

Original Article

Social characterization of COVID-19 in the state of Amazonas, Brazil

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Abstract: Objectives: To compare the number of deaths that occurred in the state of Amazonas and in Brazil, from March 16th to August 20th 2020, using the variables skin color, sex, place of death, age group and association with COVID-19, and secondly, to verify whether between 2019 and 2020, in the period from March 16th to August 20th, there was a significant change in the number of deaths from diseases not associated with COVID-19. Methods: We searched the databases of the Brazilian public agency “Transparency Portal” for the data on deaths that occurred in the state of Amazonas and Brazil in the period from March 16th to August 20th, 2019 and 2020. The absolute frequencies and percentages of the variables studied were used for statistical analysis. Results: COVID-19 was responsible for an 11.01% increase in deaths in Brazil; however, this rate quadrupled in the state of Amazonas. In relation to age group, there was a similar percentage between Amazonas and the national average. The stratified analysis showed significant differences between genders and races, with higher death rates in men and people of brown/black skin. The number of deaths at home increased significantly, especially those from causes not associated with COVID-19. Conclusions: The national drop in deaths from diseases not associated with COVID between March and August 2020 in Brazil is misleading and may be due to the result of misreported causes of death.

Keywords: Coronavirus, causa mortis, vulnerable populations, respiratory diseases, SARS-COV-2

Introduction

Caused by a β -coronavirus called SARS-CoV-2, COVID-19 is a disease that can evolve into a severe acute respiratory syndrome, and in 2020 it caused a generalized global morbidity and mortality [1]. Initially zoonotic, the new coronavirus mutated and began to be transmitted between humans by contact and through aerosols, which allowed SARS-COV-2 to reach pandemic proportions [2].

The first case of COVID in Brazil was recorded on February 26th, 2020, and, on March 12th, the first death was recorded, both of which occurred in São Paulo. Within seven months, the disease had spread to all regions of the country. Even with a long lockdown period,

which started on different dates in each municipality, and lasted for up to 80 days in some cities [3], between the 1st and the 31st of July, Brazil registered 31,669 deaths and in this period it was considered the country with the highest number of deaths in the world (European Centre for Disease Prevention and Control-ECDC). In addition, as of July, the new daily cases of COVID remained on a plateau that ranged between 20 and 70 thousand infections, though this has been slowly declining. On September 27th, the number of registered cases in Brazil was 4,689,613 and the number of related deaths was 140,537 (World Health Organization-WHO).

On March 13th, 2020, the first case of COVID-19 was reported in the state of Amazonas and on

March 23rd, the state government decreed a public health emergency and recommended social distancing (Amazon State Government-AM). In July, there was a significant reduction in the number of new cases of COVID-19 in the capital; however, municipalities in the interior of Amazonas recorded a continuous rise in new cases since the beginning of the pandemic, with 21,619 new cases (Health Surveillance Foundation-HSF). As of November 2020, due to a sum of factors, including the state electoral period that took place normally, ignoring the context of the pandemic, the beginning of the school holidays, pressure from businessmen to return to normal economic activities, a false sense of safety due to the prediction of the start of vaccination in 2021, the emergence of a new variant of SARS-CoV-2 and, also, the disregard for the risks of COVID-19 by federal and state authorities, culminated in the explosion of cases and another collapse of the public health system in the state of Amazonas in January 2021. This collapse caused many deaths from lack of oxygen supply to patients admitted to all public hospitals in the state (HSF). The crisis was reinstated and the new peak of deaths forced the governor of Amazonas to apply a total lockdown for 10 days on January 23rd (AM).

The implications of the coronavirus pandemic is not yet understood and this is reflected in the different combat policies and epidemic curves among different countries [4]. Non-medical factors, including social, behavioral and environmental determinants of health, may play a greater role than medical factors in the epidemiology of COVID-19 in ways still not understood or currently ignored [5]. However, the impossibility of predicting which variables are significant requires more directive studies, which are focused on protecting populations at risk, such as those with comorbidities [4] and neglected populations [6, 7].

