

## Deaths from post-COVID conditions in Brazil

Ana Paula Muraro (orcid.org/0000-0001-6237-1673)<sup>1</sup>

Roseany Rocha (orcid.org/0000-0002-2295-5321)<sup>1</sup>

Alexandra Crispim Boing (<http://orcid.org/0000-0001-7792-4824>)<sup>2</sup>

Ligia Regina de Oliveira (orcid.org/0000-0002-1162-0542)<sup>1</sup>

Francine Nesello Melanda (orcid.org/0000-0002-5692-0215)<sup>1</sup>

Amanda Cristina de Souza Andrade (orcid.org/0000-0002-3366-4423)<sup>1</sup>

**Abstract** *This paper aims to assess the magnitude and profile of deaths from post-COVID conditions in Brazil. Descriptive study based on preliminary data from the 2021 Mortality Information System. Records with ICD code B94.8 as the Basic Cause and with code U09 in some lines of part I or II of the declaration were considered for analysis. The distribution of deaths by geographic region, semester of occurrence, sex, age group, ethnicity/skin color, schooling, and place of occurrence was evaluated. We identified 2,948 deaths from conditions subsequent to COVID-19 were recorded, ranging from 0.5 deaths per 1,000 records in the Northeast Region to 3.6/1,000 in the Midwest Region. More than half occurred among males (58.0%), those aged 60 years or older (66.9%), and whites (51.8%). Conclusion: Deaths from post-COVID conditions had distinct sociodemographic characteristics between regions.*

**Key words** *Cause of death, Pandemics, COVID-19, Health information systems*

<sup>1</sup> Programa de Pós-Graduação em Saúde Coletiva, Universidade Federal de Mato Grosso. Av. Fernando Corrêa da Costa 2367, Boa Esperança. 78060-900 Cuiabá MT Brasil. muraroap@gmail.com

<sup>2</sup> Programa de Pós-Graduação em Saúde Coletiva, Universidade Federal de Santa Catarina. Florianópolis SC Brasil.

## Introduction

Brazil is one of the countries most affected by the COVID-19 pandemic, and accurate estimates of morbidity and mortality from the disease are a challenge shared by several countries. Until October 17, 2022, the country registered more than 4.6 million cases and 687,144 deaths from the disease<sup>1</sup>. These numbers are growing at an unprecedented pace and pose fundamental challenges for the country and the health system due to the impact of losses, sequelae, and future disease burden.

It is estimated that between 10% and 20% of people who have had COVID-19, including those with mild or even asymptomatic cases, develop “post-COVID conditions”<sup>2</sup>, also described as Long COVID, post-acute COVID-19, post-COVID syndrome, COVID long-term effects, post-acute COVID syndrome, and chronic COVID<sup>3</sup>. This manifestation is composed of signs and symptoms that appear within three months after infection, which last at least two months, are not explained by an alternative diagnosis, and compromise the daily activities and quality of life of these people<sup>3</sup>. In Brazil, the magnitude of the problem is unknown, as are the causes of deaths related to conditions in the context of the disease, including COVID *longa*<sup>4-6</sup>.

The World Health Organization recommended the emergency use of ICD-10 codes to know the dimension of the problem. The Brazilian Ministry of Health also published guidelines on the new emergency codes for causes of death related to the conditions in the context of COVID-19.

In this context and due to the lack of studies on mortality due to post-COVID-19 conditions until October 2022, this research aims to know the magnitude of the problem and the profile of deaths due to post-COVID conditions in Brazil in 2021.

## Methods

This descriptive study is based on preliminary data from the 2021 Mortality Information System (<https://datasus.saude.gov.br/dados-preliminares-2021>) collected in May 2022. Deaths with ICD-10 code were adopted as selection criteria B94.8 (sequelae of other specified infectious and parasitic diseases) as basic cause and had ICD-10 marker U09.9 (health condition after COVID-19, unspecified) in lines A, B, C, D or line II, which includes sequelae and late effects; COVID-19

old infection; residual effect of COVID-19; late effect of COVID-19; COVID-19 sequel; post COVID-19 syndrome; and post COVID-19<sup>4-6</sup>. This condition is primarily related to various signs, symptoms, conditions, or syndromes clinically described after a previously confirmed or presumed COVID-19 diagnosis.

