Original Manuscript

SOUTHERN GERONTOLOGICAL SOCIETY

Journal of Applied Gerontology
1–11

DOI: 10.1177/0733464820983976
journals.sagepub.com/home/jag
SAGE

Brazilian Older People Hospitalized by COVID-19: Characteristics and Prognostic Factors in a Retrospective Cohort Study

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Abstract

Objective: Analyzing the survival of older people hospitalized due to COVID-19 in Brazil and identifying its main predictive factors for death. **Method:** This is a retrospective, multicenter cohort study, based on 20,831 records of hospitalizations of older people due to SARS-CoV-2 in Brazil. The observation period was from February 28 to May 18, 2020. **Results:** There was a reduced overall survival time of 47.70% (95% confidence interval [CI] = [46.72%, 48.67%]) in 10 days. The variables age, race, education, intensive care unit (ICU), region, day of hospitalization, time elapsed between the first symptom and hospitalization, and the municipality that provided assistance showed increased risk of death using the multiple Cox proportional-hazards model. **Conclusion:** These results emphasize the relevance of inequality and access to health services as determinants for the death of older people with COVID-19.

Keywords

hospitalization, population aging, risk factors

Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), a novel virus that causes the COVID-19 infection, has recently caused a deadly pandemic. Studies have shown that this virus causes worse outcomes and a higher mortality rate in older adults and in those with comorbidities, such as hypertension, cardiovascular disease, diabetes, chronic respiratory disease, and chronic kidney disease (CKD; Shahid et al., 2020).

Brazil can be considered extremely vulnerable to the COVID-19 pandemic, given that rigorous public health measures are not implemented adequately to its continental dimension and there is an omnipresent ancestral socioeconomic inequality (The Lancet, 2020).

Data from the latest announcement from the Ministry of Health, dated May 29, 2020, revealed that, among the deaths caused by SARS due to COVID-19, 69.4% were of people older than 60 years, of which 63.0% had at least one risk factor. Heart disease was the primary comorbidity associated and was present in 7,318 deaths, followed by diabetes, kidney disease, neurological disease, and pneumopathy. In all risk groups, most individuals were 60 years of age or older, except for the obesity group (Secretariat of Health Surveillance, 2020a).

Most studies are concerned with understanding the pandemic in the general population. Although they point to the older population as the most vulnerable group with the highest proportion of deaths, few articles address the prognostic factors of older people hospitalized due to COVID-19. This scenario becomes more problematic, especially when evaluated in a country with limited resources and a controversial public health policy strategy. The purpose of this study is to analyze the survival of older people hospitalized due to COVID-19 in Brazil and identify its main predictive factors for death.

Manuscript received: June 20, 2020; **final revision received:** December 3, 2020; **accepted:** December 4, 2020.

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Method

Study Design and Participants

This is a retrospective, multicenter cohort study, based on hospitalization records of older people due to SARS-CoV-2. The purpose was to understand survival and its predictive factors for death. The observation period was from February 28 to May 18, 2020.

According to the mapping conducted in January 2020, Brazil has 45,848 adult intensive care unit (ICU) beds, 23,004 of which belong to the private sector. The Southeast region of Brazil has the highest number of adult ICU beds and the best per capita distribution, whereas the North region has the lowest number of beds and the worst inhabitants/bed ratio. In turn, the Northeast region has the second largest number of beds for adult intensive care, but the second worst ratio between inhabitants and available beds (Daumas et al., 2020; National Registry of Intensive Care, 2020).

All records of hospitalized older people aged 60 years or older confirmed having COVID-19 by the reverse transcription polymerase chain reaction (RT-PCR) test were included. All data were obtained from the national health surveillance system from open, anonymous, and public data. This national monitoring system, denominated InfoGripe, has been expanded to monitor COVID-19 cases in the country (Brasil. Ministério da Saúde. Secretariat of Health Surveillance, 2020a).

During the study period, 20,831 hospitalizations of older people were registered for SARS-CoV-2 infection. Of the total, 3.57% (744 / 20,831) were records with inconsistency in the database and 37.86% (7,888 / 20,831) were excluded for remaining hospitalized without any outcome. This is necessary to reduce bias in patients who could not have adequate follow-up during this cohort.

The covariables used to compare survival curves were socioeconomic factors (age, sex, race, level of education, urban and rural zone), clinical signs and symptoms (fever, cough, sore throat, diarrhea, dyspnea [shortness of breath], respiratory distress, time between first symptom and hospitalization, vomiting), hospital variables (multimorbidity, time elapsed until PCR collection, hospitalization date, influenza-like outbreak, hospital-acquired infection, O_2 saturation <95%, ICU, length of stay in the ICU, ventilatory support, X-ray result, X-ray performed, hospitalization date, municipality that provided assistance), chronic disease (cardiopathy, hematology, Down syndrome, hepatic disease, asthma, diabetes mellitus, neurological disease, pneumopathy, immunodepression, kidney disease, obesity), antiviral flu vaccination, antiviral type, use of antiviral against influenza, region, and time elapsed between first symptom and hospitalization. The other variables on the notification form, of which completion was irregular on less than 5% of the cases, were excluded from the analysis.

