Risk of death among patients hospitalized with covid-19 in mato grosso during the first year of the

Risco de morte entre pacientes internados com covid-19 em mato grosso durante o primeiro ano da pandemia, brasil

Riesgo de muerte entre pacientes hospitalizados con covid-19 en mato grosso durante el primer año de la pandemia, brasil

RESUMO

Objetivo: Analisar os fatores associados à mortalidade hospitalar por COVID-19 em Mato Grosso em 2020. Métodos: Foram considerados os registros de internação de março a dezembro de 2020, de pacientes com COVID-19 com 19 anos ou mais residentes no estado. Os dados foram obtidos do sistema do governo estadual e as razões de risco foram estimadas por modelo de regressão de Poisson. Resultados: Dos 17.523 registros de internação por COVID-19, 4.147 foram a óbito (23,7%), sendo maior risco de óbito entre os pacientes com 40 anos ou mais, pardo, indígena, com alguma comorbidade, que estiveram internados em UTI, que não residem na macrorregião central, e que foram internados nos meses de junho e julho, aqueles com maior concentração de internações por COVID-19. Conclusão: Além dos fatores individuais, a organização e o preparo da rede assistencial para atender os casos graves da doença estiveram associados ao risco de óbito por COVID-19.

DESCRITORES: COVID-19, Mortalidade hospitalar, Morte, Atençãoz à Saúde.

ABSTRACT

Objective: To analyze the factors associated with hospital mortality due to COVID-19 in Mato Grosso in 2020. Methods: We considered the hospitalization records from March to December 2020, from patients with COVID-19 aged 19 years or older residing in Mato Grosso. Data were obtained from the state government's system and Hazard Ratios were estimated using the Poisson regression model. Results: Of the 17,523 hospitalization records of COVID-19, 4,147 died (23.7%), with higher risk of death among patients aged 40 years or older, black-brown, indigenous, some comorbidity, who were admitted to the ICU bed, who did not reside in the central macro-region of the state, and who were hospitalized in June and July, those with the highest concentration of hospitalizations for COVID-19. Conclusion: Besides the individual factors, organization and preparation of the care network to attend to severe cases of the disease were associated with risk of death by COVID-19.

DESCRIPTORS: COVID-19, In-hospital mortality, Death, Health Care.

RESUMEN

Objetivo: Analizar los factores asociados a la mortalidad hospitalaria por COVID-19 en Mato Grosso en 2020. Métodos: Se consideraron los registros de hospitalización de marzo a diciembre de 2020, de pacientes con COVID-19 con edad igual o superior a 19 años. Los datos se obtuvieron del sistema del gobierno estatal y las razones de riesgo se estimaron utilizando el modelo de regresión de Poisson. Resultados: De los 17.523 registros de hospitalización por COVID-19, fallecieron 4.147 (23,7%), mayor riesgo de muerte entre pacientes de 40 años o más, negros-marrones, indígenas, alguna comorbilidad, que ingresaron en UCI, que no residir en la macrorregión central, y que fueron hospitalizados en junio y julio, los de mayor concentración de hospitalizaciones por COVID-19. Conclusión: Además de los factores individuales, la organización y preparación de la red de atención para atender los casos graves de la enfermedad se asociaron con el riesgo de muerte por COVID-19.

DESCRIPTORES: COVID-19, Mortalidad hospitalaria, Muerte, Atención de la Salud.

RECEBIDO EM: 16/01/2023 **APROVADO EM:** 03/04/2023

Amanda Cristina de Souza Andrade
Institute of Collective Health, Federal University of Mato Grosso, Cuiabá, Mato Grosso, Brazil.
ORCID:0000-0002-3366-4423

Ana Paula Muraro
Institute of Collective Health, Federal University of Mato Grosso, Cuiabá, Mato Grosso, Brazil.
ORCID:0000-0001-6237-1673

Ligia Regina de Oliveira
Institute of Collective Health, Federal University of Mato Grosso, Cuiabá, Mato Grosso, Brazil.
ORCID: 0000-0002-1162-0542

INTRODUCTION

Approximately 84 million cases of COVID-19 have been confirmed worldwide in 2020 since the first case was reported in China. About 1.8 million deaths [1] were registered in the same period. In Brazil, community transmission of SARS-CoV-2 was recognized on March 20th, 2020. [2,3] However, the first reported case was in February 2020, totaling 7.7 million cases and 195,000 deaths from the disease by the end of the year, which puts it in third place globally in number of cases and second in deaths. [2,4,5]

The Midwest Region of Brazil concentrated approximately 11% of confirmed cases of COVID-19 in 2020. However, it stood out with the highest mortality rate from the disease in the country at the end of the same year, leaving the state of Mato Grosso behind only the Federal District and with a rate approximately 40% higher than that of the country. [6] The first death was recorded on April 3rd, when the state had 44 confirmed cases of COVID-19, rising to more than 178,000 cases and 4,700 deaths [7] were recorded nine months after the first death from the disease, at the end of December 2020.

In Brazil, access to health services is provided by the Unified Health System (SUS) [8,9] since 1990. In the SUS, public health services are organized in an integrated, regionalized and hierarchical way, and health care is free for the private sector. Private services can be hired 10 when public services are insufficient to guarantee assistance coverage. Most hospitals in the country are private, but their use is predominantly through the SUS or shared between the public and private systems, pointing to the interdependence between these sectors in health care. [11]

Coping with COVID-19 in Brazil was established differently between states and municipalities. The spread of the pandemic in the country is marked by regional and social inequalities, characterized by the type of work, housing and sanitation and by the very access to care, treatment and supply of professionals. [11–15] Such factors are also associated with the severity of the disease and death. [11,16–21]

Hospital mortality rates are influenced both by the services provided and by the characteristics and severity of the cases, an indicator of service quality. [22–24] Approximately 600 thousand hospitalizations were registered by COVID-19 until January 2, 2021 in Brazil, with 56,023 in the Midwest Region and 16,330 in Mato Grosso, the second state with the highest number of hospitalizations in the region. In the same period, around 192,000 hospital deaths were recorded in the country. [6]

The analysis of mortality predictors among patients hospitalized for acute respiratory syndrome caused by SARS-CoV-2 is essential to elucidate the epidemiology of the disease. However, there are still few studies in Brazil that evaluated hospital mortality due to COVID-19. [4,5,24,25]

In addition to individual and clinical characteristics, it is important to analyze the context of hospitalization with regard to space and time, considering the heterogeneity of installed capacity and demand for assistance services according to the evolution of the epidemic in each state and region. Therefore, this study aims to analyze the factors associated with hospital mortality from COVID-19 in Mato Grosso in 2020, the first year of the pandemic.