According to the Ministry of Health's guidelines, these codes establish a relationship with COVID-19, so they should not be used in cases where the patient still has COVID-19. It should be noted that some ICD-10 categories referring to sequelae indicate that death resulted from the late effects of an illness and not during its active phase and should be informed as such, whatever the interval between the onset of the disease and the death<sup>6</sup>.

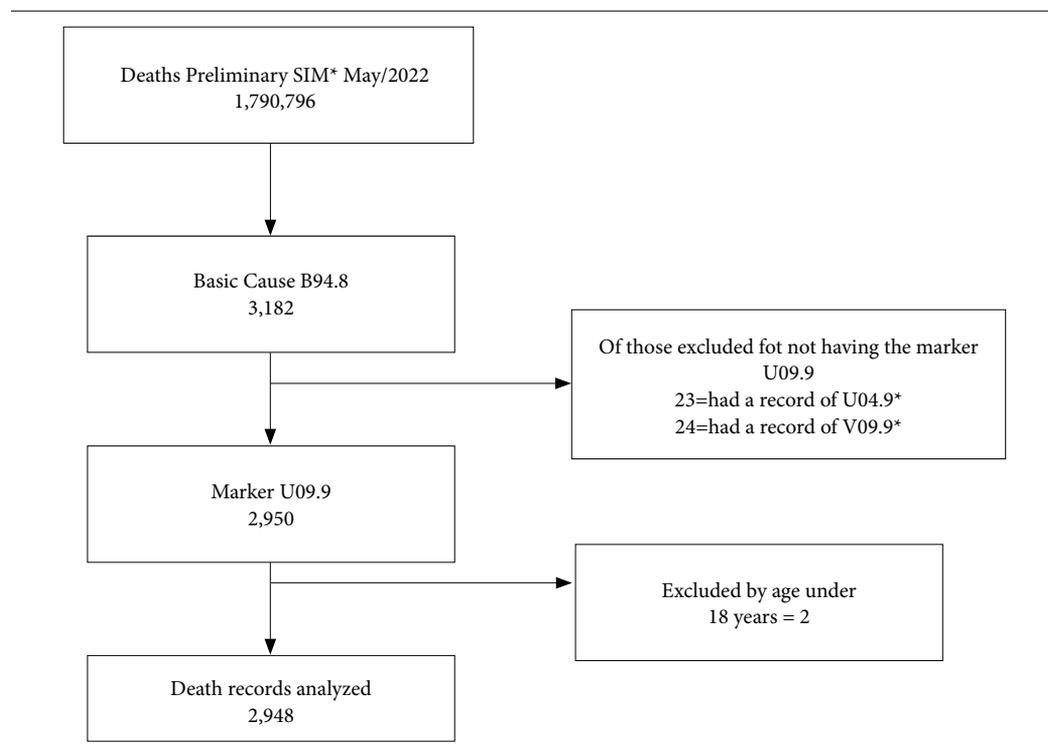
During the selection of deaths, we observed that cases classified in the underlying cause with the code B94.8 had the U04.9 code, which refers to severe acute respiratory syndrome (SARS), and others registered with V09.9, which, in turn, refers to a pedestrian injured in an unspecified transport accident (Chapter XX category – external causes). This fact suggests typing or filling errors; therefore, they were excluded from the study (Figure 1).

Death records were described by sex, age range (18-29 years, 30-49 years, 50-59 years, 60 years and over), ethnicity/skin color (white, brown, black, yellow, and indigenous), schooling (up to elementary school, incomplete and complete high school, higher education or more), month (1<sup>st</sup> or 2<sup>nd</sup> semester), and place of occurrence (hospital, other health establishments, home, public road, or others).

