

## Analysis of the mortality by eye cancer from 2010 to 2019 in Brazil

## Análise da mortalidade no Brasil por câncer ocular de 2010 a 2019

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## ABSTRACT

**Objective:** To assess the deaths caused by eye cancer from 2010 to 2019 in Brazil.

**Methods:** Data were selected from SUS' Computer Department platform at the Ministry of Health, including death certificates, from 2010 to 2019, from all Brazilian states and the Federal District, filtering the codes C69.0 to C69.9 as the cause of death, according to the International Classification of Diseases, Tenth Revision.

**Results:** There were 1,859 deaths from malignant neoplasm of eye and adnexa (C69), in Brazil, from 2010 to 2019, affecting 1,062 (57.1%) men. The site of neoplasm was unspecified (C69.9) in 719 cases, representing the most frequent etiology in the C69 group (38.67%). The malignant neoplasm of the orbit (C69.6) was the second most common cause of death (22.59%), followed by malignant neoplasm of retina (C69.2) (14.73%).

**Conclusion:** The number of deaths due to malignant neoplasm of eye and adnexa slightly increased through the years of 2010 to 2019, in Brazil.

## RESUMO

**Objetivo:** Avaliar os óbitos causados por câncer ocular durante os anos de 2010 a 2019 no Brasil.

**Métodos:** Os dados foram selecionados na plataforma do Departamento de Informática do SUS do Ministério da Saúde, incluindo declarações de óbito, durante os anos de 2010 a 2019, de todos os estados brasileiros e do Distrito Federal, filtrando os códigos C69.0 a C69.9 como causa básica de óbito, de acordo com a Classificação Internacional de Doenças e Problemas Relacionados à Saúde – 10ª Revisão.

**Resultados:** Houve 1.859 óbitos por neoplasia maligna de olho e anexos (C69), no Brasil, no período de 2010 a 2019, acometendo 1.062 (57,1%) homens. O sítio da neoplasia não foi especificado (C69.9) em 719 casos, representando a etiologia mais frequente no grupo C69 (38,67%). A neoplasia maligna da órbita (C69.6) foi a segunda causa mais comum de óbito (22,59%), seguida pela neoplasia maligna da retina (C69.2) (14,73%).

**Conclusão:** O número de óbitos por neoplasia maligna de olho e anexos aumentou discretamente ao longo dos anos de 2010 a 2019, no Brasil.

## INTRODUCTION

Eye cancer encompasses a set of rare diseases that can affect different layers of the eye and its adnexa, occurring in different age groups. In Brazil, the first ocular oncology clinic was created in the 1950s, at *Hospital AC Camargo*, which allowed for the evolution of the specialty in the national territory since then. However, there are still limitations in the Brazilian Unified Health System (SUS, acronym in Portuguese) to manage these conditions, mainly due to the high cost of some therapies.<sup>(1)</sup>

In several Brazilian cities, there are specific centers to monitor patients who suffer from eye cancer. In this context, a study carried out in an ocular oncology center in Manaus showed that 221 patients sought care at the service for ocular neoplasm, in three years, of which 71 had malignant lesions.<sup>(2)</sup> Another study, carried out in an ophthalmology center in São Paulo, showed that of 3,446 surgical specimens with histopathological evaluation, 324 were malignant lesions of the eyelids, especially basal cell carcinoma.<sup>(3)</sup> Regarding uveal melanoma, from 2000 to 2016, there were 2,166 cases in Brazil, which represented 5.4% of all causes of melanoma in that period, according to data from the National Cancer Institute.<sup>(4)</sup>

Although rare, these conditions can lead to an obscure prognosis, representing more than half of the causes of eye removal in an ophthalmology reference center in São Paulo (SP).<sup>(5)</sup> Furthermore, these tumors can progress to the death of patients, especially if the diagnosis and treatment are postponed.<sup>(6)</sup> In this context, in Brazil, from 1980 to 2002, there were 1,110 deaths from malignant ocular neoplasms among children up to 14 years old, which represented an age-adjusted mortality rate in 2002 of 0.08/100,000 in girls and 0.11/100,000 in boys.<sup>(7)</sup>