METHODS

A retrospective study was carried out based on the analysis of microdata from hospitalized patients provided by the State Department of Health of Mato Grosso (SES-MT) through the COVID-19 Panel which, in turn, its data source is the Indica-SUS System established by SES-MT in April 2020 for hospital notification of hospitalized, suspected or confirmed cases of Severe Acute Respiratory Syndrome (SARS) or COVID-19. Notification is mandatory and carried out daily by all public and private health establishments with hospitalizations in the state. [26]

The state of Mato Grosso is located in the Brazilian Midwest. In 2020, it had an estimated population of 3,526,220 inhabitants 27, distributed in 141 municipalities, only four with more than 100 thousand inhabitants, including the state capital, Cuiabá. The GDP per capita of Mato Grosso was R$ 37,914 reais (2017) 28 and its HDI was 0.725 (2010). [27]

The state is subdivided into 16 health regions, each region with a reference hospital and aggregated into five macro-regions. 29 This division aims to integrate the organization, planning and execution of health actions and services and is defined by the grouping of neighboring municipalities that share economic, social, structural and transport characteristics. [30]

In December 2020, the state had 12.15 hospital beds for every 10,000 inhabitants, with 3.72 beds exclusively for COVID-19 and 1.65 intensive care unit (ICU) beds. The number of beds per 10,000 inhabitants varied between health macro-regions. It was lower in the East region and higher in the South and Center-North regions (Table 1).

For this study, confirmed cases of COVID-19 admitted to public and private hospitals in the state of Mato Grosso from March 1st to December 31st, 2020, whose outcome was hospital discharge or death, were confirmed. Hospitalization is understood to mean patient care in a specific location in health establishments, with a stay of more than 24 hours, including health establishments with a hospital characteristic or another institution with hospitalization or observation beds. [26]

Of the 27,163 suspected cases of COVID-19 admitted to the state in insured beds, 21,927 were confirmed through clinical analysis or laboratory or imaging tests. Of these, patients who were transferred, deceased for other causes, under 19 years of age or who had no information about the length of hospital stay, with 17,523 cases included in the analysis (64.51% of the total number of hospitalized cases) (Figure 1).

The dependent variable was death from COVID-19 during the hospitalization period. The independent variables evaluated were gender (female, male), age range (19-29; 30-39; 40-49; 50-59; 60 years or older), race/skin color (white, black-brown,

yellow, indigenous, unknown) and the patient's macro-region of residence (south, west, north, east, north-central), the main comorbidities considered at risk for more severe cases of COVID-19 (Hypertension, Diabetes, Cardiovascular disease, Chronic lung disease, Chronic kidney disease and Neoplasms), the number of comorbidities (none, one, two and three or more) were included. and hospitalization in an ICU bed (yes, no), which corresponds to the information on the last day of hospitalization available in the system. The month of admission of the patient and the grouping of months into four periods (March-May; June-July, August-September, October--November) were also included.

Absolute and relative frequencies of sociodemographic variables, hospital care, comorbidities, mean, median, standard deviation, interquartile interval (IQR) for age (years) and length of stay (days) were calculated. Hospital mortality rates were calculated considering the total number of hospitalized patients and the number of person-days of follow-up, both multiplied by 100. The follow-up time was defined as the time elapsed between the date of admission and the date of discharge (death or hospital discharge). Mortality rates and

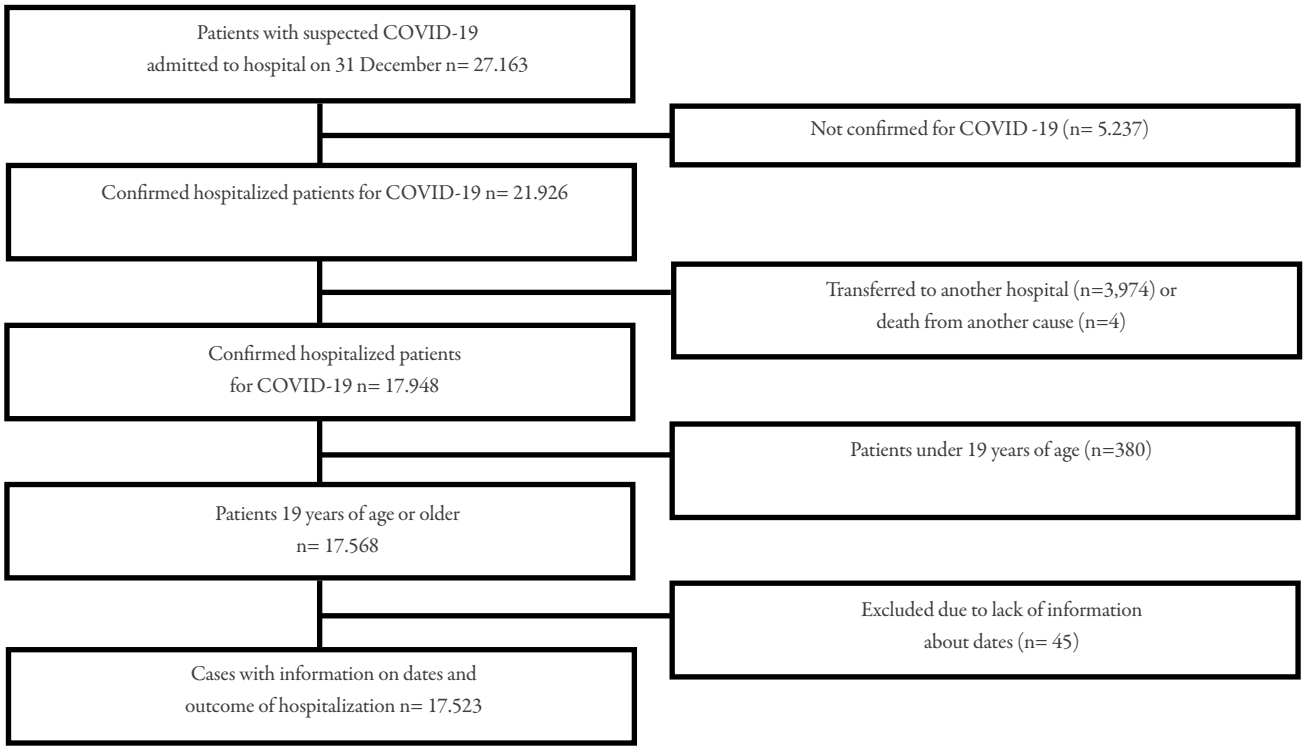
Table 1: Demographic, administrative and regional characteristics of the health system in Mato Grosso - Brazil, 2020.