Outcomes

The primary outcome was the time of follow-up until death up to May 18, 2020. The other patients were censored, that is, they were discharged from the hospital up to the same date.

Statistical Analysis

The data were analyzed from the estimates of survival functions, using the nonparametric Kaplan–Meier method (Kaplan & Meier, 1958). The log-rank test was used to compare the survival functions for each covariate, namely sociodemographic and hospital and clinical signs or symptoms. The numerical variable of age was categorized by 60 to 69 years, 70 to 79 years, and 80 years or more. The categorical variables of race and education were recategorized according to the similarity of the survival curves of each, aggregated by theoretical categories. Specifically for race, the categories were grouped from similar social strata.

To assess the risk factors associated with death, hazard ratios (HR) and 95% confidence intervals (CIs) were calculated, according to the Cox proportional-hazards model (Stel et al., 2011). The multiple model was created using covariates with a value of $p < .250$. The modeling was initiated by the most significant variables, both at the level of statistical significance and at the theoretical level, respecting the risk proportionality test and absence of multicollinearity to test the variable in the model. The final model was tested, and the device and Cox-Snell residuals were analyzed. The data were analyzed using the STATA 12.0 (StataCorp LP, College Station, TX, USA) program considering a level of significance of 5% for all analyses.

Results

Between February 28 and May 18, 2020, 12,199 hospitalizations of older people due to COVID-19 were followed retrospectively. The mean time of survival was of 13.13 days (95% CI = [12.83, 13.42]), with a median of 9.00 (95% CI = [8.76, 9.24]). At the end of the follow-up, 7,863 deaths (60.53%) and 4,415 (33.99%) censored patients were recorded.

The overall survival rate estimated was 71.26% (95% CI = [70.43%, 72.08%]) in 5 days of hospitalization and 47.70% (95% CI = [46.72%, 48.67%]) in 10 days (Figure 1). Table 1 shows the comparison of the survival curves from the sociodemographic covariates, indicating a significantly lower estimate of survival in 10 days for ages above 80 years, 37.3% (95% CI = [35.6%, 39.0%]); was Black or Mixed-race, 37.2% (95% CI = [35.4%, 39.0%]); has a lower education level, 40.6% (95% CI = [38.3%, 42.8%]); and lives in rural areas, 39.0% (95% CI = [31.9%, 45.9%]).

Comparing at the same cutoff point in 10 days (Table 1), survival estimates were significantly lower when the patients

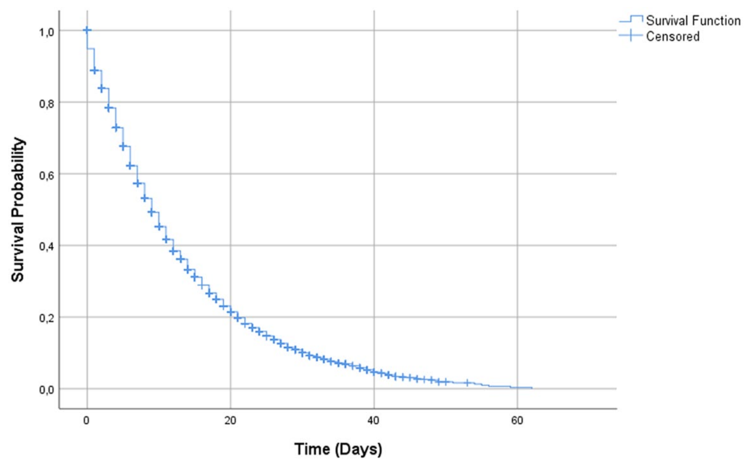

Figure 1. Overall survival of hospitalized patients.
Note. The overall survival rate estimate. The observation period was from February 28 to May 18, 2020.

presented dyspnea, 45.6% (95% CI = [44.5%, 46.8%]); respiratory distress, 44.6% (95% CI = [43.4%, 45.7%]); O_2 saturation <95%, 44.5% (95% CI = [43.4%, 45.7%]); were admitted to the ICU, 46.2% (95% CI = [44.8%, 47.6%]); had a 5-day stay in the ICU, 24.6% (95% CI = [21.9%, 27.4%]); required invasive ventilation support, 35.9% (95% CI = [34.4%, 37.5%]); and time elapsed between the first symptom and hospitalization was up to 4 days, 44.5% (95% CI = [43.2%, 45.9%]). Table 1 also shows a lower estimate of the 10-day survival rate when the patient presented chronic disease, such as liver disease, 38.8% (95% CI = [30.5%, 47.0%]); kidney disease, 42.4% (95% CI = [38.9%, 45.9%]); use of antiviral showed better survival, 50.2% (95% CI = [48.7%, 51.6%]); collection time for PCR was longer than 3 days, 46.4% (95% CI = [45.0%, 47.8%]); the time elapsed between the first symptoms and hospitalization was up to 4 days, 44.5% (95% CI = [43.2%, 45.9%]); is a resident in the northern region, 23.0% (95% CI = [20.3%, 25.8%]); and was hospitalized after April 1, 43.6% (95% CI = [42.5%, 44.7%]).