The American Cancer Society estimated that 400 deaths from eye and orbital cancer would occur in the United States in 2021.<sup>(8)</sup> In the United Kingdom, from 2016 to 2018, there were 123 deaths from eye cancer, mainly affecting the elderly.<sup>(9)</sup>

There is a limitation in the literature regarding the Brazilian data about the mortality profile of the ocular cancer. Thus, this study aimed at evaluating the deaths caused by eye cancer, in Brazil, during the years of 2010 to 2019.

## METHODS

### Study design

An aggregated, cross-sectional study was carried out using data from the Mortality Information System (SIM, acronym in Portuguese), on SUS' Computer Department

(Datusus) platform, which is controlled by the Ministry of Health in Brazil. These data are acquired through death certificates, documents uniformly used throughout the national territory, containing information regarding the underlying cause of death, demographic characteristics and clinical particularities.

### Data assessment

Data were selected from death certificates, during the period from 2010 to 2019, from all Brazilian states and the Federal District, filtering the codes C69.0 (malignant neoplasm of conjunctiva), C69.1 (malignant neoplasm of cornea), C69.2 (malignant neoplasm of retina), C69.3 (malignant neoplasm of choroid), C69.4 (malignant neoplasm of ciliary body), C69.5 (malignant neoplasm of lacrimal gland and duct), C69.6 (malignant neoplasm of orbit), C69.8 (malignant neoplasm of overlapping sites of eye and adnexa), C69.9 (malignant neoplasm of unspecified site of eye), encompassed by the code C69 (malignant neoplasm of eye and adnexa), in the International Classification of Diseases-10 (ICD-10).

### Data analysis

Values were expressed as mean and standard deviation or absolute frequency and percentage. All analyses were performed in Statistical Package for the Social Sciences (SPSS) version 20.0 for Windows. Proportional mortality indicators were calculated as follows:

$$\text{Proportional mortality (\%)} = \frac{\text{number of cases of the disease as the primary cause of death} \times 100}{\text{total number of deaths}}$$

## RESULTS

Overall, there were 1,859 deaths by malignant neoplasms of eye and adnexa, in Brazil, from 2010 to 2019, which represented 00.0148% of the 12,479,256 deaths that occurred from all causes at the same time range of the data analyzed. The lower and the highest number of cases occurred in the Midwest Region (7.4%) and in the Southeast Region (37.6%), respectively (Table 1). Deaths from eye cancer occurred among 1,062 (57.1%) men, with a mean age of 57.74 years old. The white ethnicity accounted for 1,073 (57.7%) cases, followed by brown ethnicity with 616 (33.1%) individuals (Table 2). Overall, the number of deaths from malignant neoplasm of eye and adnexa presented stability through the years (Figure 1).

When stratified by age, malignant neoplasms of eye and adnexa accounted for 481 deaths in individuals aged at least 80 year old, representing 00.0137% of the deaths

**Table 1.** Deaths by malignant neoplasm of eye and adnexa in Brazil by region and year

Region	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Total
Brazil	167(100)	151 (100)	175 (100)	186 (100)	179 (100)	168 (100)	197 (100)	226 (100)	200 (100)	210 (100)	1859 (100)
North Region	18 (10.8)	19 (12.6)	20 (11.4)	21 (11.3)	14 (7.8)	19 (11.3)	17 (8.6)	22 (9.7)	27 (13.5)	26 (12.4)	203 (10.9)
Northeast Region	44 (26.3)	41 (27.2)	49 (28.0)	48 (25.8)	58 (32.4)	53 (31.5)	59 (29.9)	66 (29.2)	44 (22.0)	59 (28.1)	521 (28.0)
Southeast Region	70 (41.9)	67 (44.4)	68 (38.9)	73 (39.2)	61 (34.1)	48 (28.6)	69 (35.0)	88 (38.9)	82 (41.0)	73 (34.8)	699 (37.6)
South Region	25 (15.0)	17 (11.3)	25 (14.3)	29(15.6)	34 (19.0)	31 (18.5)	41 (20.8)	28 (12.4)	30 (15.0)	38 (18.1)	298 (16.0)
Midwest Region	10 (6.0)	7 (4.6)	13 (7.4)	15 (8.1)	12 (6.7)	17 (10.1)	11 (5.6)	22 (9.7)	17 (8.5)	14 (6.7)	138(7.4)

Results expressed as n (%).

