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ORIGINAL ARTICLE

Mortality of Brazilian doctors due to COVID-19: between March 2020 and July 2021: a memorial to a health crisis

Mortalidade de médicos brasileiros por COVID-19: entre março de 2020 e julho de 2021: memorial de uma crise sanitária

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ABSTRACT

Introduction: Doctors, along with other healthcare professionals, worked on the frontlines of the fight against COVID-19, facing a higher risk of infection. **Objective:** To analyze the mortality rate of doctors due to COVID-19 in Brazil, compared to the general population, from March 2020 to July 2021. **Methods:** A descriptive study using secondary data on deaths due to Covid-19 in the general population and among doctors, through the frequency distribution of demographic and professional data; crude and age-standardized mortality rates (indirect method) were calculated. **Results:** COVID-19 mortality among doctors was higher among men, in the age group of 60 to 79 years, and in the specialties of gynecology, occupational medicine, and pediatrics. The temporal analysis showed a higher number of deaths at the start of the pandemic, with a peak in May 2020. Regarding the crude mortality rate, it was found that doctors had a lower risk of death than the general population. In the North and Northeast regions, these rates were higher than in the general population. **Conclusion:** The geographical disparities in the risk of death due to COVID-19 among Brazilian doctors indicated the need for interventions in the levels of protection provided to them regarding biological exposure, as well as confirmed the negative impacts of the unequal distribution of these professionals, as previously pointed out by medical demography studies.

Keywords: Mortality; COVID-19; Doctors; Healthcare professionals.

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RESUMO

Introdução: Os médicos, juntamente com outros profissionais da saúde atuaram na linha de frente do combate à COVID-19 com maior risco de infecção. **Objetivo:** analisar a mortalidade dos médicos por COVID-19 no Brasil, comparativamente à população geral, entre março/2020 a julho/2021. **Métodos:** Estudo descritivo utilizando dados secundários de óbitos por COVID-19 na população geral e entre médicos, por meio da distribuição de frequências dos dados demográficos e profissionais; calculadas as taxas de mortalidade brutas e padronizadas (método indireto). **Resultados:** A mortalidade por COVID-19 entre os médicos foi maior entre homens, na faixa etária de 60 a 79 anos e nas especialidades de ginecologia, medicina do trabalho e pediatria. A análise temporal mostrou um maior número de óbitos no início da pandemia, com pico em maio de 2020. Em relação à taxa bruta de mortalidade, verificou-se que os médicos apresentaram menor risco de morrer que a população em geral. Nas Regiões Norte e Nordeste essas taxas foram maiores que a da população geral. **Conclusão:** Os diferenciais geográficos no risco de morte por COVID-19 entre os médicos brasileiros indicaram a necessidade de intervenções nos níveis de proteção oferecidos a eles em relação à exposição biológica, bem como confirmaram os impactos negativos da distribuição desigual desses profissionais, já apontada por estudos de demografia médica realizados.

Palavras-chave: Mortalidade; COVID-19; Médicos; Profissionais de saúde.

INTRODUCTION

The COVID-19 pandemic was the greatest global health issue of our time and the most significant challenge since World War II[1]. As of December 6, 2021, more than 266 million COVID-19 cases were confirmed across 213 countries and territories, leading to 5,259,255 deaths worldwide. In Brazil, the death toll reached 615,636 during the same period[2].

The impact of this pandemic on healthcare services and the professionals involved in caring for the population has been depicted in various studies[3-6]. These impacts affected healthcare workers differently but, overall, led to an increased workload and emotional burden, highlighting social stigmas and compromising individual health[7,8].

This issue becomes even more concerning when considering the total number of healthcare professionals working in Brazil: over 3.5 million, with 2 million being doctors and nursing professionals[9]. According to the Federal Medical Council, the country had 478,010 active doctors during this period[10].

Due to the nature of their roles, healthcare professionals were exposed to COVID-19 while assisting patients, but also within their relational environments[11]. Among healthcare workers who were most affected by COVID-19 were nursing staff (27.3%) and doctors (13.2%), who contracted the virus primarily in their work environments (66.6%)[8]. A systematic review study that analyzed 152,888 infections and 1,413 deaths worldwide found that infections occurred more often among women (71.6%) and nurses (38.6%), but deaths predominantly occurred among men (70.8%) and doctors (51.4%)[12].

