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ORIGINAL ARTICLE

Excess mortality according to group of causes in the first year of the COVID-19 pandemic in Brazil

Excesso de mortalidade segundo grupo de causas no primeiro ano de pandemia de COVID-19 no Brasil

Raphael Mendonça Guimarães[I], Mariana Passos Ribeiro Pinto Basílio de Oliveira[II], Viviane Gomes Parreira Dutra[II]

[I]Fundação Oswaldo Cruz, Escola Nacional de Saúde Pública Sergio Arouca – Rio de Janeiro (RJ), Brazil.
[II]Universidade Estácio de Sá, Escola de Medicina – Rio de Janeiro (RJ), Brazil.

ABSTRACT

Objective: To estimate excess mortality by cause of death in Brazil and states in 2020. **Methods:** We estimated the expected number of deaths considering a linear trend analysis with the number of deaths between 2015 and 2019 for each group of causes and each federative unit. We calculated standardized mortality ratios (SMR) and 95% confidence intervals for each SMR assuming a Poisson distribution. We performed the analyses in the R program, version 4.1.3. **Results:** We observed a 19% excess in deaths in 2020 (SMR=1.19; 95%CI=1.18–1.20). The Infectious and Parasitic Diseases group stood out among the defined causes (SMR=4.80; 95%CI 4.78–4.82). The ill-defined causes showed great magnitude in this period (SMR=6.08; 95%CI 6.06–6.10). Some groups had lower-than-expected deaths: respiratory diseases (10% lower than expected) and external causes (4% lower than expected). In addition to the global analysis of the country, we identified significant heterogeneity among the federative units. States with the highest SMR are concentrated in the northern region, and those with the lowest SMR are concentrated in the southern and southeastern regions. **Conclusion:** Excess mortality occurs during the COVID-19 pandemic. This excess results not only from COVID-19 itself, but also from the social response and the management of the health system in responding to a myriad of causes that already had a trend pattern before it.

Keywords: Excess mortality. Cause of death. COVID-19. Brazil.

CORRESPONDING AUTHOR: Raphael Mendonça Guimarães. Avenida Brasil, 4365, sala 913, Manguinhos, CEP: 21041-960, Rio de Janeiro (RJ), Brazil. E-mail: raphael.guimaraes@fiocruz.br

CONFLICT OF INTERESTS: nothing to declare

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INTRODUCTION

The new coronavirus disease (COVID-19) was declared by the World Health Organization (WHO) as a public health emergency of international interest in January 2020, and it was declared a pandemic in March of the same year[1]. At the end of the first year of the pandemic, in 2020, approximately 1.88 million deaths from complications of COVID-19 occurred worldwide. Brazil accounted for 10.5% of these deaths, with over 195 thousand victims registered by the end of that year[2].

During the SARS-CoV-2 pandemic, federal, state, and municipal governments, as well as academic associations and consortia, reported the number of deaths from COVID-19. The diversity of information producers has made evident the heterogeneity in the accuracy and completeness of deaths resulting from COVID-19 reported by States and municipalities[3]. In addition, comparing the impact of the COVID-19 pandemic between different locations or over time has been a challenge because the reported numbers of cases and deaths can be strongly affected by the testing capacity and notification policies[4]. Therefore, other mortality assessment indicators are strongly recommended.

Monitoring excess mortality provides a more comprehensive idea of the impact of COVID-19 in addition to the number of COVID-19 deaths reported by information systems[5]. On the one hand, this estimate includes deaths directly attributable to COVID-19 that were correctly coded, besides those whose diagnosis remained unclear. Moreover, it also includes deaths indirectly associated with COVID-19 due to other causes and diseases resulting from the broader impact of the pandemic on health systems and society — whether directed towards increasing the expected number or reducing the expected number, as they were prevented due to changes related to the pandemic in social conditions and individual behaviors[6,7]. Hence, this impact tends to be differential by groups of causes of death, as some of them are related to the lack of assistance caused by the reorganization of the healthcare network, and others are related to the change in the patterns of social interaction in the population.

Previous studies have estimated the excess mortality from COVID-19 in Brazil from the first weeks of the pandemic[8], to the present time, by selected capitals[9], and by some selected groups of causes[10]. Currently, with the mortality data for Brazil in 2020 already available in its final version, it is essential to make estimates considering the set of federative units and expand the number of groups of causes. Taking this into consideration, the objective of the present study was to estimate excess mortality, according to cause of death, in Brazil and its States in the first year of the pandemic.

