Explosion in mortality in the Amazonian epicenter of the COVID-19 epidemic

Explosão da mortalidade no epicentro amazônico da epidemia de COVID-19

Explosión de la mortalidad en el epicentro amazónico de la epidemia de COVID-19

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Abstract

Manaus, the capital of the Brazilian State of Amazonas, is the current epicenter of the COVID-19 epidemic in Amazonia. The sharp increase in deaths is a huge concern for health system administrators and society. The study aimed to analyze excess overall mortality according to Epidemiological Week (EW) in order to identify changes potentially associated with the epidemic in Manaus. Overall and cause-specific mortality data were obtained from the Central Database of the National Civil Registry and the Mortality Information System for 2018, 2019, and 2020. The study analyzed age bracket, sex, place of death, EW, calendar year, and causes of death. Ratios were calculated between deaths in 2019/2018 and 2020/2019 to estimate excess deaths, with 5% confidence intervals. No significant excess overall mortality was seen in the ratios for 2019/2018, independently of EW. Meanwhile, the ratios for 2020/2019 increased from 1.0 (95%CI: 0.9-1.3) in EW 12 to 4.6 (95%CI: 3.9-5.3) in EW 17. Excess overall mortality was observed with increasing age, especially in individuals 60 years or older, who accounted for 69.1% (95%CI: 66.8-71.4) of the deaths. The ratios for 2020/2019 for deaths at home or on public byways were 1.1 (95%CI: 0.7-1.8) in EW 12 and 7.8 (95%CI: 5.4-11.2) in EW 17. The explosion in overall mortality in Manaus and the high proportion of deaths at home or on public byways reveals the epidemic's severity in contexts of heavy social inequality and weak effectiveness of government policies, especially policies meant to deal with social inequalities and strengthen the Unified Health System.

COVID-19; Vulnerable Populations; Public Health Surveillance; Mortality

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Introduction

As of May 20, 2020, two months after the World Health Organization (WHO) declared COVID-19 a pandemic, some five million cases and approximately 320,000 deaths had been reported in 216 countries/areas/territories. Even with strong evidence of underestimation of its official statistics [1], Brazil is now the third most heavily affected country, with 280,000 cases and 18,000 deaths (World Health Organization. WHO coronavirus disease (COVID-19) dashboard. https://covid19.who.int/, accessed on 20/May/2020).

Distribution of COVID-19 mortality reflects Brazil's social and geographic heterogeneity, with five states accounting for 81% of the deaths: São Paulo, Rio de Janeiro, Ceará, Pernambuco, and Amazonas, the latter having the highest proportion of infected individuals, with 10.6% (95%CI: 8.8-12.1) [2].

The State of Amazonas is located in the Brazilian Amazonia, a region occupying approximately 60% of Brazil's territory and whose population has been exposed historically to poverty and social inequality [3]. A study on the Greater Metropolitan Area of Manaus identified extensive inequality in access to health services [4]. This is a common reality for populations living in remote areas and on indigenous lands [5], whose social and economic vulnerability limits their mobility in the territory, making them more susceptible to the dramatic spread of COVID-19, especially in the more serious forms of the disease.

For more than four weeks, Manaus has shown signs of exhaustion of the public hospital network due to the rapid increase in COVID-19 cases. In the first two weeks of May alone, there were nearly 7,000 new cases, double the number identified until then. In addition, from April 19 to 28, the average daily number of burials in Manaus was 123, four times more than the daily average in the same period in 2019 [6]. The average daily number of COVID-19 deaths confirmed by health services during the same period was only 14, suggesting extensive underreporting, a problem seen elsewhere in the world, especially in places with precarious testing and deficient health services [7,8].

Despite uncertainties on COVID-19-specific mortality [9], indicators of excess deaths are one of the most objective and comparable parameters to assess the epidemic's impact on mortality [10]. This study thus aimed to analyze excess overall mortality according to Epidemiological Week (EW) in order to identify changes in the risk of death potentially associated with the epidemic.

Methods

Study design and data sources

This was a cross-sectional study with mortality data from the Central Database of the National Civil Registry (National CRC. https://sistema.registrocivil.org.br) and the Mortality Information System (SIM. http://www2.datasus.gov.br).

