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EPIDEMIOLOGICAL CHARACTERIZATION OF CUTANEOUS MALIGNANT MELANOMA DEATHS IN BRAZIL BETWEEN 2020 AND 2024: A CROSS-SECTIONAL STUDY

ANA LUIZA NAUJORKS ZIMMER[1], ISABELA LUIZA PACHECO RODRIGUES[1], MICHELLE VITÓRIA MARQUES RASSI TAHAN[2], AMANDA CAROLINA DE FARIA COSTA[2], JOSIELLY LEITE MAGALHÃES OLIVEIRA[1], MARIANA MELO SOARES[3]

1. Graduando(a) em Medicina Universidade Federal de Goiás, Goiânia/GO, Brazil.
2. Graduando em Medicina pela Universidade Federal de Jataí, Jataí/GO, Brazil.
3. Médica Dermatologista - CRM-GO 26.963 RQE: 20.103 na Universidade Federal de Goiás, Goiânia/GO, Brazil.

ABSTRACT

Cutaneous melanoma represents the most lethal subtype of skin cancer, standing out due to its high metastatic potential and its impact on mortality. This study aimed to characterize the epidemiological profile and temporal trends of cutaneous melanoma deaths in Brazil between 2020 and 2024. This was a cross-sectional, descriptive, retrospective, population-based study using data from the Mortality Information System, including records classified under International Statistical Classification of Diseases and Related Health Problems code C43. During the study period, 9,792 deaths were recorded, showing relative temporal stability and the highest number of occurrences in 2023 (2,047 cases). Mortality was more frequent among males (57.34%), individuals aged 60 years or older (69.88%), White individuals (78.38%), and those with lower educational attainment (47.67%). The Southeast and South regions accounted for 75.37% of all deaths, although the North, Northeast, and Central-West regions exhibited more pronounced proportional increases throughout the historical series. A high frequency of records with unspecified anatomical location was also observed, highlighting limitations in the specificity of the available information. The findings demonstrate the persistence of disparities in melanoma mortality in Brazil and reinforce the need for targeted strategies focused on prevention, early diagnosis, and the strengthening of epidemiological surveillance, taking into account the sociodemographic and regional inequalities identified.

Keywords: Epidemiology, Cross-sectional studies, Melanoma, Mortality.

INTRODUCTION

Cutaneous melanoma is a malignant neoplasm originating from melanocytes, with significant potential for dissemination and an unfavorable prognosis when diagnosed at advanced stages.[1-4] In Brazil, the Ministry of Health[1] reports that this tumor can affect the skin and mucous membranes, is more common in White adults, and accounts for approximately 3% of malignant skin neoplasms. Nevertheless, it is the most severe subtype due to its high metastatic potential. The National Cancer Institute[2] similarly emphasizes that invasive melanoma accounts for approximately 1% of skin cancers but is responsible for most deaths associated with this group. It is also associated with sun exposure,

skin phototype, multiple nevi, family history, and immunosuppression.

The clinical relevance of melanoma becomes even more evident in metastatic disease. Although localized melanoma has a five-year survival rate of up to 98%, this rate drops to 16% when metastatic dissemination occurs, particularly when visceral organs are affected.[3] Advances in therapeutic strategies, including immunotherapy, targeted therapies, and selected surgical approaches, have expanded the possibilities for disease control without eliminating its substantial lethality.[3] Similarly, the Instituto Nacional de Câncer[4] classifies cutaneous melanoma as the most aggressive type of skin cancer, precisely because of its high potential for invasion and spread to neighboring tissues and organs.

In the Brazilian context, the epidemiological characterization of cutaneous melanoma deaths is essential for assessing the burden of the disease and identifying sociodemographic and geographic patterns associated with mortality. The Ministry of Health[1] reports that, despite recent improvements in survival, driven primarily by early diagnosis and the introduction of immunotherapies, melanoma remains a significant public health concern, with official estimates indicating the persistence of cases and deaths in the country. Therefore, analyses covering the period from 2020 to 2024 are necessary to update the mortality profile, identify more vulnerable groups, and support prevention, early detection, and healthcare organization strategies.[1,4]

OBJECTIVES

The present study aimed to characterize the epidemiological profile and temporal trends of cutaneous melanoma deaths in Brazil between 2020 and 2024, considering their distribution according to sociodemographic, regional, and anatomical variables, as well as analyzing mortality rates and the proportion of deaths attributable to this disease among all cancer-related deaths.