METHODS

Study design

We conducted an ecological study containing analyses of national scope, based on data from the Brazilian Mortality Information System (*Sistema de Informações sobre Mortalidade* – SIM)[11], for general and cause-specific deaths, for the period from 2015 to 2020. The units of analysis were the 27 Federative Units (FUs). To estimate mortality rates, we calculated the 2020 population for each FU, based on the populations of the 2000 and 2010 Censuses of the Brazilian Institute of Geography and Statistics (IBGE)[12], by interpolation.

Data analysis

We estimated the mortality rate for the following groups of causes of death: infectious and parasitic diseases, neoplasms, endocrine causes, mental disorders, cardiovascular diseases, respiratory diseases, genitourinary tract diseases, deaths during pregnancy, childbirth, and the postpartum period, external causes, and ill-defined causes, in addition to general mortality. Although there was a documented improvement in the quality of data on cause of death in Brazil[13], in 2020, the first year of the pandemic, there was a delay in defining cases[14]. There were also significant challenges in obtaining quality mortality data, including the estimate of the degree of underreporting of deaths from COVID-19, the exact number of deaths from this cause, and inconsistency in other causes of death. Thus, we decided not to perform correction by redistributing deaths with ill-defined causes among the different groups of causes, but rather to consider them separately to confirm the hypothesis of excess deaths with this classification.

We obtained the expected number of deaths considering the five-year period 2015–2019, seeking to avoid overestimation of excess (for groups that had been showing a consistent drop) or underestimation of excess (for groups that had been showing growth in the last five years). Therefore, we conducted a linear trend analysis for each group and each FU. We considered a period of five years so that the assumption of the linear trend was not violated. With a period longer than that, it would be necessary to perform a temporal trend analysis, and the adjustment to obtain the expected number would become more complex and present a greater degree of uncertainty.

With this trend, we estimated the expected number of deaths considering Equation 1:

$$ {}_{n}D_{x}^{i,2020} = {}_{n}D_{x}^{i,2019}(1+\beta) \quad (1) $$

Where:

${}_{n}D_{x}^{i,2020}$ = number of deaths in 2020,for the group between ages x and x+n,according to the group of causes i, and β = linear trend coefficient for the group of cause *i* for each age group, between 2015 and 2019.

We estimated the population used to calculate the mortality rate by age group for the year 2017, which corresponds to the middle of the five-year period, obtained by interpolation.

We calculated the standardized mortality ratio (SMR) according to age as the ratio between the 2020 standardized mortality rate and the estimated rate, both for general and specific mortality for each group of causes. We standardized the crude mortality rates by using the direct method considering the Brazilian population as a reference. These measures estimate cases and deaths by group of causes in the FUs concerning what would be expected if the neighborhoods experienced the same rates observed in the previous five-year period.

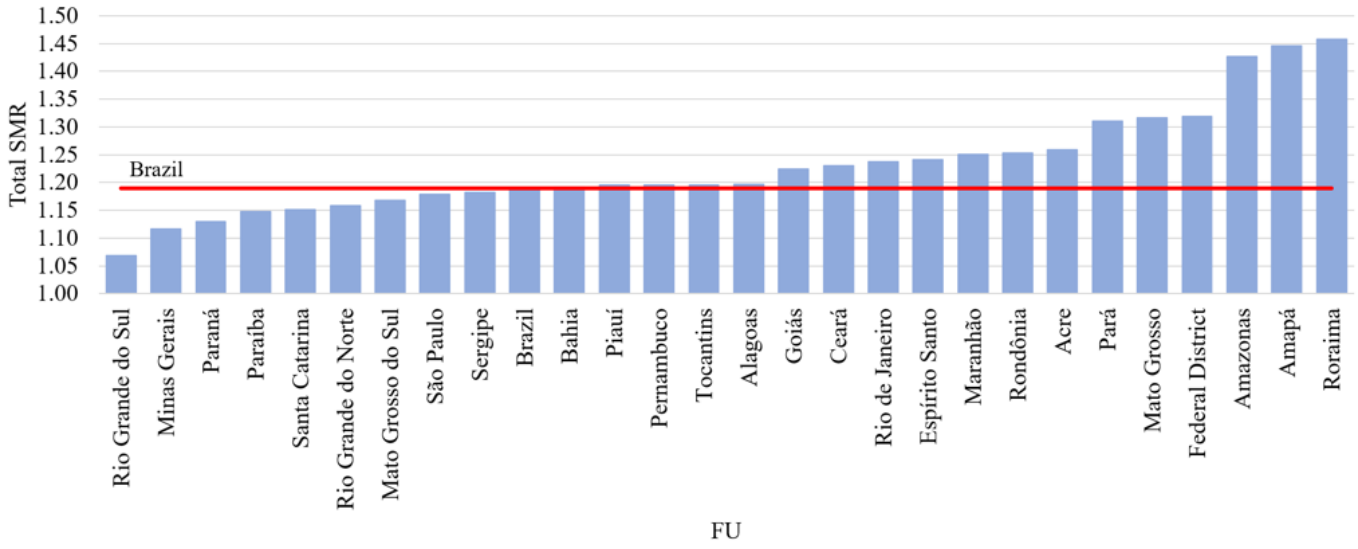
We estimated the 95% confidence intervals (95%CI) for each SMR assuming a Poisson distribution, based on the method proposed by Vandenbroucke[15]. We performed analyses in the R program, version 4.2.1. As it involves the analysis of publicly accessible and unidentified secondary data, the study is exempt from consideration by the Research Ethics Committee.