A significant number of doctors did not feel protected while working to combat COVID-19 due to the lack, scarcity, and inadequacy of Personal Protective Equipment (PPE), the widespread fear of contracting the virus, the absence of proper structures to avoid worker exposure, which increased contamination chances, and inefficient hospitalization processes[13,14].

Additionally, the pandemic scenario was exacerbated by the uneven distribution, quantity, forms of hiring, and remuneration of medical work across different regions of the country. Besides the direct impact on working conditions, these factors also affected the effective response to the pandemic, as well as morbidity and mortality indicators, as exemplified by COVID-19 during this period[10].

Understanding the magnitude of mortality among medical professionals associated with their profession is the first step toward implementing health measures aimed at improving working conditions and protection for this professional category[15,16]. A study that analyzed the deaths of Brazilian doctors during the first four months of the

COVID-19 pandemic (March to June 2020) observed that most deaths occurred among older doctors working in the clinical medicine field, with a trend showing a higher mortality rate among men[17].

Although the study by Jesus et al. (2020)[17] provided an initial overview of the impact of COVID-19 among doctors, little is known about what occurred afterward or whether the increasing trend in deaths was confirmed. Thus, this study aimed to analyze the mortality of medical professionals in Brazil, compared to the general population, due to the COVID-19 pandemic from March 2020 to July 2021, covering 17 months of the pandemic.

Methods

This is a descriptive study using secondary data on deaths due to COVID-19 in the general population and among medical professionals in Brazil from March 2020 to July 2021, sourced from different databases.

To gather the number of deaths and demographic data of Brazilian doctors, the website of the Federal Medical Council (CFM, 2021)[18] was consulted. To determine the denominator for calculating the mortality rate of doctors, the number of professionals from the "Medical Demography" study was used. The number of deaths in the general population due to COVID-19 was obtained from the Ministry of Health of Brazil's website (MS): https://covid.saude.gov.br/, which organizes data on cases and deaths related to the disease in the country. The denominator for calculating the mortality rate of the general population by COVID-19 for Brazil, regions, and states was consulted from the website of the Brazilian Institute of Geography and Statistics (IBGE, 2021)[19].

Information regarding the deaths of Brazilian doctors from March 2020 to July 2021 was collected from the "Memorial to Doctors Victims of COVID-19" organized by the CFM and the Regional Medical Councils (CRM) in tribute to doctors who died from COVID-19. In this memorial, all the published names of deceased doctors were read and reviewed by two independent researchers to reduce the chances of error in data collection. Information such as date of birth and death, the state in which the doctor was registered with the CRM, and specialty were recorded. These last two pieces of information were not available for all doctors in the memorial and were supplemented using the CFM's search tool for doctors.

For estimating the denominator of the mortality rate among doctors, data on all doctors with active CRM registration were included in the analysis. This choice was based on the fact that a doctor with an inactive CRM cannot practice medicine in the country, which would already exclude doctors who are not actively working, even if they are older than 75 years. The decision to include all doctors, including those over 75, was justified by the fact that due to the shortage of professionals to care for COVID-19 patients in various locations, retired doctors were recruited to help fight the pandemic, provided they had an active CRM[11,20].

Descriptive analyses were conducted using frequency distributions, and crude mortality rates (CMR) were calculated for the general population and doctors for Brazil, regions, and states (multiplied by 1,000). In the death database used for COVID-19, there was no possibility of stratifying deaths by age group. Therefore, it was not possible to calculate crude mortality rates considering only those over 20 years of age in the denominator. For this reason, the Standardized Mortality Rate (SMR) was calculated using the indirect method, which is used when the number of deaths for each specific age group is not available[21]. This is a method widely used in epidemiological studies, where the number of observed deaths is compared to the number of expected deaths by applying the mortality rates of a reference population to the study population. In the case of the present study, the reference population was the Brazilian population, as obtained from the 2010 IBGE Census.

Standardized mortality rates (SMR) were also calculated for Brazil and regions using the indirect method, with the 2010 Brazilian Census population aged 20 to 79 as the reference. The choice of this type of standardization is also justified by the fact that it is the most appropriate method for studying mortality in populations exposed to occupational hazards, and because it allows for the comparison of mortality rates between different populations, even when they have different age, sex, or other demographic structures[21].

