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CLINICAL OUTCOMES, USE OF INVASIVE MECHANICAL VENTILATION AND RENAL REPLACEMENT THERAPY OF ADULT AND ELDERLY PATIENTS HOSPITALIZED WITH COVID-19: A RETROSPECTIVE COHORT

RESULTADOS CLÍNICOS, USO DE VENTILAÇÃO MECÂNICA INVASIVA E TERAPIA RENAL SUBSTITUTIVA EM PACIENTES ADULTOS E IDOSOS HOSPITALIZADOS COM COVID-19: UMA COORTE RETROSPECTIVA

RESULTADOS CLÍNICOS, USO DE VENTILACIÓN MECÁNICA INVASIVA Y TERAPIA DE REEMPLAZO RENAL DE PACIENTES ADULTOS Y ANCIANOS HOSPITALIZADOS CON COVID-19: UNA COHORTE RETROSPECTIVA

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ABSTRACT

Objective: To compare the clinical and epidemiological outcomes of 1,266 patients hospitalized with COVID-19 in a private hospital in northeastern Brazil to identify differences according to age group. Methods: This observational, descriptive, and retrospective cohort study was carried out with patients hospitalized with COVID-19 in a private hospital in northeastern Brazil from May 2020 to March 2021. Outcomes such as length of stay, hospital stay, discharge, death, admission to the Intensive Care Unit (ICU), use of invasive mechanical ventilation (IMV), and renal replacement therapy were analyzed according to age group (731 adults and 535 older people ≥65 years old). Results: Elderly patients had a median age of 76 (70 – 83) years (p=0.000). The median length of stay was 12 (7 – 19) (p=0.000). Most outcomes, such as ICU admission (58.2%) (p=0.000), use of renal replacement therapy (81.6%) (p=0.000), use of mechanical ventilation (73.2%) (p =0.000)

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and death (86%) (p=0.000), occurred in the elderly. The variables age greater than or equal to 65 years (p=0.000), use of IMV (p=0.000), and ICU admission (p=0.000) were associated with mortality. Conclusion: Older people are at greater risk of hospitalization, remaining in the hospital for a more extended period, and progressing to the need for ICU admission, renal replacement therapy, and mechanical ventilation. Knowledge of the epidemiological profile of the population hospitalized for COVID-19 is an essential source of information for planning and monitoring health activities.

Keywords: SARS-CoV-2. Hospital Mortality. Epidemiology. Fatal outcome. Population health.

RESUMO
Objetivo: Comparar os desfechos clínicos e epidemiológicos de 1.266 pacientes hospitalizados com COVID-19 em um hospital privado no nordeste do Brasil para identificar diferenças de acordo com a faixa etária. Métodos: Este estudo de coorte observacional, descritivo e retrospectivo foi realizado com pacientes hospitalizados com COVID-19 em um hospital privado no nordeste do Brasil de maio de 2020 a março de 2021. Desfechos como tempo de internação, tempo de internação, alta, óbito, admissão na Unidade de Terapia Intensiva (UTI), uso de ventilação mecânica invasiva (VMI) e terapia renal substitutiva foram analisados de acordo com a faixa etária (731 adultos e 535 idosos ≥65 anos). Resultados: Os pacientes idosos apresentaram mediana de idade de 76 (70 – 83) anos (p = 0,000). A mediana de tempo de internação foi de 12 (7 – 19) anos (p = 0,000). A maioria dos desfechos, como admissão em UTI (58,2%) (p=0,000), uso de terapia renal substitutiva (81,6%) (p=0,000), uso de ventilação mecânica (73,2%) (p=0,000) e óbito (86%) (p=0,000), ocorreu em idosos. As variáveis idade maior ou igual a 65 anos (p=0,000), uso de VMI (p=0,000) e admissão em UTI (p=0,000) estiveram associadas à mortalidade. Conclusão: Idosos apresentam maior risco de hospitalização, permanecendo internados por período mais prolongado e evoluindo para necessidade de admissão em UTI, terapia renal substitutiva e ventilação mecânica. O conhecimento do perfil epidemiológico da população hospitalizada por COVID-19 é fonte essencial de informações para o planejamento e monitoramento das ações em saúde.

Palavras-chave: SARS-CoV-2. Mortalidade Hospitalar. Epidemiologia. Desfecho fatal. Saúde da população.

RESUMEN
Objetivo: Comparar los resultados clínicos y epidemiológicos de 1266 pacientes hospitalizados con COVID-19 en un hospital privado del noreste de Brasil para identificar diferencias según el grupo de edad. Métodos: Estudio de cohorte observacional, descriptivo y retrospectivo, realizado con pacientes hospitalizados con COVID-19 en un hospital privado del noreste de Brasil, entre mayo de 2020 y marzo de 2021. Se analizaron resultados como la duración de la estancia hospitalaria, la estancia hospitalaria, el alta, la mortalidad, el ingreso a la Unidad de Cuidados Intensivos (UCI), el uso de ventilación mecánica invasiva (VMI) y la terapia de reemplazo renal, según el grupo de edad (731 adultos y 535 personas mayores ≥65 años). Resultados: La mediana de edad de los pacientes mayores fue de 76 (70-83) años (p = 0,000). La mediana de la estancia hospitalaria fue de 12 (7-19) años (p = 0,000). La mayoría de los resultados, como ingreso en UCI (58,2%) (p=0,000), uso de terapia de reemplazo renal (81,6%) (p=0,000), uso de ventilación mecánica (73,2%) (p=0,000) y fallecimiento (86%) (p=0,000), se presentaron en

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adultos mayores. Las variables edad mayor o igual a 65 años (p=0,000), uso de VMI (p=0,000) e ingreso en UCI (p=0,000) se asociaron con mortalidad. Conclusión: Las personas mayores presentan un mayor riesgo de hospitalización, permaneciendo hospitalizadas durante un período más prolongado y progresando hacia la necesidad de ingreso en UCI, terapia de reemplazo renal y ventilación mecánica. El conocimiento del perfil epidemiológico de la población hospitalizada por COVID-19 es una fuente esencial de información para la planificación y el seguimiento de las actividades sanitarias.