RESULTS

Brazil registered 1,556,824 deaths in 2020. We collected the data in May 2022, that is, already in the final version of the SIM microdata made available after correction carried out by the Brazilian Ministry of Health. Excess deaths for the period were approximately 190 thousand (Appendix 1). There is also a marked difference between the FUs regarding the excess deaths (Figure 1).

Table 1 shows the SMRs in the Federal District and the Brazilian States, by group of causes, in 2020, the first year of the COVID-19 pandemic. We observed an excess of 19% in deaths in 2020 (SMR 1.19; 95%CI 1.18–1.20). The infectious and parasitic diseases group stood out among the defined causes (SMR 4.80; 95%CI 4.78–4.82). The ill-defined causes showed great magnitude in this period (SMR 6.08; 95%CI 6.06–6.10). Groups with a number of deaths that exceeded the expected by more than 10% are also noteworthy: endocrine diseases (16%); mental disorders (29%); cardiovascular diseases (16%); and deaths during pregnancy, childbirth, and the postpartum period (27%). Furthermore, some groups had lower-than-expected deaths: respiratory diseases (10% lower than expected) and external causes (4% lower than expected).

In addition to the global analysis for the country, we identified significant heterogeneity among the FUs. We observed higher excess mortality in the state of Roraima (SMR 1.46; 95%CI 1.41–1.51) and lower excess mortality in the state of Rio Grande do Sul (SMR 1.07; 95%CI 1.06–1.08). Besides, we can perceive that the States with the highest SMRs are concentrated in the northern region, and those with the lowest SMRs are concentrated in the south and southeast regions. The most remarkable differences occurred in the groups: mental disorders (RR=4.11); deaths during pregnancy, childbirth, and the postpartum period (RR=2.66); and infectious and parasitic diseases (RR=2.62). As for general mortality, we verified the highest standardized mortality ratios in northern States. It should be noted that the group of ill-defined causes also obtained a significant difference between the FUs (RR=3.44). We observed a lower SMR in the Federal District (SMR 3.62; 95%CI 3.41–3.82) and a higher SMR in the state of Ceará (SMR 12.46; 95%CI 12.22–12.69).



Source: Brazilian Mortality Information System, 2022

Figure 1. Standardized mortality ratio distribution according to Federative Units. Brazil, 2015–2020.

Table 1. Excess mortality by group of causes according to Federative Units. Brazil, 2020.