Several studies have attempted to predict the number of infections and the lethality rate of COVID in Brazil and also in Amazonas based on international data; however, the predictions were not accurate [8-12]. Furthermore, eleven months after the beginning of the pandemic in Brazil, we still do not have an accurate portrayal of the burden of social components, such as skin color, gender, place of death and age

group, on the number of deaths associated with COVID. Another gap is whether COVID deaths, which did not exist before 2020, changed the burden of these social components on the number of deaths not associated with COVID. Thus, the first aim of this study was to compare the total number of deaths (TD) and the number of deaths by COVID (COVIDD) that occurred in the state of Amazonas and in Brazil, in the period from March 16th to August 20th, 2020, using the variables skin color, sex, place of death, age group and association with COVID-19. Our second aim was to verify whether there was a significant change in the number of deaths from diseases not associated with COVID (DNC), in the period from March 16th to August 20th, 2019 and 2020, within the populations and variables analyzed (Tables S1, S2).

Methods

This is a retrospective cross-sectional study that analyzed, with an emphasis on COVID-19, all records of deaths in the public registry office between March 16th and August 20th of the years 2019 and 2020, both at the country (Brazil) and at the state level (Amazonas). Data on deaths recorded on the website “Transparency Portal” (TP) were organized in Excel spreadsheets and analyzed using IBM SPSS Statistics software, version 26. The results are presented in tables with the absolute and relative frequencies for the categorical variables. One-way ANOVA was used for the analysis of the variables and a 95% confidence interval was assumed (95% CI, P<0.05).

The data for the number of deaths due to skin color, gender, illness associated with death, place of death and deaths by age group were analyzed by comparing the national average with the numbers recorded for the state of Amazonas. The percentage of each sub-variable was calculated and used to compare these categories. The variable “skin color” included the following classifications: yellow (Y), white (W), unspecified (NS), indigenous (IN), brown (BR) and black (BL). The variable “gender” included the following classifications: male (M), female (F) and unspecified (NS). The variable “place of death” included the following classifications: public health service emergency ambulance (AMB), home (HM), hospital (HO), unspecified (NS), other (O), other health services

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Table 1. Total deaths (TD) and deaths due to COVID-19 according to skin color

Skin color	COVIDD* in Brazil N°/(%)	COVIDD in AM N°/(%)	TD** in Brazil N°/(%)	TD in AM N°/(%)
Yellow	1,313/(1.25)	2/(0.11)	5,421/(0.92)	9/(0.10)
White	47,964/(45.81)	307/(16.25)	272,132/(46.41)	1,295/(14.10)
Unspecified	10,584/(10.11)	25/(1.32)	93,829/(16.00)	326/(3.55)
Indigenous	330/(0.32)	62/(3.28)	1,170/(0.20)	164/(1.79)
Brown	36,490/(34.85)	1,455/(77.02)	175,285/(29.89)	7,195/(78.36)
Black	8,014/(7.65)	38/(2.01)	38,194/(6.51)	193/(2.10)
Total	104,695/(100)	1,889/(100)	586,031/(100)	9,182/(100)

*COVIDD-Deaths caused by COVID; **TD-Total deaths. This table presents the distribution of deaths due to COVID-19 and total deaths (TD) in relation to skin color in the period from March 16th to August 20th, 2020.

(OHS), basic health center (BHC), other ambulances (OAMB), public highway (PHW). The variable “age group” (AG) included decades from 10 years of age upwards: 10-19, 20-29, 30-39, 40-49, 50-59, 60-69, 70-79, 80-89, 90-99, as well as the age ranges <9 years, >100 years, and unspecified. The variable “disease associated with death” was divided into the sub-variables: COVID-19 (COVID), unspecified (NS), respiratory failure (RF), others (OD), pneumonia (PN), septicemia (SEP) and acute respiratory syndrome (ARS).

This study respected all ethical aspects in research and is exempt from evaluation by the Research Ethics Committee (CEP) and use of informed consent in accordance with the National Health Council Resolutions 510 of April 7th, 2016 and 466 of December 12th, 2016, since it is based on secondary data that is available in the public domain.

Results

In the period from March 16th to August 20th, 2020, there were 815,123 recorded deaths (RD) in Brazilian registry offices. Of these, 104,695 were associated with COVID-19. In the same period, 11,843 deaths were recorded in the state of Amazonas, of which 1,882 were associated with COVID-19. For the same period in 2019, there were 642,548 and 7,317 RD in Brazil and Amazonas, respectively.

