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Evaluation of survival time in people hospitalized for COVID-19 in Brazil

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ABSTRACT. This study aimed to evaluate the time between hospitalization and death of patients affected by COVID-19, and to investigate which factors are associated with this survival time. The data were obtained from the Influenza Epidemiological Surveillance Information System, which contains all cases of hospitalization for Severe Acute Respiratory Syndrome in Brazil. Initially, survival time was evaluated descriptively using the Kaplan-Meier estimator, which allows you to calculate the median survival time and the probability that a patient will survive certain periods of hospitalization. Next, a parametric regression model was constructed to investigate the relationship between the survival time and several factors jointly and the results were interpreted in terms of median survival time. Among the possible associated factors, the registration variables (gender, age, region, race and education), comorbidities and symptoms presented were considered. The results showed that the probability of a patient surviving the first day of hospitalization is 97.9%, dropping to 87.5% on the seventh day and reaching 33.5% on the thirtieth day. Half of the deaths occurred within 21 days of hospitalization and only 25% of the patients survived for more than 38 days, showing that, over time, the mortality rate decreases. Evaluating the associated factors, the results showed that elderly patients with low education have a shorter survival time and, consequently, a higher risk of death. With regard to comorbidities, neurological and liver diseases are the main risk factors. On the other hand, we do not have enough evidence to state that survival time is influenced by puerperal variables, down syndrome and abdominal pain.

Keywords: Survival analysis; SIVEP; parametric regression models.

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Introduction

In December 2019, an outbreak of a disease caused by a new coronavirus that is also characterized by causing pneumonia was reported in Hubei province, in Wuhan, China (Huang et al., 2020). The new coronavirus (COVID-19) has become one of the great challenges of the 21st century and directly affects the health and economy of the world's population. At the beginning of the outbreak, the first reported cases were related to a seafood and live animal market in Wuhan (Bogoch et al., 2020). The World Health Organization (WHO) declared a global pandemic on March 11, 2020, after reporting more than 110,000 cases distributed in more than 110 countries (Cavalcante et al., 2020).

In Brazil, the first notification of COVID-19 occurred in the state of São Paulo on February 20, 2020 (Coronavirus Brazil, 2020). Currently, the country registers more than 29 million cases and more than 650,000 deaths from COVID-19, ranking 3rd among the countries with the most deaths from the virus.

Among patients infected with COVID-19, many require hospitalization in an infirmary or Intensive Care Unit (ICU). It is known that, in general, long periods of hospitalization cause problems related to mobility, leading to muscle atrophy, which causes peripheral nerve damage and thrombosis, according to Dr. Fernanda Netto (UNIFOR - Fortaleza, Ceará, Brazil). The doctor further explains that weakness of the respiratory muscles can occur, leading to other infections. The presence of heart-related diseases also affects the function of the respiratory muscles, in which patients can present weakness and failure of the respiratory muscles (Azeredo & Machado, 1999).

According to Needhan (2008) patients surviving severe critical illness have significant neuromuscular alteration and complications that are detrimental to physical, functional development, as well as quality of life after hospital discharge. Because of muscle atrophy and weakness, patients lose several movements due to difficulty eating, walking and talking. In this scenario, physiotherapy, post-discharge rehabilitation and having adequate nutrition will help the patient's recovery, even though it is a time-consuming process.

The relevance of this research is justified by the importance of evaluating the survival time of patients hospitalized for COVID-19, especially in underdeveloped countries where health care resources are scarce. Supported by this, they can help managers to better plan hospital beds to meet the high pandemic demand, as well as detect individuals at higher risk of aggravation and death.

Considering the severity of this disease, studies are needed to expand the available data to guide therapeutic strategies to improve health care for the affected population. Given these assumptions, this study aimed to evaluate the length of stay of patients affected by COVID-19 together with the occurrence of death.

Next, a description of the database and a brief review of the methodologies used to analyze patient survival time is presented. Subsequently, the results of the analyses of the proportion of deaths and survival time as a function of the associated factors in simple and multiple forms are presented, through descriptive analyses and a parametric regression model for time, respectively. Finally, a discussion of the results found and the conclusions of this study is conducted.