The proportion was calculated by dividing the number of deaths recorded with underlying cause B94.8 and marker U09.9 by the total number of deaths and multiplied by 1,000. The absolute and relative frequencies of death records characterized as post-COVID-19 sequelae were evaluated, stratified by region, using the chi-square test and maximum likelihood ratio at a significance level of 5%. The analyses were performed using the SPSS Software, version 23. The research project was approved by the Health Research Ethics Committee (Opinion n° 5.415.255).

## Results

A total of 1,790,796 deaths were identified in Brazil in 2021, of which 2,948 were over 18 years of age and had B94.9 as the underlying cause and



**Figure 1.** Flowchart of death records evaluated considering post-COVID-19 health conditions. Brazil, 2021.

\*Mortality Information System (Sistema de Informação sobre Mortalidade – SIM, in portuguese). \*\*Record in any of the cause lines or line ii of the SIM death certificate.

Source: Authors.

marker U09.9. We identified 1.6 deaths due to post-COVID conditions for every 1,000 records in 2021 in the country. Notably, this proportion was 3.6 for every 1,000 deaths in the Midwest Region, and 0.5 deaths/1,000 in the Northeast Region (Table 1).

More than half of the deaths occurred in the Southeast Region (55.2%). No difference was observed by sex between the regions of the country. The Southeast Region had a higher proportion of death records in the first semester, while more than half of the deaths occurred in the second semester of 2021 in the other regions ( $p$ -value < 0.05). Most deaths occurred among older adults. However, younger people's deaths were higher in the Northeast and Midwest regions. When evaluating education, about one-third of deaths occurred among people up to elementary school, highlighting the higher proportion of individuals with no education in the North and Northeast regions (18.7% and 14.7%, respectively). Most deaths occurred in hospitals, with higher pro-

portions occurring at home in the Northeast and South regions. About 25% of the records lacked education information, and 5.6%, ethnicity/skin color, with the highest proportions of the incompleteness of both variables reported in the Southeast Region (34.4% and 8.9%, respectively) (Table 2).

## Discussion

The present study reveals a vital record of the deaths caused by post-COVID conditions in 2021 in Brazil, with differences concerning sociodemographic characteristics between regions. Based on the literature search, this is the first study that evaluates mortality due to post-COVID conditions in Brazil and is, therefore, a limiting factor for comparing the results with other studies. The results point to the relevance of considering mortality from this cause when assessing the impact of COVID-19 on people's

**Table 1.** Number and percentage of total deaths, number of deaths due to post-COVID-19 sequelae, proportional mortality (1,000) by geographic region. Brazil, 2022.

Region	Number of deaths recorded		Number of deaths with basic cause B94.8 (Marker U09.9)	Proportional mortality 1.000
	n	%		
North	121,862	6.80	246	2.0
Northeast	438,234	24.47	224	0.5
Southeast	813,841	45.44	1626	2.0
South	284,336	15.88	377	1.3
Midwest	132,523	7.40	475	3.6
Total	1,790,796	100.00	2,948	1.6

Source: Authors.

**Table 2.** Characteristics of deaths\* due to post-COVID-19 sequelae, according to demographic variables and place of occurrence. Brazil, 2021.