In Brazil, both in relation to COVIDD and total deaths (sum of COVIDD and deaths from diseases not associated with COVID), the highest relative percentage by skin color corresponded to white individuals (respectively 45.81% and 46.41%). People with other skin colors accounted for 52.97% of COVIDD and 52.41%

of total deaths. In the state of Amazonas, this percentage changes, with 77.02% of COVIDD and 78.36% of the total deaths attributed to brown-skinned people. People with white skin accounted for only 16.25% of COVIDD records and 14.10% of total deaths (**Table 1**).

Regarding the gender (**Table 2**), for Brazil, it was observed that 57.94% of the COVIDD and 54.26% of the total deaths were male individuals. Female individuals represented 42.03% of COVIDD and 45.44% of total TD deaths, while individuals of unspecified gender represented 0.03% of COVIDD and 0.3% of total deaths. For the state of Amazonas, the male gender made up 65.67% of deaths from COVID and in 58.54% of total deaths, the female gender made up 34.33% of deaths from COVID and in 40.12% of the total deaths, the unspecified gender was observed in 1.34% of the total deaths, but was not observed in deaths by COVID.

In relation to the place of death, **Table 3** shows the relative percentage records for each place of death. The hospital has the highest registration percentage for COVIDD, with an average of 90.14% in Brazil and 93.78% in Amazonas. The hospital also has the highest percentage of records for the total number of deaths with 68.81% in Brazil and 73.48% in Amazonas. For the variable “total number of deaths”, there were also many records for the location “Home”, both in the national average (19.43%) and for the state of Amazonas (21.42%).

Table 4 shows the relative percentage of COVIDD and the total number of deaths for each age group in the specified period. The age group with the highest percentage of COVIDD in Brazil is between 70-79 years, with 25.31%,

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Table 2. Total deaths (TD) and deaths due to COVID-19 and gender

Gender	COVIDD* in Brazil N°/(%)	COVIDD in AM N°/(%)	TD** in Brazil N°/(%)	TD in AM N°/(%)
Male	60,657/(57.94)	1,236/(65.67)	442,313/(54.26)	6,933/(58.54)
Female	44,005/(42.03)	646/(34.33)	370,359/(45.44)	4,751/(40.12)
Unspecified	33/(0.03)	0/(0.00)	2,451/(0.30)	159/(1.34)
Total	104,695/(100)	1,882/(100)	815,123/(100)	11,843/(100)

*COVIDD-Deaths caused by COVID; **TD-Total Deaths. This table presents the distribution of deaths by COVID-19 and total deaths (TD) by gender in the period from March 16th to August 20th, 2020.

Table 3. Total deaths (TD) and deaths due to COVID-19 according to location

Place of death	COVIDD* in Brazil N°/(%)	COVIDD in AM N°/(%)	TD** in Brazil N°/(%)	TD in AM N°/(%)
Ambulance***	8/(0.01)	1/(0.05)	81/(0.00)	3/(0.03)
Home	2,662/(2.54)	87/(4.62)	158,373/(19.43)	2,537/(21.42)
Hospital	94,372/(90.14)	1,765/(93.78)	569,078/(69.81)	8,702/(73.48)
Unspecified	1,476/(1.41)	0/(0.00)	15,597/(1.91)	160/(1.35)
Others	787/(0.75)	14/(0.74)	16,876/(2.07)	167/(1.41)
Other health services	5,232/(5.00)	12/(0.64)	45,024/(5.52)	139/(1.17)
Basic health center	44/(0.04)	1/(0.05)	423/(0.05)	2/(0.02)
OAMB****	1/(0.00)	0/(0.00)	12/(0.00)	0/(0.00)
Public highway	113/(0.11)	2/(0.11)	9,659/(1.18)	133/(1.12)
Total	104,695/(100)	1,882/(100)	815,123/(100)	11,843/(100)

*COVIDD-Deaths caused by COVID; **TD-Total Deaths; ***Public health service emergency ambulances; ****OAMB-Other ambulances. This table presents the distribution of deaths by COVID-19 and total deaths according to location in the period from March 16th to August 20th, 2020.