Material and methods

In this paper, a cross-sectional study is presented using data available in SIVEP-Gripe, an official system of the Health Surveillance Secretariat of the Ministry of Health. This system was started in 2009 and aggregates the records of cases of hospitalization for Severe Acute Respiratory Syndrome (SARS) being updated weekly on new cases reported in the country.

All cases of hospitalization for COVID-19 reported during 2020 in Brazil were selected, totaling 480,788 patients, and the outcome of this study is the time from hospitalization to death for COVID-19, calculated as the number of days between the dates of hospitalization and death/discharge. In the case of patients who have not died, time is considered a censored observation (Colosimo & Giolo, 2006). The database was updated on 01/18/2021 and the survival time of patients who were neither discharged nor died by this date is also considered censored. The goal is to evaluate the survival time of hospitalized patients and relate it to several associated factors, which are presented in Table 1.

Table 1. Exploratory analysis of survival time of COVID-19 inpatients and associated factors.

Associated Factors		Total		Deaths		Survival Probability		Median	p-value
		n	%	n	%	7 days	30 days		
Region	North	35514	7.4	15112	42.6	77.87	30.83	18	< 0.001
	Northeast	83647	17.4	38174	45.6	78.3	30.28	18	
	Midwest	45151	9.4	14661	32.5	87.52	34.37	22	
	Southeast	243757	50.7	85648	35.1	85.72	34.09	21	
	South	72683	15.1	22344	30.7	89.34	36.58	23	
Age group	Adult	213684	44.4	41227	19.3	91.48	50.25	31	< 0.001
	Elderly	267104	55.6	134732	50.4	79.49	26.07	17	
Sex	F	210959	43.9	74747	35.4	84.19	34.19	21	0.09
	M	269770	56.1	101195	37.5	84.79	33.09	20	
Race	White	94553	56.2	32472	34.3	86.53	33.79	21	< 0.001
	Black	10869	6.5	4669	43.0	81	29.39	18	
	Yellow	1852	1.1	683	36.9	84.64	32.57	20	
	Brown	60208	35.8	24877	41.3	81.38	31.17	19	
	Indigenous	713	0.4	302	42.4	81.3	28.8	16	
Education	None	12458	7.0	7260	58.3	70.65	20.46	14	< 0.001
	Incomplete Elementary School	48683	27.5	23019	47.3	79.66	26.17	17	
	Complete Elementary School	33043	18.7	13157	39.8	83.74	31.16	19	
	High School	55064	31.1	15728	28.6	88.79	37.77	23	
	College	27735	15.7	6287	22.7	92.76	43.22	26	
ICU inpatients	No	267332	61.2	58197	21.8	88.08	43.28	26	< 0.001
	Yes	169284	38.8	99617	58.9	81.53	27.63	18	
Fever	No	183698	38.2	74634	40.6	81.92	30.42	19	< 0.001
	Yes	297090	61.8	101325	34.1	86.13	35.61	22	
Cough	No	141891	29.5	61305	43.2	80.4	30.11	19	< 0.001
	Yes	338897	70.5	114654	33.8	86.26	35.12	22	
Sore Throat	No	398654	82.9	151169	37.9	84.01	32.81	20	< 0.001

