Original Article

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PREDICTORS OF DEATHS ASSOCIATED WITH COVID-19 IN PATIENTS ADMITTED TO TWO HOSPITALS IN THE STATE OF SANTA CATARINA, BRAZIL

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ABSTRACT

Objective: To investigate predictors of deaths associated with COVID-19 in patients admitted to two hospitals in the state of Santa Catarina, Brazil.
Method: This is a retrospective cross-sectional study with 799 patients admitted to hospital for COVID-19 in 2020. The study took place in two reference hospitals for COVID-19 located in Greater Florianópolis, Santa Catarina, Brazil. Data collection took place from November 2020 to January 2021. Electronic medical records were used to collect data and were recorded in the Survey Monkey® application. The database was published in the Figshare Dataset Springer Nature© repository. Multivariate and bivariate analyzes were performed.
Results: There was a predominance of male patients (57.9%), white patients (93.4%), senior patients (41.5%). The mean age was 61.5 years (±15.8). There was a higher occurrence of Diabetes Mellitus (54.2%) and hypertension (34.2%). Thus, 222 patients (27.8%) were admitted to the Intensive Care Unit. The outcome of death was observed in 157 patients (19.6%). There was a correlation between death and some sociodemographic and clinical variables.
Conclusion: The study showed a higher prevalence of previous diseases such as hypertension, Diabetes Mellitus, obesity and chronic obstructive pulmonary disease. Age proved to be an independent risk factor for death. Occurrence of death in the age group over 80 years was 13 times higher compared to the younger population.

DESCRIPTORS: COVID-19. Coronavirus Infections. Mortality. Risk Factors. Coronavirus.

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PREDITORES DE ÓBITOS ASSOCIADOS À COVID-19 EM PACIENTES INTERNADOS EM DOIS HOSPITAIS DO ESTADO DE SANTA CATARINA, BRASIL

RESUMO

Objetivo: Investigar os fatores preditores de óbitos associados à Covid-19 em pacientes internados em dois hospitais do estado de Santa Catarina, Brasil.
Método: Estudo transversal retrospectivo com 799 pacientes internados por Covid-19 em 2020. O estudo ocorreu em dois Hospitais referência para Covid-19 situados na Grande Florianópolis, Santa Catarina, Brasil. A coleta ocorreu de novembro de 2020 a janeiro de 2021. Para a coleta de dados, foram utilizados prontuários eletrônicos, sendo registrados no aplicativo *Survey Monkey*®. O banco de dados foi publicado no repositório *Figshare Dataset Springer Nature*©. Análises multivariadas e bivariadas foram realizadas.
Resultados: Predominaram pacientes do sexo masculino (57,9%), brancos (93,4%), idosos (41,5%). A média de idade foi de 61,5 anos (±15,8). Houve maior ocorrência de Diabetes Mellitus (54,2%) e Hipertensão Arterial Sistêmica (34,2%). 222 pacientes (27,8%) foram internados na Unidade de Terapia Intensiva. O desfecho óbito foi observado em 157 pacientes (19,6%). Houve correlação do óbito entre algumas variáveis sociodemográficas e clínicas.
Conclusão: O estudo evidenciou maior prevalência de doenças prévias como a hipertensão, diabetes mellitus, obesidade e doença pulmonar obstrutiva crônica. A idade mostrou-se um fator de risco independente para óbito. A ocorrência de óbito na faixa etária acima de 80 anos foi 13 vezes maior em relação à população mais jovem.

DESCRITORES: Covid-19. Infecções por coronavírus. Mortalidade. Fatores de risco. Coronavírus.

PREDICTORES DE MUERTES ASOCIADAS AL COVID-19 EN PACIENTES INGRESADOS EN DOS HOSPITALES DEL ESTADO DE SANTA CATARINA, BRASIL

RESUMEN

Objetivo: Investigar los predictores de muertes asociadas a COVID-19 en pacientes ingresados en dos hospitales del estado de Santa Catarina, Brasil.
Métodos: Estudio transversal retrospectivo con 799 pacientes hospitalizados por COVID-19 en 2020. El estudio se desarrolló en dos hospitales de referencia para COVID-19 ubicados en la Gran Florianópolis, Santa Catarina, Brasil. La recolección se realizó de noviembre de 2020 a enero de 2021. Para la recolección de datos se utilizaron historias clínicas electrónicas y se registraron en la aplicación Survey Monkey®. La base de datos se publicó en el repositorio Figshare Dataset Springer Nature©. Se realizaron análisis multivariados y bivariados.
Resultados: Hubo predominio de pacientes masculinos (57,9%), pacientes blancos (93,4%), pacientes ancianos (41,5%). La edad media fue de 61,5 años (±15,8). Hubo mayor aparición de Diabetes Mellitus (54,2%) e hipertensión arterial sistémica (34,2%). Ingresaron en la Unidad de Cuidados Intensivos 222 pacientes (27,8%). El desenlace de muerte se observó en 157 pacientes (19,6%). Hubo correlación entre la muerte y algunas variables sociodemográficas y clínicas.
Conclusión: El estudio mostró una mayor prevalencia de enfermedades previas como hipertensión, Diabetes Mellitus, obesidad y enfermedad pulmonar obstructiva crónica. La edad demostró ser un factor de riesgo independiente de muerte. La ocurrencia de muertes en el grupo de edad mayor de 80 años fue 13 veces mayor en comparación con la población más joven.