METHODS

This was a cross-sectional, descriptive, retrospective, population-based study focused on analyzing the epidemiological profile and temporal trends of melanoma mortality in Brazil from 2020 to 2024. Data were obtained from the Health Information System(SIM)[5], made available by the Department of Informatics of the Unified Health System (DATASUS)[5] and extracted using the TabWin application.

The initial selection of population records was performed using the underlying cause of death variable (CAUSABAS). Initially, all records classified under the chapter of neoplasms (tumors), corresponding to codes C00 to D48 of the International Statistical Classification of Diseases and Related Health Problems (ICD-10), were extracted. Subsequently, a sequential filtering process was applied to define the scope of the study: first, malignant neoplasms (C00–C97) were selected; next, the search was restricted to malignant neoplasms of the skin (C43–C44); and finally, specific cases of cutaneous malignant melanoma, identified by code C43, were isolated.

To characterize the sociodemographic profile of individuals who died from melanoma, the variables sex (SEXO), age (IDADE), race/skin color (RACACOR), and educational attainment (ESC) were analyzed. Age was assessed through its distribution across age groups and by determining the median for each year analyzed and for the aggregated period. The geographic distribution of deaths was determined based on the municipality of residence (CODMUNRES), subsequently grouped into the five Brazilian macroregions (North, Northeast, Central-West, Southeast, and South). In addition, the most frequent anatomical locations of melanoma were identified using the ICD-10 subcategories recorded in the CAUSABAS variable, considering codes C43.0 to C43.9,

allowing the analysis of death frequencies according to the primary anatomical site of the neoplasm.

For each year of the study period, the absolute number of deaths from cutaneous malignant melanoma was calculated, along with their frequency relative to the total number of deaths from all neoplasms, malignant neoplasms (C00–C97), and their proportion among deaths from malignant neoplasms of the skin (C43–C44). Additionally, annual melanoma mortality rates were calculated, expressed per 100,000 inhabitants, by dividing the number of recorded deaths by the estimated resident population for the corresponding year and multiplying the result by 100,000.

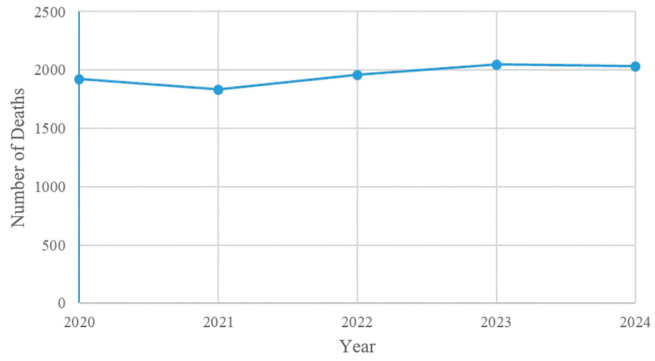
All analyses and indicators were initially processed separately for each year of the study period (2020 to 2024) using spreadsheets processed in Microsoft Excel. In the subsequent stage, data from the entire period were consolidated into a unified database, enabling comparisons of temporal trends and changes in the variables over the five years studied.

Furthermore, a narrative literature review was conducted to provide epidemiological, clinical, and molecular context for malignant melanoma and to support the discussion of the results. Scientific databases and institutional documents were consulted, including PubMed, the Ministério da Saúde, the Instituto Nacional de Câncer (INCA), DATASUS, and the Instituto Brasileiro de Geografia e Estatística (IBGE). At the end of the search, 19 references were selected, including scientific articles, reviews, government documents, and official databases, covering aspects related to melanoma epidemiology, incidence, mortality, risk factors, prevention, diagnosis, and treatment. No strict time limit was established for the inclusion of references, since some classic studies and institutional documents remain fundamental references in the field and retain scientific and historical relevance for understanding the disease.

As this study was based exclusively on secondary, aggregated, publicly available data, without personal identification or risk of breaching participant confidentiality, submission to and prior approval by a Research Ethics Committee were not required, in accordance with the guidelines of Resolution No. 466/2012 of Conselho Nacional de Saúde (National Health Council).