Due to the pandemic scenario, the National CRC assembled a COVID-19 Registration Panel (Portal da Transparência. https://transparencia.registrocivil.org.br/registral-COVID, accessed on 10/May/2020), aimed at furnishing data on causes of death from Death Certificates recorded at notary public offices, which represents the totality of natural deaths, treated here as a proxy for general mortality. The data are updated daily and comply with legal guidelines and deadlines. The time between recording of the death and its transfer to the COVID-19 Registration Panel is 14 days or less, after which the data become public.

Working definitions

According to the National CRC criteria, a suspected or confirmed death from COVID-19 is one in which the death certificate mentions the terms COVID-19, coronavirus, or novel coronavirus in sections I (lines a, b, c, d) or II (other preexisting disease conditions not directly related to the death and not recorded in the causal sequence listed in part I). Besides COVID-19, other possible causes were considered based on the National CRC: severe acute respiratory syndrome (SARS); pneumonia; septicemia; and respiratory failure. Deaths not classified in any of the above-mentioned conditions

were included in the category "other causes". Finally, "indeterminate" deaths (causes of deaths related to respiratory causes, but inconclusive) accounted for fewer than 1% of the sample and were not presented separately.

The National CRC data were updated on May 19, 2020, 66 days after the start of EW 12 and 24 days after the last day of EW 17. The start of EW 12 corresponds to the two days after confirmation of the first case of COVID-19 and to the 15 days prior to the first death from COVID-19 in Manaus.

For purposes of comparison, we also used data on overall mortality from the SIM, furnished for the EW in question in 2018 in the city of Manaus.

Study variables

The study variables were age bracket, sex, death at home or on public byways, EW, calendar year, and causes of death. Deaths from SARS, pneumonia (PNM), and respiratory failure (RF) were aggregated in a variable called "SARS+PNM+RF", which excludes the group of deaths suspected or confirmed by COVID-19 and according to the criteria of the National CRC.

Data analysis

We calculated the ratios between deaths in 2019 and 2018 (2019/2018) and in 2020 and 2019 (2020/2019), in EW 12 to 17 in Manaus. We also calculated the ratios between deaths in 2020/2019 in EW 14 to 17, stratified by sex, age bracket, and cause of death. For the mortality ratios, we calculated confidence intervals with 5% significance. The analyses were performed in the R program, version 3.6.1 (http://www.r-project.org).

Results

In 2018, according to the SIM, the mean weekly number of deaths in Manaus was 230, close to the weekly number observed in the first 70 days of 2019 and 2020 according to data from the National CRC, or 225 and 218 deaths, respectively.

As shown in Figure 1, the overall mortality ratio for 2019/2018 is very close to one, independently of EW, while the ratio 2020/2019 only showed a similar pattern (close to one) from EW 12 to 14, with a major increase in the subsequent weeks. In other words, the ratio increased from 1.0 (95%CI: 0.9-1.3) in EW 12 to 4.6 (95%CI: 3.9-5.3) in EW 17.

The overall mortality ratios for 2020/2019 according to age bracket were not statistically significant in males under 40 years of age or females under 30 years of age, revealing the excess mortality from those age brackets upwards in 2020, especially in males (Table 1).

When comparing the 2020/2019 mortality ratio according to groups of causes of death, the data showed a gradual increase over the weeks, especially starting in EW 15, for deaths from "SARS+PNM+RF" (Figure 2). In the group of "other causes", the mortality ratio remained close to one until EW 14, when it increased, reaching a ratio of 3 by EW 17.

As for the distribution of deaths across age brackets, 69.1% of the deaths occurred in individuals 60 years or older (95%CI: 66.8-71.4). The ratio of deaths occurring at home or on public byways (43/38) in EW 12 was 1.1 (95%CI: 0.7-1.8). This same ratio (268/33) reached 8.1 (95%CI: 5.7-11.7) in EW 17 (data not shown).