DESCRIPTORES: COVID-19. Infecciones por Coronavirus. Mortalidad. Factores de Riesgo. Coronavirus.

INTRODUCTION

Currently, many uncertainties persist about the situation and, particularly, about the future of the COVID-19 pandemic. Looking to the year 2023, the most important uncertainties are related to the future of this infection and this disease[1].

In December 2019, the world went into a state of alert with the emergence of SARS-CoV-2, responsible for affecting the respiratory tract, causing everything from asymptomatic infections to serious infections, such as acute respiratory syndrome, which can lead to death[1–2]. In Brazil, epidemiological surveillance authorities implemented the Public Health Emergency Operations Center for Human Infection by the New Coronavirus[3–4] and declared a Public Health Emergency of National Concern. In a few epidemiological weeks of 2020, isolation and social distancing were established to implement actions to tackle COVID-19, such as expanding available beds and strategies to minimize the growing number of cases[5–6].

In the state of Santa Catarina, the first cases of COVID-19 were confirmed on March 12, 2020. The spread of the disease to some cities in the state led the government to institute Decree 515 of March 17, 2020, which determined the closure of non-essential services. The population was advised to stay at home, establish social isolation and avoid crowds[6].

Knowledge about the social dynamics of the disease in developing countries and regions with fewer resources required deepening, and around 5% of patients present severe conditions and require hospital admission in Intensive Care Units[7]. Studies have also shown that COVID-19 has a mortality rate of around 2% in cases where there is massive alveolar damage and progressive respiratory failure[8–9].

COVID-19 displays a wide clinical spectrum, ranging from asymptomatic or mild cases to more severe situations. International research has identified some variables that predict mortality from COVID-19, such as being male, aged between 49 and 75 years or older, reporting smoking, having high blood pressure, diabetes, heart and respiratory system diseases as well as symptoms such as difficulty breathing, chest pain, cough, diarrhea, nausea, blood expectoration and fatigue[10].

In this regard, the epidemiology, clinical course, pathogenesis and risk factors related to complications as well as registration of COVID-19 are not yet fully understood. This study contributes in this sense, since all of its analysis is based on data prior to the existence of vaccines. As far as we know, it is the only study that included all patients admitted due to COVID-19 in two hospitals in the state of Santa Catarina, Brazil. Thus, we sought to answer the following research questions: How are sociodemographic and clinical factors characterized in patients admitted to hospital with COVID-19? What factors are predictors of death in patients admitted to hospital with COVID-19?

Therefore, this study aimed to investigate predictors of deaths associated with COVID-19 in patients admitted to two hospitals in the state of Santa Catarina, Brazil.

METHOD

This is a retrospective cross-sectional study of 799 patients admitted with a medical diagnosis of COVID-19 to two reference hospitals due to COVID-19 in the state of Santa Catarina, Brazil. As a way of ensuring the rigor and transparency of this study, the criteria indicated by the STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) initiative were adopted[11].

The population of this study consists of all patients diagnosed with COVID-19, admitted to both institutions, between April 1 and December 31, 2020. A review of electronic medical records was carried out.

All patients aged 18 or over admitted to the hospital with a diagnosis of COVID-19 were included. No criteria were applied to exclude patients.

Data collection was carried out using questionnaires that were stored on the Survey Monkey® platform, which contained questions about sociodemographic data, health conditions, clinical, therapeutic and outcome data. The variables considered for this study were sociodemographic (gender, age, age group, race, marital status, years of study), health conditions (pulmonary involvement, ventilation pattern, high concentration O^2 mask, evolution of patients' condition and previous illnesses), clinical and therapeutic data (number of hospital admissions, hospital admission sector, number of days of hospital admission, risk classification, diagnostic test for COVID-19, type of diagnostic test for COVID-19 and outcome (deaths and non-deaths). The type of diagnostic test for COVID-19 variable considered the performance of a reverse transcription laboratory test followed by polymerase chain reaction (RT-PCR), collected using a nasopharyngeal or oropharyngeal swab, rapid test and serology.

The complete study database is published in Springer Nature's Figshare Dataset repository, a specific public access repository (https://doi.org/10.6084/m9.figshare.16746073.v3)[12].

