Racial inequality in access to cancer care in Brazil: an intersectional analysis with data from SIM-SUS (2011-2023)

Desigualdade racial no acesso à assistência oncológica no Brasil: uma análise interseccional com dados do SIM-SUS (2011-2023)

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Abstract

The concept of intersectionality describes how complex processes create and perpetuate health inequities. Social and economic inequalities create barriers to cancer care, directly affecting treatment outcomes. This study analyzes racial disparities between Black and White individuals in access to oncological care using a nonlinear statistical decomposition and microdata from the Mortality Information System (SIM-SUS, in Portuguese acronymous) from 2011 to 2023. The results show a 5.9 percentage point gap in access to medical care, with larger disparities observed in breast cancer (7.2 p.p.), skin cancer (7.1 p.p.), hematologic malignancies (6.5 p.p.), tumors of the digestive organs (6.3 p.p.), and female genital organs (6.3 p.p.). The decomposition reveals that 83.8% of the racial gap is due to differences in effects - unexplained by observable characteristics - indicating structural inequality. Black populations face higher premature cancer mortality rates, are concentrated in regions with limited healthcare services, and experience lower returns on education and employment. These findings emphasize the need for public policies that ensure equitable access to cancer care and address racial and socioeconomic disparities in health outcomes.

Keywords: Racial Inequality; Cancer; Cancer Care; Intersectionality; SIM-SUS.

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DOI 10.1590/S0104-12902026250472en

Resumo

O conceito de interseccionalidade descreve que processos complexos criam e perpetuam as desigualdades em saúde. Existem barreiras ao acesso aos cuidados oncológicos devido a desigualdades de ordem social e econômica, e isso influencia diretamente os resultados do tratamento. Este estudo analisa o diferencial entre pessoas brancas e negras no acesso ao cuidado oncológico por meio de uma decomposição estatística não linear e microdados do Sistema de Informação sobre Mortalidade (SIM-SUS) de 2011 a 2023. Os resultados mostram que existe uma diferença de 5,9 pontos percentuais no acesso à assistência médica. Os diferenciais são maiores para os cânceres de mama (7,2 p. p.), pele (7,1 p. p.), neoplasias hematológicas (6,5 p. p.) e tumores nos órgãos digestivos (6,3 p. p.) e órgãos genitais femininos (6,3 p. p.). A decomposição indica que diferenças nos efeitos são responsáveis por 83,8% do diferencial por raça/cor da pele. O que implica desigualdade estrutural. A população negra morre mais precocemente por câncer, está concentrada nas regiões com menor oferta de serviços de saúde e apresenta retornos menores para educação e ocupação no mercado de trabalho. Os achados indicam a necessidade de políticas públicas que promovam o acesso mais igualitário ao cuidado oncológico.

Palavras-chave: Desigualdade Racial; Câncer; Assistência Oncológica; Interseccionalidade; SIM-SUS.

Introduction

Cancer is among the leading causes of death in Brazil and represents a major public health challenge because of the growing demand for prevention and control measures (Instituto Nacional de Câncer [INCA], 2017). Indeed, cancer mortality already exceeds cardiovascular mortality in Brazilian municipalities with high household income (Rache et al., 2024). A study by the International Agency for Research on Cancer (IARC, 2022), linked to the World Health Organization (WHO), estimated that approximately 554,000 Brazilians will die from tumors by 2050.

Although cancer affects people of different racial and ethnic backgrounds, sexes, and age groups, it does not affect them equally (Vieira, 2023). Likewise, patients' access to medical care directly influences treatment outcomes (Tong, Latoya, Artiga, 2022).

Against this backdrop, the literature has highlighted the importance of analyses that incorporate race and ethnicity in order to understand the social determinants of health (Coelho and Campos, 2024). In particular, the concept of intersectionality describes how interactions among complex processes create and perpetuate health inequalities (Shannon et al., 2022), with the main social markers including income, skin color, gender, disability, place of residence, and age group (Macedo; Medeiros, 2025). Intersectionality, therefore, serves as an analytical tool for interpreting the determinants of health inequalities (Paula, 2024).

In general, patients with intersectional identities face barriers that negatively affect access to screening, diagnosis, treatment, and cancer survival (Kelly-Brown et al., 2022). This implies that access to cancer care is closely tied to broader social and economic inequalities (Paulista, Assunção, and Lima, 2020). Among the Black population, this is reflected in a higher frequency of advanced-stage diagnoses, delays in treatment initiation, and poorer survival outcomes for some cancer types (Tong, Latoya, Artiga, 2022).