Characteristics	Geral		North		Northeast		Southeast		South		Midwest	
	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)
Month of occurrence**												
1st Semester (January-June)	1,444	(49.0)	61	(24.8)	93	(41.5)	1018	(62.6)	114	(30.2)	158	(30.2)
2nd Semester (July-December)	1,504	(51.0)	185	(75.2)	131	(58.2)	608	(37.4)	263	(69.3)	317	(69.8)
Sex												
Male	1,709	(58.0)	147	(59.8)	132	(58.9)	938	(57.7)	217	(57.6)	275	(57.9)
Female	1,239	(42.0)	99	(40.2)	92	(41.1)	688	(42.3)	160	(42.4)	200	(42.4)
Age range**												
18 to 29	45	(1.5)	3	(1.2)	7	(3.1)	22	(1.4)	3	(0.8)	10	(2.1)
30 to 49	416	(14.1)	31	(12.6)	41	(18.3)	209	(12.9)	45	(11.9)	90	(18.9)
50 to 59	516	(17.5)	38	(15.4)	47	(21.0)	273	(16.8)	55	(14.6)	103	(21.7)
60 to mais	1,971	(66.9)	174	(70.7)	129	(57.6)	1122	(69.0)	274	(72.7)	272	(57.3)
Ethnicity /skin color**												
White	1,528	(51.8)	71	(28.9)	73	(32.6)	873	(53.7)	306	(81.2)	205	(43.2)
black	218	(7.4)	11	(4.5)	23	(10.3)	131	(8.1)	23	(6.1)	30	(6.3)
Yellow	16	(0.5)	2	(0.8)	1	(0.4)	9	(0.6)	-	-	4	(0.8)
brown	1,016	(34.5)	155	(63.0)	123	(54.9)	468	(28.8)	42	(11.1)	228	(48.0)
Indigenous	6	(0.2)	3	(1.2)	1	(0.4)	-	-	-	-	2	(0.4)
ignored	164	(5.6)	4	(1.6)	3	(1.3)	145	(8.9)	6	(1.6)	6	(1.3)
Education level**												
None	244	(8.3)	46	(18.7)	33	(14.7)	92	(5.7)	21	(5.6)	52	(10.9)
Incomplete/complete primary education	1,021	(34.6)	90	(36.6)	68	(30.4)	500	(30.8)	179	(47.5)	184	(38.7)
Complete high school/ incomplete higher education	571	(19.4)	58	(23.6)	45	(20.1)	288	(17.7)	62	(16.4)	118	(24.8)
complete higher education	363	(12.3)	30	(12.2)	42	(18.8)	187	(11.5)	37	(9.8)	67	(14.1)
Ignored	749	(25.4)	22	(8.9)	36	(16.1)	559	(34.4)	78	(20.7)	54	(11.4)
Place of occurrence**												
Hospital	2,691	(91.2)	217	(88.2)	195	(87.1)	1524	(93.7)	316	(83.8)	437	(92.0)
Hospital	94	(3.2)	17	(6.9)	8	(3.6)	45	(2.8)	12	(3.2)	12	(2.5)
Other health establishments	144	(4.9)	12	(4.9)	21	(9.4)	46	(2.8)	43	(11.4)	22	(4.6)
Residence	5	(0.2)	-	-	-	-	3	(0.2)	1	(0.3)	1	(0.2)
Public highway	16	(0.5)	-	-	-	-	8	(0.5)	5	(1.3)	3	(0.6)
Others												

\* Individuals 18 years of age or older. \*\*P-value &lt; 0.05.

Source: Authors.

health rather than limiting ourselves to estimating mortality in the acute phase.

Assessing socioeconomic and sociodemographic characteristics is essential to identify possible higher-risk groups or uneven recording of this cause of death. Our results indicate a higher proportion of deaths due to post-COVID conditions among men and older adults, similar to the mortality observed in the acute phase of the disease<sup>7-10</sup>. This difference between genders may be related to biological and socioeconomic factors, where men have less access to health services and less adherence to healthy habits than women<sup>11,12</sup>. The higher proportion of deaths among older adults may be related to factors that deteriorate the acute phase, which, in turn, is related to the higher prevalence of long-term COVID<sup>13-15</sup>. Regarding schooling, evaluated as a socioeconomic proxy, the proportion of deaths without schooling or even complete elementary school was substantial. However, the significant incompleteness of the records hindered an accurate analysis.

Employing statistical models, Pontes<sup>16</sup> estimated the total global burden of morbidity caused by COVID-19, attributable to both immediate death and late death and long-term COVID, and highlighted that fatality during the acute phase of the disease will likely contribute only to a share of the total COVID-19 morbidity. In most models, the entire load fell heavily on women and young people. As a result, the author concludes that all sources of morbidity should be

considered instead of focusing only on mortality in the acute phase of the disease. Such results gain particular importance in a country with the highest number of cases and deaths, profoundly unequal, with a universal public health system, in which attention to the consequences after infection by SARS-CoV-2 must be considered in the planning of actions and allocation of resources and services.