Descriptive and analytical analyzes were carried out using the Statistical Package for the Social Sciences version 25.0 computational tool. A p-value≤ 0.05 was considered significant. The binary logistic regression technique was used to observe the independent variables' predictive/explanatory capacity (sociodemographic and clinical profile) on the death outcome. The independent variables listed to compose the initial model were those that presented a significant result in comparison with the outcome. The selection of representative variables occurred using the conditional backward method. To check the goodness of fit of the final logistic regression model, Nagelkerk and Hosmer-Lemeshow R^2 estimators were considered. The probability of gradual entry of variables into the model was 0.05, and for removal, 0.10.

The results were presented using descriptive statistics using absolute and relative distributions (n – %) as well as measures of central tendency (mean and median) and variability (standard deviation and interquartile range), with a study of the symmetry of distributions of continuous variables analyzed by the Kolmogorov-Smirnov test.

The comparison of continuous variables with the outcome was death vs. no death, and occurred using Student's t-test (independent groups) and Mann-Whitney U (asymmetric distributions) test. Considering the comparison of categorical variables and the outcome (death vs. non-death), Pearson's chi-square test (X2) and Yates' continuity correction were used.

P-value was estimated using the F test. In the adjusted analysis, the variables that presented a p-value <0.200 in the unadjusted analysis were included in the model, and the variables that reached a p-value <0.05 and/or adjusted the analysis remained in the model.

To carry out this study, all ethical precepts determined by Resolution n.º 580/18 of the Brazilian National Health Council. The study was submitted to the Research Ethics Committee of the *Universidade Federal de Santa Catarina*.

RESULTS

Most participants were male (57.9%), white (93.4%), older adults (41.5%), married or in a stable union (60.8%), with an education level of elementary education (60.2%). The mean age was 61.5 years (SD=15.8 years). The most prevalent comorbidities were hypertension (34.2%) and Diabetes Mellitus (DM) (54.2%). A total of 222 patients (27.8%) were transferred to an Intensive Care Unit (ICU).

The outcome of death was observed in 157 patients (19.6%). Figure 1 describes the number of cases that died observing a certain characteristic, divided by the total number of cases in each age group.