Difficulties in accessing cancer care are also reflected in differences in cancer mortality according to the level of social and economic development, exposure to risk factors, and lifestyle. Mortality is higher in specific groups and territories

(Lima et al., 2018). This problem is compounded by the shortage of specialized services: more than half of cancer patients must travel to other locations to receive treatment (Fonseca et al., 2021), since only 3.1% of Brazilian municipalities have high-complexity oncology services (Silva; O'Dwyer; Castro, 2019).

One study showed that 55% of cancer deaths in Brazil occur among people with low income and low educational attainment (Instituto Oncoguia, 2023). In addition, cancer patients with no formal education, Indigenous patients, and residents of the North, Northeast, and Midwest regions are more likely to die at home (Silva et al., 2024). Taken together, these findings suggest that disparities in cancer indicators arise from a combination of socioeconomic inequality, health system inequality, and structural racism (Vieira, 2023). An intersectional analysis, therefore, helps clarify how systems of oppression shape each cancer patient's experience and intensify the inequalities faced by certain groups (Mesa et al., 2023).

In light of the above, this study aims to quantify and explain racial inequalities in access to cancer care in Brazil by analyzing differences between White and Black people through a nonlinear statistical decomposition. Using microdata from the Mortality Information System (SIM-SUS) from 2011 to 2023, we investigated the extent to which observable characteristics – such as age, education, occupation, and region of residence – as well as the returns to these variables, contribute to the observed gap in access. To the best of our knowledge, this is the first application of this approach to cancer mortality data, which allows us to identify evidence of cancer care structural inequality. Studies of this kind are relevant for designing public policies that can promote more equitable access to cancer care and respond more effectively to the expected increase in cancer incidence over the coming decades.

Methods

Data

SIM-SUS was developed by the Ministry of Health to collect mortality data nationwide. The information it contains allows obtaining quantitative and qualitative data on deaths in Brazil, thereby supporting decision-making in health care (Brasil, 2009). Data collection is the responsibility of states and municipalities, through death certificates gathered by their respective health secretariats. SIM-SUS was computerized in 1979 and is considered the longest historical series of public data in Brazil (Brasil, 2009).

SIM-SUS microdata are available for free download in .dbc format from the Department of Information and Informatics of the Brazilian Unified Health System (DATASUS) "File Transfer" platform. National data can be downloaded by year, and mortality can also be analyzed by state. The study covered the period from 2011 to 2023, and 2024 data are still preliminary.

The database is divided into six sections. The first contains death identification data, followed by information on residence and place of occurrence. Section four summarizes fetal mortality and deaths among children younger than 1 year. Finally, sections five and six address the conditions and causes of death and deaths from external causes, respectively (Brasil, 2019).

In addition to data on the type, date, and time of death, we can obtain socioeconomic information about deceased individuals, such as age, gender, ethnicity/skin color, marital status, education level, among others. In SIM-SUS, the variable RACACOR describes the skin color reported by the person responsible for the deceased's information, namely, 1-White, 2-Black, 3-Brown, 4-Yellow, and 5-Indigenous. In this study, the fields for individuals in the database with values 1 and 4 were considered white; the others were classified as Black.

Empirical strategy

This study investigates the determinants of racial differences in access to cancer care between White and Black individuals from 2011 to 2023. In particular, it uses the information recorded in the ASSISTMED variable in section five of SIM-SUS, which corresponds to the question: "Did the patient receive medical care during the illness that caused death?" This field refers to the continued medical care the patient did – or did not – receive during the

illness that led to death. There are three valid values: 1. Yes; 2. No; 9. Unknown (Brasil, 2019). In this study, individuals were considered to have received cancer care when the field value was one (1), and zero (0) was assigned to all other cases.

Given the qualitative nature of the dependent variable, a decomposition analysis was applied to identify the contribution of a set of independent variables to the differential in access to medical care for cancer. More specifically, the Fairlie decomposition (2005) was employed to decompose the determinants of inequality in access to medical care. This method is an extension of the Oaxaca-Blinder decomposition for nonlinear regression models, such as *logit*, *probit*, and Poisson models with binary dependent variables. Considering a linear model, the mean difference in the outcome variable between groups A and B can be decomposed as:

$$\bar{Y}_A - \bar{Y}_B = \overline{F(\boldsymbol{X}_A\beta_A)} - \overline{F(\boldsymbol{X}_B\beta_B)} = \left\{\overline{F(\boldsymbol{X}_A\beta_A)} - \overline{F(\boldsymbol{X}_B\beta_A)}\right\} + \left\{\overline{F(\boldsymbol{X}_B\beta_A)} - \overline{F(\boldsymbol{X}_B\beta_B)}\right\} \quad (1)$$

In (1), the first expression in braces refers to the share of the gap attributable to differences in endowments or characteristics, generally called the explained component or characteristics effects. The second term denotes the share of the gap attributable to differences in coefficients or effects, generally called the unexplained component or coefficient effects (Powers; Yoshioka; Yun, 2011).