	Mato Grosso	Macro-Região				
		South	West	East	North	Mid-North
Population*						
Population projection	3.526.220	538.592	319.269	344.775	782.449	1.541.135
Adult population projection[1]	2.437.644	377.334	4 219.369	233.205	536.243	1.071.493
Age group (years)						
<20	1.088,576 (30,87%)	161.258 (29,94%)	99.900 (31,29%)	111.570 (32,36%)	246.206 (31,47%)	469.642 (30,47%)
20-39	1.163,954 (33,01%)	176.286 (32,73%)	100.298 (31,41%)	109.214 (31,68%)	270.949 (34,63%)	507.207 (32,91%)
40-59	879.874 (24,95%)	138.556 (25,73%)	79.636 (24,94%)	84.245 (24,43%)	188.616 (24,11%)	388.821 (25,23%)
60-69	236.968 (6,72%)	37.017 (6,87%)	22.647 (7,09%)	23.373 (6,78%)	47.841 (6,11%)	106.090 (6,88%)
70-79	111.343 (3,16%)	17.815 (3,31%)	11.570 (3,62%)	11.575 (3,36%)	20.933 (2,68%)	49.450 (3,21%)
≥80	45.505 (1,29%)	7.660 (1,42%)	5.218 (1,63%)	4.798 (1,39%)	7.904 (1,01%)	19.925 (1,29%)
Gender						
Female (%)	49,32%	49,01%	49,96%	48,46%	48,52%	49,90%
Administrative division						
Health Region	16	1	2	4	5	4
Municipalities	141	19	22	30	35	35
Supply of hospital beds (in December)						
Beds (per 10,000)[2]						
Hospital beds	12,15	15,05	12,35	11,92	11,17	11,62
ICU beds	4,14	3,21	2,10	1,29	2,41	6,38
Beds for COVID-19 (per 10,000)[2]						
Hospital beds	3,72	4,11	2,55	0,86	3,43	4,60
ICU beds	1,65	1,30	1,14	0,81	1,14	2,32

Proportion of beds for COVID-19 (%)						
Hospital beds	30,67%	27,29%	20,66%	7,19%	30,72%	39,60%
ICU beds	39,90%	40,50%	54,35%	63,33%	47,29%	36,40%

ICU= Intensive Care Unit. *Projection for 2020. Source: Brazilian Institute of Geography and Statistics. [1] Population aged ≥20 years; [2] National Register of Health Establishments in Brazil (CNES); [3] COVID-19 Epidemiological Bulletin of December 21, 2020 (Mato Grosso, 2021).

Figure 1: Flowchart of data from hospitalized patients used in this study. Mato Grosso, 2020.



*Clinical confirmed; Clinical Confirmed - Image; Laboratory confirmed; Confirmed Epidemiological Link

their respective 95% confidence intervals (95% CI) were calculated according to the independent variables.

The risk ratio (HR) and the respective 95% CI were estimated, crude and adjusted, using the Poisson regression model with the logarithm of the follow-up time as a compensation term. All analyzes were performed using Stata version 12.0 for Windows.

The study was carried out with secondary data freely accessible through the Panel of the State Department of Health of Mato Grosso. Therefore, it does not require approval of the ethics committee and signature of the consent form.

RESULTS

From March to December 2020, in Mato Grosso, 17,523 individuals over 18 years of age were hospitalized for COVID-19, and of these, 4,147 died. The mortality rate was 23.67% (95% CI: 23.04; 24.30). The length of stay ranged from 1 to 199 days, with a mean of 9 days (± 10) and a median of 6 days. The median time between hospitalization and death was 21 days.

Regarding the evolution of hospitalization cases and the mortality rate per month of hospitalization, the highest number of cases was registered in the months of June (n=2,978), July (n=4,102) and August (n=3,306), representing 59.27% of the total cases in the period from March to December. Hospitalizations decreased from September, however, with an increase of 88.74% in the number of hospitalizations in December compared to the previous month. June, July and August registered the highest mortality rate, at 28.88%, 27.21% and 24.05%, respectively (Table 2).

The proportion of ignored data in the race/skin color variable was 16.31% and varied according to the month of hospitalization, the worst filling was from March (30.77%) to June (52.85%), with an increasing trend and a higher percentage in June. As of July, there was a significant improve-

Table 2: Selected demographic variables related to hospitalization for covid-19 by month of hospitalization. Mato Grosso - Brazil, 2020.Mato Grosso - Brasil, 2020.