Studies have shown an excess of deaths in Brazil<sup>9,17,18</sup>, part of which is not directly explained by COVID-19 and deaths outside the hospital, which reinforces the need to assess the causes for post-COVID<sup>10</sup>.

Limitations focus on underreporting and the registration period, as the Ministry of Health published the post-COVID code guidelines in May 2021. Thus, the impact on the mortality profile can be better evaluated with more recent data. Furthermore, deaths due to post-COVID conditions point to the need for studies aimed at reviewing all causes of death associated with respiratory symptoms by epidemiological surveillance services.

The results presented draw attention to their magnitude and, considering the possibility of underreporting, the number of deaths due to post-COVID conditions may be even higher. Thus, the need for the adequate recording of the causes of death is highlighted. The improvement and constant improvement of health information systems at all levels favor efficient mortality monitoring and contribute to decision-making.

## Collaborations

AP Muraro and R Rocha contributed to the study's conception and design, analysis, interpretation of results, writing, and critical review of the manuscript's content. AC Boing, FN Melanda, LR Oliveira, and Andrade ACS contributed to the data analysis and interpretation, writing, and critical review of the manuscript's content. All authors approved the final version of the manuscript and are responsible for all aspects of the manuscript, including ensuring its accuracy and integrity.

## References

1. Johns Hopkins. Mortality analyses [Internet]. [cited 2022 out 17]. Available from: <https://coronavirus.jhu.edu/data/mortality>
2. Office for National Statistics Updated Estimates of the Prevalence of Long COVID Symptoms [Internet]. [cited 2022 jan 16]. Available from: <https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/healthandlifeexpectancies/adhocs/12788updatedestimatesoftheprevalenceoflongCOVIDsymptoms>
3. Centers for Disease Control and Prevention (CDC). Post-COVID conditions: information for healthcare providers [Internet]. [cited 2022 jul 27]. Available from: <https://www.cdc.gov/coronavirus/2019-ncov/hcp/clinical-care/post-COVID-conditions.html>
4. Ministério da Saúde (MS). Orientações para codificação das codificações das causas de morte causas de morte no contexto da no contexto da COVID-19 [Internet]. [acessado 2022 jul 27]. Disponível em: <https://saude.rs.gov.br/upload/arquivos/202005/06141402-nt-med-COVID-04-05-2020-final.pdf>
5. Ministério da Saúde (MS). Nota técnica nº 62 [Internet]. [acessado 2022 jul 15]. Disponível em: [https://www.cosemssp.org.br/wp-content/uploads/2021/11/SEI\\_MS-0023992174-Nota-Tecnica-62-Anexo-Oficio-Circular-101.pdf](https://www.cosemssp.org.br/wp-content/uploads/2021/11/SEI_MS-0023992174-Nota-Tecnica-62-Anexo-Oficio-Circular-101.pdf)
6. Ministério da Saúde (MS). *Manual para avaliação e manejo de condições pós-COVID na Atenção Primária à Saúde*. Brasília: MS; 2022.
7. Vestergaard LS, Nielsen J, Richter L, Schmid D, Bustos N, Braeye T, Denissov G, Veideman T, Luomala O, Möttönen T, Fouillet A, Caserio-Schönemann C, An der Heiden M, Uphoff H, Lytras T, Gkolfinopoulou K, Paldy A, Domegan L, O'Donnell J, De' Donato F, Noccioni F, Hoffmann P, Velez T, England K, van Asten L, White RA, Tønnessen R, da Silva SP, Rodrigues AP, Larrauri A, Delgado-Sanz C, Farah A, Galanis I, Junker C, Perisa D, Sinnathamby M, Andrews N, O'Doherty M, Marquess DF, Kennedy S, Olsen SJ, Pebody R; ECDC Public Health Emergency Team for COVID-19, Krause TG, Mølbak K. Excess all-cause mortality during the COVID-19 pandemic in Europe - preliminary pooled estimates from the EuroMOMO network. *Euro Surveill* 2020; 25(26):2001214.