In the decomposition, group A (White individuals) is the comparison group, whereas group B (Black individuals) is the reference group. Thus, the explained component reflects the expected difference if group A had the same covariate distribution as group B. The unexplained component, in turn, indicates the expected difference if group B experienced the same behavioral responses to the explanatory variables as group A (Powers; Yoshioka; Yun, 2011).

Fairlie (2005) considers a binary dependent variable for two analytic groups. In this case, the function that maps the independent variables onto the outcome differs between linear and binary-response models. In a *logit* model, the aim is to estimate the probability that a given event occurs. Thus, the function $F(\boldsymbol{X}\beta)$ is given by:

$$P(Y = 1|\,\boldsymbol{X}) = \frac{e^{\boldsymbol{X}\beta}}{1 + e^{\boldsymbol{X}\beta}} \quad (2)$$

Where $P(Y = 1|\boldsymbol{X})$ is the probability that an individual received medical care, given the explanatory variables contained in vector **X**. This vector includes the observable characteristics reported on the death certificates, namely gender, age, age squared, residence in the Southeast and South, High School, Higher Education, and being married. The model also includes year dummies to control for the effect of possible changes in SUS public policies over time, as well as age squared to capture possible nonlinear effects of age on the probability of receiving medical care. The probability may increase with age up to a certain point and then decline at very advanced ages.

The nonlinear decomposition model has been used in many studies aimed at analyzing differentials in health, education, and labor market outcomes (Fairlie, 2005). The statistical procedure used to apply the nonlinear decomposition followed the algorithm developed by Powers, Yoshioka, and Yun (2011). The mvdcmp package was created by these authors for the Stata statistical software, and Powers (2023) later adapted the algorithm to the R language and made the script freely available on GitHub.

Results

Descriptive statistics

The database contains 2,703,864 individuals who died from cancer between 2011 and 2023. Notably, 1,756,553 observations (65.0%) received medical care for cancer. However, 760,734 cases (28.1%) contained no information on access to care. In addition, 112,223 observations (4.2%) were coded as 9 (Unknown), and only 74,354 (2.7%) indicated that no medical care had been received for cancer treatment. Table 1 below presents the means and proportions for the dependent variable and the socioeconomic characteristics used in the statistical decomposition, according to skin color:

Table 1 shows a 5.9-percentage-point gap in access to medical care for cancer between White (67.3%) and Black (61.5%) individuals. A

test of proportions indicates that this difference is statistically significant. For the remaining variables, the sample of White individuals shows higher completion of higher education and a greater concentration in technical occupations rather than service occupations. Another relevant pattern is the large number of Black individuals living in the North, Northeast, and the Midwest. In contrast, the White population is concentrated in the Southeast and South. The mean age at death is lower among Black individuals, as is the proportion of married individuals.

Cancer types were grouped according to the International Classification of Diseases (ICD-10) codes reported in the CAUSABAS variable of SIM-SUS. This variable specifies the underlying cause of death. Thus, the ICD-10 codes were aggregated according to tumor type. For example, C30 to C39 indicate malignant neoplasms of the respiratory system, C69 to C72 refer to tumors of the eye and central nervous system, and so on.

Accordingly, 14 categories were analyzed: endocrine gland neoplasms; lip, oral cavity, and pharynx; ill-defined or secondary sites; breast; hematologic neoplasms; eye and central nervous system; female and male genital organs; bones and cartilage; skin; respiratory system; soft tissues; urinary tract; and other cancer types. Figure 1 below presents the gap in access to medical care between the two groups by skin color, according to cancer type. The red bars indicate the proportion of assisted cases among Black individuals, whereas the other color highlights the proportions for White individuals.

The largest gaps in access to cancer care were observed for cancers of the female genital organs (6.3 percentage points), digestive organs (6.3 p.p.), hematologic neoplasms (6.5 p.p.), skin (7.1 p.p.), breast (7.2 p.p.), and other cancers (8.0 p.p.).