The data were stored and analyzed using Microsoft Excel. The results were discussed in light of national and international literature in public health, with a focus on worker health.

Following the guidelines of Resolution 510/2016 from the National Health Council, since the data used in the research are public domain and anonymized in the sources, there was no need to submit the study to an Ethics in Research Committee.

Results

During the 16-month period of the pandemic (data collected up to July 6, 2021), 844 deaths of medical professionals caused by COVID-19 were recorded. The majority occurred among men (87%); those aged over 60 years (77.5%; average age of 66.9 years; minimum age 26, maximum age 97 years); and in 2020 (66.5%). For 38.3% (N=323) of the doctors, there was no information available on their registered specialty with the CRM. Among the registered specialties, the most frequent were gynecology (9.8%), occupational medicine (7.7%), pediatrics (7.0%), internal medicine (6.6%), and general surgery (6.2%) (Table 1).

The crude mortality rate (CMR) for COVID-19 in the general population was 2.5 deaths per thousand inhabitants, while for doctors, it was 1.61 deaths per thousand professionals. However, when observing this indicator by geographical regions and states, there was significant variability in the crude mortality rates, ranging from 1.88 in the Northeast region to 3.01 in the Central-West region for the general population, and from 0.83 in the Southeast region to 7.64 in the North region for doctors (Table 2).

Table 1. Profile of Doctors who died from COVID-19, Brazil, 2020-2021.

Sociodemographic variables	N = 844	%
Gender		
Male	734	86.97
Female	110	13.03
Age group		
26-39 years	32	3.79
40-59 years	154	18.25
60-79 years	546	64.69
80 yeas and over	108	12.80
Not informed	4	0.47
Year of death		
2020	561	66.47
2021	281	33.29
Not informed	2	0.24
Doctor's specialty[1]		
Gynecology	83	9.83
Occupational Medicine	65	7.70
Pediatrics	59	6.99
Internal Medicine	56	6.64
General Surgery	52	6.16
Orthopedics	42	4.98
Anesthesiology	28	3.32
Cardiology	26	3.08
Ophthalmology	19	2.25
Psychiatry	16	1.90
Urology	15	1.78
Gastroenterology	10	1.18
Other specialties[2]	148	17.54
No registered specialty	275	32.58
Not found	48	5.69
Number of specialties	**N = 521**	
One	420	49.76
Two	86	10.19
Three	14	1.66
Four	1	0.12

Source: Prepared by the authors.

- The total does not sum to 100% because several doctors registered more than one specialty with the CFM.

2 - Other specialties: Acupuncture, Hospital Administration, Angiology, Digestive System Surgery, Plastic Surgery, Thoracic Surgery, Vascular Surgery, Cytopathology, Dermatology, Emergency Medicine, Endocrinology, Endoscopy, Geriatrics, Hematology, Homeopathy, Infectious Diseases, Breast Surgery, Physical Medicine and Rehabilitation, Family and Community Medicine, Traffic Medicine, Intensive Care Medicine, Legal Medicine, Preventive and Social Medicine, Nephrology, Neurosurgery, Neurology, Nutritional Medicine, Oncology, Otorhinolaryngology, Pathology, Pulmonology, Proctology, Radiology, Radiotherapy, Rheumatology, and Ultrasonography.

Considering the CMR, doctors had a lower risk of dying than the general population in the Southeast, South, and Central-West regions. However, in the North and Northeast regions, the CMR was higher for doctors than for the general population (Table 2).

In the North Region, doctors died 5.2 times more than the general population in the state of Pará, 3.3 times more in Acre, and 3.2 times more in Amazonas. Only in Rondônia was the crude mortality rate (CMR) for doctors due to COVID-19 lower than that of the general population. In

Table 2. Crude Mortality Rates for COVID-19 in the General Population and Medical Professionals, Brazil, Regions, and Federative Units, 2020-2021.