	Yes	82134	17.1	24790	30.2	87.07	37.65	23	
Dyspnea	No	136862	28.5	39406	28.8	88	39.99	24	< 0.001
	Yes	343926	71.5	136553	39.7	83.21	31.41	20	
Respiratory Distress	No	203345	42.3	61186	30.1	87.8	39.04	23	< 0.001
	Yes	277443	57.7	114773	41.4	82.21	30.12	19	
O2 saturation < 95%	No	193782	40.3	53554	27.6	88.13	39.88	24	< 0.001
	Yes	287006	59.7	122405	42.7	82.26	30.32	19	
Diarrhea	No	415446	86.4	156911	37.8	83.93	33.05	20	< 0.001
	Yes	65342	13.6	19048	29.2	88.38	37.05	23	
Vomit	No	443578	92.3	164116	37	84.38	33.29	20	< 0.001
	Yes	37210	7.7	11843	31.8	86.26	36.94	22	
Abdominal Pain	No	465487	96.8	171348	36.8	88.44	33.49	21	< 0.001
	Yes	15301	3.2	4611	30.1	87.31	35.31	22	
Fatigue	No	421328	87.6	157144	37.3	84.05	33.69	21	< 0.001
	Yes	59460	12.4	18815	31.6	87.94	32.06	21	
Loss of Taste	No	451211	93.8	169416	37.6	84.06	33.28	20	< 0.001
	Yes	29577	6.2	6543	22.1	91.93	38.06	24	
Loss of Smell	No	451442	93.9	169411	37.5	84.08	33.3	20	< 0.001
	Yes	29346	6.1	6548	22.3	91.73	37.68	24	
Postpartum woman	No	479390	99.7	175705	36.7	84.51	33.52	21	< 0.001
	Yes	1398	0.3	253	18.1	91.9	46.7	29	
Cardiovascular	No	306899	63.8	98404	32.1	85.55	35.66	22	< 0.001
	Yes	173889	36.2	77555	44.6	82.84	29.58	19	
Hematological	No	477034	99.2	174101	36.5	84.56	33.57	21	< 0.001
	Yes	3754	0.8	1858	49.6	80.86	31.23	19	
Down Syndrome	No	479546	99.7	175407	36.6	84.54	33.54	21	0.3
	Yes	1242	0.3	552	44.4	81.43	34.35	19	
Hepatic	No	476185	99.0	173391	36.4	84.6	33.66	21	< 0.001
	Yes	4603	1.0	2568	55.8	77.09	24.85	16	
Asthma	No	467988	97.3	172013	36.8	84.41	33.42	21	< 0.001
	Yes	12800	2.7	3946	30.8	88.73	38.42	23	
Diabetes Mellitus	No	352401	73.3	117614	33.4	85.57	35.32	22	< 0.001
	Yes	128387	26.7	58345	45.4	81.81	29.6	19	
Neurological	No	460391	95.8	163906	35.6	84.95	34.01	21	< 0.001
	Yes	203987	4.2	12053	59.1	75.78	25.65	16	
Pneumopathy	No	460946	95.9	164823	35.8	84.8	33.99	21	< 0.001
	Yes	19842	4.1	11136	56.1	78.69	26.28	17	
Immunodepression	No	467438	97.2	169185	36.2	84.63	33.61	21	< 0.001
	Yes	13350	2.8	6774	50.7	80.93	31.59	19	
Renal	No	459685	95.6	163455	35.6	84.85	33.99	21	< 0.001
	Yes	21103	4.4	12504	59.3	78.02	26.78	17	
Obesity	No	450885	93.8	164560	36.5	84.36	33.51	21	< 0.001
	Yes	29903	6.2	11399	38.1	87.01	34.13	21	
Another factor	No	342503	71.2	114497	33.4	85.3	35.35	21	< 0.001
	Yes	138285	28.8	61462	44.5	82.69	30.05	19	

Initially, an exploratory analysis of the database was performed using absolute and relative frequencies in order to describe the associated factors and the proportions of deaths associated with these factors. Due to the existence of censored observations, for the analysis of survival time, Survival Analysis techniques were used (Klein & Moeschberger, 2003; Colosimo & Giolo, 2006). More specifically, the non-parametric Kaplan-Meier (KM) estimator (Kaplan & Meier, 1958) was used to estimate the probability of survival of patients at different time points and the median survival time. Using the Log-rank test (Mantel, 1966) it was verified whether survival time differs according to the levels of each associated factor.