The covariates of the clinical signs showed a better estimate of the survival for patients in 10 days when they presented fever, 49.3% (95% CI = [48.2%, 50.5%]); cough, 49.5% (95% CI = [48.4%, 50.5%]); a sore throat, 48.9% (95% CI = [46.6%, 51.2%]); or diarrhea, 53.0% (95% CI = [50.0%, 55.9%]; Table 1).

Table 2 shows, after assessing the proportional risks, that the statistically significant covariates that presented the highest risk of death were the age of 80 years or more, 1.62 (95% CI = [1.53, 1.71]); Black or Mixed-race, 1.59 (95% CI = [1.51, 1.69]); lower education, 2.05 (95% CI = [1.79, 2.35]); living in rural areas, 1.29 (95% CI = [1.10, 1.52]); having dyspnea, 1.37 (95% CI = [1.28, 1.47]); respiratory distress, 1.39 (95% CI = [1.31, 1.48]); O_2 saturation <95%, 1.40 (95% CI = [1.32, 1.50]); consolidated X-ray, 1.22 (95% CI = [1.00, 1.49]); admission to ICU, 1.12 (95% CI = [1.07, 1.17]); ICU length of stay up to 5 days, 3.24 (95% CI = [2.93, 3.58]); time elapsed between first symptom and hospitalization up to 4 days, 1.18 (95% CI = [1.13, 1.24]); invasive ventilation support, 1.96 (95% CI = [1.82, 2.10]); liver disease, 1.23 (95% CI = [1.02, 1.49]); neurological disease, 1.30 (95% CI = [1.20, 1.42]); kidney disease, 1.14 (95% CI = [1.05, 1.24]); collection time for PCR longer than 3 days, 1.14 (95% CI = [1.09, 1.18]); time for hospitalization up to 4 days after the first symptoms, 1.18 (95% CI = [1.13, 1.24]); resident in the northern region, 3.91 (95% CI = [3.40, 4.50]); hospitalization after April 1, 1.99 (95% CI = [1.87, 2.11]); and municipality that provided assistance, 47.1% (95% CI = [46.0%, 48.2%]).

Patients had a better prognosis when they presented signs or symptoms such as fever, 0.88 (95% CI = [0.83, 0.93]); cough, 0.87 (95% CI = [0.82, 0.93]); sore throat, 0.94 (95% CI = [0.88, 0.98]); diarrhea, 0.86 (95% CI = [0.80, 0.93]); or use of antiviral, 0.91 (95% CI = [0.86, 0.96]; Table 2).

No significant differences were found in the survival curves or the proportional risks of the covariables sex, hospital-acquired infection, heart disease, diabetes, if the hospitalization was due to influenza syndrome, vomiting, obesity, pneumopathy, immunodepression, X-ray result, or some type of antiviral.

After adjusting for confounding variables, they remained significant in the multiple model for increased risk of death when patients were 80 years of age or older, 1.63 (95% CI = [1.45, 1.84]); Black or Mixed-race, 1.18 (95% CI = [1.05, 1.33]); had lower education, 1.60 (95% CI = [1.35, 1.89]); were admitted to the ICU, 1.26 (95% CI = [1.14, 1.39]); were residents in the northern region, 3.33 (95% CI = [2.64, 4.21]); were hospitalized after April 1, 1.47 (95% CI = [1.28, 1.68]); the time elapsed between the first symptom and hospitalization was up to 4 days, 1.12 (95% CI = [1.02, 1.24]);

Table 1. Comparison of Survival Estimates for Patients Hospitalized Due to SARS-CoV-2 at 5 and 10 Days (n = 12,199).