	General Population			Doctors		
Brazil, Regions and Federative Units	**Population**	**Number of deaths[1]**	**Crude mortality rate**	**Population**	**Number of deaths**	**Crude Mortality Rate[1]**
Brazil	210,147,125	525,112	2.50	523,528	844	1.61
North Region	18,430,980	43,776	2.38	23,964	183	7.64
Acre	881,935	1,757	1.99	1,058	7	6.62
Amapá	845,731	1,852	2.19	1,006	7	6.96
Amazonas	4,144,597	13,349	3.22	5,398	55	10.19
Pará	8,602,865	15,587	1.81	9,212	87	9.44
Rondônia	1,777,225	6,213	3.50	3,160	11	3.48
Roraima	605,761	1,756	2.90	975	7	7.18
Tocantins	1,572,866	3,262	2.07	3,155	9	2.85
Northeast Region	57,071,654	107,536	1.88	96,303	218	2.26
Alagoas	3,337,357	5,433	1.63	5,266	11	2.09
Bahia	14,873,064	24,312	1.63	24,413	37	1.52
Ceará	9,132,078	22,753	2.49	15,100	14	0.93
Maranhão	7,075,181	9,164	1.30	7,642	34	4.45
Paraíba	4,018,127	8,703	2.17	8,194	40	4.88
Piauí	3,273,227	6,657	2.03	5,250	12	2.29
Pernambuco	9,557,071	17,908	1.87	19,318	36	1.86
Rio Grande do North	3,506,853	6,841	1.95	6,741	28	4.15
Sergipe	2,298,696	5,765	2.51	4,379	6	1.37
Central-West Region	16,297,074	49,056	3.01	44,658	93	2.08
Goiás	7,018,354	19,409	2.77	16,027	43	2.68
Mato Grosso	3,484,466	11,970	3.44	6,666	32	4.80
Mato Grosso do Sul	2,778,986	8,365	3.01	6,552	6	0.92
Federal District	3,015,268	9,312	3.09	15,413	12	0.78
Southeast Region	88,371,433	244,390	2.77	278,325	231	0.83
Espírito Santo	4,018,650	11,556	2.88	11,070	35	3.16
Minas Gerais	21,168,791	47,120	2.23	56,412	18	0.32
Rio de Janeiro	17,264,943	56,039	3.25	63,873	101	1.58
São Paulo	45,919,049	129,675	2.82	146,970	77	0.52
South Region	29,975,984	80,354	2.68	80,278	119	1.48
Paraná	11,433,957	31,529	2.76	28,513	64	2.24
Santa Catarina	7,164,788	17,064	2.38	18,927	38	2.01
Rio Grande do Sul	11,377,239	31,761	2.79	32,838	17	0.52

Source: Prepared by the authors.

1 - Crude Mortality Rate, per thousand inhabitants.

the Northeast Region, the states with the highest mortality rates among doctors were Maranhão (3.4 times higher than the general population), Paraíba, and Rio Grande do Norte (2 times higher than the general population).

The Southeast Region had the lowest CMR among doctors (0.83), a value 3.3 times lower than in the general population. The states that most contributed to this difference were Minas Gerais, with the lowest rate observed in the study (0.32), which was 7 times lower than the general population, and São Paulo (0.52), which was 5.4 times lower than the general population (Table 2).

In Figure 1, it is possible to visualize the crude mortality rates for each Geographical Region and for Brazil.

The temporal analysis of the number of doctors who died from COVID-19 in Brazil between March 2020 and July 2021 shows a higher number of deaths at the beginning of the pandemic, with a peak in May 2020 (N=107). In the following months, a stabilization was observed, followed by a decline between September and October, with a new increase starting in November 2020, continuing until January 2021. From January 2021, when the COVID-19 vaccination campaign began in the country, a decline in the number of doctors who died was observed, with a more pronounced decrease starting in March, which continued until July 2021 (Figure 2).

When adjusting the mortality rates for the resident population in Brazil in 2010, aged between 20 and 79 years, a change in the mortality rates among doctors was observed. Overall, the trend of higher mortality from COVID-19 among the general population remained, except for the North Region, which showed a higher Standardized Mortality Rate (SMR) among doctors (159.30) (Table 3).