Month of admission	n	Median age (IQR)	Male n (%)	Race/skin color n (%)	Comor-bidities n (%)	ICU n (%)	Length of stay (days) (IQR)	Mortality n (%)
General	17.523	57 (26)	9,884 (56,41)	10 (0,05)	10,259 (58,55)	5,254 (29,98)	6 (8)	4.147 (23,67)
March	13	42 (24)	3 (23,08)	4 (30,77)	4 (30,77)	10 (76,92)	9 (13)	2 (15,38)
April	68	49 (26)	34 (50,00)	26 (38,24)	32 (47,06)	32 (47,06)	7 (11)	11 (16,18)
May	643	51 (23)	371 (57,70)	284 (44,17)	325 (50,54)	228 (35,46)	7 (8)	125 (19,44)
June	2.978	56 (25)	1.676 (56,28)	1.574 (52,85)	1.636 (54,94)	1.000 (33,58)	6 (7)	860 (28,88)
July	4.102	58 (25)	2.344 (57,14)	474 (11,56)	2.445 (59,61)	1.277 (31,13)	6 (8)	1.116 (27,21)
August	3.306	58 (25)	1.882 (56,93)	93 (2,81)	1.990 (60,19)	983 (29,73)	6 (7)	795 (24,05)
September	2.327	59 (26)	1.326 (56,98)	87 (3,74)	1.368 (58,79)	664 (28,53)	6 (7)	502 (21,57)
October	1.418	60 (28)	799 (56,35)	90 (6,35)	856 (60,37)	370 (26,09)	7 (8)	258 (18,19)
November	924	59 (28)	504 (54,55)	50 (5,41)	557 (60,28)	258 (27,92)	7 (7)	195 (21,10)
December	1.744	56 (25)	942 (54,01)	176 (10,09)	1.046 (59,98)	432 (24,77)	6 (7)	283 (16,23)

IQR: Interquartile range.

Table 3: Characterization of hospitalizations due to covid-19 and mortality rate according to sociodemographic variables, comorbidities and those related to hospitalization. Mato Grosso - Brazil, 2020.

Variables	Hospitalizations (n=17.523)		Deaths (n=4.147)		
	n	%	n	%	IC95%
Gender					
Female	7.642	43,61	1.687	22,08	21,16; 23,02
Male	9.881	56,39	2.460	24,90	24,05; 25,76
Age (years)					
19-29	899	5,13	55	6,12	4,73; 7,89
30-39	2.173	12,4	166	7,64	6,59; 8,83
40-49	2.962	16,9	392	13,23	12,06; 14,50
50-59	3.541	20,21	689	19,46	18,19; 20,80
60 or older	7.948	45,36	2.845	35,80	34,75; 36,86
Race/Skin color					
White	4.263	24,33	862	20,22	19,04; 21,45

Black or brown	10.002	57,08	2.395		23,12; 24,79
Yellow	206	1,18	50	24,27	18,89; 30,61
Indigenous	194	1,11	68	35,05	28,65; 42,04
Ignored	2.858	16,31	772	27,01	25,41; 28,67
Region					
South	3.826	21,83	827	21,62	20,34; 22,95
West	1.149	6,56	309	26,89	24,41; 29,53
North	2.860	16,32	627	21,92	20,44; 23,48
East	1.589	9,07	313	19,70	17,81; 21,73
Mid-North	8.099	46,22	2.071	25,57	24,63; 26,53
Hypertension					
No	10.334	58,97	1.910	18,48	17,75; 19,24
Yes	7.189	41,03	2237	31,12	30,06; 32,20
Diabetes					
No	13.577	77,48	2.878	21,20	20,52; 21,89
Yes	3.946	22,52	1.269	32,16	30,72; 33,63
Heart Disease					
No	15.607	89,07	3.438	22,03	21,39; 22,69
Yes	1.916	10,93	709	37,00	34,87; 39,19
Chronic pulmonary disease					
No	16.585	94,65	3.783	22,81	22,18; 23,45
Yes	938	5,35	364	38,81	35,74; 41,97
Chronic kidney disease					
No	16.863	96,23	3.834	22,74	22,11; 23,38
Yes	660	3,77	313	47,42	43,63; 51,24
Cancer					
No	17.171	97,99	4.001	23,30	22,67; 23,94
Yes	352	2,01	146	41,48	36,43; 46,71
Number of comorbidities					
None	8.216	46,89	1.290	15,70	14,93; 16,50
1	5.032	28,72	1.306	25,95	24,76; 27,18
2	3.131	17,87	1.055	33,70	32,06; 35,37
3 or more	1.144	6,53	496	43,36	40,51; 46,25
Intensive Care Unit					
No	12.269	70,02	608	4,96	4,59; 5,35
Yes	5.254	29,98	3.539	67,36	66,08; 68,61
Hospital admission period					
March to may	724	4,13	138	19,06	16,36; 22,09
June to July	7.080	40,4	1.976	27,91	26,88; 28,97
August to September	5.633	32,15	1.297	23,03	21,94; 24,14
October to November	4.086	23,32	736	18,01	16,86; 19,22

CI 95%: 95% confidence interval.

Table 4: Hazard ratio (HR) raw and adjusted according to sociodemographic variables, comorbidities and those related to hospitalization for covid-19. Mato Grosso - Brazil, 2020.