Covariables	Death	%	5 days (%)	95% CI	10 days (%)	95% CI	*p* value
Age (years)							
60–69	2,490	31.8	77.0	[75.7, 78.2]	55.7	[54.0, 57.3]	<.001
70–79	2,618	33.4	71.5	[70.0, 72.9]	48.8	[47.1, 50.5]	
80 or more	2,729	34.8	64.0	[62.3, 65.5]	37.3	[35.6, 39.0]	
Sex							
Male	4,465	56.8	71.6	[70.5, 72.7]	47.3	[45.9, 48.6]	.079
Female	3,398	43.2	70.9	[69.6, 72.1]	48.3	[46.8, 49.7]	
Race							
White or Asian	2,542	50.5	76.9	[75.6, 78.2]	53.7	[52.1, 55.4]	<.001
Black or Mixed	2,490	49.5	60.9	[59.2, 62.6]	37.2	[35.4, 39.0]	
Level of education							
Illiterate or low education	1,515	66.4	64.7	[62.6, 66.7]	40.6	[38.3, 42.8]	<.001
Intermediate/Elementary education	521	22.8	74.8	[71.7, 77.7]	51.1	47.3, 54.8]	
Higher education	246	10.8	85.0	[81.6, 87.8]	65.2	[60.4, 69.5]	
Zone							
Urban	6,754	97.8	71.1	[70.2, 72.0]	47.5	[46.4, 48.5]	.001
Rural	152	2.2	61.2	[54.3, 67.5]	39.0	[31.9, 45.9]	
Influenza-like outbreak							
Yes	2,039	36.9	70.0	[68.3, 71.6]	45.7	[43.8, 47.6]	.026
No	3,481	63.1	71.6	[70.3, 72.8]	48.6	[47.1, 50.0]	
Hospital-acquired infection							
Yes	359	6.7	71.5	[67.0, 75.5]	47.5	[42.6, 52.2]	.210
No	5,019	93.3	71.9	[70.9, 72.9]	48.3	[47.0, 49.5]	
Fever							
Yes	5,645	80.2	72.6	[71.6, 73.5]	49.3	[48.2, 50.5]	<.001
No	1,393	19.8	68.7	[66.7, 70.7]	45.0	[42.7, 47.4]	
Cough							
Yes	5,828	82.8	72.7	[71.8, 73.6]	49.5	[48.4, 50.6]	<.001
No	1,208	17.2	67.2	[64.8, 69.4]	44.0	[41.5, 46.6]	
Sore throat							
Yes	1,392	25.0	72.7	[70.9, 74.5]	48.9	[46.6, 51.2]	.036
No	4169	75.0	71.6	[70.5, 72.8]	48.7	[47.4, 50.0]	
Dyspnea (shortness of breath)							
Yes	930	13.0	69.3	[68.3, 70.2]	45.6	[44.5, 46.8]	<.001
No	6,199	87.0	80.5	[78.6, 82.4]	58.1	[55.5, 60.7]	
Respiratory distress							
Yes	5,383	80.4	68.2	[67.2, 69.3]	44.6	[43.4, 45.7]	<.001
No	1,315	19.6	79.3	[77.6, 80.9]	56.7	[54.4, 58.9]	
O_2 saturation <95%							
Yes	5,718	84.2	68.6	[67.5, 69.6]	44.5	[43.4, 45.7]	<.001
No	1,072	15.8	80.5	[78.6, 82.1]	58.8	[56.4, 61.2]	
Diarrhea							
Yes	819	15.2	76.9	[74.5, 79.0]	53.0	[50.0, 55.9]	<0.001
No	4,562	84.8	70.8	[69.7, 71.9]	47.6	[46.3, 48.9]	
Vomit							
Yes	4,779	91.0	74.8	[71.6, 77.8]	51.0	[47.1, 54.8]	.087
No	473	9.0	71.5	[70.4, 72.5]	48.1	[46.9, 49.4]	
Cardiopathy							
Yes	3,889	75.3	72.2	[71.0, 73.4]	48.3	[46.9, 49.7]	.259
No	1,276	24.7	71.7	[69.6, 73.6]	49.2	[46.8, 51.6]	
Hepatic disease							
Yes	109	3.2	64.4	[55.9, 71.7]	38.8	[30.5, 47.0]	.024
No	3,276	96.8	71.7	[70.4, 72.9]	48.3	[46.7, 49.8]	

(continued)

Table 1. (continued)