8. Pérez-López FR, Tajada M, Savirón-Cornudella R, Sánchez-Prieto M, Chedraui P, Terán E. Coronavirus disease 2019 and gender-related mortality in European countries: a meta-analysis. *Maturitas* 2020; 141:59-62.
9. Orellana JDY, Cunha GMD, Marrero L, Moreira RI, Leite IDC, Horta BL. Excesso de mortes durante a pandemia de COVID-19: subnotificação e desigualdades regionais no Brasil. *Cad Saude Publica* 2020; 36(1):e00259120.
10. Sanchez M, Moura E, Moreira J, Lima R, Barreto I, Pereira CCA, Santos LMP. Mortalidade por COVID-19 no Brasil: análise do registro civil de óbitos de janeiro de 2020 a fevereiro de 2021. *SciELO Preprints* 2021. DOI: <https://doi.org/10.1590/SciELOPreprints.2012>
11. Hunt K, Adamson J, Hewitt C, Nazareth I. Do women consult more than men? A review of gender and consultation for back pain and headache. *J Health Serv Res Policy* 2011; 16(2):108-117.
12. Krieger N, Chen J, Waterman PD. Excess mortality in men and women in Massachusetts during the COVID-19 pandemic. *Lancet* 2020; 395 (10240):1829.
13. Bellan M, Soddu D, Balbo PE, Baricich A, Zeppego P, Avanzi GC, Baldon G, Bartolomei G, Battaglia M, Battistini S, Binda V, Borg M, Cantaluppi V, Castello LM, Clivati E, Cisari C, Costanzo M, Croce A, Cuneo D, De Benedittis C, De Vecchi S, Feggi A, Gai M, Gambaro E, Gattoni E, Gramaglia C, Grisafi L, Guerriero C, Hayden E, Jona A, Invernizzi M, Lorenzini L, Loreti L, Martelli M, Marzullo P, Martino E, Panero A, Parachini E, Patrucco F, Patti G, Pirovano A, Prosperrini P, Quaglino R, Rigamonti C, Sainaghi PP, Vecchi C, Zecca E, Pirisi M. Respiratory and psychophysical sequelae among patients with covid-19 four months after hospital discharge. *JAMA* 2021; 4(1):e2036142.
14. Sudre CH, Murray B, Varsavsky T, Graham MS, Penfold RS, Bowyer RC, Pujol JC, Klaser K, Antonelli M, Canas LS, Molteni E, Modat M, Jorge Cardoso M, May A, Ganesh S, Davies R, Nguyen LH, Drew DA, Astley CM, Joshi AD, Merino J, Tsereteli N, Fall T, Gomez MF, Duncan EL, Menni C, Williams FMK, Franks PW, Chan AT, Wolf J, Ourselin S, Spector T, Steves CJ. Attributes and predictors of long COVID. *Nature* 2021; 27(4):626-631.
15. Xiong Q, Xu M, Li J, Liu Y, Zhang J, Xu Y, Dong W. Clinical sequelae of COVID-19 survivors in Wuhan, China: a single centre longitudinal stud. *Clin Microbiol Infect* 2021; 27(1):89-95.
16. Pontes L, Danski MTR, Piubello SMN, Pereira JFG, Jantsch LB, Costa LB, Santos JO, Arruê AM. Perfil clínico e fatores associados ao óbito de pacientes COVID-19 nos primeiros meses da pandemia. *Esc Anna Nery* 2022; 26:e20210203.
17. Silva GA, Jardim BC, Santos CVB. Excesso de mortalidade no Brasil em tempos de COVID-19. *Cien Saude Colet* 2020; 25(9):3345-3354.
18. Baqui P, Bica I, Marra V, Ercole A, van der Shaar M. Ethnic and regional variations in hospital mortality from COVID-19 in Brazil: a cross-sectional observational study. *Lancet Glob Health* 2020; 8(8):e1018-e1026.

---

Article submitted 19/10/2022

Approved in 25/10/2022

Final version submitted 27/10/2022

---

Chief editors: Romeu Gomes, Antônio Augusto Moura da Silva