Estimates

Table 2 below summarizes the results obtained from the nonlinear decomposition.

Notably, the gap is positive: White individuals show a higher proportion of assisted cancer cases. In other words, the estimates suggest that Black individuals are, on average, 5.9 percentage points less likely to receive cancer care than White individuals.

The estimates in Table 2 for the explanatory variables are interpreted according to the sign of each component. When the value is positive, the indicator increases the gap and favors the comparison group (White individuals). Conversely, when the estimate is negative, the gap narrows

Table 1 – Descriptive analysis.

Variable	White (n = 1,611,636)	Black (n = 1,092,228)
Did they receive medical care during the cancer that caused their death?	Yes: 1,085,310 (67.3%)	Yes: 671,243 (61.5%)
Mean age (years)	67.5	63.8
Marital status (married)	782,185 (48.5%)	476,970 (43.6%)
Gender (female)	771,675 (47.9%)	511,445 (46.8%)
High School	250,541 (15.5%)	135,466 (12.4%)
Higher Education	176,929 (11.0%)	43,543 (4.0%)
Occupation (technical area)	374,879 (23.3%)	202,833 (18.6%)
Residing in the Southeast and South	1,319,786 (81.9%)	488,011 (44.7%)

Source: Prepared by the authors using data from SIM-SUS (2025).

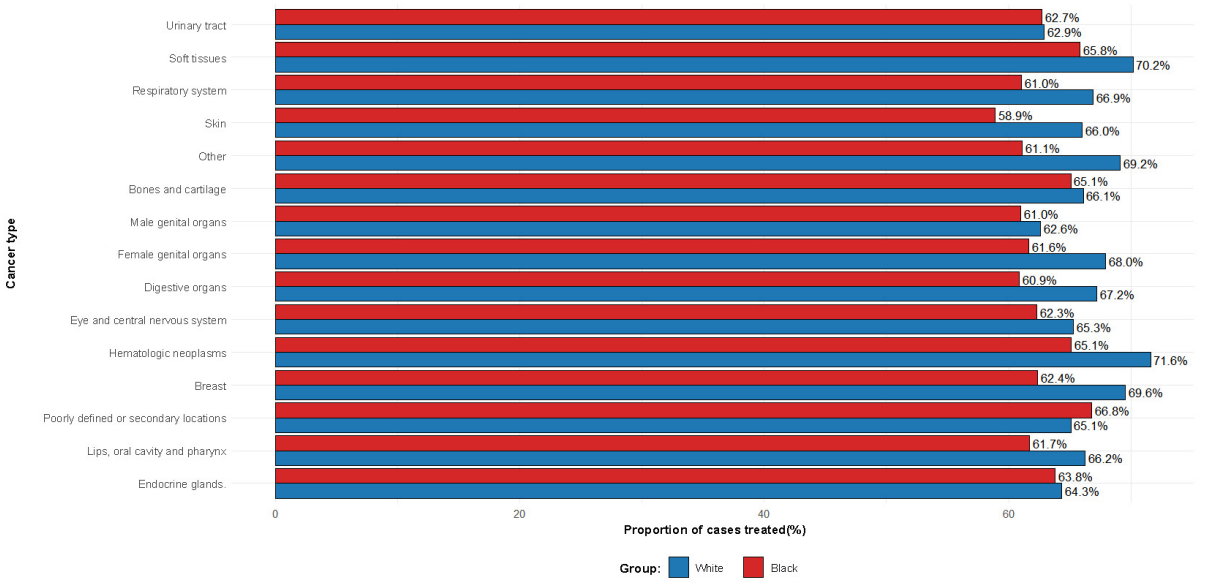

Figure 1 – Proportion of cases treated by cancer type and ethnicity/skin color (2011-2023).

Source: Prepared by the authors with data from SIM-SUS (2025).

and indicates an advantage for the reference group (Black individuals).

In addition, only 16.2% of this difference is explained by observable characteristics such as age, gender, schooling, occupation, region, and so forth. The characteristic contributing most to the gap is residence in the Southeast and South, accounting for 14.3% of the total difference. As shown in the descriptive analysis, most Black individuals reside in the North, Northeast, and the Midwest, where health service infrastructure is more limited.

Differences in effects account for 83.8% of the racial gap observed in cancer care. This means that most of the disparity is not explained by observable characteristics, but rather by differences in the effects of these variables across groups. In other words, the findings point to structural inequality or discrimination.

These results indicate that the gap is driven by differences in the effects of the characteristics (coefficients). More precisely, the same observable characteristics yield different returns - for example, schooling has a different impact among Black individuals than among White individuals.