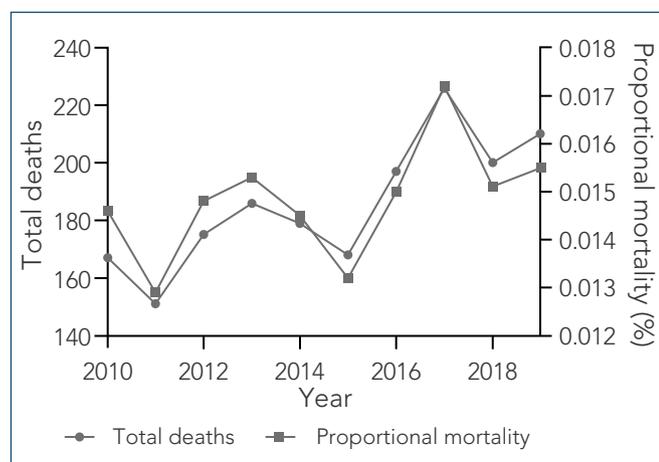
**Table 2.** Demographic profile of the deaths due to tumors included as malignant neoplasm of eye and adnexa

Type of neoplasm	Mean age	Gender		Ethnicity*				
		Men	Women	White	Black	Asian	Mixed ethnicity	Indigenous
C69.0	64.17 (±20.16)	40 (68.96)	18 (31.03)	33 (58.92)	2 (03.57)	1 (01.78)	20 (35.71)	-
C69.1	70.83 (±27.01)	7 (58.33)	5 (41.66)	7 (63.63)	-	-	4 (36.36)	-
C69.2	08.12 (±16.31)	165 (60.21)	109 (39.78)	95 (36.67)	13 (05.01)	1 (00.38)	143 (55.21)	7 (02.70)
C69.3	61.22 (±15.12)	66 (47.48)	73 (52.51)	110 (82.08)	2 (01.49)	1 (00.74)	21 (15.67)	-
C69.4	68.20 (±19.22)	76 (58.46)	54 (41.53)	81 (65.85)	5 (04.06)	-	36 (29.26)	1 (00.81)
C69.5	58.48 (±18.24)	17 (48.57)	18 (51.42)	23 (65.71)	-	1 (02.85)	11 (31.42)	-
C69.6	62.70 (±23.28)	245 (58.33)	175 (41.66)	237 (58.08)	25 (06.12)	-	143 (35.04)	3 (00.73)
C69.8	61.73 (±26.90)	42 (58.33)	30 (41.66)	41 (60.29)	2 (02.94)	-	24 (35.29)	1 (01.47)
C69.9	70.02 (±19.61)	404 (56.18)	315 (43.81)	446 (64.17)	29 (04.17)	3 (00.43)	214 (30.79)	3 (00.43)

Results expressed as mean ± standard deviation or n (%).

C69.0: malignant neoplasm of conjunctiva; C69.1: malignant neoplasm of cornea; C69.2: malignant neoplasm of retina; C69.3: malignant neoplasm of choroid; C69.4: malignant neoplasm of ciliary body; C69.5: malignant neoplasm of lacrimal gland and duct; C69.6: malignant neoplasm of orbit; C69.8: malignant neoplasm of overlapping sites of eye and adnexa; C69.9: malignant neoplasm of unspecified site of eye.

\*70 deaths certificates were missing ethnicity information.