Variables	Not adjusted (n= 17,523)		Adjusted			
			Model 1 (n= 17.523)		Model 2 (n= 14.665)	
	HR	IC 95%	HR	IC 95%	HR	IC 95%
Gender						
Female	1,00		1,00		1,00	
Male	1,02	0,96; 1,09	0,98	0,92; 1,04	0,99	0,93; 1,06
Age (years)						
19-29	1,00		1,00		1,00	
30-39	1,12	0,82; 1,51	1,12	0,83; 1,53	1,11	0,79; 1,57
40-49	1,67	1,26; 2,21	1,45	1,09; 1,92	1,40	1,03; 1,92
50-59	2,19	1,66; 2,88	1,51	1,14; 1,99	1,49	1,10; 2,03
60 ou mais	3,57	2,73; 4,66	2,10	1,61; 2,75	2,16	1,61; 2,91
Race/skin color						
White	1,00					
Black or Brown	1,10	1,02; 1,19	1,17	1,08; 1,27	1,17	1,08; 1,27
Yellow	1,22	0,92; 1,63	1,21	0,91; 1,61	1,22	0,92; 1,62
Indigenous	1,79	1,40; 2,29	1,65	1,29; 2,13	1,65	1,28; 2,13
Ignored	1,34	1,22; 1,48	1,30	1,18; 1,44		
Region						
South	1,15	1,06; 1,24	1,41	1,30; 1,53	1,37	1,25; 1,50
West	1,29	1,15; 1,46	1,47	1,30; 1,66	1,40	1,23; 1,59
North	1,12	1,02; 1,22	1,37	1,25; 1,50	1,33	1,20; 1,47
East	1,11	0,98; 1,24	1,20	1,07; 1,36	1,21	1,06; 1,39
Mid-North	1,00		1,00		1,00	
Comorbidities						
None	1,00		1,00		1,00	
1	1,47	1,36; 1,59	1,14	1,06; 1,24	1,14	1,05; 1,25
2	1,68	1,55; 1,82	1,15	1,06; 1,26	1,13	1,03; 1,24
3 or more	2,06	1,86; 2,28	1,39	1,25; 1,54	1,35	1,20; 1,52
Intensive Care Unit						
No	1,00		1,00		1,00	
Yes	9,24	8,48; 10,07	8,59	7,87; 9,37	8,80	7,99; 9,69

Hospital admission period						
March to May	1,00		1,00		1,00	
June to July	1,82	1,53; 2,17	1,81	1,52; 2,16	1,77	1,40; 2,24
August to September	1,48	1,24; 1,76	1,53	1,28; 1,84	1,55	1,22; 1,96
October a November	1,24	1,04; 1,49	1,40	1,16; 1,69	1,45	1,13; 1,84

HR – hazard ratio; CI 95%: 95% confidence interval.

ment in information, with 10.09% of incompleteness in December (Table 2).

Most inmates were male (56.39%), aged 60 years or older (45.36%), brown (57.08%) and lived in the Central-North region (46.22%). More than 50% of hospitalized patients had at least one comorbidity, with hypertension (41.03%) and diabetes (22.52%) being the most frequent, and were not admitted to the ICU (70.02%) (Table 3).

In the unadjusted analysis, the risk of death was higher in individuals aged 40 years or more, of mixed ethnicity/black color, indigenous and of unknown ethnicity/color, living in the South, West and North regions, with comorbidity and hospitalized in ICU. As for the period of hospitalization, the highest mortality rate was recorded from June to July, followed by August-September and October-December (Table 3).

In the adjusted analysis, the same variables remained associated with death from COVID-19. A dose-response effect on the risk of death was observed with increasing age and the number of comorbidities. The risk was higher in individuals residing in the South, West, East and North regions admitted to the ICU in the months of June to July, August to September and October to November (Table 4).

Two multiple models were estimated. Model 1 included the unknown category of the variable ethnicity/skin color and Model 2 excluded the observations of the unknown category (n=2,858; 16.31%). The results were similar, with the variables remaining with a significant association, without discrepancies in the magnitude of the association (Table 4).

DISCUSSION

This study presents the analysis of hospital mortality due to COVID-19 in residents of the state of Mato Grosso and found the highest risk of death among patients aged 40 years or older, brown, indigenous and with unknown information on race/color, those with some comorbidity, hospitalized in an ICU bed, not residents of the Central-North macro-region of the state and hospitalized in the months of June and July. The hospital mortality of patients with COVID-19 observed in this study (23.67%) was much higher than the hospital mortality rate due to respiratory diseases in Brazil (11.49%) and Mato Grosso (9.51%) in 2019. [31].

The months with the highest number of hospitalizations due to COVID-19 in the state were those with the highest risk of hospital death, compared to the first months of onset of cases of the disease, in line with what was observed in Brazil and in the Midwest region. [25] In the state of Mato Grosso, the number of cases remained high until the end of July, with a peak in epidemiological week 30 (July 19th to 25th, 2020). According to state bulletins, this increase in the number of cases reflected the rapid increase in ICU bed occupancy, rising from 22.8% on June 1st to 92.9% on July 1st. The state remained for several weeks with an occupancy rate close to 90% of all exclusive beds for COVID-19, with hospitals experiencing bed saturation, which possibly impaired adequate hospital care for critically ill patients and contributed to a more significant risk of death. [7]

As for demographic factors, there was no significant difference in the risk of hospital death between genders, in agreement with the results of other studies conducted in Brazil [5,32] and in other countries. [33,34] As for demographic factors, there was no significant difference in the risk of hospital death between genders, in agreement with the results of other studies conducted in Brazil. [35,36]

As for demographic factors, there was no significant difference in the risk of hospital death between genders, in agreement with the results of other studies conducted in Brazil. [34,36] The elderly are among the risk groups for more severe cases of COVID-19. However, in the present study, patients aged 40 to 59 years had an approximately 50% higher risk of death compared to those aged 19 to 29 years. This result draws attention to the impact of the disease on economically active age groups.

Regarding race/skin color, the highest mortality was found among black, brown and indigenous patients, compared to whites, in agreement with a recent systematic review of the literature that points to the worst clinical outcomes among blacks and ethnic minorities. [37] However, another meta-analysis did not find black skin color as

an independent risk factor for higher mortality, compared to white, suggesting that the worst prognosis found in some studies may be, at least in part, explained by worse housing conditions, access to health services and higher prevalence of comorbidities.[38]

In Brazil, based on the analysis of national SIVEP-Flu data, Baqui et al.[4] highlighted the higher mortality from COVID-19 among black and brown people admitted to hospitals when compared to whites, this being the second most important risk factor after age group. Among the possible explanations, the authors highlighted that they observed fewer ICU admissions of brown patients, which, in turn, is related to the organizational differences between the public and private health systems. Other studies found no difference in hospital mortality by ethnicity/skin color after adjusting for confounding variables such as sex, age group and comorbidities. [5,39,40]