Next, single and multiple parametric regression models were constructed to estimate the impact of associated factors on patient survival time. The probability distribution was determined according to log-likelihood values and the Akaike Information Criterion (AIC) (Akaike, 1998; Saccaro et al., 2019). The selection of variables was performed using stepwise and backward automatic selection techniques and the interpretation of the model parameters was performed in terms of the ratio of median survival times, which are calculated by exponentiating the regression coefficient (β). The analyses were conducted in R software, version 4.0.2 (The R Foundation, 2020), using the packages survival (Therneau & Grambsch, 2000) for the KM estimates and flexsurvreg (Jackson, 2016) for the regression models. In all analyses, a 5% significance level was adopted.

The research was previously exempt from approval by the Research Ethics Committee, as the database is public. In accordance with Resolution 466/12 of the Brazilian Research Council, the researchers reported a total ethical commitment in the handling, analysis and publication of data so that the research does not require approval.

Result

Exploratory Analysis

Table 1 gives a brief description of the database used in this study. It is noted that most cases of hospitalization due to COVID-19 occurred in male patients (56.1% of the total), elderly (55.6%), from the Southeast region (50.7%) of the White race (56.2%) or Brown (35.8%). Regarding symptoms, there was a higher frequency of patients with dyspnea (71.5%), cough (70.5%) and fever (61.8%). Among the most common comorbidities, diabetes (26.7%), chronic cardiovascular disease (36.2%) and obesity (6.2%) stand out, with 28.8% of patients having some unspecified comorbidity. Furthermore, 38.8% of the patients were hospitalized in the ICU, while the majority (61.2%) of the patients stayed in the ward.

Table 1 also shows the proportions of deaths for each level of the associated factors. In this sense, the highest proportions of deaths occur among male patients (37.5%), elderly (50.4%), without schooling (58.3%), from the Northeast (45.6%) and North (42. 6%) and of the Black race (43.0%). Regarding comorbidities, the highest death rates occur in patients with chronic neurological disease (59.1%), chronic liver disease (55.8%), chronic lung disease (56.1%), immunodeficiency (50.7%) and in patients with kidney problems (59.3%) (p-value < 0.001). It is also noted that the proportion of deaths of patients hospitalized in the ICU is 58.9% against 21.8% of patients who were hospitalized only in the ward.

Regarding the survival time of the patients, there were 175,959 (36.6%) deaths caused by COVID- 19, so that, for the remaining 304,829 patients who were discharged or died from another cause, the survival time is considered censored. Figure 1 presents the survival function estimated by the KM method for the survival time of COVID-19 inpatients in general, that is, without considering associated factors. Through these estimates, it was found that the probability of a patient surviving the first day of hospitalization is 97.9%, dropping to 87.5% on the seventh day and reaching 33.5% on the thirtieth day. The median survival time is 21 days, that is, half of the deaths occurred within 21 days of hospitalization. On the other hand, 25% of patients survived for more than 38 days, showing that most deaths are concentrated in the first days after hospitalization and, over time, the mortality rate decreases.