Figure 1

Overall mortality ratios for the years 2019/2018 and 2020/2019 by Epidemiological Week (EW). Manaus, Amazonas State, Brazil.
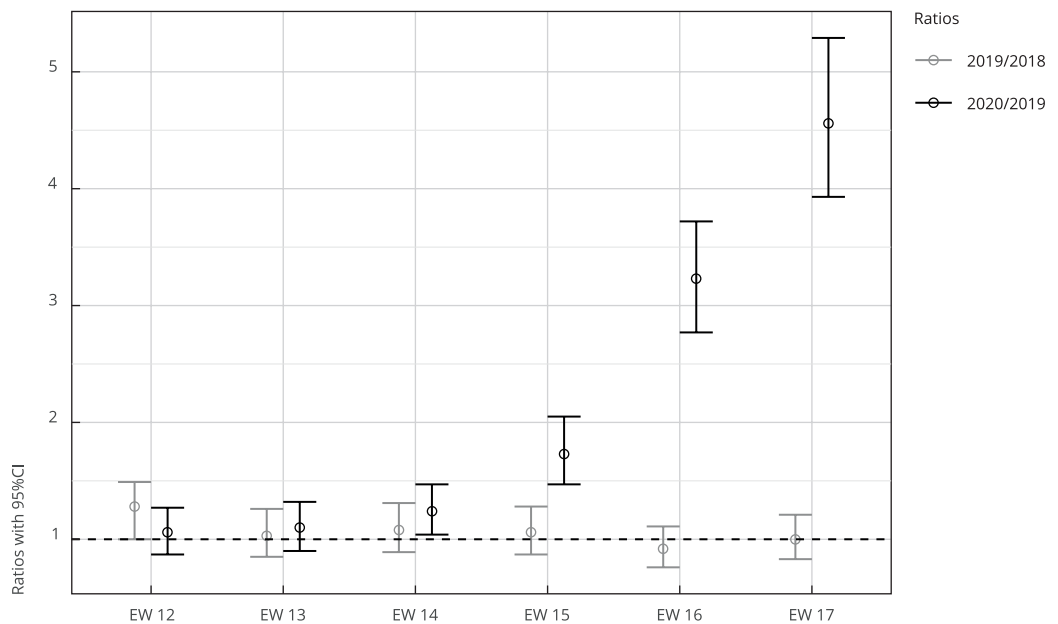
Sources: Civil Registry National Database (National CRC. https://sistema.registrocivil.org.br) and Mortality Information System (SIM. http://www2.datasus.gov.br).

Table 1

Overall mortality and respective ratios and confidence intervals for Epidemiological Weeks (EW) 14 to 17, according to age bracket and sex. Manaus, Amazonas State, Brazil.

Sex/Age bracket (years)	2020 (n)	2019 (n)	Ratio	95%CI
Male				
0-9	51	61	0.84	0.58-1.21
10-19	9	6	1.50	0.53-4.21
20-29	35	27	1.30	0.78-2.14
30-39	54	37	1.46	0.96-2.22
40-49	110	38	2.89	2.00-4.19
50-59	195	42	4.64	3.33-6.48
60-69	315	87	3.62	2.86-4.59
70-79	332	91	3.65	2.89-4.60
80 and over	317	89	3.56	2.82-4.50
All	1,418	478	2.97	2.67-3.29

(continues)

Table 1 (continued)

Sex/Age bracket (years)	2020 (n)	2019 (n)	Ratio	95%CI
Female				
0-9	48	48	1.00	0.67-1.49
10-19	3	8	0.38	0.10-1.41
20-29	15	11	1.36	0.63-2.97
30-39	30	12	2.50	1.28-4.89
40-49	65	28	2.32	1.50-3.62
50-59	94	38	2.47	1.69-3.61
60-69	175	47	3.72	2.70-5.14
70-79	185	79	2.34	1.80-3.05
80 and over	263	108	2.44	1.95-3.04
All	878	379	2.32	2.05-2.61
Both sexes				
0-9	99	109	0.91	0.69-1.19
10-19	12	14	0.86	0.40-1.85
20-29	50	38	1.32	0.86-2.01
30-39	84	49	1.71	1.21-2.43
40-49	175	66	2.65	1.99-3.50
50-59	289	80	3.61	2.82-4.63
60-69	490	134	3.66	3.02-4.43
70-79	517	170	3.04	2.56-3.62
80 and over	580	197	2.94	2.50-3.46
All	2,296	857	2.68	2.48-2.90

Source: Civil Registry National Database (National CRC. https://sistema.registrocivil.org.br) .