Covariables	Death	%	5 days (%)	95% CI	10 days (%)	95% CI	*p* value
Diabetes							
Yes	2,781	59.8	71.2	[69.8, 72.6]	47.0	[45.3, 48.6]	.102
No	1,869	40.2	71.9	[70.2, 73.6]	49.0	[47.0, 50.9]	
Neurological disease							
Yes	718	19.7	66.4	[63.2, 69.4]	38.8	[35.5, 42.1]	<.001
No	2,931	80.3	72.1	[70.7, 73.4]	49.1	[47.5, 50.7]	
Pneumopathy							
Yes	613	17.1	73.9	[70.8, 76.7]	47.7	[44.1, 51.3]	.852
No	2,969	82.9	71.2	[69.9, 72.6]	48.3	[46.7, 49.9]	
Immunodepression							
Yes	338	9.8	71.5	[67.2, 75.4]	51.7	[46.9, 56.4]	.309
No	3,121	90.2	71.3	[70.0, 72.6]	47.9	[46.3, 49.4]	
Kidney disease							
Yes	656	18.2	69.5	[66.2, 72.6]	42.4	[38.9, 45.9]	.002
No	2,949	81.8	71.4	[70.1, 72.7]	48.7	[47.1, 50.3]	
Obesity							
Yes	229	6.9	74.4	[69.3, 78.8]	49.4	[43.5, 55.0]	.500
No	3,069	93.1	71.3	[70.0, 72.6]	47.8	[46.2, 49.4]	
Antiviral flu vaccination							
Yes	1,121	41.7	74.0	[71.9, 75.9]	50.3	[47.7, 52.8]	.011
No	1,567	58.3	70.1	[68.2, 72.0]	46.2	[44.0, 48.4]	
Antiviral							
Yes	3,459	55.7	73.8	[72.6, 74.9]	50.2	[48.7, 51.6]	<.001
No	2,749	44.3	71.6	[70.2, 72.9]	48.2	[46.5, 49.9]	
Antiviral type							
Oseltamivir	3,212	97.2	74.1	[72.8, 75.3]	50.3	[48.8, 51.8]	.598
Zanamivir	10	0.3	57.9	[33.2, 76.3]	57.9	[33.2, 76.3]	
Other	83	2.5	73.2	[64.4, 80.1]	51.9	[42.0, 60.9]	
ICU							
Yes	4,187	58.9	71.8	[70.6, 73.0]	46.2	[44.8, 47.6]	<.001
No	2,923	41.1	72.8	[71.6, 74.0]	51.8	[50.2, 53.3]	
Ventilatory support							
Yes, invasive	3,405	50.0	61.0	[59.4, 62.5]	35.9	[34.4, 37.5]	<.001
Yes, not invasive	2,442	35.9	76.2	[74.9, 77.5]	53.4	[51.8, 55.0]	
No	962	14.1	82.5	[80.8, 84.0]	63.2	[60.7, 65.5]	
X-ray result							
Normal	139	3.4	77.5	[71.6, 82.4]	57.5	[50.2, 64.0]	.104
Infiltrate interstitial	2,016	48.9	73.3	[71.8, 74.9]	49.3	[47.4, 51.2]	
Consolidated	315	7.6	71.6	[67.1, 75.5]	48.7	[43.7, 53.5]	
Mixed	351	8.5	73.7	[69.6, 77.3]	49.6	[45.0, 54.1]	
Other	1,302	31.6	77.7	[75.8, 79.4]	53.5	[51.1, 55.8]	
X-ray performed							
Yes	4,123	83.3	74.8	[73.7, 75.9]	51.0	[49.6, 52.3]	<.001
No	824	16.7	68.4	[65.8, 70.9]	46.8	[43.8, 49.8]	
Municipality that provided assistance							
Different city	1,171	16.1	72.8	[70.6, 74.8]	52.2	[49.6, 54.6]	.029
Same city	6,097	83.9	71.2	[70.3, 72.1]	47.1	[46.0, 48.2]	
Multimorbidity							
Yes	1,800	57.2	71.0	[68.9, 73.0]	45.5	[43.1, 47.8]	<.001
No	1,348	42.8	71.9	[70.2, 73.5]	50.0	[48.0, 52.0]	
Region							
Northern	455	5.8	48.3	[45.2, 51.4]	23.0	[20.3, 25.8]	<.001
Northeast	1,121	14.3	65.6	[63.4, 67.7]	39.9	[37.5, 42.2]	

(continued)

Table 1. (continued)

Covariables	Death	%	5 days (%)	95% CI	10 days (%)	95% CI	*p* value
Southeast	5,633	71.7	73.9	[73.0, 74.9]	50.7	[49.5, 51.9]	
South	502	6.4	88.0	[85.1, 90.3]	70.2	[65.8, 74.1]	
Midwest	149	1.9	79.7	[73.2, 84.8]	63.2	[55.4, 70.1]	
Time elapsed between first symptom and hospitalization (days)							
Up to 4	4,444	58.5	69.2	[68.0, 70.3]	44.5	[43.2, 45.9]	<.001
>4	3,150	41.5	73.4	[72.2, 74.6]	51.2	[49.7, 52.7]	
Length of stay in the ICU (days)							
Up to 5	885	50.5	41.3	[38.4, 44.2]	24.6	[21.9, 27.4]	<.001
>5	869	49.5	93.8	[92.3, 95.0]	67.3	[64.5, 69.9]	
Time elapsed until PCR collection (days)							
Up to 3	3,422	46.6	74.1	[72.9, 75.3]	51.4	[50.0, 52.9]	<.001
>3	3,927	53.4	70.9	[69.7, 72.1]	46.4	[45.0, 47.8]	
Hospitalization date							
Up to April 1	1,285	16.3	82.9	[81.2, 84.4]	64.7	[62.5, 66.7]	<.001
After April 1	6,578	83.7	68.5	[67.6, 69.5]	43.6	[42.5, 44.7]	

Note. CI = confidence interval; ICU = intensive care unit; PCR = polymerase chain reaction.

Table 2. Comparison of Cox Proportional Hazards (HR) in Relation to the Risk of Death (n = 12,199).