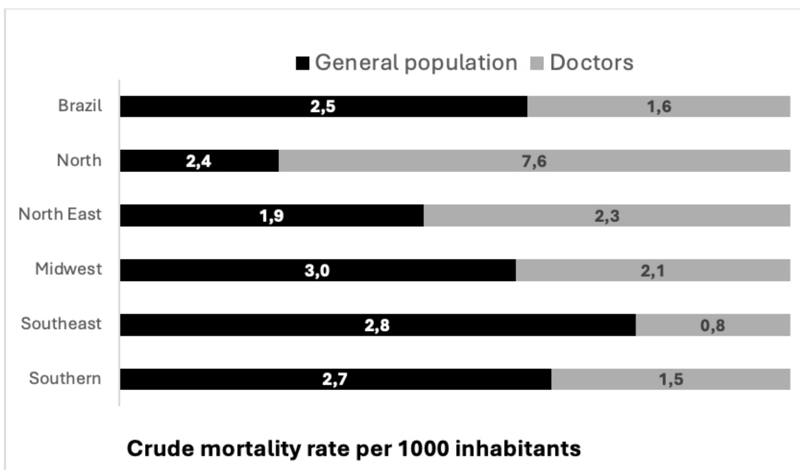

Figure 1. Crude mortality rates from COVID-19 in the general population and in medical professionals, Brazil and Regions, 2020-2021.
Source: Prepared by the authors.

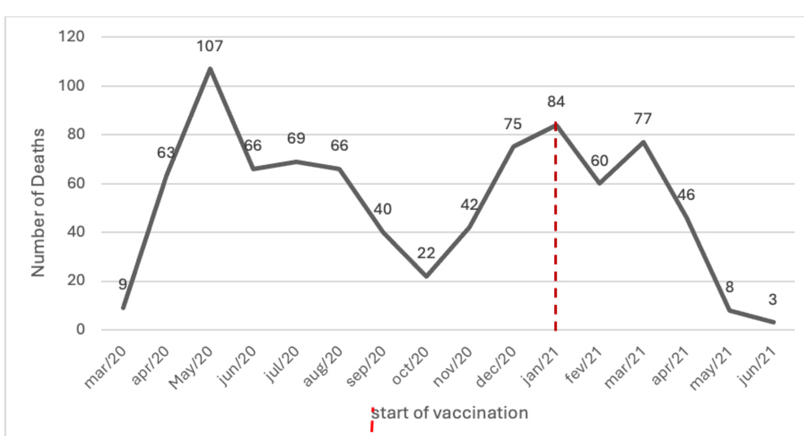

Figure 2. Temporal analysis of the number of doctors who died from COVID-19 in Brazil between March 2020 and July 2021.
Source: Prepared by the authors.

Table 3. Standardized mortality rates[1] for COVID-19 among medical professionals, Brazil and Regions, 2020-2021.

	Doctors			
Brazil and Regions	**Estimated population of doctors [2]**	**Observed Deaths**	**Expected Deaths**	**Standardized Mortality Rate [1]**
Brazil	523,528	844	2,201.10	38.34
North Region	23,964	183	114.88	159.30
Northeast Region	96,303	218	314.09	69.41
Central-West Region	44,658	93	237.98	39.08
South Region	80,278	119	346.33	34.36
Southeast Region	278,325	231	1,237.57	18.67

Source: Prepared by the authors.

1 - Standardized Mortality Rate (SMR) by the indirect method, for the Brazilian population aged 20 to 79 years in the year 2010, per thousand inhabitants.

2 - Total number of doctors registered with the respective professional council in each geographic region.

Discussion

The findings of this study revealed a higher risk of death from COVID-19 in the general population compared to medical professionals in Brazil. However, a higher risk was observed among doctors in the North Region compared to the general population.

The profile of doctors who died from COVID-19 showed higher mortality among men, aged between 60 and 79, which aligns with the profile of doctors in Brazil, where the majority of professionals were male (53.4%) in 2020[10]. Furthermore, it is important to highlight that general mortality from COVID-19 has shown a higher fatality rate among men over 60, both in Brazil[22] and globally[23].

The highest proportion of deaths among doctors occurred in 2020 (approximately 67%), with the peak in March, coinciding with the start of the epidemic in Brazil. This period saw a significant increase in infections in the general population[12], leading to a rise in hospitalizations, consultations, and deaths among both the general public and doctors.

Several factors can help explain the higher number of deaths observed early in the pandemic, such as the delay in health system organization and preparedness, limited knowledge about the disease (particularly regarding patient management and healthcare worker biosafety)[24], and a global shortage of Personal Protective Equipment (PPE) that had a significant impact in Brazil[25].