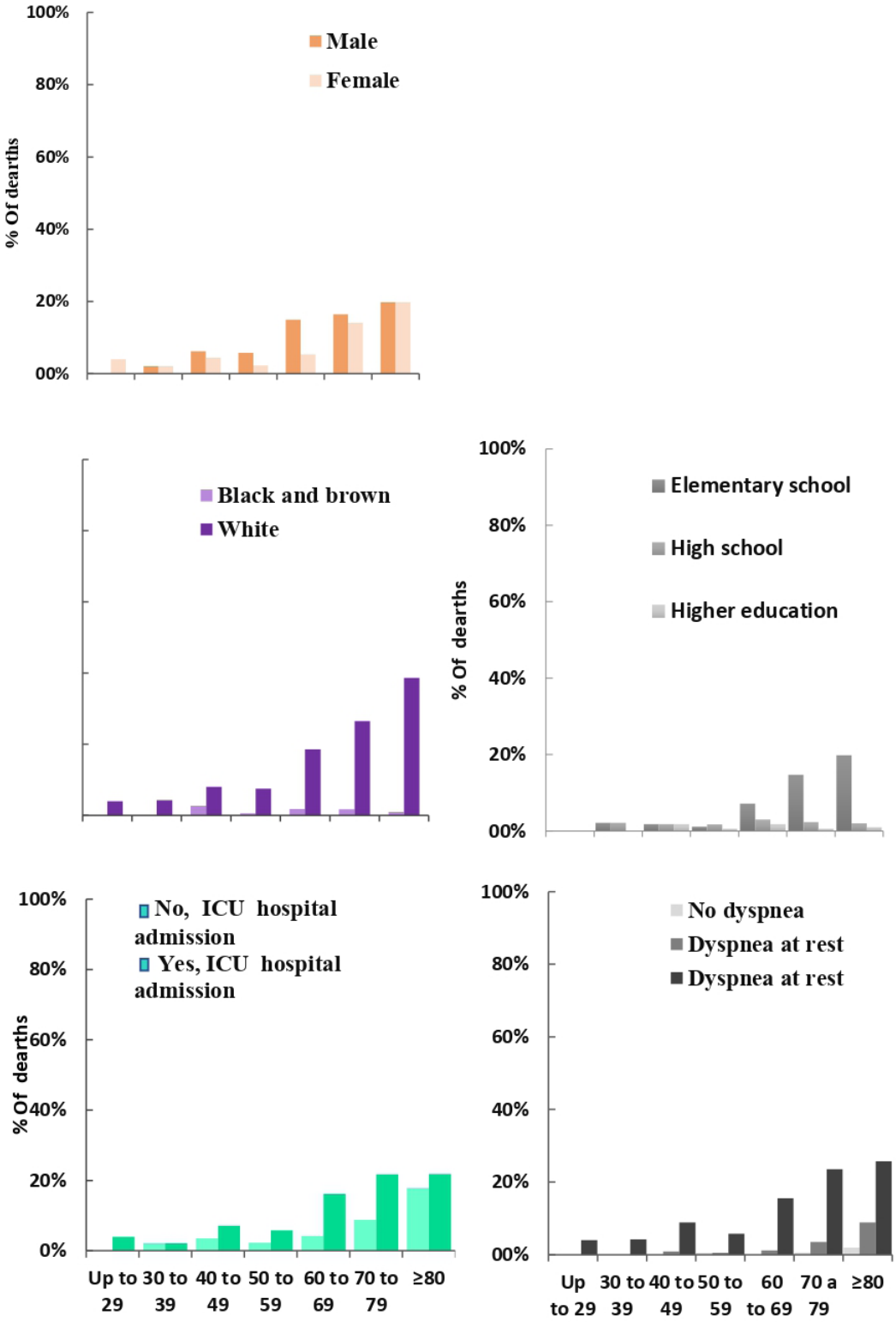

Figure 1 – Proportions of deaths by age group, Santa Catarina, Brazil, 2021.

In the bivariate and multivariate analysis, it was observed that the risk of death increases according to the days of hospital admission. In the first hospital admission, for each additional day

of hospital admission, there is a 2.8% greater chance of a patient dying [OR: 1.028; 95%CI: 1.015 – 1.041]. In the second hospital admission, it was observed that, with each additional day of hospital admission, there is a 3.8% greater chance of a patient dying [OR: 1.038; 95%CI: 1.031 – 1.087]. ICU admission (27.8%) and death (48.6%) showed a significant association with mortality ($X^2_{(g.l.=5)}$ =11.388; p<0.001).

Patients with lung involvement greater than 75% were 2.668 [95%CI: 1.255 – 5.671] times more likely to die, when compared to those with involvement less than 50%. With lung involvement between 50 and 75%, the risk was 1.891 [95%CI: 1.069 – 3.344]. The presence of sepsis resulted in a 7.841 [95%CI: 5.176 – 11.877] times greater chance of a patient dying. For cases requiring dialysis, the risk of death was significantly higher when compared to the group of cases without the need for dialysis [OR: 43.348; 95%CI: 21.666 – 86.726] x [OR: 6.709; 95%CI: 3.786 – 11.887].

Considering the risk estimates on previous diseases, it was found that the presence of chronic obstructive pulmonary disease (COPD) [OR: 1.943; 95%CI: 1.213 – 4.522], chronic kidney failure [OR: 2.949; 95%CI: 1.142 – 2.985] and stroke [OR: 2.447; 95%CI: 1.266 – 5.941] implies a higher risk of death, as shown in Table 1.

Table 1 – Demographic and clinical characterization according to the outcome and risk estimate (Odds Ratio) for occurrence of death, Florianópolis, SC, Brazil, 2021 (n=799).

Variables	Sample (n=799) [n (%)]	Outcome [A]			Unadjusted Odds Ratio		
		G1 (Deaths) (n=157)	G2 (No death) (n=642)	p [B]	OR	95%CI	
Sex – (n=795)				0,862			
Male	461 (58.0)	92 (20.0)	369 (80.0)		1.032	0.724	1.471
Female	334 (42.0)	65 (19.5)	269 (80.5)		1.0		
Age (n=795)							
Mean ± (standard deviation)	61.5 ± 15.8	70.9 ± 13.3	59.3 ± 15.5	<0. 001	1.058	1.043	1.073
Age group (years) (n=795)				<0. 001			
Up to 49 years old	184 (23.1)	15 (07.6)	169 (91.8)		1. 0		
From 50 to 59	173 (21.8)	14 (08.1)	159 (91.9)		0.992	0.464	2.121
From 60 to 69	167 (21.0)	34 (20.4)	133 (79.6)		2.880	1.506	5.509
From 70 to 79	170 (21.4)	52 (30.6)	118 (69.4)		4.965	2.669	9.236
80+	101 (12.7)	40 (39.6)	61 (06.4)		7.388	3.812	14.318
Race (n=768)				0.592			
White	720 (93.75)	142 (19.7)	578 (80.3)		1.0		
Black/brown	48 (6.25)	11 (22.9)	37 (77.1)		1.210	0.602	2.431
Marital status (n=644)				0.022			
Married/stable union	394 (61.2)	87 (22.1)	307 (77.9)		1.631	1.051	2.489
Does not live together	250 (38.8)	37 (14.8)	213 (85.2)		1.0		
Education (n=465)				0.060			
(I + C) ES	280 (60.2)	62 (22.1)	218 (77.9)		1.564	0.700	3.497
(I + C) HS	133 (28.6)	17 (12.8)	116 (87.2)		0.806	0.250	2.001
(I + C) HE	52 (11.2)	08 (15.4)	44 (84.6)		1.0		
Number of hospital admissions due to COVID-19				0.591			
First	728 (92.5)	141 (19.4)	587 (80.6)		1.0		
Second	50 (6.4)	12 (24.0)	38 (76.0)		1.356	0.877	1.998
Third	09 (1.1)	01 (11.1)	08 (88.9)		–		

Table 1 – Cont.