Covariables	*n*	HR	95% CI	*p* value
Age (years)				
60–69	8,398	1.00		
70–79	6,772	1.23	[1.17, 1.30]	<.001
80 or more	5,613	1.62	[1.53, 1.71]	<.001
Sex				
Male	11,476	1.04	[0.99, 1.08]	.090
Female	9,352	1.00		
Race				
White or Asian	7,009	1.00		
Black or Mixed	6,018	1.59	[1.51, 1.69]	<.001
Level of education				
Illiterate or low education	888	2.05	[1.79, 2.35]	<.001
Intermediate/Elementary education	1,413	1.66	[1.43, 1.94]	<.001
Higher education	3,738	1.00		
Zone				
Urban	17,809	1.00		
Rural	420	1.29	[1.10, 1.52]	.002
Influenza-like outbreak				
Yes	5,338	1.00	[1.12, 0.032]	1.000
No	8,909	1.00		
Hospital-acquired infection				
Yes	730	1.07	[0.96, 1.19]	.227
No	13,208	1.00		
Fever				
Yes	15,067	0.88	[0.83, 0.93]	<.001
No	3,554	1.00		
Cough				
Yes	15,795	0.87	[0.82, 0.93]	<.001
No	2,863	1.00		
Sore throat				
Yes	3,976	0.94	[0.88, 0.98]	.043
No	10,770	1.00		

(continued)

Table 2. (continued)

Covariables	*n*	HR	95% CI	*p* value
Dyspnea (shortness of breath)				
Yes	15,188	1.37	[1.28, 1.47]	$<.001$
No	3,325	1.00		
Respiratory distress				
Yes	12,862	1.39	[1.31, 1.48]	$<.001$
No	4,370	1.00		
O_2 saturation $<95\%$				
Yes	13,426	1.40	[1.32, 1.50]	$<.001$
No	3,962	1.00		
Diarrhea				
Yes	2,472	0.86	[0.80, 0.93]	$<.001$
No	11,661	1.00		
Vomit				
Yes	1,393	0.92	[0.84, 1.01]	.099
No	12,339	1.00		
Cardiopathy				
Yes	9,530	1.03	[0.97, 1.10]	.276
No	3,301	1.00		
Hepatic disease				
Yes	221	1.23	[1.02, 1.49]	.030
No	8,162	1.00		
Diabetes				
Yes	6,748	1.05	[0.98, 1.11]	.115
No	4,712	1.00		
Neurological disease				
Yes	1,408	1.30	[1.20, 1.41]	$<.001$
No	7,556	1.00		
Pneumopathy				
Yes	1,309	1.01	[0.92, 1.09]	.857
No	7,546	1.00		
Immunodepression				
Yes	769	0.94	[0.84, 1.06]	.327
No	7,801	1.00		
Kidney disease				
Yes	1,252	1.14	[1.05, 1.24]	.002
No	7,508	1.00		
Obesity				
Yes	512	0.96	[0.84, 1.10]	.515
No	7,642	1.00		
Antiviral flu vaccination				
Yes	3,265	0.91	[0.84, 0.98]	.015
No	3,966	1.00		
Antiviral				
Yes	8,110	0.91	[0.86, 0.96]	$<.001$
No	7,995	1.00		
Antiviral type				
Oseltamivir	7,381	1.00		
Zanamivir	29	0.74	[0.40, 1.38]	.350
Other	265	1.03	[0.83, 1.28]	.780
ICU				
Yes	7,742	1.12	[1.07, 1.17]	$<.001$
No	9,649	1.00		

(continued)

Table 2. (continued)

Covariables	*n*	HR	95% CI	*p* value
Ventilatory support				
Yes, invasive	4,489	1.96	[1.82, 2.10]	<.001
Yes, not invasive	7,452	1.27	[1.18, 1.37]	<.001
No	5,180	1.00		
X-ray result				
Normal	439	1.00		
Infiltrate interstitial	4,968	1.13	[0.95, 1.34]	.158
Consolidated	710	1.22	[1.00, 1.49]	.048
Mixed	782	1.13	[0.93, 1.38]	.202
Other	3,438	1.07	[0.89, 1.27]	.454
X-ray performed				
Yes	10,337	1.00		
No	2,528	1.17	[1.09, 1.26]	<.001
Municipality that provided assistance				
Different city	3,053	1.00		
Same city	14,786	1.07	[1.00, 1.13]	.035
Multimorbidity				
Yes	3,024	1.12	[1.04, 1.20]	.001
No	4,872	1.00		
Region				
South	992	1.00		
Northern	1,917	3.91	[3.40, 4.50]	<.001
Northeast	3,845	2.55	[2.23, 2.92]	<.001
Southeast	13,700	1.85	[1.63, 2.10]	<.001
Midwest	377	1.26	[1.00, 1.60]	.050
Time elapsed between first symptom and hospitalization (days)				
Up to 4	9,643	1.18	[1.13, 1.24]	<.001
>4	8,610	1.00		
Length of stay in the ICU (days)				
Up to 5	1,376	3.24	[2.93, 3.58]	<.001
>5	1,279	1.00		
Time elapsed until PCR collection (days)				
Up to 3	10,182	1.00		
>3	9,176	1.14	[1.09, 1.18]	<.001
Hospitalization date				
Until April 1	4,662	1.00		
After April 1	16,169	1.99	[1.87, 2.11]	<.001

Note. HR = hazard ratio; CI = confidence interval; ICU = intensive care unit; PCR = polymerase chain reaction.

and concerning the municipality that provided assistance, 1.19 (95% CI = [1.04, 1.36]; Figure 2).