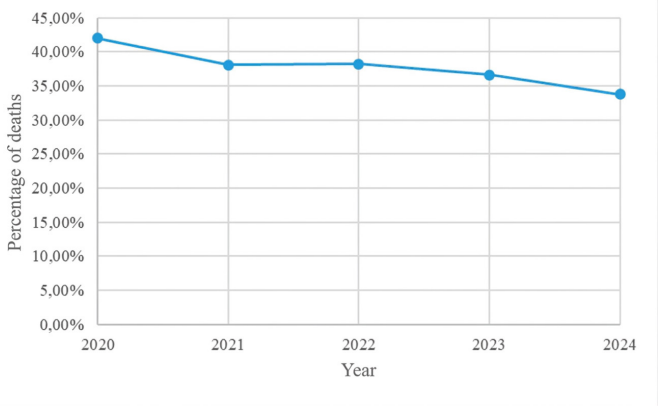
RESULTS AND DISCUSSIONS

The number of deaths from malignant melanoma in Brazil over the past five years showed a high degree of homogeneity (CVp: 4.45%), peaking in 2023 (2,047 deaths). The annual average was 1,958.4 deaths, totaling 9,792 cases over the study period.



Graph 1: Temporal variation in the number of deaths from malignant melanoma from 2020 to 2024.
Source: Prepared by the authors using data from the Health Information System (SIM).

Among deaths from neoplasms, these figures represent 0.8% of all neoplasms, 0.81% of malignant neoplasms, and 37.49% of malignant skin neoplasms. During the 2020–2024 period, the proportions among malignant skin neoplasms were 42.02%, 38.06%, 38.24%, 36.63%, and 33.75%, respectively. This corresponds to a standard deviation of 2.68 and a coefficient of variation (CV) of 7.09%, indicating low dispersion and a small but consistent decline in the proportion of deaths from malignant skin neoplasms attributable to melanoma.



Graph 2: Temporal Variation in the Percentage of Deaths from Cutaneous Malignant Melanoma Among Deaths from Malignant Skin Neoplasms from 2020 to 2024.
Source: Prepared by the authors using data from the Health Information System (SIM).

When evaluating the sociodemographic profile of individuals who died from melanoma through an analysis of mortality by age group and sex, a predominance of deaths among males (57.34%) compared with females (42.66%) was observed, along with an age-related mortality distribution showing marked right-skewness, with 69.88% of all deaths occurring among individuals aged 60 years or older. A disparity in median age at death was also observed throughout the study period, with male mortality reaching its highest absolute number of deaths in the 70–79 age group, whereas deaths among females were concentrated at older ages, particularly among those aged 80 years or older.

Table 1: Percentage Distribution of Deaths from Malignant Melanoma by Age Group and Sex from 2020 to 2024.

Age Group	Male	Female	Overall Total
<1	0,00%	0,01%	0,01%
1-30	0,88%	0,76%	1,63%
30-39	2,47%	1,53%	4,00%
40-49	4,87%	4,11%	8,98%
50-59	9,33%	6,16%	15,49%
60-69	13,16%	8,83%	22,00%
70-79	14,11%	9,22%	23,34%
>=80	12,51%	12,04%	24,55%
Overall Total	**57,34%**	**42,66%**	**100,00%**

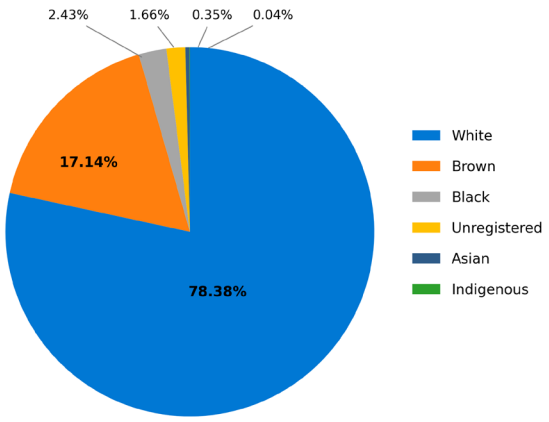
Source: Prepared by the authors using data from the Health Information System (SIM).

Regarding race/skin color, the distribution of deaths showed a consistent predominance of White individuals (78.38%) throughout the study period. The second-largest group was individuals of mixed race (pardo), accounting for 17.14% of deaths, while Black individuals ranked third, representing only 2.43% of deaths. Deaths among White individuals increased by 7.1% over the period, despite a decline in 2021, whereas deaths among individuals of mixed race increased by only 5.98%, declining from 2020 to 2022 before rising from 2023 onward. Deaths among Black individuals, although relatively low in absolute numbers, showed the greatest increase, rising by 17% between 2020 and 2024.