Large Region	FU	IPD	Neoplasms	Endocrine causes	Mental disorders	CVD	RSD
		SMR (95%CI)	SMR (95%CI)	SMR (95%CI)	SMR (95%CI)	SMR (95%CI)	SMR (95%CI)
North	Rondônia	5,86 (5,62–6,11)	1,04 (0,98–1,09)	1,29 (1,19–1,38)	1,19 (0,89–1,48)	1,27 (1,10–1,43)	0,76 (0,70–0,81)
	Acre	5,55 (5,20–5,89)	0,99 (0,90–1,07)	0,94 (0,82–1,07)	0,78 (0,45–1,12)	0,87 (0,65–1,09)	0,72 (0,66–0,79)
	Amazonas	6,87 (6,71–-7,04)	0,99 (0,95–1,03)	1,27 (1,20–1,33)	1,62 (1,29–1,94)	1,27 (1,14–1,40)	1,10 (1,05–1,15)
	Roraima	8,22 (7,70–8,75)	1,18 (1,07–1,30)	0,85 (0,72–0,98)	1,22 (0,46–1,98)	1,09 (0,80–1,37)	0,91 (0,79–1,02)
	Pará	4,94 (4,85–5,04)	1,05 (1,02–1,08)	1,19 (1,15–1,23)	1,53 (1,35–1,71)	1,38 (1,29–1,47)	1,32 (1,29–1,36)
	Amapá	7,79 (7,37–8,22)	1,14 (1,04–1,24)	1,25 (1,09–1,41)	2,67 (1,74–3,59)	1,28 (1,01–1,56)	0,75 (0,67–0,83)
	Tocantins	6,12 (5,81–6,43)	1,00 (0,94–1,06)	1,11 (1,03–1,19)	1,34 (1,12–1,57)	1,14 (0,98–1,30)	0,90 (0,83–0,97)
Northeast	Maranhão	4,04 (3,94–4,14)	1,05 (1,02–1,08)	1,27 (1,23–1,31)	1,32 (1,19–1,45)	1,17 (1,08–1,26)	1,28 (1,24–1,31)
	Piauí	5,07 (4,90–5,24)	0,97 (0,93–1,00)	1,06 (1,00–1,11)	1,20 (1,06–1,34)	1,19 (1,09–1,29)	0,83 (0,79–0,87)
	Ceará	6,19 (6,08–6,29)	1,05 (1,03–1,07)	1,19 (1,14–1,23)	1,16 (1,08–1,23)	1,18 (1,13–1,23)	0,83 (0,81–0,85)
	Rio Grande do Norte	4,60 (4,46–4,74)	1,05 (1,02–1,09)	0,96 (0,91–1,00)	1,26 (1,11–1,41)	1,10 (1,02–1,19)	0,86 (0,82–0,90)
	Paraíba	4,27 (4,15–4,39)	1,05 (1,02–1,08)	1,12 (1,08–1,17)	1,30 (1,15–1,44)	1,19 (1,10–1,27)	0,89 (0,86–0,93)
	Pernambuco	4,78 (4,70–4,86)	1,02 (0,99–1,04)	1,21 (1,18–1,24)	2,17 (2,05–2,29)	1,31 (1,25–1,36)	0,95 (0,93–0,97)
	Alagoas	4,83 (4,69–4,97)	1,07 (1,02–1,11)	1,07 (1,03–1,12)	1,22 (1,07–1,37)	0,98 (0,88–1,08)	0,80 (0,76–0,84)
	Sergipe	5,35 (5,16–5,55)	1,06 (1,01–1,11)	0,98 (0,91–1,04)	1,13 (1,02–1,25)	1,21 (1,09–1,33)	0,88 (0,83–0,93)
	Bahia	3,72 (3,66–3,78)	1,11 (1,09–1,13)	1,19 (1,16–1,22)	1,39 (1,32–1,46)	1,27 (1,22–1,32)	0,81 (0,79–0,83)
Southeast	Minas Gerais	3,14 (3,09–3,18)	1,07 (1,05–1,08)	1,12 (1,10–1,15)	1,18 (1,14–1,22)	1,17 (1,14–1,20)	0,84 (0,83–0,85)
	Espírito Santo	7,96 (7,75–8,17)	1,05 (1,02–1,08)	1,27 (1,21–1,33)	1,16 (1,03–1,30)	1,21 (1,14–1,28)	0,85 (0,82–0,89)
	Rio de Janeiro	4,99 (4,94–5,04)	1,00 (0,99–1,01)	1,10 (1,08–1,12)	1,22 (1,15–1,29)	1,03 (1,00–1,07)	0,93 (0,91–0,94)
	São Paulo	5,45 (5,41–5,50)	1,00 (1,00–1,01)	1,27 (1,25–1,29)	1,33 (1,29–1,38)	1,12 (1,10–1,14)	0,99 (0,98–1,00)
South	Paraná	4,75 (4,66–4,84)	1,05 (1,04–1,07)	1,11 (1,08–1,14)	1,30 (1,22–1,37)	1,21 (1,17–1,25)	0,78 (0,77–0,80)
	Santa Catarina	4,50 (4,40–4,61)	1,06 (1,04–1,09)	1,09 (1,05–1,13)	0,92 (0,83–1,02)	1,11 (1,05–1,16)	0,77 (0,75–0,79)