In Mato Grosso, it is estimated that 82.3% of indigenous people live in indigenous territory, with implications for limited access to health services, which often depends on visits by doctors and other health professionals to the villages. [41] In this study, the higher risk of death among indigenous people hospitalized due to COVID-19 was highlighted when compared to whites, which is in line with what was verified by Ranzani et al. [25] from the analysis of the first 250,000 hospitalizations due to COVID-19 in Brazil, and with other studies that pointed to the higher lethality of the disease identified in this population group. [41,42] Thus, the importance of controlling the spread of the disease in indigenous communities is highlighted, which, due to cultural and behavioral factors, can spread easily. [43]

The proportion of records with unknown race/color in the hospitalization data in Mato Grosso was high in the first months of the epidemic in the state, mainly in June, which registered a significant increase in the number of hospitalizations (almost five times the number of hospitalizations registered in the previous month), in which more than half of the medical records did not contain information about race/skin color. However, there were no differences in the associations of the evaluated factors with regard to hospital mortality when excluding records from the multivariate analysis.

As widely described in the literature, the present study showed that comorbidities were an independent risk factor for mortality from COVID-19 [17,44], with a dose-response relationship regarding the number of reported comorbidities. More than half of patients hospitalized for COVID-19 in the state in 2020 had at least one comorbidity, similar to what was observed by Zhou et al. [21] in a multicenter cohort study of hospitalized patients. Commonly, the most reported comorbidities related to a higher risk of complications and deaths from COVID-19 are cardiovascular disease, high blood pressure, diabetes mellitus, obesity, respiratory disease, chronic kidney disease and cancer. [15,20,21,24,45–47]

Non-communicable chronic diseases are considered the main causes of death in the world, corresponding to 74% of causes of death in Brazil. 48 It is estimated that 24.5% of the Brazilian population is hypertensive, and of these, 83.1% are undergoing treatment, with a lower percentage among males (78.5%). People with diabetes represent 7.4% of the population and obese 20.3%, with a growing trend of obesity between 2006 and 2019. [49] Thus, the high prevalence of chronic diseases in the Brazilian population is an aggravating factor for the observed lethality due to COVID-19.

Living in another macro-region other than the Center-North, where the state capital is located, proved to be a risk of death from COVID-19. This result can be explained by the unequal distribution of hospital beds in the state. Considering the large territorial extension of Mato Grosso, the concentration of beds in the Central-North Macro-region and the unequal distribution among the other health macro-regions may have contributed to the high hospital mortality observed, in view of the need for many patients with complications resulting from the disease, they are transferred to the municipality where the region's bed is located or even to another health macro-region. Although all macro-regions have exclusive ICU beds for treating severe cases of COVID-19, in mid-2020, only nine municipalities had this type of bed in the state [50], expanded to 19 of the 141 municipalities in the state at the end of the year.[7]

As an example, we can mention the West macro-region, which serves more than 300,000 inhabitants in 22 municipalities, standing out for the low number of ICU beds agreed in June 2020 (5 ICU beds agreed, representing 0.17 beds per 10,000 inhabitants). [50] There was an increase in this type of bed to 25 at the end of the year, still below ideal for adequate support for critically ill patients (1.14 beds per 10,000 inhabitants). [7] For several weeks in June, the West macro-region had 100% occupation of ICU beds, with cities more than 350 kilometers away from the city where the ICU bed was located. [50]

Among the main limitations of this study are the restrictions inherent to the use of secondary data from the government information system, with low completeness of information for some variables that could favor a better analysis of the data, such as skin color, and lack of records of socioeconomic and clinical information such as education, length of stay in each type of bed (ward or ICU), condition at admission (such as saturation and respiratory rate) and type of hospital management. In addition, the available microdata did not include information about the condition of the patient using mechanical ventilation at the time of admission. However, we can also state that, even in the face of these limitations, the availability of secondary databases allows the investigation of various aspects of COVID-19, contributing to greater knowledge and coping with the disease.

CONCLUSION

Analyzes of hospitalizations, such as the one presented in this study, are essential for building preventive measures and coping with COVID-19. The results indicated that, in addition to individual and clinical characteristics that have been widely studied for their impact on hospital mortality from COVID-19, issues related to the spatial and

temporal distribution of cases associated with the risk of mortality, which may be related to the organization and preparation of the care network for the treatment of severe cases of the disease. The lower number of ICU beds in the macro-regions that do not include the state capital and the rapid increase in the number of cases may have contributed to the heterogeneity of the risk of death,

observed in space and time in the first year of the pandemic, when there were no vaccines or proven effective treatments against the disease.

Comorbidities as a risk and severity factor for COVID-19 indicate the need for actions that transcend the biological approach and focus on the care of chronic non-communicable diseases. Structural issues, organization and quality of health services in each territory must also be considered when facing the pandemic.

Also noteworthy is the high risk of hospital mortality among the economically active age groups and the most vulnerable ethnic groups, indicating the need for more robust analyzes of the mechanisms that may contribute to the increased risk of COVID-19 mortality in these groups in order to ensure that they are meaningfully and appropriately included in public health measures and health services.

REFERENCES

1. World Health Organization (WHO). WHO Coronavirus Disease (COVID-19) Dashboard [Internet]. 2021. 2021 [cited 2021 Jun 2]. Available from: https://covid19.who.int

2. Saúde M da. Boletim Epidemiológico coronavírus - N44 [Internet]. 2021. Available from: https://coronavirus.saude.gov.br/boletins-epidemiologicos

3. Croda J, Oliveira WK de, Frutuoso RL, Mandetta LH, Baia-Da-silva DC, Brito-Sousa JD, et al. Covid-19 in Brazil: Advantages of a socialized unified health system and preparation to contain cases. Rev Soc Bras Med Trop. 2020;53(April):2–7.

4. Baqui P, Bica I, Marra V, Ercole A, van der Schaar M. Ethnic and regional variations in hospital mortality from COVID-19 in Brazil: a cross-sectional observational study. Lancet Glob Heal [Internet]. 2020;8(8):e1018–26. Available from: http://dx.doi.org/10.1016/S2214-109X(20)30285-0

5. Maciel EL, Jabor P, Goncalves Júnior E, Tristão-Sá R, Lima R de CD, Reis-Santos B, et al. Fatores associados ao óbito hospitalar por COVID-19 no Espírito Santo, 2020. Epidemiol e Serv saude Rev do Sist Unico Saude do Bras. 2020;29(4):e2020413.

