilians is higher in São Paulo, compared to Barretos region, which may explain the difference in rates between the two regions. A lower mortality rate for cervical cancer in Asian women was observed in the Barretos region and São Paulo, in line with a 22-year analysis (1996–2017) of all reported deaths from cervical cancer in Brazil, with Asian women having the lowest mortality rates in the country [26].

The major strengths of this study was the use of a comprehensive and high-quality government mortality database that spans over 15 consecutive years used alongside a detailed ethnic information obtained from the Brazilian Demographic Census. The main limitation was an assumption that mortality rates at the municipal or regional level were homogeneous; the analysis did not account for existing differences in SES at a more granular level, or indeed other local determinants of cancer mortality.

Conclusions

In summary, our findings contribute to a better understanding of the profile of the cancer burden within Brazil and the direct impact of ethnicity on the risk of cancer death in the State of São Paulo. We have highlighted substantial disparities in cancer mortality according to ethnic group that points to differentials in access to health care services. Further research is warranted to delve deeper into the specific mechanisms so that targeted interventions aimed at reducing

existing cancer disparities in these vulnerable populations can be developed and implemented.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s10552-023-01812-w>.

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Author contributions Conceptualization: AGR and FB; Methodology: AGR, FB and JF; Formal analysis and investigation: AGR; Writing draft preparation: AGR; Writing review and editing: AGR, FB, JF, SV, MRDOL and JHTGF; Visualization: AGR and FB; Funding acquisition: AGR and JHTGF; Resources: AGR and FB; Supervision: FB; Project Administration: JHTGF and FB.

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Data availability Cancer mortality data are available from a Brazilian public government database entitled Information System on Mortality, which is part of the Informatics Department of the Unified Health System (DATASUS). Information on ethnicity is available from the Brazilian Demographic Census, a public database of the Brazilian Institute of Geography and Statistics (IBGE).

Declarations

Conflict of interests The authors have no relevant financial or non-financial interests to disclose.

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