Variables	Sample (n=799) [n (%)]	Outcome [A]			Unadjusted Odds Ratio		
		G1 (Deaths) (n=157)	G2 (No death) (n=642)	p [B]	OR	95%CI	
Hospital admission sector				<0. 001			
Clinic/ward	720 (90.1)	99 (13.8)	621 (86.3)		1.0		
Intensive Care Unit	222 (27. 8)	108 (48.6)	114 (51.4)		3.845	1.987	11.64
First time in hospital (days)							
Median (1st – 3rd quartile)	6. 0 (4. 0 – 11. 0)	11.0 (4.0 – 19.0)	6. 0 (3.0 – 9.0)	<0.0001	1.028	1.015	1.041
Second time spent in hospital (days) MD=3(6.0%)							
Median (1st- 3rd quartile)	5.0 (2.0 – 9.0)	13 (5.0 –22.0)	2 (1.0 – 7.0)	0.002	1.038	1.031	1.087
Risk stratification (n=472)				<0.001			
Green	147 (31.2)	18 (12.2)	129 (87.8)		1.0		
Yellow	223 (47.2)	32 (14.3)	191 (85.7)		1.201	0.646	2.230
Red	102 (21.6)	56 (54.9)	46 (45.1)		8.725	4.653	16.361
COVID-19 test carried out (n=768)				0. 261			
Yes, with positive results	646 (84.1)	120 (18.6)	526 (81.4)		1.0		
Yes, with negative result	122 (15.9)	28 (23.0)	94 (77.0)		1.305	0.977	1.955
Which COVID-19 test (n=763)				0. 247			
Rt-PCR	594 (77.9)	122 (83.0)	472 (76.6)		1.265	0.955	1.674
Quick test	89 (11.7)	13 (14.6)	76 (85.4)		0.988	0.856	1.201
Serology	80 (10.5)	12 (15.0)	68 (85.0)		1.0		
Standard Lung Involvement – Tomographic (n=483)				0.013			
Lower than 50% (< 50%)	277 (57.3)	28 (10.1)	249 (89.9)		1. 0		
Between 50 and 75%	154 (31.9)	27 (17.5)	127 (82.5)		1.891	1.069	3.344
Greater than 75% (>75%)	52 (10.8)	12 (23.1)	40 (76.9)		2.668	1.255	5.671
Ventilatory pattern (n=750)				<0.001			
Dyspnea with respiratory effort	341 (45.5)	116 (34.0)	225 (66.0)		9.486	3.752	23.983
Dyspnea without respiratory effort	312 (41.6)	19 (6.1)	293 (93.9)		1.193	0.433	3.284
No dyspnea	97 (12.9)	5 (5.2)	92 (94.8)		1.0		
High concentration O^2 mask (n=761)				<0.001			
Yes	358 (47.0)	114 (31.8)	244 (68.2)		6.025	3.887	9.341
No	403 (53.0)	29 (7.2)	374 (92.8)		1.0		
Evolution							
Pulmonary thromboembolism	18 (2.4)	1 (5.6)	17 (94.4)	0.165	0.854	0.766	1.855
ULT cardiac dysfunction	44 (5.8)	21 (47.7)	23 (52.3)	<0.001	4.527	2 005	8.441
ULT acute respiratory failure (n=776)	148 (19.1)	86 (58.1)	62 (41.9)	<0.001	11.811	7.805	17.875
ULT pulmonary sepsis (n=770)	133 (17.3)	69 (51.9)	64 (48.1)	<0.001	7.841	5.176	11.877

Table 1 – Cont.

Variables	Sample (n=799) [n (%)]	Outcome [A]			Unadjusted Odds Ratio		
		G1 (Deaths) (n=157)	G2 (No death) (n=642)	p [B]	OR	95%CI	
Acute renal failure (n=773)				<0.001			
Yes, no need for dialysis	59 (7.6)	26 (44.1)	33 (55.9)		6.709	3.786	11.887
Yes, in need of dialysis	67 (8.7)	56 (83.6)	11(16.4)		43.348	21.666	86.726
No ULT	647 (83.7)	68 (10.5)	579 (64.7)		1.0		
Negative influenza result	311 (38.9)	60 (19.3)	251 (80.7)	0.366	0.856	0.785	1.142
Previous illnesses[B]							
Diabetes	273 (34.2)	55 (20.1)	218 (79.9)	0.799	0.963	0.718	1.291
Hypertension	419 (52. 4)	91 (21.7)	328 (78.3)	0.122	1.056	0.986	1.130
Asthma	40 (5. 0)	8 (20.0)	32 (80.0)	0.954	0.977	0.441	2.164
Chronic obstructive pulmonary disease	82 (10.3)	25 (30.5)	57 (69.5)	0.009	1.943	1.213	4.522
Chronic renal failure	17 (2.1)	7 (41.2)	10 (58.8)	0.024	2.949	1.142	2.985
Congestive heart failure	59 (7.3)	17 (28.8)	42 (71.2)	0.066	1.139	0.965	1.345
Overweight	28 (3.5)	4 (14.3)	24 (85.7)	0.467	0.935	0.588	1.206
Obesity	96 (12.0)	12 (12.5)	84 (87.5)	0.060	1.650	0.953	2.856
Stroke	33 (4.1)	12 (36.4)	21 (63.6)	0.014	2.447	1.266	5.941
Smoking	92 (11.5)	14 (15.2)	78 (84.8)	0.255	0.941	0.856	1.034
Sedentary lifestyle	9 (1.1)	3 (33.3)	6 (66.7)	–			
HIV	8 (1.0)	3 (37.5)	5 (62.5)	–			
Cancer	16 (2.0)	9 (56.3)	7 (43.8)	0.001	5.514	2.318	18.499
Alzheimer's	16 (2.0)	9 (56.3)	7 (43.8)	0.001	5.514	2.318	18.499
Parkinson's	6 (0.8)	1 (16.7)	5 (83.3)	–			