Table 4. Total deaths (TD) and deaths due to COVID-19 according to age group

Age group	COVIDD* in Brazil N°/(%)	COVIDD in AM N°/(%)	TD** in Brazil N°/(%)	TD in AM N°/(%)
<9	440/(0.42)	11/(0.58)	24,559/(3.01)	780/(6.59)
10-19	245/(0.23)	10/(0.53)	5,234/(0.64)	132/(1.11)
20-29	1,042/(1.00)	29/(1.54)	14,812/(1.82)	372/(3.14)
30-39	3,286/(3.14)	52/(2.76)	25,880/(3.17)	497/(4.20)
40-49	6,930/(6.62)	146/(7.76)	49,127/(6.03)	848/(7.16)
50-59	13,417/(12.82)	244/(12.96)	93,002/(11.41)	1,413/(11.93)
60-69	23,175/(22.14)	512/(27.21)	151,457/(18.58)	2,275/(19.21)
70-79	26,501/(25.32)	464/(24.65)	179,653/(22.04)	2,46/(20.77)
80-89	21,620/(20.65)	305/(16.21)	173,499/(21.29)	2,018/(17.04)
90-99	7,361/(7.03)	103/(5.47)	79,614/(9.77)	795/(6.71)
>100	434/(0.41)	5/(0.27)	7,197/(0.88)	87/(0.73)
N/I***	244/(0.23)	1/(0.05)	11,089/(1.36)	166/(1.40)
Total	104,695/(100)	1,882/(100)	815,123/(100)	11,843/(100)

*COVIDD-Deaths caused by COVID; **TD-Total Deaths; ***N/I-Not identified. This table presents the distribution of deaths by COVID-19 and total deaths (TD) according to age group from March 16th to August 20th, 2020.

followed by the 60-69 and 80-89 years, which account for 22.14% and 20.65%, respectively. In Amazonas, the highest percentage of COVIDD occurs in the 60-69 age group (27.21%), followed by the 70-79 and 80-89 age groups, with 24.65% and 16.21%, respectively. The age

group with the highest percentage of records for total deaths is between 70-79 years old, both in the general average of Brazil (22.04%) and in the specific records for Amazonas (20.77%). In second place, in Brazil, the age group is between 80-89 years old with 21.29%.

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Table 5. Recorded deaths and diseases associated with the death

Disease	Deaths in Brazil March to August			Deaths in AM March to August		
	2019 Nr/(%)	2020 Nr/(%)	Variation between years %	2019 Nr/(%)	2020 Nr/(%)	Variation between years %
COVID-19	0/(0)	104,951/(12.84)	100	0/(0)	1,882/(15.89)	100
Unspecified	4,377/(0.60)	5,779/(0.71)	32.02	84/(1.02)	114/(0.96)	35.87
Respiratory failure	62,985/(8.58)	61,821/(7.58)	-1.85	409/(4.96)	635/(5.36)	55.37
Others	413,502/(56.31)	417,619/(51.23)	1.0	5,222/(63.35)	5,662/(47.81)	8.42
Pneumonia	142,386/(19.39)	115,227/(14.14)	-19.07	1,340/(16.26)	1,703/(14.38)	27.10
Septicemia	110,086/(14.99)	98,157/(12.04)	-10.84	1,166/(14.15)	1,194/(10.08)	2.37
Acute respiratory syndrome	940/(0.13)	11,825/(1.45)	1,157.88	22/(0.27)	653/(5.51)	2,921.62
Total	734,276/(100)	815,123/(100)	11.01	8,243/(100)	11,843/(100)	43.68

This table presents the comparison of the distribution of deaths from disease associated or not with COVID in the period from March 16th to August 20th-for the years 2019 and 2020.

In Amazonas, the second percentage position is for the age group between 60-69, with 19.21%.

The number of deaths observed in Brazil between January and August 2020 was 11.01% higher than the same period in 2019. In Amazonas, this increase was four times greater, 43.68% (**Table 5**). Composing the percentage increase in the national average, we have a significant increase in the record of deaths from undetermined causes (32.01%), a super-expressive increase in the record of deaths from acute respiratory syndrome (1157.88%) and a slight increase in the registration of deaths from other diseases (0.1%). On the other hand, there was a reduction in the number of deaths due to respiratory failure (-1.85%), septicemia (-10.84%) and pneumonia (-19.07%).