	Rio Grande do Sul	3,56 (3,50–3,63)	1,01 (0,99–1,02)	1,16 (1,13–1,19)	1,36 (1,27–1,45)	1,11 (1,08–1,15)	0,74 (0,72–0,76)
Midwest	Mato Grosso do Sul	4,68 (4,50–4,85)	1,03 (0,99–1,07)	0,79 (0,74–0,84)	0,65 (0,51–0,78)	1,21 (1,11–1,30)	0,86 (0,83–0,90)
	Mato Grosso	6,59 (6,41–6,77)	1,10 (1,06–1,14)	1,15 (1,09–1,21)	1,20 (1,04–1,35)	1,28 (1,17–1,39)	0,89 (0,85–0,93)
	Goiás	5,15 (5,05–5,26)	1,06 (1,03–1,08)	1,15 (1,10–1,19)	1,44 (1,32–1,55)	1,32 (1,26–1,39)	0,83 (0,81–0,86)
	Federal District	6,62 (6,41–6,83)	1,07 (1,03–1,11)	1,26 (1,17–1,35)	1,21 (1,08–1,34)	1,16 (1,07–1,25)	0,92 (0,86–0,97)
	Brazil	4,8 (4,78–4,82)	1,03 (1,03–1,04)	1,16 (1,16–1,17)	1,29 (1,28–1,31)	1,16 (1,15–1,17)	0,90 (0,90–0,91)
Large Region	**FU**	**GT**	**PCP**	**External causes**	**Ill-defined**	**Total**	
		SMR (95%CI)	SMR (95%CI)	SMR (95%CI)	SMR (95%CI)	SMR (95%CI)	
North	Rondônia	1,01 (0,88–1,13)	1,42(0,78-2,06)	0,96(0,91-1,02)	6,31(6,05-6,57)	1,25(1,23-1,28)	
	Acre	1,00 (0,79–1,21)	0,68(0,08-1,27)	0,90(0,83-0,98)	7,35(6,99-7,71)	1,26(1,22-1,29)	
	Amazonas	1,09 (0,99–1,20)	1,12(0,87-1,37)	0,92(0,89-0,96)	5,65(5,55-5,75)	1,43(1,41-1,44)	
	Roraima	0,79 (0,57–1,01)	1,79(1,00-2,57)	1,04(0,96-1,12)	6,59(5,89-7,30)	1,46(1,41-1,51)	
	Pará	1,16 (1,09–1,23)	1,12(0,95-1,30)	0,84(0,82-0,87)	5,77(5,68-5,86)	1,31(1,30-1,32)	
	Amapá	1,01 (0,79–1,24)	1,36(0,67-2,05)	1,10(1,02-1,19)	6,23(5,84-6,62)	1,45(1,40-1,49)	
	Tocantins	1,13 (0,96–1,29)	1,29(0,69-1,88)	0,97(0,92-1,02)	5,46(5,10-5,82)	1,20(1,17-1,22)	
Northeast	Maranhão	1,12 (1,05–1,20)	1,30(1,05-1,55)	0,99(0,96-1,02)	6,20(6,05-6,35)	1,25(1,24-1,26)	
	Piauí	1,07 (0,97–1,17)	1,03(0,74-1,33)	1,01(0,97-1,05)	5,59(5,42-5,77)	1,20(1,18-1,21)	
	Ceará	0,99 (0,94–1,05)	1,15(0,95-1,34)	1,01(0,99-1,03)	12,46(12,22-12,69)	1,23(1,22-1,24)	
	Rio Grande do Norte	0,99 (0,92–1,07)	1,05 (0,70–1,40)	0,89 (0,85–0,92)	6,90 (6,67–7,13)	1,16 (1,14–1,17)	
	Paraíba	1,03 (0,96–1,10)	1,24 (0,91–1,56)	0,98 (0,94–1,01)	6,69 (6,53–6,86)	1,15 (1,14–1,16)	
	Pernambuco	1,00 (0,96–1,05)	1,50 (1,20–1,79)	0,98 (0,96–1,01)	8,90 (8,74–9,07)	1,20 (1,19–1,20)	
	Alagoas	0,99 (0,89–1,08)	1,39 (0,96–1,82)	0,95 (0,91–0,98)	7,01 (6,81–7,22)	1,20 (1,18–1,21)	
	Sergipe	0,95 (0,86–1,05)	1,81 (1,19–2,43)	0,89 (0,85–0,93)	5,78 (5,63–5,94)	1,18 (1,16–1,20)	
	Bahia	1,16 (1,11–1,20)	1,51 (1,27–1,74)	1,01 (0,99–1,03)	6,58 (6,53–6,63)	1,19 (1,18–1,20)	
Southeast	Minas Gerais	1,14 (1,11–1,17)	1,18 (0,98–1,38)	0,91 (0,89–0,93)	6,97 (6,91–7,03)	1,12 (1,11–1,12)	
	Espírito Santo	1,09 (1,01–1,16)	1,39 (0,97–1,80)	0,99 (0,95–1,02)	8,49 (7,96–9,03)	1,24 (1,23–1,26)	
	Rio de Janeiro	0,98 (0,95–1,00)	1,29 (1,13–1,46)	0,91 (0,89–0,92)	4,27 (4,24–4,31)	1,24 (1,23–1,24)	
	São Paulo	1,07 (1,05–1,09)	1,23 (1,10–1,35)	1,00 (0,98–1,01)	5,93 (5,88–5,97)	1,18 (1,17–1,18)	