6. Saúde M da. Painel CORONAVIRUS Brasil [Internet]. [cited 2021 Jan 15]. Available from: https://covid.saude.gov.br/

7. Saúde MGS do E de. Painel Informativo COVID-19 em Mato Grosso [Internet]. 2021 [cited 2021 Jan 15]. Available from: http://www.saude.mt.gov.br/informe/584

8. Brasil. Lei 8.080, de 19 de setembro de 1990: Brasil; 1990.

9. Noronha JC, Lima LD MC. O Sistema Único de Saúde – SUS. In: Editora Fiocruz, editor. Políticas e Sistemas de Saúde no Brasil. Rio de Janeiro; 2008.

10. Paim J, Travassos C, Almeida C, Bahia L, Macinko J. The Brazilian health system: History, advances, and challenges. Lancet [Internet]. 2011;377(9779):1778–97. Available from: http://dx.doi.org/10.1016/S0140-6736(11)60054-8

11. Viacava F, De Oliveira RAD, Carvalho C de C, Laguardia J, Bellido JG. SUS: Supply, access to and use of health services over the last 30 years. Cienc e Saude Coletiva. 2018;23(6):1751–62.

12. Barreto ML, de Barros AJD, Carvalho MS á., Codeço CT, Hallal PRC, Medronho R de A, et al. What is urgent and necessary to inform policies to deal with the covid-19 pandemic in brazil? Rev Bras Epidemiol. 2020;23:1–4.

13. Hillesheim D, Tomasi YT, Figueiró TH, Paiva KM de. Síndrome respiratória aguda grave por COVID-19 em crianças e adolescentes no Brasil: perfil dos óbitos e letalidade hospitalar até a 38a Semana Epidemiológica de 2020. Epidemiol e Serv saude Rev do Sist Unico Saude do Bras. 2020;29(5):e2020644.

14. Natividade M dos S, Bernardes K, Pereira M, Miranda SS, Bertoldo J, Teixeira M da G, et al. Social distancing and living conditions in the pandemic COVID-19 in Salvador-Bahia, Brazil. Cienc e Saude Coletiva. 2020;25(9):3385–92.

15. Niquini RP, Lana RM, Pacheco AG, Cruz OG, Coelho FC, Carvalho LM, et al. Description and comparison of demographic characteristics and comorbidities in SARI from COVID-19, SARI from influenza, and the Brazilian general population. Cad Saude Publica. 2020;36(7):1–12.

16. Feng Y, Ling Y, Bai T, Xie Y, Huang J, Li J, et al. COVID-19 with different severities: A multicenter study of clinical features. Am J Respir Crit Care Med. 2020;201(11):1380–8.

17. Guan W et al. Risikofaktor Komorbiditäten bei COVID-19- Erkrankung. Pneumologie. 2020;74(10):640.

18. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet. 2020;395(10223):497–506.

19. Li R, Pei S, Chen B, Song Y, Zhang T, Yang W, et al. Substantial undocumented infection facilitates the rapid dissemination of novel coronavirus (SARS-CoV-2). Science (80-). 2020;368(6490):489–93.

20. Richardson S, Hirsch JS, Narasimhan M, Crawford JM, McGinn T, Davidson KW NC-19 RC. Presenting characteristics comorbidities and outcomes among 5700 patients hospitalized with COVID-19 in the New York City Area. JAMA. 2020;323(20):2052–9.

21. Zhou F, Yu T, Du R, Fan G, Liu Y, Liu Z, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. Lancet [Internet]. 2020;395(10229):1054–62. Available from: http://dx.doi.org/10.1016/S0140-6736(20)30566-3

22. Travassos C, Noronha JC de, Martins M. Mortalidade hospitalar como indicador de qualidade: uma revisão. Cien Saude Colet. 1999;4(2):367–81.

23. Machado JP, Martins ACM, Martins MS. Avaliação da qualidade do cuidado hospitalar no Brasil: uma revisão sistemática. Cad Saude Publica. 2013;29(6):1063–82.

24. Escosteguy CC, Eleuterio T de A, Pereira AGL, Marques MRVE, Brandão AD, Batista JPM. COVID-19: estudo seccional de casos suspeitos internados em um hospital federal do Rio de Janeiro e fatores associados ao óbito hospitalar. Epidemiol e Serv saude Rev do Sist Unico Saude do Bras. 2020;30(1):e2020750.

25. Ranzani OT, Bastos LSL, Gelli JGM, Marchesi JF, Baião F, Hamacher S, et al. Characterisation of the first 250 000 hospital admissions for COVID-19 in Brazil : a retrospective analysis of nationwide data. Lancet. 2021;2600(20):1–12.

26. Grosso M. Portaria GBSES No 141 DE 17/04/2020 - Institui o Sistema INDICASUS para a notificação hospitalar de casos de internação, suspeitos ou confirmados, de Síndrome Respiratória Aguda Grave-SRAG ou COVID-19 [Internet]. 2020. Available from: https://www.iomat.mt.gov.br/portal/visualizacoes/pdf/15876/#/p:23/e:15876

27. Estatística I-IB de G e. IBGE Cidades [Internet]. Available from: https://cidades.ibge.gov.br/brasil/mt/panorama

28. Públicas MGS-S de E de P e GSA de P e G de P. Contas Regionais: Produto Interno Brutode Mato Grosso em 2017 [Internet]. 2017. Available from: http://www.seplan.mt.gov.br/-/10948750-produto-interno-bruto-de-mato-grosso?ciclo=cv_gestao_inf

29. MT MGC de IBRC. CIB 057 de 26 de julho de 2018 [Internet]. 2018. Available from: http://www.saude.mt.gov.br/legislacao?origem=19&p=&num=57&mes=&ano=2018

30. Xavier DR, De Oliveira RAD, Barcellos C, De Freitas Saldanha R, Ramalho WM, Laguardia J, et al. Health regions in brazil based on hospital admissions: A method to support health regionalization. Cad Saude Publica. 2019;35:1–15.