Figure 2

Mortality ratios by specific groups of causes for the years 2020/2019 by Epidemiological Week (EW). Manaus, Amazonas State, Brazil.
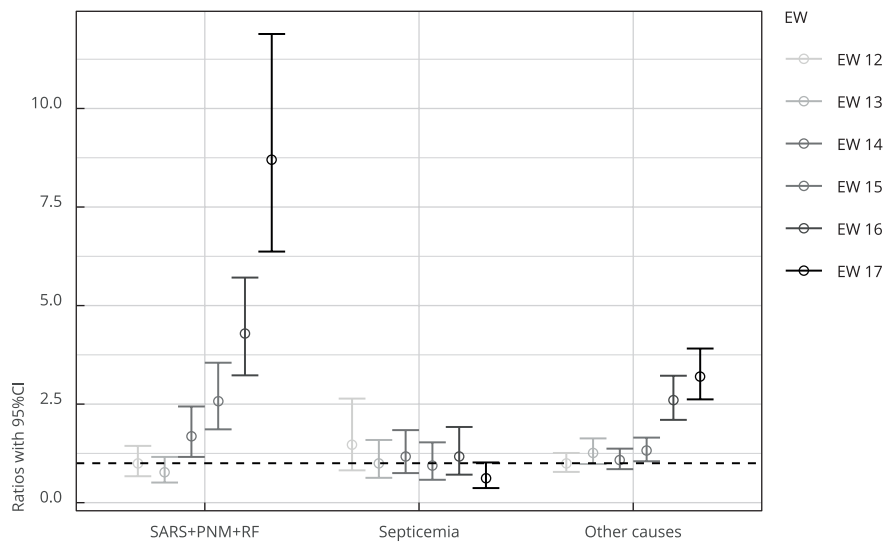
SARS+PNM+RF: severe acute respiratory syndrome + pneumonia + respiratory failure.

Sources: Civil Registry National Database (National CRC. https://sistema.registrocivil.org.br) and Mortality Information System (SIM. http://www2.datasus.gov.br).

Discussion

According to the results, total deaths reported in 2019 were similar to 2018, comparing EW 12 through 17 in those two years. However, the comparison between total deaths in 2020 and 2019 revealed excess mortality starting in the 15th EW of 2020, with the ratio exploding in EW 17, when the number of deaths was 200% higher than in 2019.

The increase in deaths started in EW 15, approximately 15 days after confirmation of the first 30 cases of COVID-19 in Manaus. In EW 17, the anomalous number of deaths coincided with the collapse in the public hospital system. During this period, the mean number of burials per day tripled. Deaths at home or on public byways also increased, as did COVID-19 cases in neighboring municipalities. This set of events probably resulted from a major acceleration in the epidemic in Manaus [11] in the previous weeks.

The fragility of the healthcare network in Manaus and in neighboring municipalities [4], combined with extensive social inequality [3], help explain the critical situation with the COVID-19 epidemic. Excess mortality in the pandemic is not limited to low- and middle-income countries, but has also appeared in New York City, United States, and in the provinces of Bergamo and Brescia in northern Italy [9,12,13].

In relation to age, nearly 70% of the deaths occurred in persons 60 years or older, consistent with studies in other countries [9,12,13,14]. In this age bracket, comorbidities are more prevalent and have been associated with worse prognosis in cases of hospitalization for COVID-19 [15].

Another key aspect involves gender differences, with a higher risk of mortality among men, corroborating findings from other studies [16,17]. Lower case-fatality may be associated with women's heightened perception of the symptoms and search for health services, whereas men would only tend to turn to health services in the more serious stages of COVID-19, when therapeutic possibilities are more limited. However, Zeng et al. [18] argued that higher IgG antibody levels in women could partially explain the relatively higher case-fatality in men.

There was an explosive increase in mortality from respiratory problems (SARS+PNM+RF), common complications of COVID-19 [14], during the COVID-19 pandemic. There was also a significant increase in mortality from other causes, possibly resulting from factors such as: the patient's postponement of treatment in order to avoid exposure to the virus in hospitals, health services' prioritization of care for COVID-19 patients [19].

One strength of this study was the use of the overall mortality indicator to estimate excess deaths, which appears to be a useful resource for rapid and low-cost evaluations, besides serving as a more robust and comparable indicator in a pandemic scenario [10]. Unlike COVID-19-specific mortality, overall mortality does not depend on testing strategies, health systems' organization and financing, demographic structure, or the choice of denominator, which can make the case-fatality estimates vary widely [9]. However, the interpretation of this study's results should take some limitations into account, such as the lack of standardization or review of the causes of death on the death certificates and a possible under-recording of deaths on the digital platform of the National CRC, especially in 2019, which could overestimate the ratios between total deaths in 2020 and 2019, for example. However, judging by the comparisons between total deaths in 2019 and 2018, where the ratios were always close to one, this distortion may possibly be small.