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Table 1. Continuation.

Large Region	FU	GT	PCP	External causes	Ill-defined	Total
		SMR (95%CI)	SMR (95%CI)	SMR (95%CI)	SMR (95%CI)	SMR (95%CI)
South	Paraná	1,14 (1,09–1,19)	1,27 (1,00–1,54)	1,01 (0,99–1,03)	6,87 (6,73–7,02)	1,13 (1,12–1,14)
	Santa Catarina	1,09 (1,03–1,15)	1,19 (0,80–1,57)	1,00 (0,97–1,03)	5,02 (4,88–5,16)	1,15 (1,14–1,16)
	R. Grande do Sul	1,22 (1,17–1,26)	1,33 (1,01–1,65)	0,89 (0,87–0,91)	5,22 (5,15–5,30)	1,07 (1,06–1,08)
Midwest	Mato Grosso do Sul	1,45 (1,33–1,56)	0,73 (0,37–1,08)	0,95 (0,91–0,99)	5,57 (5,31–5,84)	1,17 (1,15–1,18)
	Mato Grosso	1,18 (1,09–1,28)	1,27 (0,94–1,61)	1,06 (1,02–1,09)	6,40 (6,23–6,57)	1,32 (1,30–1,33)
	Goiás	1,14 (1,08–1,20)	1,22 (0,97–1,47)	0,96 (0,93–0,98)	7,63 (7,40–7,87)	1,22 (1,21–1,24)
	Federal District	1,21 (1,07–1,35)	1,15 (0,67–1,62)	0,94 (0,89–0,98)	3,62 (3,41–-3,82)	1,32 (1,30–1,34)
	Brazil	1,08 (1,07–1,09)	1,27 (1,22–1,32)	0,96 (0,91–1,02)	6,31 (6,05–6,57)	1,25 (1,23–1,28)

FU: Federative Unit; IPD: infectious and parasitic diseases; CVD: cardiovascular disease; RSD: respiratory system diseases; SMR: standardized mortality ratio; GT: genitourinary tract; PCP: pregnancy, childbirth, and the postpartum period.
Source: Brazilian Mortality Information System, 2022.

DISCUSSION

The data investigated in our study show excess deaths of 19% more than expected in Brazil in 2020. The distribution of this excess was different due to group of causes of death and Brazilian FUs. The most recent WHO estimates show that the total number of deaths directly or indirectly associated with the COVID-19 pandemic in the years 2020 and 2021 was approximately 14.9 million[16].

As aforementioned, excess mortality includes deaths associated directly (due to the disease) or indirectly (due to the impact of the pandemic on health systems and society) with COVID-19. Deaths indirectly associated with COVID-19 are attributable to other health conditions for which people have not had access to prevention and treatment because the pandemic has overburdened health systems. The estimated number of excess deaths may also be influenced by deaths prevented during the pandemic due to the lower risks of specific events such as car accidents or occupational accidents. This diagnosis is important because it indicates the need for local health systems to be more resilient so that they can sustain essential health services during crises, including more consistent health information systems[17].

Many countries report excess deaths during 2020. In the United States of America, one of the epicenters of the pandemic in the first year, there were excess deaths of 17.3% compared with the previous triennium (2017–2019). It is worth mentioning that this excess includes a substantial volume of deaths not directly related to COVID-19[18]. Moreover, the study by Sanmarchi et al.[19], conducted on 67 countries, pointed out that, in some countries, excess mortality was significantly higher than deaths directly caused by COVID-19. This can indicate two things: the capacity of the different national health systems to test and diagnose COVID-19; and their ability to respond to the health crisis, including the organization of local systems to meet the regular demand. More precisely, the study by Kelly et al.[20] estimated the residual mortality rate, resulting from subtracting the death rate due to COVID-19 from excess mortality, for 35 countries. Despite the heterogeneity between the analysis locations, higher mortality from other causes after excluding deaths from COVID-19 was positively correlated to places with higher population density and negatively correlated to the Human Development Index (HDI).

This result is similar on a subnational scale. The study by Stokes et al.[21], conducted in the USA, concluded that for every 100 deaths attributed to COVID-19, there were 120 deaths from all causes (95%CI 116–124), implying that 17% (95%CI 14–19) of the excess deaths were attributed to causes of death other than COVID-19 itself. The models presented by the authors demonstrated that the percentage of excess deaths not attributed to COVID-19 was substantially higher among municipalities with lower median family income and lower level of formal education, in addition to cities with more precarious health.