*A: Percentages obtained based on the total response categories in each variable; †B: Pearson's chi-square test; ‡MD: Missing data; §(I+C) ES: (Incomplete + complete) elementary school; ||(I+C) HS: (Incomplete + complete) high school; ¶(I+C) HE: (Incomplete + complete) higher education; **HIV: Acquired Immunodeficiency Syndrome; ††OR: Unadjusted Odds Ratio; ‡‡ULT: Ultrafiltered.

In Table 2, in the final regression model, age group was observed as a greater risk factor for death in the 60 to 69 years old [OR: 7.299] and 80 years and older [OR: 13.564] groups, when compared to age range up to 49 years.

Regarding the hospital admission sector, patients who were admitted to the ICU were 3.742 times more likely to die when compared to those who were admitted to the clinic/ward sector.

In relation to ventilation pattern, patients with exertional dyspnea were 9.061 times more likely to die. For acute renal failure, the need for dialysis was 25.421 times more likely to die, and, in cases without dialysis, the risk was 7.351 times, as shown in Table 2.

Table 2 – Initial and final binary logistic regression models to predict the outcome of death through independent sociodemographic and clinical variables with a significant association with the outcome of death. Florianópolis, SC, Brazil, 2021 (n=799).

Variables	P	Unadjusted Odds Ratio		
		OR	95%CI	
Initial Model				
Age group (years) (n=795)				
Up to 49 years old		1. 0		
From 50 to 59	0.580	0.635	0.127	3.174
From 60 to 69	0.915	1.076	0.276	4.197
From 70 to 79	0.002	7.247	2.076	25.300
Eighty and older	0.000	12.528	3.046	51.537
Hospital admission sector				
Clinic/ward		1.0		
Intensive Care Unit	0.005	3.654	1.485	8.994
Number of days in first hospital admission				
Median (1^{st}-3^{rd} quartile)	0.013	1.086	1.022	1.116
Risk stratification (n=472)				
Green		1.0		
Yellow	0.015	1.357	1.103	4.203
Red	0.009	2.677	1.790	9.064
Lung Involvement – Tomographic Pattern (n=483)				
Lower than 50% (< 50%)		1.0		
Between 50 and 75%	0.456	1.258	0.858	2.304
Greater than 75% (> 75%)	0.005	1.919	1.272	3.108
Ventilatory pattern (n=750)				
Dyspnea with respiratory effort	<0.001	6.530	2.528	13.837
Dyspnea without respiratory effort	0.366	1.383	0.986	3.591
No dyspnea		1. 0		
High concentration O^2 mask (n=761)				
Yes	0.009	2.727	1.364	7.199
No		1. 0		
Evolution				
ULT cardiac dysfunction (n=765)	0.003	3.261	1.805	8.441
ULT acute renal failure (n=776)	<0.001	7.811	2.805	13.875
ULT pulmonary sepsis (n=770)	<0.001	5.514	2.176	12.336
Acute renal failure (n=773)				
Yes, no need for dialysis	0.008	7.146	3.460	20.757
Yes, in need of dialysis	<0.0001	15.893	11.506	26.590
No ULT		1. 0		
Previous illnesses B				
Chronic obstructive pulmonary disease	0. 007	1. 936	1. 472	6. 380

Table 2 – Cont.