**Figure 1.** Total deaths and proportional mortality due to eye cancer from 2010 to 2019 in Brazil.

in this age group. Regarding ages between one to four years old, there were 220 deaths due to neoplasms included in the C69 group, configuring 00.3556% of all deaths in individuals aged one to four years old, from 2010 to 2019, which was the age bracket where the malignant neoplasm of eye and adnexa corresponded to the highest proportional mortality. The second most affected group in terms of proportional mortality was composed by the ages of five to nine years would, which showed a proportional mortality of 00.1739% (Table 3).

The site of neoplasm was unspecified (C69.9) in 719 cases, representing the most frequent etiology in the C69 group (38.67%), pointing a mean age of 70.02 years old and occurring mostly in men (56.18%). The malignant

**Table 3.** Total deaths and proportional mortality related to malignant neoplasm of eye and adnexa during 2010 to 2019 in Brazil according to age bracket

Age bracket (years old)	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Total
<1	-	2 (0.0050)	2 (0.0051)	-	-	2 (0.0053)	1 (0.0027)	-	2 (0.0055)	3 (0.0085)	12 (0.0031)
1-4	22 (0.3139)	21 (0.3153)	28 (0.4415)	23 (0.3629)	21 (0.3439)	20 (0.3574)	24 (0.3863)	16 (0.2703)	28 (0.4770)	17 (0.2919)	220 (0.3556)
5-9	8 (0.1923)	7 (0.1699)	8 (0.2024)	6 (0.1611)	5 (0.1377)	5 (0.1530)	4 (0.1213)	7 (0.2149)	6 (0.1953)	6 (0.1895)	62 (0.1739)
10-14	2 (0.0349)	-	2 (0.0350)	1 (0.0175)	-	-	1 (0.0205)	1 (0.0216)	2 (0.0458)	1 (0.0236)	10 (0.0197)
15-19	-	-	1 (0.0047)	2 (0.0093)	1 (0.0045)	3 (0.0140)	3 (0.0137)	1 (0.0046)	1 (0.0052)	1 (0.0059)	13 (0.0063)
20-29	4 (0.0070)	5 (0.0089)	4 (0.0070)	7 (0.0127)	2 (0.0035)	1 (0.0018)	5 (0.0089)	5 (0.0089)	-	2 (0.0040)	35 (0.0064)
30-39	5 (0.0080)	5 (0.0079)	9 (0.0139)	9 (0.0139)	9 (0.0138)	3 (0.0046)	8 (0.0123)	8 (0.0125)	7 (0.0114)	2 (0.0033)	65 (0.0102)
40-49	14 (0.0149)	6 (0.0063)	18 (0.0192)	16 (0.0171)	9 (0.0098)	11 (0.0120)	17 (0.0183)	15 (0.0168)	12 (0.0135)	10 (0.0112)	128 (0.0139)
50-59	16 (0.0112)	20 (0.0137)	16 (0.0110)	21 (0.0140)	27 (0.0180)	23 (0.0150)	21 (0.0133)	31 (0.0202)	19 (0.0123)	34 (0.0218)	228 (0.0151)
60-69	22 (0.0121)	24 (0.0128)	18 (0.0094)	24 (0.0122)	20 (0.0100)	18 (0.0085)	31 (0.0139)	42 (0.0188)	30 (0.0130)	40 (0.0168)	269 (0.0129)
70-79	40 (0.0173)	20 (0.0084)	18 (0.0076)	35 (0.0143)	30 (0.0121)	34 (0.0132)	34 (0.0128)	46 (0.0172)	40 (0.0147)	39 (0.0138)	336 (0.0132)
≥80	34 (0.0116)	41 (0.0132)	51 (0.0162)	42 (0.0127)	55 (0.0162)	48 (0.0133)	48 (0.0127)	54 (0.0139)	53 (0.0136)	55 (0.0134)	481 (0.0137)
Total	167 (0.0146)	151 (0.0129)	175 (0.0148)	186 (0.0153)	179 (0.0145)	168 (0.0132)	197 (0.0150)	226 (0.0172)	200 (0.0151)	210 (0.0155)	1859 (0.0148)

Results expressed as n (%).