Our study corroborates analyses carried out in Brazil, performed with preliminary data (from 2020) from the SIM. Likewise, Santos et al.[10] observed a reduction in mortality from respiratory diseases and external causes. Regarding external causes, the results are consistent with the adoption of social distancing measures. The change in behavior, associated with limited external activities and economic shutdown, seems to play a role in the pandemic's "protective" effect on this group of cause of death. Drops in mobility have an expected impact on traffic accidents, considering that people who stay at home are not at risk of these events. However, the decreases in violent causes are less obvious, with a tendency to increase in the medium and long term, especially suicides and deaths from domestic violence[22]. Therefore, this effect may be reverted to a future analysis with data from 2021.

Another study[23], conducted in Italy, described an increase in deaths from *diabetes mellitus*, hypertensive heart disease, cerebrovascular diseases, and ill-defined causes. Deaths from conditions such as decompensated diabetes and cardiovascular diseases prove that there was an impact caused by COVID-19 on the entire health system, causing

lack of assistance for other health problems that could not be adequately managed[24]. Thus, the excess deaths during the pandemic are probably due, in part, to the lethality of COVID-19. Still, it can also be a consequence of overburdened health services, resulting in more precarious health care, especially for patients with chronic diseases such as cancer and certain cardiovascular conditions[25]. The analysis performed by Jardim et al.[26] demonstrated that the excess deaths from cancer and cardiovascular conditions as a comorbidity in 2020 might indicate that COVID-19 had a considerable impact among patients with these conditions. However, there was a reduction of 9.7 and 8.8%, respectively, compared with the same period of the previous year. The result of this study is aligned with the idea presented by Caldas et al.[27] of the assumption of independence from the risks of dying from complications related to COVID-19 in the face of other causes, and that such an assumption may lead to an overestimation of the decline in life expectancy. For this reason, it is crucial to consider the analysis of competing causes for a more robust description of mortality scenarios in Brazil.

Regarding deaths from mental disorders, it should be noted that developing countries seem to be more susceptible to the effects of confinement on mental health due to economic restrictions, unavailability of food, and general socioeconomic insecurity, which can aggravate psychological conditions. In addition, psychotropic drugs at clinically relevant levels are involved in a set of inflammatory dysregulation mechanisms, posing a risk to those with severe mental conditions[28]. Conversely, deaths in the group of deaths during pregnancy, childbirth, and in the postpartum period reflect concern about the impact of the pandemic, especially on maternal mortality. In addition to the physiological mechanisms of pregnancy, which create windows of biological susceptibility to the attack of SARS-CoV-2, we add the fact that maternal mortality is strongly influenced by the access and availability of care resources for prenatal care, childbirth, and the postpartum period, an association already presented in a previous study[29]. Taking this into consideration, we emphasize that the assessment of the total impact of the pandemic on mortality should include both the direct effect of the pandemic on deaths from COVID-19 and the indirect impact of the pandemic on deaths from other causes, as can be expected due to the interruption of health services or broader economic and social changes[30].

Furthermore, there are essential differences in the profile of deaths compared with western and eastern countries, especially regarding the volume of deaths and factors such as median age, prevalence of obesity, and political stability (and the rigor in the adoption of restrictive measures)[31]. This last factor was essential in describing the historical series of deaths from COVID-19 in Brazil[32,33], which was added to other countries in the evidence that part of the observed variability in mortality can be explained by political factors[34]. That is why excess of all-cause mortality is recommended as a more reliable metric to assess the magnitude of COVID-19 in the mortality scenario.

It is worth mentioning that the analysis of countries can mask significant heterogeneities at the subnational level[35]. Hence, we consider it appropriate to observe the estimates by FU. In this sense, it is vital to ensure that changes in the Brazilian mortality pattern do not occur uniformly. Moreover, the heterogeneity among the FUs reflects regional inequalities, whether for exposure to risk factors or for the diagnostic and therapeutic opportunity[36].

It should be mentioned that the total impact of the pandemic was possibly much higher than indicated by the deaths reported due to COVID-19 alone[37]. The strengthening of death registration systems around the world, essential to the global public health strategy, is necessary to improve the monitoring of this and future pandemics[38,39], especially considering that socioeconomic factors should be considered when implementing public health interventions to improve disparities in the impact of COVID-19 on vulnerable population groups[40].

As a limitation, it is worth mentioning that estimates of excess deaths depend on analyses, and adjustment for age is an essential factor to be considered[41]. For this purpose, the estimations were performed considering the standardized rates by age, seeking to make the different FUs comparable, whose age structures are very diverse.