However, composing the percentage increase in the number of deaths in Amazonas, we had increased deaths from all the following: respiratory failure (55.37%), unspecified (35.9%), pneumonia (27.1%), septicemia (2.37%), and others (8.42%). The explosion in records of deaths from acute respiratory syndrome also occurred in Amazonas, but with an intensity three times greater than the national average (2,921.61%). Up until the month of August 2020, the registration of deaths from COVID (COVIDD) corresponds to 12.84% of the total deaths in Brazil and 15.89% in the Amazonas (TP).

Discussion

In Brazil, there was an increase of 11.01% in the total number of deaths in the period from

March to August 2020 (815,123) when compared to the same period in 2019 (734,276). In Amazonas, there was also a 43.68% increase in the number of deaths (2019-8,243 vs 2020-11,843), which is a much higher rate than the national average (TP). The reason for this excessive and sudden increase in the number of deaths (+80,847) obviously cannot be explained by the 0.76% population increase alone (IBGE), and is most likely the result of the COVID-19 pandemic [13].

In relation to skin color (**Table 1**), the higher percentage of deaths recorded for white-skinned people (45.81%) in relation to deaths of brown-skinned people (34.85%) disagrees with the color distribution of the Brazilian population, in which brown-skinned people make up 46.5% and white skinned people make up 43.1% of the population (Brazilian Institute of Geography and Statistics-IBGE). On the other hand, the percentage of registered deaths of black-skinned people, yellow-skinned people and indigenous people are directly correlated with the population distribution, respectively 9.3%, 0.8% and 0.3%. In Amazonas, the percentage of deaths registered by brown-skinned people (77.02%), white-skinned people (16.25%), black-skinned people (2.011%), yellow-skinned people and indigenous (3.38%) are also directly correlated with the population distribution. This is not surprising, since brown-skinned people represent 77.4% of the population, white-skinned people represent 16.8%, black-skinned people represent 3%, and yellow-skinned people and indigenous combined represent 2.8% (IBGE). The difference between the national death registration rate and

the population distribution by color can be explained, for example, by the difference between the skin color present on the birth certificate and the self-declarations made in the National Survey of Household Samples (PNAD). Another factor that may be associated is the different unemployment rates between white-skinned people (9.5%) and black or brown-skinned people (14.1%), which would expose a percentage of 4.6% more white-skinned people to the break in social isolation. However, this factor does not apply to Amazonas, although the unemployment rate is also higher among people with black and brown skin (19.1%) than among people with white skin (11.2%).

Although the male population (48.89%) in Brazil is slightly smaller than the female population (IBGE) in relation to gender (**Table 2**), there was a greater record of male deaths (54.26%). It is possible that this data is correlated with two factors: (1) the greater number of employed men (IBGE), which predisposes them to more breaks in social isolation and consequently optimizes the risks of contagion and (2) the male population's historical neglect in regards to health care [14]. As men represent 50.2% of the population of Amazonas, surpassing the national average, there was also an increase in the difference between genders in the number of deaths in the state, therefore in 2020, while the national difference in the registration of deaths of men and women is 8.83%, in Amazonas it is 18.42%.

Regarding the location of deaths (**Table 3**), both in Brazil and in Amazonas, the place where there was the highest number of deaths was recorded was the "hospital", followed by deaths recorded at home. These data suggest that, on average, 70% of the population had access to the health system during the pandemic; a percentage that is far from ideal, since Brazil has been a signatory of Alma-Ata since 1978, by which it assumed the commitment to provide basic health care assistance for its entire population [15]. However, it is not possible to confirm that 20% of deaths occurred at home due to lack of access to health systems. It is important to consider that one of the premises used to combat COVID-19 was social isolation, which may have led a large number of people to abstain from seeking medical assistance, even in severe cases [16].