Deaths from malignant neoplasm of eye and adnexa (deaths due to malignant neoplasm of eye and adnexa x 100/ total deaths from all causes).

**Table 4.** Deaths and proportional mortality caused by ophthalmic cancer during 2010 to 2019 in Brazil

Malignant neoplasm	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
C69*	167(0.0146)	151(0.0129)	175(0.0148)	186(0.0153)	179(0.0145)	168(0.0132)	197(0.0150)	226(0.0172)	200(0.0151)	210(0.0155)
C69.0	3(0.0002)	4(0.0003)	7(0.0005)	3(0.0002)	5(0.0004)	7(0.0005)	6(0.0004)	9(0.0006)	4(0.0003)	10(0.0007)
C69.1	1(0.00008)	2(0.0001)	-	2(0.0001)	1(0.00008)	-	1(0.00007)	1(0.00007)	2(0.0001)	2(0.0001)
C69.2	28(0.0024)	22(0.0018)	36(0.0030)	31(0.0025)	27(0.0022)	24(0.0018)	28(0.0021)	19(0.0014)	33(0.0025)	26(0.0019)
C69.3	13(0.0011)	9(0.0007)	11(0.0009)	12(0.0009)	10(0.0008)	10(0.0007)	18(0.0013)	21(0.0015)	15(0.0011)	20(0.0014)
C69.4	16(0.0014)	19(0.0016)	7(0.0005)	8(0.0006)	13(0.0010)	14(0.0011)	15(0.0011)	12(0.0009)	10(0.0007)	16(0.0011)
C69.5	1(0.00008)	3(0.0002)	4(0.0003)	6(0.0004)	2(0.0001)	3(0.0002)	3(0.0002)	4(0.0003)	3(0.0002)	6(0.0004)
C69.6	38(0.0033)	33(0.0028)	45(0.0038)	48(0.0039)	49(0.0039)	25(0.0019)	39(0.0029)	57(0.0043)	34(0.0025)	52(0.0038)
C69.8	5(0.0004)	5(0.0004)	5(0.0004)	8(0.0006)	7(0.0005)	10(0.0007)	6(0.0004)	11(0.0008)	8(0.0006)	7(0.0005)
C69.9	62(0.0054)	54(0.0046)	60(0.0050)	68(0.0056)	65(0.0052)	75(0.0059)	81(0.0061)	92(0.0070)	91(0.0069)	71(0.0052)

Results expressed as n (%).

\*Sum of C69.0-C69.9. C69.0: malignant neoplasm of conjunctiva; C69.1: malignant neoplasm of cornea; C69.2: malignant neoplasm of retina; C69.3: malignant neoplasm of choroid; C69.4: malignant neoplasm of ciliary body; C69.5: malignant neoplasm of lacrimal gland and duct; C69.6: malignant neoplasm of orbit; C69.8: malignant neoplasm of overlapping sites of eye and adnexa; C69.9: malignant neoplasm of unspecified site of eye. Deaths from the indicated disease (deaths from the indicated disease x 100 / total deaths from all causes).

neoplasm of the orbit (C69.6) was the second most common basic cause of death in the C69 group, totaling 420 cases (22.59%), which affected 245 men (58.33%) and 175 women (41.66%), observing an average age of 62.70 years. The third most common cause of death among the malignant neoplasm of eye and adnexa was the malignant neoplasm of retina (C69.2), encompassing 274 cases (14.73%) that affected 165 men (60.21%) and 109 women (39.79%) represented by a mean age of 8.12 years old (Tables 2 and 4). When separating individuals aged <18 years old that died from retinal neoplasms, the mean age was 3.49 years old, including 249 individuals, comparing to a mean age of 54.28 years old among the ones who were ≥18 years old, representing 25 cases.