From May 2020, there was a decrease in the number of deaths among doctors, which lasted until October of that year. This reduction could be attributed to the improvement of knowledge among healthcare teams about the virus's management, including biosafety measures, as well as the intensification of restrictive measures (social distancing and service closures) that helped reduce the circulation of people and, consequently, the spread of the virus[24,26].

At the end of 2020 and beginning of 2021, there was a resurgence in the number of deaths among doctors. This period saw a resurgence of the epidemic in Brazil, with deaths reaching 3,829 on a single day[2]. Furthermore, there was an overload of healthcare services nationwide, with intensive care units (ICUs) reaching occupancy rates of 80% in 25 states and 90% in 19 capitals[3].

The significant decline in deaths among doctors observed from March 2021 coincided with the onset of the COVID-19 vaccination campaign in Brazil, started on January 18, 2021[22]. As recommended by the World Health Organization (WHO), vaccination, in combination with non-pharmacological measures, was the most effective strategy for reducing COVID-19 mortality[27].

This study identified a higher number of deaths among doctors in clinical specialties (gynecology, occupational medicine, pediatrics), which was also observed in another Brazilian study conducted at the beginning of the pandemic[17]. Although there is no consensus in the literature regarding which specialties are most exposed, it appears that professionals providing first-contact care in outpatient settings — often using inadequate PPE — are more exposed to infection compared to those working in urgent care and hospital settings[28]. However, the data should be analyzed with caution, as specialties were not identified for a considerable portion of the deceased doctors.

When analyzing the crude mortality rates (TMB) by geographic region and state, a highly diverse scenario was observed. In the North Region, the COVID-19 mortality rate among doctors was 3.2 times higher than that in the general population, with the greatest impact in the states of Amazonas, Pará, and Maranhão. Standardized mortality rates showed the continuation of this trend. This was one of the regions most severely affected by the pandemic, experiencing a high number of deaths, the collapse of the healthcare system, and shortages of oxygen, intubation drugs, and ICU beds [29]. Amazonas, especially its capital Manaus, went through two severe waves of the COVID-19 pandemic — one in April/May 2020 and the other in January 2021 — with high ICU occupancy rates and death tolls[30,31].

Additionally, the P1 (B.1.1.28) variant of the SARS-CoV-2 virus emerged in this region in November 2020[29]. This variant may have contributed to worse outcomes for infected individuals due to high viral load, increased contagion, or immune response suppression[32], which could have exacerbated the mortality rates among doctors in the region.

Other factors, such as the use of unproven drugs for disease prevention ("early treatments"), which were widely reported in the North Region, may have also contributed to the higher infection rates. According to a 2020 prospective study conducted in Manaus with 3,046 individuals, the use of preventive drugs was associated with a higher prevalence of SARS-CoV-2 infection[33]. It is possible that this practice was adopted by individuals with greater vulnerability and risk of contagion who, believing in early treatment, increased their exposure at the expense of proven preventive measures, such as wearing masks and social distancing, bearing in mind that, until that moment, no vaccine was available

The historical shortage of healthcare professionals in the North Region, especially in Amazonas[34], led to the recruitment of many doctors to work in this region[31]. Many of these doctors may have fallen ill or died. However, as these professionals remained linked to their original state's Regional Medical Council (CRM), the reporting of their deaths was done through their CRM of registration, which could have led to an underestimation of the true mortality rate of doctors in the region. It's important to note that the North Region has a doctor-to-population ratio of 1.30 per 1,000 inhabitants, which is 43% lower than the national average (2.27 per 1,000)[10].

The Northeast Region also showed a higher TMB for doctors than for the general population, although this difference was reduced after standardization. Despite the risk of death was lower among doctors in this region, it still presented the second-highest mortality rate in the study and the one with the smallest difference in the risk of death in the general population, as observed by Jesus et al. (2020)[17]. This region's challenges, such as limited healthcare infrastructure, economic disparities, and political factors, contribute to higher mortality rates. The Northeast and North regions have the lowest socio-economic development in the country[34] and have many small, remote municipalities with limited access to healthcare facilities[35] and intensive care beds[3]. Access to ICU varies between cities and regions and is even lower in the poorer and less developed areas, such as these two[36].