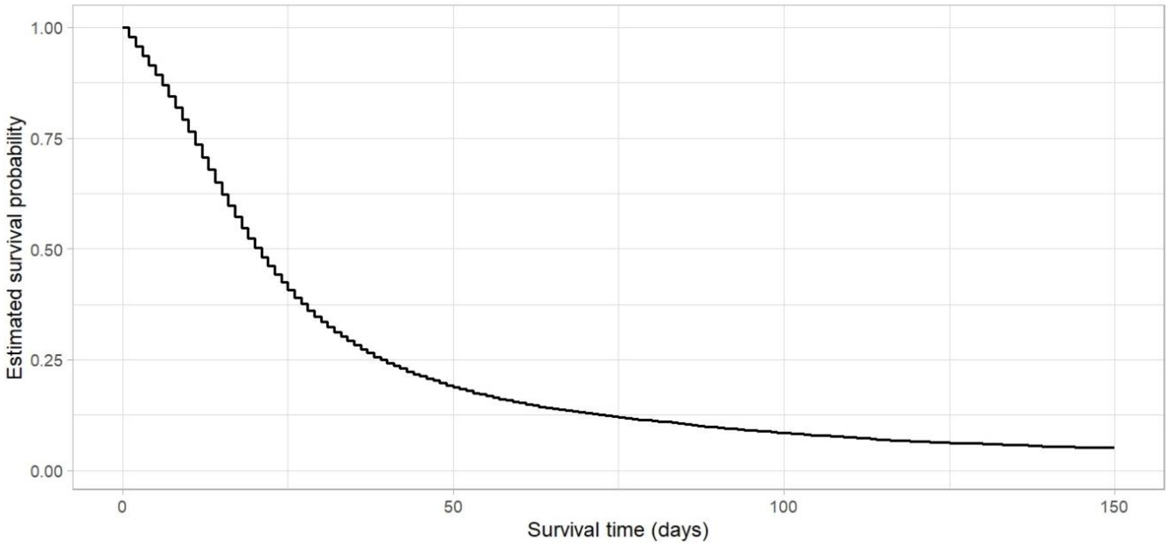

Figure1. Survivalfunction,estimatedbyKaplan-Meier,forthesurvivaltimeofpatientshospitalizedfor COVID-19.

An exploratory analysis of survival time according to associated factors is also performed in Table 1, which presents the probabilities of the patient surviving for one week and one month (after hospitalization), the median survival time and the Log-rank test value. The longest median survival times are found in Adult patients, from the South Region, Caucasian or Yellow and with Higher Education. More specifically, it is noted that the median time, as well as the chances of survival, increase as the patient's level of education increases, with the median time of patients without schooling being 14 days, approximately half when compared to patients with a higher level. For the Gender variable, the difference between the median times is only one day and, according to the Log-rank test, there is no evidence that the survival time of men and women is different.

Evaluating the median survival time as a function of symptoms, the greatest differences between patients who had and who did not have a specific symptom occur for Dyspnea (4 days), Respiratory distress (4 days) and Oxygen saturation below 95% (5 days). For the symptoms Loss of Taste and Loss of Smell, there were also differences of 4 days, but, in these cases, patients who registered these symptoms had a longer survival time. Finally, regarding comorbidities, the lowest median times and survival probabilities are found in patients with Chronic Liver Disease (16 days), Chronic Neurological Disease (16 days), Chronic Kidney Disease (17 days) and Other Chronic Lung Disease (17 days).

Considering the log-rank test, in general, most of the factors considered in this study seem to significantly affect the survival time of patients, and only for the factors Gender (p=0.09) and Down Syndrome (p=0.30) the results were not significant. However, the analyses performed here evaluate these factors individually and for a joint analysis a regression model was built and is presented in the next section.

Regression models

To build the regression model, several probability distributions capable of modeling patient survival timeswereseconsidered.Evaluating the Akaike criterion and the log-likelihood value of the tested distributions, the Log-Logistic model proved to be the most appropriate, as can be seen inTable 2.

Table 2. AIC and log-likelihood (L(θ)) values of the fitted models.

Distribution	AIC	ln L(θ)
Exponential	1588795	-794396.6
Weibull	1577537	-788766.5
Gamma	1573510	-786752.8
Generalized Gamma	1568203	-784098.6
Log-Normal	1572565	-786280.3
Log-Logistic	1566898	-783447.0
Gompertz	1588503	-794249.7

Next, simple and multiple regression models were adjusted for the survival time according to the variables described in Table 1, considering the log-logistic distribution for survival time. Due to the large number of factors and in order to determine the set of variables that best explain survival time, automatic selection techniques were used, namely, stepwise and backward (Klein & Moeschberger, 2003; Montgomery et al., 2012; Hosmer Jr, 2013) using the AIC as a selection criterion. The final multiple model, found by both techniques, contains all factors except the symptom Abdominal pain, the comorbidity Down syndrome and the puerperal variable and the results are shown in Table 3. For the multiple model, it is noted that all variables were significant ($p<0.05$), that is, they all affect the survival time of patients.

Evaluating the results of the simple and multiple models, it is observed that the gender variable, which did not have a significant effect in the simple model (p=0.137), becomes significant in the presence of the other factors. On the other hand, when we consider the factors together, we do not have significant evidence that the puerperal variables, down syndrome and abdominal pain influence the survival time of patients hospitalized for COVID-19.