Table 2:Percentage Distribution of Deaths from Malignant Melanoma by Race/Skin Color from 2020 to 2024.

Race/Skin Color	Year					Total	Relative Frequency
	2020	2021	2022	2023	2024		
White	1485	1424	1576	1599	1591	7675	78.38%
Black	47	42	45	49	55	238	2.43%
Asian	7	5	6	7	9	34	0.35%
Mixed Race	338	316	307	359	358	1678	17.14%
Indígenous	3	0	0	1	0	4	0.04%
Not recorded	43	45	25	32	18	163	1.66%
Total	**1923**	**1832**	**1959**	**2047**	**2031**	**9792**	**100.00%**

Source: Prepared by the authors using data from the Health Information System (SIM).



Graph 3: Percentage Distribution of Total Deaths from Malignant Melanoma from 2020 to 2024.
Source: Prepared by the authors using data from the Health Information System (SIM).

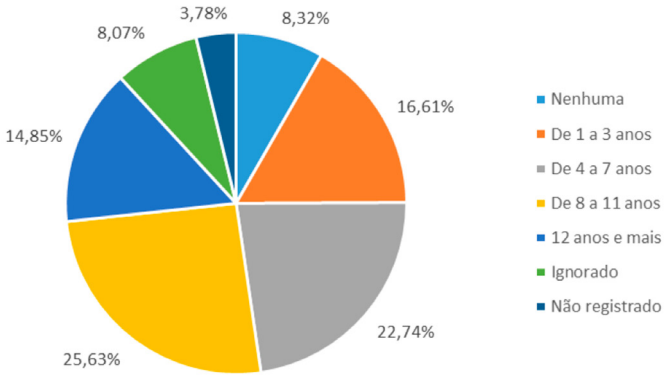
Regarding educational attainment, three categories were established for analysis: low educational attainment (categories: “none,” “1 to 3 years,” and “4 to 7 years”), medium educational attainment (“8 to 11 years”), and high educational attainment (“12 years or more”). The low educational attainment group accounted for 4,668 deaths (47.67%), while the medium and high educational attainment groups accounted for 25.63% and 14.85% of deaths, respectively. In the temporal analysis, the high educational attainment group showed the greatest increase (28.68%,

CV: 11.5%), while the medium educational attainment group increased by 22.20% (CV: 11.89%), and the low educational attainment group remained relatively stable (CV: 2.78%).

Table 3: Percentage Distribution of Deaths from Malignant Melanoma by Years of Education from 2020 to 2024.

Years of educations	2020	2021	2022	2023	2024	Total	Relative frequency
None	156	156	170	168	165	815	8.32%
1 to 3 anos	341	328	330	321	306	1626	16.61%
4 to 7 anos	437	415	433	483	459	2227	22.74%
8 to 11 anos	464	419	522	538	567	2510	25.63%
12 yeras or more	258	260	286	318	332	1454	14.85%
Unknown	172	157	157	160	144	790	8.07%
Not recorded	95	97	61	59	58	370	3.78%
Total	**1923**	**1832**	**1959**	**2047**	**2031**	**9792**	**100.00%**

Source: Prepared by the authors using data from the Health Information System (SIM).



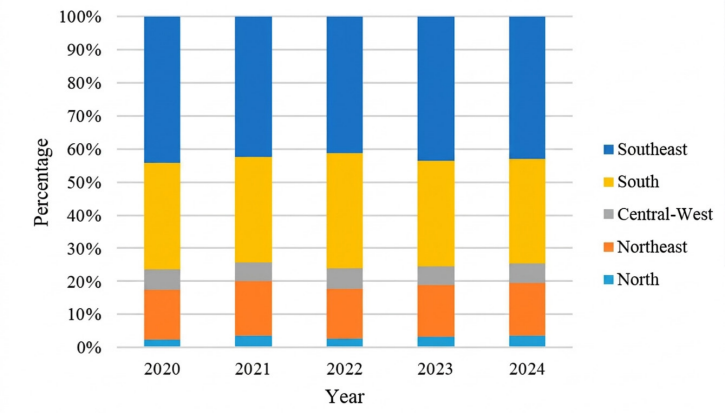
Graph 4: Distribution of Educational Attainment Among Deaths from Malignant Melanoma in Brazil from 2020 to 2024.
Source: Prepared by the authors using data from the Health Information System (SIM).