In the unexplained component, positive coefficients indicate an expected increase in the gap in care between White and Black individuals if Black individuals had the same returns (coefficient effects) on the explanatory variables as White individuals (Powers, Yoshioka, and Yun, 2011). For example, if Black individuals had the same return to residence in the more developed regions as White individuals, the gap would increase by 2.02 percentage points, representing 34.3% of the total observed difference and further expanding the White advantage in access to care.

The factor contributing most to the unexplained gap in access to cancer care is the combined effect of age and age squared. This is consistent with the fact that aging is one of the main risk factors for developing cancer. If Black individuals had the same return (coefficient effects) to age combined with age squared as White individuals, the access gap would increase by 75.7% of the observed total, further deteriorating the disadvantage in access. This corresponds to an increase of approximately 4.45 percentage points.

By contrast, the negative coefficients for education and labor market position indicate that the Black population is more heavily penalized, that is, it receives lower returns to these characteristics than the White population. Thus, even when Black

Table 2 – Decomposition summary.

Indicator	Value	
Proportion of access to medical care		
White	67.34%	
Black	61.46%	
Total difference	0.0589	
Part explained (Appropriations)	0.0095 (16.2%)	
Part not explained (Coefficients)	0.0493 (83.8%)	
Explanatory variables	**Appropriations**	**Coefficients**
Intercept	-	-0.023 (-39.1%)
Mean age (years)	-0.003 (-5.4%)	0.053 (89.2%)
Age squared	-0.001 (-1.9%)	-0.008 (-13.5%)
Marital status (married)	0.001 (1.7%)	0.003 (5.4%)
Gender (female)	0.000 (0.6%)	-0.002 (-4.0%)
High School	-0.000 (-0.2%)	-0.003 (-5.1%)
Higher Education	-0.001 (-0.8%)	-0.001 (-2.2%)
Occupation (technical area)	0.003 (5.2%)	-0.002 (-3.7%)
Residing in the Southeast and South	0.008 (14.3%)	0.020 (34.3%)

Source: Prepared by the authors using data from SIM-SUS (2025).

individuals achieve the same level of schooling or occupation as White individuals, they are less likely to receive cancer care. This reveals inequality in the returns to these variables across groups. For secondary education, the gap would decrease by 0.3 percentage points, corresponding to 5.1% of the observed difference.

The large contribution of the unexplained component to the gap indicates that the same profile of characteristics among White and Black individuals does not generate the same outcomes for the two groups. The negative intercept underscores that, even when all characteristics are the same, a structural disadvantage persists for Black individuals.

Discussion

The results show that Black individuals who died from cancer between 2011 and 2023 had, on average, less access to cancer care. To the best of our knowledge, this is the first study to identify a gap of 5.9 percentage points between White and Black individuals. In addition, the largest differentials in access to cancer care were observed for breast

cancer, skin cancer, hematologic neoplasms, and tumors of the digestive organs and female genital organs.

The nonlinear decomposition showed that observable characteristics, such as education, occupation, and age, generate different returns across groups. Thus, even when both groups share the same characteristics, the impact of education or occupation differs. This points to the existence of structural inequality. During the period analyzed, the Black population died earlier from cancer, was more concentrated in regions with fewer health services, and received lower returns to education and labor market position.

Despite this, some limitations should be acknowledged. First, the estimates are based on public data, and the accuracy of the information cannot be guaranteed. As noted above, 28.1% of the total sample had no valid response to the question on access to medical care for the illness that caused death. A second limitation concerns the completeness of the ethnicity/skin color variable. This field became mandatory in SUS information systems only after the implementation of Federal Ordinance N°344/2017. In SIM-SUS, the completeness of this variable is lower in the Northeast than in other regions (Coelho et al., 2023), and this is precisely one of the regions with the largest Black population.

Even so, the results are consistent with a broad body of literature that recognizes the importance of analyzing differences in access to cancer care through the lens of ethnicity/skin color in order to understand the social determinants involved (Coelho; Campos, 2024) and support racial equity in health (Cunha et al., 2024).

The concept of intersectionality holds that certain groups face greater barriers to health care as a result of overlapping processes of oppression. Economic inequalities are tied to social markers such as skin color, gender, age, place of residence, and disability, which in turn shape health-disease-care processes (Macedo; Medeiros, 2025). Multiple forms of discrimination are institutionalized in society and ultimately affect equitable access to health care (Shannon et al., 2022). For this reason, health inequalities are grounded in broader processes of differentiation and power (Paula, 2024). Socioeconomic status and skin color are, therefore, key factors in access to cancer care and, consequently, in patient survival (Kelly-Brown et al., 2022).