Through the estimates presented in Table 3, it is noted that the median survival time of the elderly is 37% lower than that of adults. In addition, the median time for men is 3% lower when compared to women and patients who were admitted to the ICU had a 21% reduction in this time. Education also has a great impact on survival time, and the higher the education, the longer the time. More specifically, patients that went to college had a median time 73% longer than patients with no education. Large differences in survival time were also found in different races and regions, with patients from the northern region having the lowest survival time when compared to other regions. For race, it stands out that the shortest survival time is among the indigenous patients followed by the black patients.

Regarding the symptoms, it is observed that patients who had dyspnea, respiratory distress or low saturation have a median survival time 14, 12 and 15% lower than those who did not have these symptoms, respectively. However, patients with cough or loss of taste have a median time 17 and 15% longer than patients who did not have these symptoms, respectively.

For the comorbidities, it is noted that their presence has a negative impact on the survival time of patients, except for asthma. Neurological and hepatic comorbidities stand out with greater impacts, so that the median time for patients with these comorbidities is 19 and 17%, respectively, shorter than patients who do not have these conditions.

Table 3. Estimates of the parameters of the single and multiple regression models assuming a log-logistic distribution for patient survival time.

Associated Factors		Simple Model					Multiple Model				
		β	exp(β)	LI	LS	p-valor	β	exp(β)	LI	LS	p-valor
Region	Midwest	-0.07	0.93	0.91	0.94	<0.001	-0.22	0.80	0.77	0.82	<0.001
	Southeast	-0.15	0.86	0.85	0.88	<0.001	-0.26	0.77	0.76	0.79	<0.001
	Northeast	-0.38	0.68	0.67	0.69	<0.001	-0.43	0.65	0.63	0.67	<0.001
	North	-0.39	0.67	0.66	0.69	<0.001	-0.57	0.56	0.55	0.58	<0.001
Age group	Elderly	-0.63	0.53	0.53	0.54	0	-0.46	0.63	0.62	0.64	<0.001
Sex	Male	0.00	1.00	1.00	1.01	0.137	-0.03	0.97	0.96	0.98	<0.001
Race	Yellow	-0.06	0.94	0.91	0.98	0.002	-0.04	0.96	0.90	1.02	0.198
	Brown	-0.18	0.84	0.83	0.85	<0.001	-0.06	0.94	0.93	0.96	<0.001
	Black	-0.20	0.82	0.80	0.83	<0.001	-0.11	0.90	0.87	0.92	<0.001
	Indigenous	-0.21	0.81	0.76	0.87	<0.001	-0.18	0.84	0.75	0.93	<0.001
Education	Incomplete Elementary School	0.27	1.31	1.28	1.35	<0.001	0.16	1.17	1.14	1.20	<0.001
	Complete Elementary School	0.42	1.53	1.49	1.57	<0.001	0.23	1.26	1.23	1.30	<0.001
	High School	0.65	1.91	1.86	1.95	<0.001	0.34	1.41	1.37	1.45	<0.001
	College	0.85	2.34	2.28	2.41	<0.001	0.55	1.73	1.68	1.79	<0.001
ICU	Yes	-0.33	0.72	0.71	0.72	0	-0.24	0.79	0.78	0.80	<0.001
Fever	Yes	0.18	1.19	1.18	1.20	0	0.08	1.09	1.07	1.10	<0.001
Cough	Yes	0.22	1.24	1.23	1.25	0	0.16	1.17	1.16	1.19	<0.001
Sore throat	Yes	0.14	1.15	1.14	1.16	<0.001	0.05	1.05	1.03	1.07	<0.001
Dyspnea	Yes	-0.23	0.80	0.79	0.80	0	-0.15	0.86	0.85	0.88	<0.001
Respiratory	Yes	-0.25	0.78	0.77	0.78	0	-0.12	0.88	0.87	0.90	<0.001
Distress	Yes	-0.26	0.77	0.76	0.77	0	-0.16	0.85	0.83	0.86	<0.001
Low Saturation	Yes	0.18	1.20	1.18	1.21	<0.001	0.10	1.10	1.08	1.13	<0.001
Vomit	Yes	0.10	1.10	1.08	1.12	0	0.03	1.03	1.01	1.06	0.005
Abdominal pain	Yes	0.11	1.12	1.09	1.14	<0.001	*	*	*	*	*
Fatigue	Yes	0.11	1.12	1.11	1.13	<0.001	0.06	1.06	1.04	1.08	<0.001
Loss of taste	Yes	0.32	1.38	1.35	1.40	<0.001	0.14	1.15	1.10	1.20	<0.001
Loss of smell	Yes	0.31	1.37	1.34	1.39	0	0.07	1.07	1.02	1.12	0.002
Postpartum woman	Yes	0.41	1.50	1.36	1.65	<0.001	*	*	*	*	*
Cardiovascular	Yes	-0.14	0.87	0.86	0.87	<0.001	-0.02	0.98	0.97	1.00	0.016
Hematological	Yes	-0.12	0.89	0.85	0.92	0	-0.09	0.91	0.86	0.98	0.003
Down Syndrome	Yes	-0.09	0.92	0.85	0.99	0.011	*	*	*	*	*
Hepatic	Yes	-0.27	0.76	0.73	0.79	<0.001	-0.19	0.83	0.78	0.88	<0.001
Asthma	Yes	0.18	1.20	1.17	1.23	<0.001	0.11	1.12	1.07	1.17	<0.001
Diabetes Mellitus	Yes	-0.16	0.85	0.84	0.86	<0.001	-0.05	0.95	0.94	0.96	<0.001
Neurological	Yes	-0.32	0.73	0.72	0.74	<0.001	-0.21	0.81	0.79	0.84	<0.001
Other Pneumopathy	Yes	-0.23	0.79	0.78	0.81	<0.001	-0.09	0.92	0.89	0.94	<0.001
Immunodepression	Yes	-0.10	0.90	0.88	0.92	<0.001	-0.12	0.89	0.86	0.92	<0.001
Renal	Yes	-0.25	0.78	0.77	0.79	<0.001	-0.12	0.88	0.86	0.91	<0.001
Obesity	Yes	0.09	1.09	1.07	1.11	<0.001	-0.03	0.97	0.94	0.99	<0.001
Other comorbidity	Yes	-0.13	0.88	0.88	0.89	<0.001	-0.07	0.94	0.92	0.95	<0.001