The analysis of the regional distribution of the 9,792 deaths from malignant melanoma in Brazil between 2020 and 2024 revealed marked geographic asymmetry, with a strong predominance in the southern half of the country. The Southeast and South macroregions accounted for more than three-quarters of all deaths nationwide (75.37%). Throughout the study period, the ranking of regions by absolute number of deaths remained unchanged. The Southeast recorded the highest proportion, accounting for 42.86% of the total, followed by the South (32.51%), Northeast (15.63%), Central-West (5.89%), and North (3.11%).

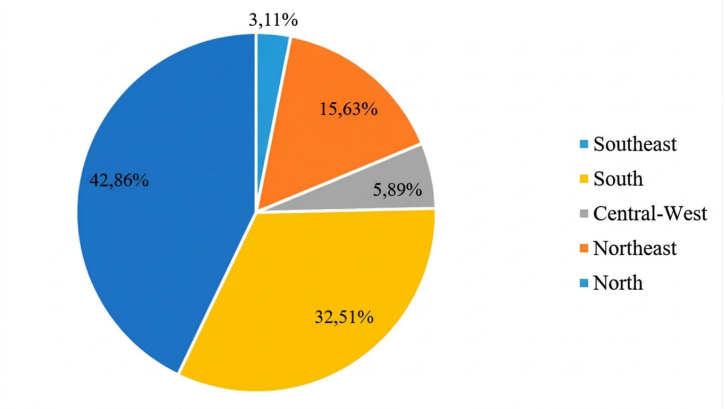
The analysis of longitudinal trends revealed that all five macroregions experienced an increase in the absolute number of deaths when comparing the beginning and end of the study period, although the magnitude of these changes varied. The North region recorded the greatest proportional increase, rising from 47 cases in 2020 to 70 cases in 2024. The Northeast and Central-West regions also exhibited a continuous upward trend from 2022 onward.

Meanwhile, the regions with the highest numbers of deaths, the South and Southeast, showed the lowest

growth rates when directly comparing the first and last years of the study period. Both exhibited similar patterns during the historical series, with a simultaneous decline in 2021 (583 cases in the South and 778 cases in the Southeast), followed by substantial increases in subsequent years. The South region reached its peak number of deaths in 2022 (n=685), while the Southeast recorded its highest number in 2023 (n=890).



Graph 5: Annual Distribution of Deaths from Malignant Melanoma from 2020 to 2024.
Source: Prepared by the authors using data from the Health Information System (SIM).



Graph 6: Total Percentage Distribution of Deaths from Malignant Melanoma from 2020 to 2024.
Source: Prepared by the authors using data from the Health Information System (SIM).

Finally, the assessment of the distribution of deaths according to the topography and anatomical location of the lesion revealed a marked concentration of records in unspecified categories. The predominance of unspecified lesions (C43.9) accounted for 83.10% of all melanoma deaths, followed by two other types of records: invasive malignant melanoma of the skin (code C43.8) and malignant melanoma of other and unspecified parts of the face (code C43.3), accounting for 6.99% and 1.24% of deaths, respectively.

1. General Analysis:

The 2020–2024 time series demonstrated predominantly stable mortality rates from cutaneous malignant melanoma in Brazil. A slight decline was observed between 2020 and 2021, followed by an

increase over the subsequent two years and another minor decline in 2024, after the peak in cases. At the same time, a progressive reduction in its proportion among malignant skin neoplasms was observed.

This pattern contrasts with the previous trend reported by Silva, Alencar, Abreu, Lima, and Freitas Junior[6], who identified significant fluctuations between 2013 and 2022, and with the findings of Melo, Wainstein, Buzaid, Shoushtari, Weber, and Sasse[7], who, when analyzing mortality and incidence from 2000 to 2013, observed an increase in incidence among both men and women, accompanied by a moderate increase in the mortality rate among men. It is partially consistent with the projection by Santos and Souza[8], who observed a progressive increase in the absolute number of deaths, although this increase occurred at a higher rate than expected and reached 2,000 deaths before 2030.