Variables	P	Unadjusted Odds Ratio		
		OR	95%CI	
Final model				
Age group (n=795)				
Up to 49 years old		**1. 0**		
From 50 to 59	0.617	0.673	0.142	3. 185
From 60 to 69	0.914	1.075	0.290	3. 985
From 70 to 79	0.001	7.299	2.165	22.602
Eighty and older	0.000	13.564	8.409	28.959
Hospital admission sector				
Clinic/ward		1.0		
Intensive Care Unit	0.003	3.742	1.551	9.028
Ventilatory pattern (n=750)				
Dyspnea with respiratory effort	<0.001	9.061	6.240	18.894
Dyspnea without respiratory effort	0.409	1.974	0.224	5.502
No dyspnea		1.0		
Evolution				
ULT cardiac dysfunction (n=765)	0.009	3.261	1.805	8.441
ULT acute respiratory failure (n=776)	0.000	7.811	2.805	13.875
Acute renal failure (n=773)				
Yes, no need for dialysis	0.000	7.351	2.688	20.105
Yes, in need of dialysis	0.000	25.421	6.243	103.523
No ULT		1.0		

*MD: Missing data; †ULT: ultrafiltered; ‡Regression model parameters; §Starting model: R2 from Nalgelkerke =0.586; Cox & Nel=0.317; 2LL=175.358; ||Hosmer-Lemeshow test (Chi square (8)=11.855; p=0.158; ¶ Confusion matrix: Total 97.1%; **Final model: R2 from Nalgelkerke =0.577; Cox & Nel=0.312; 2LL=178.443; ††Hosmer-Lemeshow test (Chi square (8)=10.029; p=0.263; ‡‡ Confusion matrix: Total 92.1%.

The binary logistic regression model aimed to investigate the impact of chronic diseases on death, controlling for possible confounding factors. In this study, the age group presented this characteristic. Previous illnesses with a representative number of cases (n ≥ 50) were considered for the regression models. In the new analyses, controlled exclusively by age group, COPD lost its explanatory power [OR: 1.390; 95%CI: 0.817 – 2.366; p=0.224], being the only disease initially proven to be representative [OR: 1.943; 95%CI: 1.213 – 4.522], i.e., age group stands out as a potential predictor of death in this population and with the variables analyzed. Other previous illnesses were also analyzed as a predictive factor for death, considering control by age group and diabetes as well as age group, DM and hypertension. However, the results remained non-significant, as shown in Table 3.

Regarding age group, the evolution of some disease burdens was compared, and there is evidence that patients aged 65 or over are associated with cardiac dysfunction (p=0.013) (16.8%) (n=18), acute renal failure (p=0.007) (55.0%) (n=61), and pulmonary sepsis (p=0.008) (51.4%) (n=56).

Regarding the analysis that compares different age groups with disease incidence, the age group of 65 years and over presents a significant association with DM (p=0.005), corresponding to 46.4% (n=52), hypertension (p<0.001), corresponding to 71.4% (n=80), COPD (p<0.001), corresponding to 24.1% (n=27), and congestive heart failure (p=0.008), corresponding to 15.2% (n=17). Furthermore,

it was observed that patients aged up to 64 years are significantly associated with the presence of obesity (p=0.008), reaching 21.8% (n=24).

Table 3 – Binary logistic regression models for each of the diseases (n ≥ 50) as independent variables to predict the outcome of death, with control for age group, diabetes and hypertension. Florianópolis, SC, Brazil, 2021 (n=799).

Regression models	Unadjusted Odds Ratio			
	p [B]	OR	95%CI	
Age-controlled models				
Diabetes	0.256	0.862	0.543	1.177
Hypertension	0.122	0.884	0.602	1.297
Chronic obstructive pulmonary disease	0.224	1.390	0.817	2.366
Congestive heart failure	0.720	1.120	0.602	2.083
Obesity	0.532	0.810	0.418	1.569
Smoking	0.304	0.724	0.391	1.341
Models controlled for age group and diabetes				
Hypertension	0.319	1.064	0.711	1.590
Chronic obstructive pulmonary disease	0.249	1.368	0.803	2.333
Congestive heart failure	0.709	0.888	0.477	1.654
Obesity	0.557	1.220	0.629	2.367
Smoking	0.286	1.401	0.754	2.602
Controlled models for age group and diabetes and hypertension				
Chronic obstructive pulmonary disease	0.236	1.383	0.809	2.364
Congestive heart failure	0.673	1.145	0.611	2.148
Obesity	0.575	1.210	0.622	2.356
Smoking	0.293	1.395	0.750	2.540

*B: Significance level for logistic regression models; †MD: Missing data.

DISCUSSION

Our findings highlighted the clinical characteristics with the highest prevalence of previous diseases, with the most prevalent being hypertension, DM, obesity and COPD, corroborating other studies[13–15]. The results also showed that most patients were male and over 60 years of age, corroborating data from other studies[14–16]. In a study by Zangrillo *et al*.[15], most male patients were found with a mean age of 73.4 years (±12.7). Males had a more frequent occurrence of death than females, as observed in other studies[16–17]. In contrast with our finding, the study[18] that assessed health professionals observed higher rates in females, non-white individuals, younger age groups and states in northern Brazil.

Considering age, the proportion of deaths increased significantly in the age groups of 60 to 69 years, 70 to 79 years and 80 years or more, when compared to younger age groups. Older individuals have a higher mortality rate in relation to COVID-19, especially those with chronic diseases, which may be influenced by increased vulnerability of this population[19–20].