LI = Lower Limit; LS=Upper Limit; *Variable not included in the final model. exp(β) represents the ratio of median survival times.

Discussion

Although Brazil was considered the first country in South America to present a confirmed case of COVID-19, this occurred several weeks after most countries in the northern hemisphere.

The presence of cardiovascular disease is a risk factor among patients diagnosed with COVID-19, since the survival time of these patients is 2% lower when compared to patients who do not have this comorbidity. This result is in line with other studies that also found significant associations between cardiovascular comorbidity and the chance of death from COVID-19 (Du et al., 2020; Shi et al., 2020; Sousa et al., 2020; Yao et al., 2020; Zhang et al., 2020).

On the other hand, when assessing patients with asthma, it is noted that the median survival time of these patients is longer than that of patients without asthma ($p<0.001$). This result differs from others found in the literature (Halvatsiotis et al., 2020; Mowla et al., 2020; Sousa et al., 2020) in which no significant relationships were found between mortality from COVID-19 and the presence of asthma.

In a large study published by the Chinese Center for Disease Control and Prevention (Team, 2020) 44,672 confirmed cases of COVID-19 infection were analyzed and the most frequent comorbidities in patients who died were high blood pressure (39.7%), cardiovascular disease (22.7%) and diabetes mellitus (19.7%), while in our analysis the most frequent comorbidities were cardiovascular disease (44.08%), diabetes mellitus (33.16%) and kidney disease (7.11%).