Caution is required when interpreting the data, particularly those relating to 2020 and 2021, due to the impact of the COVID-19 pandemic on healthcare services. Findings in the literature are heterogeneous in the context of cutaneous melanoma. One study conducted at the University Hospital of the Universidade Federal do Rio de Janeiro found that, during the first year of the pandemic (2020), there was a reduction in cutaneous melanoma diagnoses and that tumor thickness was greater than in the previous eight years.[9] On the other hand, another retrospective observational study found no statistically significant differences in either tumor thickness or the number of cases diagnosed between January 2019 and September 2022.[10]

In this context, the current data suggest a possible stabilization despite the increase, which may be related to a combination of factors, such as improvements in early diagnosis, the implementation of more effective treatments, or the relative stability of public health policies and environmental risk factors that improve prognosis.[11]

Regarding the male predominance in mortality from the disease, a gradual increase in the male proportion was observed. Whether sex influences melanoma incidence and mortality remains a subject of debate; however, no robust genetic evidence of predisposition has yet been identified, only disparities in risk factors attributed to different lifestyles and behaviors[12], including delayed diagnosis.[8]

2. Population Analysis of Mortality

The marked concentration of deaths among White individuals, accounting for 78.38% of all recorded deaths, remained consistent throughout the study period. This is in line with the epidemiological literature reviewed[6-8], which describes higher melanoma incidence and mortality among fair-skinned individuals due to lower melanin levels and the consequent reduction in natural protection against the carcinogenic effects of ultraviolet radiation.

Although individuals of mixed race (Pardo) accounted for the second-largest proportion of deaths (17.14%), a more modest proportional increase was observed over the study period. In contrast, Black individuals, despite accounting for only 2.43% of recorded deaths, exhibited the greatest proportional increase between 2020 and 2024. This pattern should be interpreted with caution, as small absolute variations tend to produce large percentage fluctuations. Nevertheless, this finding reinforces the need to avoid the misconception that melanoma exclusively affects White individuals, since diagnosis among Black populations frequently occurs at more advanced stages, contributing to poorer clinical outcomes.[13]

3. Regional Analysis of Mortality:

The South and Southeast regions accounted for 75.37% of all recorded deaths, consistently maintaining the highest absolute numbers throughout the study period. This pattern is consistent with the demographic

composition of these macroregions, which have the highest proportion of self-identified White individuals in Brazil.[14] In this context, the high mortality observed in these regions may reflect not only their larger population size but also a population inherently more susceptible to developing melanoma.

The findings corroborate the observations of Santos and Souza[8], who identified the South and Southeast regions as the main areas of concentration of melanoma mortality in Brazil and projected that this pattern would persist until 2032.

Despite the predominance of the South and Southeast regions in absolute numbers, the highest proportional growth rates were observed in the North, Northeast, and Central-West regions. The North showed the most substantial increase, rising from 47 deaths in 2020 to 70 in 2024, which is consistent with the frequent treatment delays observed in this region compared with others.[15]

Overall, the relative stability of national figures observed during the study period suggests that the disease burden remains strongly concentrated among population groups historically more vulnerable to melanoma. It also reinforces the need for prevention, health education, and early diagnosis strategies targeting not only the regions traditionally most affected but also areas that have recently experienced increasing mortality.

4. Social Analysis of Educational Attainment:

The analysis of educational attainment revealed a predominance of deaths among individuals with lower educational attainment, who accounted for 47.67% of all melanoma deaths recorded between 2020 and 2024. This finding may reflect not only the age composition of the Brazilian population but also historical inequalities in access to health information, specialized healthcare services, and early diagnosis. Studies have demonstrated an association between melanoma incidence and prognosis in populations of higher and lower socioeconomic status, with the latter experiencing delayed diagnoses at advanced stages and higher mortality.[16] This scenario may be related to health literacy, which educates individuals about protective measures against skin cancer, behavioral changes, early detection, and disease awareness.[17]

Despite the predominance of deaths among individuals with lower educational attainment in absolute numbers, the greatest proportional increases were observed in the medium and high educational attainment groups, which showed increases of 22.20% and 28.68%, respectively, throughout the study period. This pattern suggests a gradual change in the sociodemographic profile of melanoma mortality.

5. Topography and Anatomical Location

The analysis of the anatomical location of melanoma deaths reveals significant challenges regarding the specificity of the records. A substantial proportion of reports classify tumor topography nonspecifically (e.g., “melanoma of unspecified site” or generic categories involving the limbs and trunk), limiting the accuracy of correlations between tumor location and associated risk factors.