Regarding the mean age related to deaths, the findings showed that the patients who died had a mean age of 70 years (±13.3), similar to a study[21] in which deaths were related to a mean age of 68 years. In another study[22], patients with a mean age of 63.6 years (±16.2) died. Another study[23] used a multivariate regression model and showed that age was associated with mortality and

that the risk of death increased with each additional year of life. Corroborating this finding, a study[24] indicated that concomitant mortality risk analyzes were less significant; however, the risk rate increased proportionately with age for those aged 75 and older.

In relation to the hospital admission unit, patients admitted to the ICU presented an outcome with a greater chance of death, which was also frequently found in other studies[25]. It is worth noting that the higher number of deaths in the ICU may be related to the high demand and insufficient supply of beds in these locations, associated with the severity of these patients' clinical conditions and uncertainty regarding what criteria to establish for occupying available beds[26].

The prevalence of smoking also drew attention. The highest incidence of deaths with statistically significant differences were identified in people with COPD, chronic kidney disease and stroke. However, the results obtained did not contribute to the other variables present in the model in a representative way. In the new analyses, controlling exclusively by age group, COPD was the only disease that was initially representative, but lost its explanatory power, i.e., the age group stood out as a predictor of death.

Other previous illnesses were also analyzed to verify whether they could have been responsible for the deaths, considering control by age group and DM as well as age group, DM and hypertension. However, the results did not show statistically significant differences. These findings differ, in part, from another study[25], which associated the presence of heart disease, diabetes, hypertension and kidney disease with deaths from COVID-19, and autoimmune diseases were the only significant predictor of death after adjusting for age and sex.

In a study[27] that carried out a multivariate analysis of independent factors related to death, a prevalence of neurological diseases and neoplasms was found. Cerebrovascular disease and cancer[28] were also identified as factors most strongly associated with severe COVID-19 infection.

The presence of hypertension, DM, COPD and coronary disease is consistently associated with a higher risk of complications and death as well as advanced age[29]. In addition to the diseases mentioned, obesity was also highlighted as the most prevalent complication[30]. Studies indicate[31–32] DM, chronic kidney disease, chronic respiratory disease and cardiovascular diseases as the most frequent comorbidities in people who died due to COVID-19.

Regarding ventilation pattern, the presence of dyspnea and respiratory compromise was frequent in relation to the tomographic pattern, highlighting cases of 50% – 75% of the lung being affected. The main tomographic findings observed in patients with COVID-19 were: ground-glass opacities; ground-glass opacities associated with thickening of the interlobular septa, characterizing a mosaic paving pattern; and ground-glass opacities associated with consolidations[33]. The literature shows that the typical findings on chest computed tomography (bilateral ground-glass image of the lung parenchyma, consolidative pulmonary opacities) are compatible with pulmonary edema, which leads to worsening of clinical picture, admission to ICU and frequent death[34].

Ground glass opacities, which appear in both lungs and in multiple lobes, are the most frequently observed results in CT scans of COVID-19 cases, generally associated with acute respiratory distress syndrome[35]. A previous study[36] established a link between the degree of lung impairment and patients' need for ventilatory support. Furthermore, another study[37] indicated that the mean percentage of lung involvement on tomography was 55.4% among patients, and a greater extent of lung involvement was associated with a higher mortality rate, which was also observed in this study, in which patients with greater pulmonary involvement had a higher risk of death compared to those with less involvement.

As limitations of this study, the lack of data in medical records relating to certain variables is highlighted, making collection difficult. However, regarding missing information characterization, there was a random pattern (Missing completely at random, MCAR), i.e., there were missing data that did not impact the observed effects. The database is available for reuse[38]. Other issues that may

have caused bias are that patients admitted to a clinical unit and patients admitted to an ICU were analyzed. Data from tools used to predict mortality such as SAPS and SOFA and laboratory markers did not comprise this analysis.

CONCLUSION

The study was carried out and completed during 2020, before vaccines were available. Clinical, sociodemographic characteristics and predictors of death were analyzed in patients admitted to hospital with COVID-19 in two hospitals in southern Brazil. A higher prevalence of previous diseases was evidenced, particularly hypertension, DM, obesity and COPD. Advanced age was an important risk factor for hospital admission and death. Older patients were highly vulnerable. In the age group of 60 to 69 years, there was a seven times greater chance of death, and among individuals aged 80 and older, this chance increased to 13 times when compared to the age group up to 49 years.

Studies involving different populations can help build a clinical and sociodemographic portrait and understand the variables involved in occurrence of death in patients admitted to hospital with COVID-19. Furthermore, such studies can support actions by health teams, which promote the implementation of care for patients with COVID-19. We recommend that future studies can be conducted to elucidate the interrelationship of variables and predictors of death in patients with COVID-19, considering the emergence of new variants of the virus and the current availability of vaccines.

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NOTES

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CONFLICT OF INTEREST

There is no conflict of interest.

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