The Black population faces greater difficulties in accessing diagnosis and treatment for many types of cancer because of economic and social barriers (Paulista; Assunção; Lima, 2019). For example, breast cancer is the tumor type with the highest mortality among women. Our estimates indicate that the gap in access to cancer care for this type of cancer is approximately 7.2 percentage points.

This finding is consistent with disparities observed in breast cancer screening, staging, treatment, and mortality: Black women undergo mammography less often (Silva; Scorzafave, 2025) and face a higher risk of death and a higher proportion of advanced-stage diagnoses (Lemos et al., 2024). Similar patterns are observed for other cancers (Tong, Latoya, Artiga, 2022): in cervical cancer, mortality is higher among Black women (Luiz et al., 2024), and the incidence of prostate cancer is higher among Black men (Romero et al., 2012).

Some barriers to accessing cancer care are not amenable to change, such as age and race/skin color (Paulista; Assunção; Lima, 2019). However, other social determinants can be modified through public policies. The nonlinear statistical decomposition indicated that the effect of age is the most relevant factor in explaining the gap in cancer care between the groups, followed by region of residence.

To this end, age has a more positive effect for the reference group; that is, among Black individuals, the probability of receiving care increases more with advancing age than among White individuals. Likewise, residence in the Southeast and South increases the probability of access to cancer care among Black individuals. These findings are related to the fact that older White individuals, on average, live longer and are concentrated in the more developed regions, which may reduce the positive impact of age and region for that group.

Higher mortality rates among older Black individuals reflect the greater prevalence of chronic conditions and comorbidities in these populations, as well as the impact of adverse socioeconomic, environmental, and health conditions (Jain et al.,

2024). Unfavorable socioeconomic conditions, unequal access to education, and exposure to violence are the main factors behind the five-year life expectancy gap between White and Black individuals (Instituto Mobilidade e Desenvolvimento Social [IMDS], 2024).

Similarly, the Black population is more concentrated in the North and Northeast, precisely the regions most in need of Public Health policies. The centralized distribution of high-complexity oncology services affects patient survival and, consequently, cancer mortality (Silva; O'Dwyer; Castro, 2019). Patients living in the North and Midwest must travel the greatest distances to reach these services (Fonseca et al., 2022). Notably, however, most cancer deaths in the country occur in hospitals (Silva et al., 2024), which may indicate that most patients do obtain some access to cancer care.

Final considerations

This study analyzed the determinants of the gap in access to medical care for cancer between White and Black individuals. The findings show a 5.9-percentage-point gap in access to cancer care, with particularly large disparities in cancers such as breast and skin cancer. In addition, the results show that the Black population died earlier from cancer between 2011 and 2023, was concentrated in regions with fewer health services, and received lower returns to education and labor market position.

This study adds to a still-developing literature on inequalities in access to health care across socioeconomic groups. Particularly, intersectionality offers a useful framework for examining unequal access to health. Our results, therefore, contribute to the field and highlight opportunities for multidisciplinary analyses aimed at promoting more equitable access to health services. Future research should focus on understanding the complex interactions among socioeconomic, environmental, biological, and behavioral factors that drive health disparities across the life course, in order to inform public policies that consider social markers toward equitable access to health care.

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Authorship Credits

Alana Ramos da Silva contributed to the conceptualization, data curation, formal analysis, investigation, methodology, computer programs, validation, visualization, writing – original draft and writing – revision and editing.

Fernando Antonio Slaibe Postali contributed to the conceptualization, formal analysis, funding acquisition, methodology, project management, supervision, and writing – revision and editing.

Ethical Considerations

This study used publicly available data from the Mortality Information System of the Informatics Department of the Unified Health System.

Funding

This research was funded by the National Institute for Health and Care Research (NIHR) 133252: "Global Health Research Unit: Health financing for UHC in challenging times: leaving no-one behind", using UK international development funding from the UK Government to support global health research. The opinions expressed are those of the authors and not necessarily those of the NIHR or the UK government.

Acknowledgments

The authors thank the Foundation Institute of Economic Research (FIPE) for the postdoctoral fellowship.

Conflict of Interest

The authors have no conflicts of interest to declare.

Data Availability Statement

The research data are available within the main text of the article.

Editors: José Miguel Olivar, Daniel Campos
Received: 07/11/2025
Approved: 01/05/2025