This finding indicates a significant limitation of health information systems, as the high proportion of nonspecific codes suggests shortcomings in the completion of death certificates or in the clinical investigation of the primary tumor location. Subtypes such as acral melanoma, which develops without an association with recreational sun exposure, remain underreported until advanced stages[18] and have high mortality rates, predominantly affecting non-White populations.[19]

Nevertheless, the distribution of cases for which topographic identification is possible indicates a predominant concentration in the trunk and limbs. From a clinical perspective, it is important to emphasize that anatomical location has a direct impact on prognosis: lesions located in areas that are

difficult to self-examine or in acral regions are more likely to be diagnosed at advanced stages.

6. Limitations:

It is necessary to consider certain limitations inherent in the cross-sectional design and the data sources used. The accuracy of the analyses depends on the quality of the information recorded on Death Certificates (DCs) in the Mortality Information System (SIM). The presence of records with nonspecific classifications, such as "unspecified site" for tumor topography or missing data regarding ethnicity and educational attainment, introduces biases that may underestimate the prevalence of certain melanoma subtypes or distort sociodemographic correlations.

Furthermore, the cross-sectional nature of this study limits the ability to infer causal relationships, allowing only the identification of epidemiological patterns and temporal trends. It should be emphasized that the absence of incidence data prevents the calculation of specific case fatality indicators, restricting the analysis to the absolute number of deaths. Finally, although educational attainment and self-reported race/skin color are essential variables for understanding the social context, they reflect the subjectivity involved in completing secondary databases, requiring caution when extrapolating the findings to the individual level.

Despite these limitations, this study provides an essential overview of melanoma mortality trends in Brazil, highlighting the need for greater rigor in completing health information system records and the imperative for screening strategies that take into account regional characteristics and the different risk profiles of the Brazilian population.

CONCLUSION

The results demonstrated that the number of deaths remained relatively stable throughout the study period, with a predominance among males, older individuals, White individuals, and those with lower educational attainment. Furthermore, a significant concentration of mortality was observed in the South and Southeast regions, although regions such as the North, Northeast, and Central-West showed proportional increases in recorded deaths throughout the study period.

These findings reinforce the persistence of epidemiological and social inequalities related to melanoma in Brazil, highlighting the need for strategies targeting the most vulnerable population groups. Identifying the most affected profiles may contribute to the planning of preventive measures, awareness campaigns regarding sun exposure, strengthening of early diagnosis, and improved timely access to specialized healthcare services. Additionally, the observed regional distribution provides a basis for allocating resources and developing public policies according to the specific needs of each region.

However, the results should be interpreted in light of the study's inherent limitations. The use of secondary data from the Mortality Information System is subject to inconsistencies in data recording, underreporting, and a high frequency of nonspecific records, particularly regarding the anatomical location of tumors. In this context, the results should be interpreted with caution, especially during the initial years of the study period (2020–2021), as the impact of the COVID-19 pandemic on access to healthcare services and melanoma diagnosis may have influenced the observed indicators. Furthermore, the cross-sectional design precludes the establishment of causal relationships, limiting the analyses to the description of patterns and trends observed during the period.

Therefore, it is recommended that future research incorporate data on incidence, tumor staging, access to healthcare services, and patients' treatment characteristics, allowing for a more comprehensive understanding of the factors associated with melanoma mortality. Analytical and longitudinal studies

may also contribute to identifying prognostic determinants and evaluating the effectiveness of disease prevention and control policies.

In summary, cutaneous melanoma remains a significant public health concern in Brazil, with mortality concentrated among historically more vulnerable population groups and regions. Understanding this epidemiological profile is essential for improving surveillance, prevention, and healthcare strategies, contributing to reducing the disease burden and improving outcomes.

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MAILING ADDRESS
ANA LUIZA NAUJORKS ZIMMER
5ª avenida, s/n - Setor Leste Universitário , Goiânia/GO, Brasil.
E-mail: naujorks.zimmer@discente.ufg.br

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Authors:
Ana Luiza Naujorks Zimmer - http://lattes.cnpq.br/8076289651834199 - https://orcid.org/0000-0001-8055-9821

Isabela Luiza Pacheco Rodrigues - http://lattes.cnpq.br/7700244285082906 - https://orcid.org/0009-0009-3936-0007

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