Regarding the age groups present in the death records (**Table 4**), it was found that in 2020 68.81% of deaths in Brazil were concentrated in the age group of 60 and 90 years, while in Amazonas this range covers 73.47% of the deaths recorded. These data are explained by the greater non-fatal burden of diseases that this age group has, in other words, it is due to the amount of comorbidities that individuals of this age group live with. An adequate concept for analyzing the impact of new diseases on different age groups is the "Years of Life lost due to Disability" (YLD) [17]. This concept indicates an average length of time in years that each age group lives with comorbidities. Below the age of 70, the average length of time in which people live with severe comorbidities is much less than the average length of time seen in people over 70 years. Therefore, the longer you live with severe comorbidities, the greater the likelihood of death from COVID-19 [17].

Of the 815,123 recorded deaths in Brazil between March 16th and August 20th, 2020, 48.77% were due to respiratory diseases and 12.84% were specifically due to COVID-19 (**Table 5**). In the same period, in the state of Amazonas, there were 11,843 recorded deaths, with rates similar to the national average; 52.2% of deaths from respiratory diseases and 15.89% specifically from COVID-19 (TP). In both cases, the percentages of COVIDD represent approximately a quarter of all deaths from respiratory diseases in the period. These data suggest a homogeneous epidemiological distribution of the virus throughout Brazil, which was little affected by regional ethnic differences.

In isolation, the registration of deaths due to COVID (12.84%) in Brazil does not allow us to make inferences about underreporting rates or an increase in the global burden of diseases. However, when we relate the total number of deaths due to COVID (COVIDD) (104,695) in Brazil to the estimated mortality rates, such as those of the Imperial College (0.7%) [18] and Samy Dana (6.6%) [19], it is possible to observe that the respective projections of infections are 14,956,429 for Brazil and 1,586,289 for Amazonas. These values, as already explained, are mere projections, since the number of tests carried out in Brazil between March and August 2020 was very low, with 84,069 tests per 1 million inhabitants (WorldMeters). Based on this logistical problem, we can infer, initially,

that the explosion in records of deaths from acute respiratory syndrome in Brazil and Amazonas occurred mainly due to the absence of confirmation by COVID. However, it is not possible to ignore the increase in the global burden of other diseases during the pandemic and to rule out a possible increase in its lethality, especially respiratory co-infections, since globally the flu rates remained unexplained until March 2020 and then suddenly began to decrease [20].

It is worth noting that when we analyze the total number of deaths registered in Brazil in 2020, by subtracting the death from COVID, we have a reduction of 3.25% of the TD, that is, less deaths that are not associated with COVID than in 2019, despite the population growth of 0.76% between July 2019 and July 2020 (IBGE). This data may indicate two scenarios. Firstly, that there was a reduction in deaths not associated with COVID, due to social isolation and more efficient hygiene measures, and secondly, and most likely, that many deaths are being wrongly attributed to COVID. Amazonas showed an increase in the registration of deaths by all diseases and an overall increase of 43.68% in RD in 2020, subtracting COVID, the increase in TD is maintained, but at a lower rate, in this case of 20.85%. These data clearly demonstrate that worse socioeconomic indicators are associated with increased mortality from diseases (IBGE).

Conclusion

It is apparent that COVID-19 was responsible for the increase of at least 12% of the total deaths in Brazil, and 15% of the total deaths in Amazonas in 2020. In Brazil, for the skin color and gender variables, there are differences in the percentages of deaths by COVID-19. These differences are likely to be due to inequalities in access to formal employment, especially in Amazonas, where this difference is even more pronounced. The high percentage of total deaths registered at home is a reflection of the fear of contracting COVID in health facilities. Regarding the age group, both the total number of deaths and COVID was higher among people aged 60 or over. These averages were similar for Brazil and the state of Amazonas. Finally, the drop in the number of deaths from diseases not associated with COVID may be due to errors in records, both due to the delay in diagnosis

and the lack of discernment of the following clinical outcomes: “deaths with COVID” and “deaths by COVID”. This study does not have enough data to make inferences about the biological aspects that are involved in the different mortality rates between ethnicities and genders, and neither is there specific data on the misreported causes of death attributed to COVID. However, it can be noted that there were serious errors in the registration of deaths during the pandemic. As such, this study opens the way for further studies by identifying gaps in knowledge regarding the different mortality rates caused by COVID.

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Disclosure of conflict of interest

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