Discussion

This multicenter retrospective cohort study of older patients hospitalized due to COVID-19 has found important differences in survival times and risk factors for the death of patients in Brazilian hospitals. There was a reduced overall survival time and an association with lower survival estimates and a higher risk of death related to age, region, race, date of hospitalization, level of education, time elapsed between the first symptom and hospitalization, ICU admission, and municipality that provided assistance. The mean survival time found in this study was of 13.13 days. At the end of the follow-up, 60.53% of the patients died.

Wang et al. described the clinical characteristics of older COVID-19 patients who faced the highest risk of death after the SARS-CoV-2 infection. More than 70% of 339 older patients were in severe or critical condition, with 19% of fatality rate. The fast progress of the disease until death was found with a median survival time of 5 days after admission (Wang et al., 2020).

During April 2020, the number of accumulated cases in Brazil virtually doubled every week. The cumulative number of deaths also followed this pace, regardless of the age of the patients (Secretariat of Health Surveillance, 2020b). The increasing need for hospital structure and duly trained

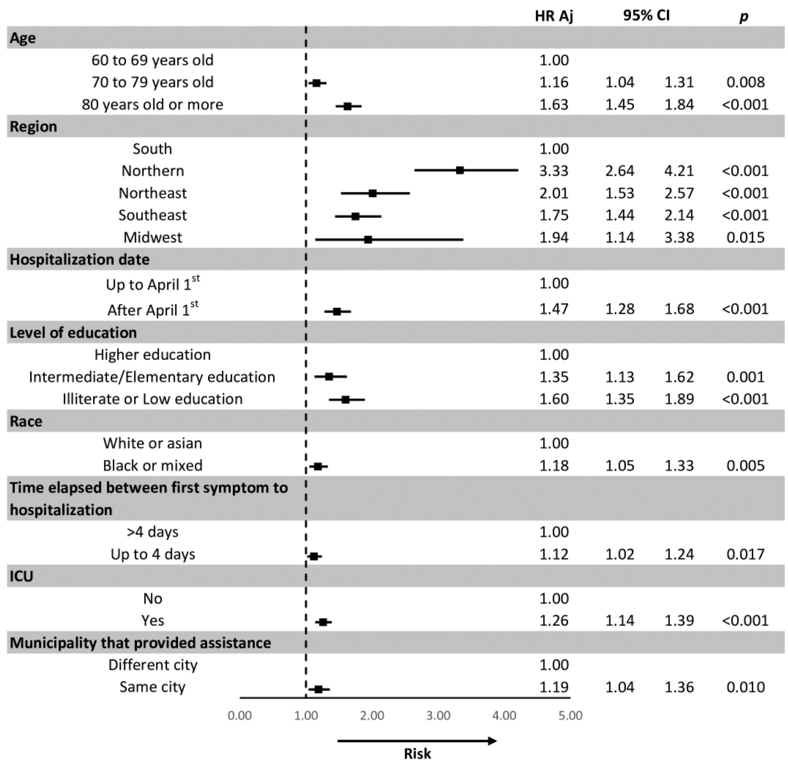

Figure. 2. Multivariate model for the comparison of risks (HR) adjusted for death.
Note. Cox's proportional-hazards model multivariate. HR = hazard ratio; CI = confidence interval; ICU = intensive care unit.

multiprofessional teams may have contributed to a higher risk of death among the elderly since April 1. The challenge is that there may not be enough medical staff or equipment to meet the surge in demand. The high infection and mortality rates among older people, relative to younger populations, have ignited equity debates surrounding decision-making and allocation of scarce resources required for survival (Landry et al., 2020).

This study showed that older patients (80 years or older), non-White, less educated, and residents of the Northern or Northeast regions who were treated in the same municipality of their residence had the highest risk of death. Individuals older than 80 years already have a natural substantial drop in immune response. Furthermore, the chance of comorbidities is much higher. These Brazilian regions have a lower density of multiprofessional teams, a deficient structure, and less access by the population to public health services. These are regions with less access to water and sanitation, predominance of Black or Mixed-race individuals who live in situations of vulnerability or inequality in municipalities with a high population density.

The lower median age of infection and hospitalization compared with other countries is expected due to a younger populational structure. Although age was not a risk factor for hospitalization by comorbidities after control, the age distribution among patients who were hospitalized differed from other studies. Socioeconomic disparity determines access to SARS-CoV-2 testing in Brazil (Marciel de Souza et al., 2020).

The United States has seen an exponential increase in the number of cases with most deaths also occurring for people aged 65 years or older (Le Couteur et al., 2020). A cohort of hospitalized adults with COVID-19 in Georgia found that most patients were Black, and had a similar probability of receiving invasive mechanical ventilation (IMV) or dying during hospitalization compared with non-Black patients. Although a larger proportion of older patients had worse outcomes (IMV or death), a considerable proportion of patients aged 18 to 64 years who lacked high-risk conditions received ICU-level care and died (23% and 5%, respectively; Gold et al., 2020).