The proportion of deaths among individuals over 60 years of age is 50.44%, so that this group represents 76% of deaths among people over 18 years of age. Similar results are also presented in Sousa et al. (2020) and Bialek et al. (2020).

Sousa et al. (2020) evaluated the time between the onset of symptoms and death from COVID-19 in patients in the state of Ceará, Brazil, and reported that people with comorbidities (cardiovascular, neurological, pneumopathy) had a higher risk of death and a lower probability of survival. These results are reaffirmed by our study, in which the only comorbidity that is not a risk factor is asthma.

In another study of factors associated with mortality from COVID-19 carried out in Tacna, Peru, a predominance of male patients (74.10%) was registered and the most registered comorbidities were obesity (24.5%), arterial hypertension (27%) and diabetes mellitus (24.5%). Among the hospitalized patients, 70.10% had records of O2 saturation below 90% and of the patients requiring ventilation, only 73.40% were admitted to the ICU and the median time of these patients staying in the ICU is 13 days (Hueda-Zavaleta et al., 2021). Compared to Brazil, data show that 59.70% of patients had low saturation records (<95%), while 55.17% of patients were admitted to the ICU, with a median survival time of 18 days.

In the regression analysis, it is observed that elderly patients are a risk group, as they have a median survival time 37% lower than adults aged less than 60 years. In a study carried out in Coahuila, Mexico, after the variables were evaluated in a multiple regression model, patients over 60 years of age had a risk ratio (RR) of 8.04 with a confidence interval of 95% (CI: 7 .03 - 9.19). In the same scenario, patients with diabetes mellitus (RR: 1.63, CI: 1.40 – 1.89), obesity (RR: 1.37, CI: 1.18 – 1.60) and kidney disease (RR: 2.06, CI:1.64 – 2.59) had statistically significant differences, which is similar to the data analyzed in Brazil during the year 2020. A study involving survival analysis in 2,070 Brazilian patients found a 3.7-fold risk in patients with chronic neurological disease (CI: 1.8 – 7.9) (Sousa et al., 2020).

Several studies have reported a higher risk of dying in the elderly and people with comorbidities, especially cardiovascular diseases (Jordan et al., 2020; Rodriguez et al., 2020), not differing from the findings of the present study. Among the limitations of this study, several missing pieces of information are found, which limits the existing data and makes it difficult to monitor the patient. Other limitations are involved in the patient's response or the healthcare professional's judgment without any additional confirmatory testing; for example, obesity was only interpreted by the health professional, being considered only in its advanced stages.

Conclusion

This study evaluated the cases of hospitalization due to COVID-19, notified in 2020, in Brazil, using data provided by SIVEP-Gripe. Through the results, it was found that most patients hospitalized for COVID-19 are male, the most frequent comorbidities were neurological and cardiovascular diseases, and the most common symptoms were cough and dyspnea. The probability of a patient surviving the first day of hospitalization is 97.9% and reaches 33.5% on the thirtieth day. Half of the deaths occurred within 21 days of hospitalization and only 25% of the patients survived for more than 38 days, showing that, over time, the mortality rate decreases.

Since Brazil is a country of continental dimensions, it was decided to include the patient's region among the associated factors and significant differences were observed, so that patients hospitalized in the North and Northeast regions have a higher risk of death. Regarding the characteristics of the patients, several results are similar to those found in other studies, highlighting the impact of the age group, with the elderly presenting a much lower survival time than adults, an effect similar to that of the presence of cardiovascular disease and/or diabetes. The presence of kidney disease also appeared as a risk factor of great impact in this study.

Considering the need to use hospital beds and deaths resulting from the disease, the results of this study can help organize the hospital care network supported by the recognition of the epidemiological profile of diagnosed cases. In addition, epidemiological research must be strengthened in order to apply strategies aimed at these populations and also to protect the population vulnerable to COVID-19. It is noteworthy that Brazil and countries with international reference in public health need to analyze the effects of the COVID-19 pandemic and invest in global agreements and commitments, preparing for the capacity to respond to future pandemics.

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