31. Ministério da Saúde. DATASUS [Internet]. 2021. Available from: http://tabnet.datasus.gov.br/cgi/tabcgi.exe?sih/cnv/nruf.def

32. Sousa GJB, Garces TS, Cestari VRF, Florêncio RS, Moreira TMM, Pereira MLD. Mortality and survival of COVID-19. Epidemiol Infect. 2020;

33. Price-Haywood EG, Burton J, Fort D, Seoane L. Hospitalization and Mortality among Black Patients and White Patients with Covid-19. N Engl J Med. 2020;382(26):2534–43.

34. Silverio A, Di Maio M, Citro R, Esposito L, Iuliano G, Bellino M, et al. Cardiovascular risk factors and mortality in hospitalized patients with COVID-19: systematic review and meta-analysis of 45 studies and 18,300 patients. BMC Cardiovasc Disord [Internet]. 2021;21(1):1–13. Available from: https://doi.org/10.1186/s12872-020-01816-3

35. Mesas AE, Cavero-Redondo I, Álvarez-Bueno C, Cabrera MAS, de Andrade SM, Sequí-Dominguez I, et al. Predictors of in-hospital COVID-19 mortality: A comprehensive systematic review and meta-analysis exploring differences by age, sex and health conditions. PLoS One. 2020;15(11 November):1–23.

36. Palaiodimos L, Kokkinidis DG, Li W, Karamanis D, Ognibene J. Severe obesity, increasing age and male sex are independently associated with worse in-hospital outcomes, and higher in-hospital mortality, in a cohort of patients with COVID-19 in the Bronx, New York. Metab Clin Exp. 2020;108(January):154262.

37. Pan D, Sze S, Minhas JS, Bangash MN, Pareek N, Divall P, et al. The impact of ethnicity on clinical outcomes in COVID-19: A systematic review. EClinicalMedicine [Internet]. 2020;23:100404. Available from: https://doi.org/10.1016/j.eclinm.2020.100404

38. Sze S, Pan D, Nevill CR, Gray LJ, Martin CA, Nazareth J, et al. Ethnicity and clinical outcomes in COVID-19: A systematic review and meta-analysis. EClinicalMedicine [Internet]. 2020;29–30:100630. Available from: https://doi.org/10.1016/j.eclinm.2020.100630

39. Ogedegbe G, Ravenell J, Adhikari S, Butler M, Cook T, Francois F, et al. Assessment of Racial/Ethnic Disparities in Hospitalization and Mortality in Patients With COVID-19 in New York City. JAMA Netw open. 2020;3(12):e2026881.

40. Yehia BR, Winegar A, Fogel R, Fakih M, Ottenbacher A, Jesser C, et al. Association of Race With Mortality Among Patients Hospitalized With Coronavirus Disease 2019 (COVID-19) at 92 US Hospitals. JAMA Netw open. 2020;3(8):e2018039.

41. Palamim CVC, Ortega MM, Marson FAL. COVID-19 in the Indigenous Population of Brazil. J Racial Ethn Heal Disparities. 2020;7(6):1053–8.

42. Santos VS, Souza Araújo AA, de Oliveira JR, Quintans-Júnior LJ, Martins-Filho PR. COVID-19 mortality among Indigenous people in Brazil: a nationwide register-based study. J Public Health (Bangkok). 2020;1–2.

43. Cupertino GA, do Carmo Cupertino M, Gomes AP, Braga LM, Siqueira-Batista R. COVID-19 and Brazilian indigenous populations. Am J Trop Med Hyg. 2020;103(2):609–12.

44. Ssentongo P, Ssentongo AE, Heilbrunn ES, Ba DM, Chinchilli VM. Association of cardiovascular disease and 10 other pre-existing comorbidities with COVID-19 mortality: A systematic review and meta-analysis. PLoS One [Internet]. 2020;15(8 August):1–16. Available from: http://dx.doi.org/10.1371/journal.pone.0238215

45. Docherty AB, Harrison EM, Green CA, Hardwick HE, Pius R, Norman L, et al. Features of 20 133 UK patients in hospital with covid-19 using the ISARIC WHO Clinical Characterisation Protocol: Prospective observational cohort study. BMJ. 2020;369(March):1–12.

46. Grasselli G, Greco M, Zanella A. Risk Factors Associated With Mortality Among Patients With COVID-19 in Intensive Care Units in Lombardy, Italy. JAMA Intern Med. 2020;180(10).

47. Gupta S, Hayek SS, Wang W, Chan L, Mathews KS, Melamed ML, et al. Factors Associated with Death in Critically Ill Patients with Coronavirus Disease 2019 in the US. JAMA Intern Med. 2020;02115(11):1436–46.

48. WHO WHO-. NoncommunicableNoncommunicable diseases country profiles 2018 [Internet]. 2018. Available from: https://www.who.int/nmh/publications/ncd-profiles-2018/en/

49. Ministério da Saúde. Vigitel Brasil 2019 : vigilância de fatores de risco e proteção para doenças crônicas por inquérito telefônico : estimativas sobre frequência e distribuição sociodemográfica de fatores de risco e proteção para doenças crônicas nas capitais dos 26 estados [Internet]. 2020. Available from: http://bvsms.saude.gov.br/bvs/publicacoes/vigitel_brasil_2019_vigilancia_fatores_risco.pdf

50. Muraro AP, Santos ES, Oliveira LR, Ceconello MS SR. Demanda por UTIs em Mato Grosso em decorrência da pandemia da Covid-19: situação e projeção para as macrorregiões de saúde. Nota Técnica. ICET/IGHD/ISC – UFMT: Cuiabá [Internet]. 2020. Available from: http://geografiaufmt.com.br/index.php/pt-br/covid-leitos-uti