The mortality rates in Hubei and Wuhan decline continuously. Timely supplied medical resources, including the reallocation of acute care beds, the rapid construction of new hospitals, and the generous aid of health workers by other less-severe areas, apparently helped the epicenter of the outbreak in Hubei (Wuhan). This unique pattern may reflect the fact that COVID-19 patients in Wuhan (or Hubei) have been treated more effectively daily (Zhang et al., 2020). This study indicated that older patients in ICU with first symptoms that appeared up to 4 days before hospitalization had more risk of death. These patients had atypical symptoms and signs of COVID-19. Besides, only worse or alarm symptoms may be noted during anamnesis. Niu et al. collected information on confirmed older patients transferred by the Beijing Emergency Medical Service to the designated hospitals. The 40% older patients presented fever, with body temperatures between 37.3°C and 38.0°C. The body temperature of 38.3% of the patients was superior to 38.0°C. While not all older patients had a fever, 21.7% of them were afebrile, which may occur in older populations with low immune function (Niu et al., 2020).

Many factors were found to be predictors for death, such as symptoms of dyspnea, comorbidities, such as cardiovascular disease and chronic obstructive pulmonary disease (COPD), and complications, such as acute respiratory distress syndrome (ARDS; Wang et al., 2020).

The consequences of possible epidemics in long-term care facilities (LTCFs) could be severe on a population of older adults who are, by definition, frail and immunologically naive toward this virus, even if the theoretical risk is transitory. Therefore, it seems essential to limit the risk of spreading the virus in facilities caring for older patients at all costs. This could mean drastic quarantine measures for staff members who have stayed in high-risk areas or have been in close contact with possible cases (Garnier-Crussard et al., 2020).

LTCFs are high-risk settings for severe outcomes of COVID-19 outbreaks due to the advanced age and frequent chronic underlying health conditions of the residents, as well as the movement of health care personnel among facilities. COVID-19 outbreaks in these facilities can considerably affect vulnerable older adults and local health care systems. The findings also suggest that once COVID-19 has been introduced into an LTCF, it has the potential to spread rapidly and widely (McMichael et al., 2020).

In Brazil, the pandemic's progression is still in a phase of exponential growth, with not enough historical data to analyze control measures at a national level. However, following the example of other countries, some states have adopted control measures to slow this growth. The country has still not adopted a nationwide control measure, which may delay the containment of the disease in Brazil (de Paula Antunes et al., 2020).

The high prevalence of older individuals in Western countries puts the health and social systems in a catastrophic crisis because it decompensates for problems otherwise better overcome in younger people. The early assessment of these problems in the community and long-term care settings can prevent these systemic crises. Consequently, a new and modern health care system based on an integrated approach is required. Moreover, it is important to plan the hospital organization, relocating health care resources and expertise (Landi et al., 2020).

A continuing education in critical-care medicine has an important role to play in preparing for and responding to such emergencies. Critical-care medicine is crucial in public health emergencies. Standardized training helps in the development of critical-care medicine disciplines and improves the clinical level of practitioners, which means that teams are better prepared to deal with health emergencies in the ICUs (Li et al., 2020).

In face of COVID-19, the Brazilian Unified Health System (SUS, in Portuguese) assumes a central role in the containment of the disease, using a wide network of hospitals, laboratories, research centers, health units, blood banks and blood products, private network linked to supporting institutions, and public universities (de Souza et al., 2020). A strong primary care may reduce unnecessary admissions, relieving the hospital system and expanding the availability of beds, also saving financial resources for the health system itself, ensuring its sustainability (Kringos et al., 2013).

Prevention and protection measures must be effectively advocated to reduce the various forms of contagion anywhere older adults may be, whether in their homes, cared for by caregivers and family members through social isolation, or for residents of LTCFs, contributing to a reduction in the mortality rate of people aged 60 years or older (Lima et al., 2020). Political affiliation also seems to play a significant role, not only attitude but also intention. This comes as no surprise because the pandemic has recently become highly politicized. This has been partially due to inconsistent public policies at a national level, especially regarding the severity of the virus and the best practices for mitigating its spread (Callow et al., 2020).

Although the work with secondary data, such as notification forms, has its limitations, this problem is partially solved, mainly due to the urgency of the country in maintaining more accurate data to monitor the COVID-19.

Conclusion

Older patients who have been confirmed to present COVID-19 infection have a low survival ratio. The prognosis of infection is associated with sociodemographic and hospital predictors. It is worth mentioning the importance in the development of new studies, such as controlled and randomized clinical trials. Furthermore, these results emphasize the relevance of inequality and access to health services as determinants for death in this segment of the population.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: All authors are employed by the government or other public funded institutions, and all expenses were covered by themselves.

Ethics of Clearance

The authors of this research used only secondary data set without identifiable personal information.

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