The lower mortality rates observed in other regions of the country may be related to the higher number of medical professionals in these areas and their greater socioeconomic development. This association appears to be confirmed by the TMB (mortality rate) of doctors due to COVID-19 in the Southeast Region (0.83), which remains lower among doctors even after standardization (TMP = 18.67), as well as in the South and Central-West Regions. The impact of socioeconomic issues on healthcare has been observed in relation to other health conditions, as identified by Baptista et al. (2019)[37], who found a steady decline in mortality from chronic diseases between 2001 and 2015 in the Southeast and South Regions, unlike in the North and Northeast.

Among the factors that may explain the lower risk of death among doctors, compared to the general population, despite their greater exposure to the virus, is the fact that they belong to a professional class exposed to different social determinants compared to the majority of the population. These include higher education, higher income, social class, better living and housing conditions, access to private transportation, and the ability to implement more effective physical isolation in their relational environment. Additionally, they are among the first groups prioritized in the National Vaccination Operationalization Plan against COVID-19, ranking just behind institutionalized people over 60 years old, institutionalized people with disabilities, and Indigenous peoples living on Indigenous lands[22]. Added to these factors are the greater knowledge about the modes of transmission, proper management of signs and symptoms, as well as better access to individual (quality and appropriate PPE based on exposure level) and collective protection strategies for more exposed individuals, such as healthcare professionals.

It is worth highlighting that there is no systematized information about the number of healthcare professionals who were vaccinated in the country; however, data released by the Ministry of Health show that, between January 16 and July 14, 2021, 42.42% of the entire Brazilian population had received the first dose of the vaccine, and only 15.2% were fully vaccinated[38], a percentage that is still very low given the epidemiological situation at the time.

Unequal access to the vaccine is a reality observed worldwide, which led to the resurgence of the epidemic in different locations and at different times, allowing for a higher chance of virus mutation, collapse of healthcare services, and higher mortality rates in the population and among healthcare professionals, particularly those on the front lines of care, such as doctors[39]. In Brazil, it was observed that as vaccination progressed in the population with greater vulnerability, including the elderly, there was a rejuvenation of COVID-19 mortality[40], which made vaccination for the other age groups even more urgent and necessary.

Despite providing important and unprecedented information during the researched period, this study has some limitations, which include: the absence of systematized data on the illness and death of healthcare professionals, particularly specific categories such as doctors and nurses; the available data at the time may have presented inconsistencies and regional fluctuations due to the location of registration in the Professional Council and the location of the death, which could have impacted the death counts by region. The data on the mortality of doctors analyzed here comes from a list that makes up a tribute memorial, meaning it may have been underestimated and only represent a portion of the total number of doctors who died from COVID-19. Despite these limitations, the data confirmed a trend observed in the general population, which suggests that the information found in this study was not out of line with reality and might only represent a fluctuation in the absolute number of deaths.

Conclusion

This study identified that mortality rates among doctors were lower than those observed in the general population, despite their greater exposure to the virus. Only in the North Region of Brazil was a higher risk of death from COVID-19 observed among doctors. It is believed that factors related to the disease (mutations and higher lethality rates in certain population groups), social determinants affecting the majority of the population (poverty, low education, limited access to healthcare, information, and PPE), and aspects related to collective measures (insufficient resource allocation to meet healthcare demands and delays in the initiation of vaccination) may help explain the observed differences.

It is believed that the information obtained from accessing different databases contributes to identifying the incidence of deaths among medical professionals in Brazil, highlighting the need for more targeted interventions in the protection levels offered, including the use of PPE, optimization of work organization and conditions, and, most importantly, more efficient national collective measures that support healthcare professionals when handling health emergencies, such as the COVID-19 pandemic. Furthermore, the findings of this study suggest the impacts of the unequal distribution of professionals, as previously pointed out in medical demography studies conducted in 2011 and 2020, not only on access to healthcare services but also on healthcare professional mortality. The low retention of doctors in the most vulnerable regions may lead to greater work overload and worse working conditions for those practicing in these areas.

Wide and unrestricted vaccination, once available, both among healthcare professionals and the general population, as well as better distribution of financial and human resources, are essential measures for improving the situation of illness and death from infectious diseases in the country.

Author's Contributions

We describe contributions to the papers using the taxonomy (CRediT) provided above:

Conceptualization, Research, Methodology, Visualization & Writing – analysis and editing: LSS. *Research, Methodology, Visualization & Writing – analysis and editing*: APR; GLO. *Research, Methodology, Visualization & Writing – analysis and editing*: PDA.

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