The malignant neoplasm of choroid (C69.3) and the malignant neoplasm of lacrimal gland and duct (C69.5) were the only etiologies of death that were more frequent in women, which represented 52.51% and 51.42% of their totals, respectively. The white ethnicity was observed for most of the deaths in the isolated causes, except for malignant neoplasm of retina (C69.2), in which the brown ethnicity was the most frequent.

## DISCUSSION

According to our data, 1,859 deaths occurred due to malignant neoplasm of eye and adnexa, during 2010 and 2019, in Brazil. The tumors included in the C69 group presented a slight elevation in their total of deaths and proportional mortality alongside the evaluated years, what could be associated with a better identification of these diseases, as there are increasingly more professionals capable of recognizing these conditions in Brazil. However, there is no scientific evidence associated with this correlation.

In this context, one study from Singapore pointed an annual incidence of eye and adnexa cancer, excluding eyelid neoplasm, of 1.89 and 1.89 per million for men and women, respectively.<sup>(10)</sup> In the United Kingdom, this group

of diseases was related to 123 deaths between 2016 and 2018, totaling 0.00768% of the deaths, compared to 623 deaths in Brazilian data, during the same period, which represented 0.01581% of the deaths.<sup>(9,11)</sup> This discrepancy could possibility occur due to a delay in the diagnosis or treatment of patients with these cancers, thus interfering negatively in their prognosis.

Regarding gender, several studies point a higher incidence of eye cancer among men.<sup>(12,13)</sup> By considering that there would be no gender differences in prognosis, as our study approaches no incidence values, this data would fit our results, as 1,062 men and 797 women died from a malignant neoplasm of eye and adnexa. American data suggested that eye and orbit cancer would be the cause of death of 220 men and 180 women in 2021, representing a similar proportion to the data found in our analysis.<sup>(8)</sup>

Overall, 304 deaths of patients aged zero to 14 years old occurred due to malignant neoplasm of eye and adnexa, from 2010 to 2019, in Brazil, representing a mean of 30.4 deaths per year. Ribeiro et al also assessed the same data during the years 1980 to 2002, finding a total of 1,110 deaths, which corresponded to a mean of 48.2 deaths per year, pointing to a high percentage of deaths caused by retina tumors (80.5%).<sup>(7)</sup> In our data, there were 312 deaths among individuals aged less than 18 years old from malignant neoplasm of eye and adnexa, of which 249 (79.80%) were caused by retina tumors. This predominance might be caused mainly by the high incidence of retinoblastoma in younger patients. In addition, there was a decrease in the number of deaths from retina cancer, which could possibly be influenced by the popularization of the red reflex nationwide, predisposing the acceleration of diagnosis and treatment of this condition. This exam was firstly considered obligatory in maternities in Rio de Janeiro, in 2002, thus starting to become a national screening test during the following years.<sup>(14)</sup>

There were 481 (25.87%) deaths from tumors included in the C69 group among individuals aged ≥ 80 years

old. Data from the United Kingdom point that there are increases in the number of deaths by eye cancer according to aging. Governmental data states that around 41% of the deaths from eye tumors occur in individuals aged 75 years old or more, similarly to our findings, with no discrepancies in mortality rates related to gender.<sup>(9)</sup>

Among the limitations of this study, death certificates can be incorrectly filled out, what can cause incongruence in the mortality data and mislead the interpretation of the results acquired. Furthermore, the lack of precise data regarding malignant ocular neoplasm prevalence and incidence limits the development of mortality indicators. Moreover, the evaluated ICD-10, C69, does not encompass all the cancers related to ophthalmology, as some of these neoplasms can be listed in other parts of the ICD-10.

## CONCLUSION

The number of deaths from malignant neoplasm of eye and adnexa presented a slight increase, followed by a proportional elevation in its proportional mortality, through the years of 2010 to 2019, in Brazil. Regarding the specific tumors in this group, malignant neoplasm of unspecified site of eye (C69.9) was the most frequent diagnosis, followed by malignant neoplasm of the orbit (C69.6), while malignant neoplasm of retina (C69.2) was the predominant tumor among individuals aged less than 18 years old.

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