The analytical strategy adopted in this study unequivocally reveals the high excess mortality in Manaus and the epidemic's severity in contexts of great social inequality, weak effectiveness of public policies, and fragility in health services. Efforts must be stepped up by administrators at the municipal, state, and federal levels to contain or mitigate the harmful effects of COVID-19, especially in more vulnerable areas where the pandemic tends to have a heavier impact on mortality.

Contributors

J. D. Y. Orellana, G. M. Cunha and I. C. Leite participated in the study's conception, interpretation, and final drafting of the manuscript. L. Marrero and B. L. Horta participated in the interpretation and final drafting of the manuscript.

Additional informations

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Resumo

Manaus, capital do estado brasileiro do Amazonas, é o atual epicentro da epidemia na Amazônia com um aumento repentino de mortes que preocupa gestores e sociedade. O objetivo do estudo foi analisar o excesso na mortalidade geral, segundo Semanas Epidemiológicas (SE), visando a identificar mudanças potencialmente associadas à epidemia em Manaus. Dados de mortalidade geral e grupos de causas foram obtidos na Central de Informações do Registro Civil Nacional e no Sistema de Informações sobre Mortalidade, para 2018, 2019 e 2020. Analisou-se faixa etária, sexo, local de ocorrência do óbito, SE, ano-calendário e causas de morte. Calcularam-se razões entre as mortes ocorridas em 2019/2018 e 2020/2019 para avaliar o excesso de mortes, com intervalos de confiança no nível de 5%. Não observou-se excesso de mortalidade geral significativo nas razões 2019/2018, independentemente da SE. Já as razões de 2020/2019 passaram de 1,0 (IC95%: 0,9-1,3) na SE 12 para 4,6 (IC95%: 3,9-5,3) na SE 17. Observou-se excesso de mortalidade geral com a progressão da idade, especialmente em indivíduos com 60 anos e mais, os quais concentraram 69,1% (IC95%: 66,8-71,4) das mortes. A razão 2020/2019 para óbitos em domicílio/via pública foi de 1,1 (IC95%: 0,7-1,8) na SE 12 e de 7,8 (IC95%: 5,4-11,2) na SE 17. A explosão da mortalidade geral em Manaus e a elevada proporção de óbitos em domicílio/via pública expõe a gravidade da epidemia em contextos de grande desigualdade social e fraca efetividade de ações governamentais, em especial aquelas voltadas ao enfrentamento das desigualdades sociais e para a garantia e fortalecimento do Sistema Único de Saúde.

COVID-19; Populações Vulneráveis; Vigilância em Saúde Pública; Mortalidade

Resumen

Manaus, capital del estado brasileño del Amazonas, es el actual epicentro de la epidemia en Amazonia y el aumento repentino de muertes preocupa a gestores y a la sociedad. El objetivo del estudio fue analizar el exceso en la mortalidad general, según Semanas Epidemiológicas (SE), con el objetivo de identificar cambios potencialmente asociados a la epidemia en Manaus. Los datos de mortalidad general y grupos de causas se obtuvieron en la Central de Información del Registro Civil Nacional y en el Sistema de Información sobre Mortalidad, referentes a 2018, 2019 y 2020. Se analizó franja de edad, sexo, lugar donde se produjo el fallecimiento, SE, año-calendario y causas de muerte. Se calcularon las causas entre las muertes acaecidas en 2019/2018 y 2020/2019 para evaluar el exceso de muertes, con intervalos de confianza en el nivel de 5%. No se observó un exceso de mortalidad general significativo en las causas 2019/2018, independientemente de la SE. Ya las causas de 2020/2019 pasaron de 1,0 (IC95%: 0,9-1,3) en la SE 12 a 4,6 (IC95%: 3,9-5,3) en la SE 17. Se observó un exceso de mortalidad general con la progresión de la edad, especialmente en individuos con 60 años y más, quienes concentraron un 69,1% (IC95%: 66,8-71,4) de las muertes. La razón 2020/2019 para óbitos en domicilio/vía pública fue de 1,1 (IC95%: 0,7-1,8) en la SE 12 y de 7,8 (IC95%: 5,4-11,2) en la SE 17. La explosión de la mortalidad general en Manaus y la elevada proporción de óbitos en domicilio/vía pública expone la gravedad de la epidemia en contextos de gran desigualdad social y débil efectividad de las acciones gubernamentales, en especial aquellas dirigidas al combate de las desigualdades sociales y para la garantía y fortalecimiento del Sistema Único de Salud.

COVID-19; Poblaciones Vulnerables; Vigilancia en Salud Pública; Mortalidad