The analyzed data allow us to assume, therefore, that COVID-19 had an impact, directly and indirectly, on the health of the Brazilian population. Mortality data indicate coincidence in the most critical periods of the pandemic and a higher number of deaths from other causes, suggesting collapse and impoundment of health problems. This excess results not only from COVID-19 itself, but also from the social response and the management of the health system in responding to a myriad of causes that already had a trend pattern before it.

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RESUMO

Objetivo: Estimar o excesso de mortalidade segundo causa de óbito no Brasil e estados em 2020. **Métodos:** O número de óbitos esperado foi estimado considerando análise de tendência linear com o número de mortes entre os anos de 2015 e 2019, para cada grupo de causas e cada unidade da federação. Calculamos as razões de mortalidade padronizadas, e os intervalos com 95% de confiança para cada SMR foram calculados assumindo uma distribuição Poisson. As análises foram realizadas no programa R, versão 4.1.3. **Resultados:** Observamos um excesso de 19% nos óbitos em 2020 (SMR=1,19; IC=1,18–1,20). O grupo de Doenças Infecciosas e Parasitárias obteve maior destaque entre as causas definidas (SMR=4,80; IC95% 4,78–4,82). As causas mal definidas apresentaram grande magnitude neste período (SMR=6,08; IC95% 6,06–6,10). Há, ainda, grupos que apresentaram número de óbitos abaixo do esperado: doenças do aparelho respiratório (10% abaixo do esperado) e causas externas (4% abaixo do esperado). Além da análise global para o país, identificamos grande heterogeneidade entre as unidades da federação. Os estados com maiores SMR estão concentrados na região norte, e os que possuem menores SMR estão concentrados nas regiões sul e sudeste. **Conclusões:** Há um excesso de mortalidade ocorrendo durante a pandemia de COVID-19. Este excesso é resultado não apenas da COVID-19 em si, mas da resposta social e da gestão do sistema de saúde em responder a uma miríade de causas que já possuíam um ritmo de tendência anterior a ela.

Palavras-chave: Excesso de mortalidade. Causa de morte. COVID-19. Brasil.

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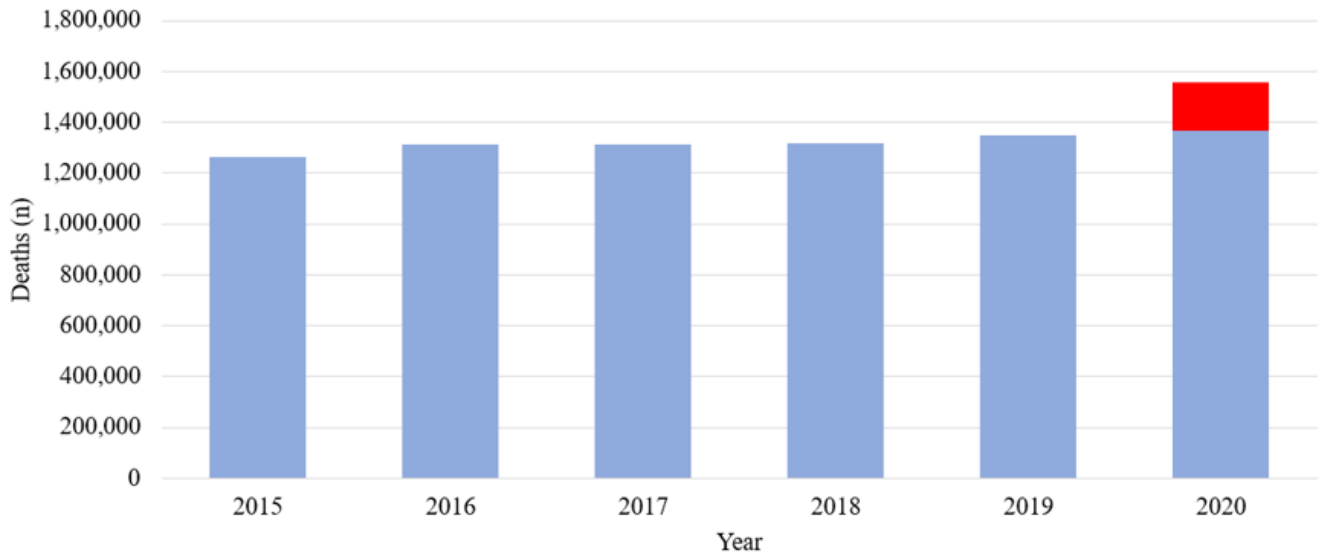
Appendix 1. Number of deaths per year. Brazil, 2015–2020.



Source: Brazilian Mortality Information System, 2022