Palabras clave: SARS-CoV-2. Mortalidad hospitalaria. Epidemiología. Desenlace fatal. Salud poblacional.

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INTRODUCTION

At the end of 2019, pneumonia with an unknown etiological factor was initially discovered in Wuhan, China, and declared a COVID-19 pandemic in March 2020 by the World Health Organization (WHO). From then on, this disease was caused by a new virus, with high mutation rates and high transmissibility, characterized by the severe acute respiratory syndrome coronavirus 2 (Sars-Cov-2) and spread rapidly around the world.[1]

The pandemic has become a global challenge for health systems, with socioeconomic differences evident and variations in transmissibility rates between different regions. Countries with a higher level of socioeconomic development found it easier to contain the spread of the disease.[2]

In Brazil, this disease was responsible for 37,319,254 cases and 700,556 confirmed deaths by April 2023. It is noteworthy that 7,336,349 cases and 134,846 deaths occurred in the Northeast region, which has one of the highest mortality rates in the country, only lower than the Southeast region.[3]

In this context, the variation in the distribution of COVID-19 cases between locations reflected the economic, environmental, and social diversities between different regions of the country.[4] The divergence between demographic characteristics, access to the health system, and infrastructure in different areas became evident in this scenario. This situation was also severe in the largest state in the Northeast, Bahia, where most deaths occurred in public institutions, compared to private and philanthropic hospitals, so socioeconomic variables were decisive for mortality and morbidity from COVID-19.. [5,6]

Initially, strategies to mitigate the pandemic scenario focused on testing suspected patients and prioritizing severe cases in inpatient units due to the limited number of tests. Before vaccination, other measures included the adoption of social distancing policies and restrictions on the movement of people, in addition to the construction of field hospitals and the opening of new beds in various locations across the country.[7–9]

Despite efforts, public policies were characterized by the unequal distribution of resources, both in the socio-spatial sphere and between the Brazilian public and private sectors. Most of the resources were concentrated in the private sector, with idle and deactivated beds compared to the waiting list in the Unified Health System. Allocation inequality also occurred between regions of the country, with more resources being allocated to the South and Southeast than other locations, such as the North. This difference in distribution is historical and based on determinants of resource allocation that

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favor more developed regions of the nation, such as the removal of bed stock..[10,11] This dichotomy brought limitations to the effective fight against the pandemic, as discrepancies in access to health systems interfere with hospital mortality rates.[12]

In this scenario, observation of the epidemiological situation emerges as a tool to target resources effectively. This includes visualizing the evolution and impact of the pandemic at a local level to produce information that guides the development of coping strategies focused on the particular conditions of each region.

Is the clinical-epidemiological profile and clinical evolution of patients with COVID-19 admitted to a private hospital in northeastern Brazil related to age? To answer this question, this study aims to compare the clinical and epidemiological outcomes of 1,266 patients hospitalized with COVID-19 in a private hospital in northeastern Brazil to identify differences according to age group.

METHODS

This observational, descriptive, and retrospective cohort study was carried out following the recommendations of the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE).

The present investigation was conducted in a private hospital in the city of Salvador (Bahia), with the electronic medical records of adult and elderly patients admitted to the unit with a diagnosis of COVID-19 from May 2020 to March 2021.

Medical records from two different groups were analyzed. Group 1: adult individuals (≥18 years old) of both sexes with 731 individuals; Group 2: Older people (>65 years old) of both sexes with 535 people. All patients evaluated were hospitalized with a diagnosis of COVID-19 proven by a specific test to identify the virus.

Medical records of adult patients (≥18 years old) admitted to the hospital with SARS-CoV-2 infection confirmed by reverse transcriptase reaction followed by polymerase chain reaction (RT-PCR) were included. The exclusion criterion was age under 18 years old.

Adults and elderly people (≥65 years) were compared, observing the primary outcome of death or discharge due to COVID-19 and the secondary outcomes of admission to the intensive care unit (ICU), use of oxygen, invasive mechanical ventilation (IMV), and time of permanence. A comparison of the number of deaths and hospital discharges in the two populations, adult and elderly, was also carried out, as the potential confounding factor

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for this study is the age of the patients. Comorbidities were identified upon admission based on the history prior to hospitalization.

Patient data were retrospectively retrieved from the medical records of all patients with COVID-19 admitted to the hospital during the period. The following data were collected: age, sex, comorbidities (chronic respiratory disease, chronic obstructive pulmonary disease, asthma, cerebrovascular disease, heart disease, arterial hypertension, diabetes, renal failure, immunosuppressed, obesity, dementia), length of hospital stay, discharge, death, ICU admission, use of IMV and renal replacement therapy.

This research was submitted and approved by the Research Ethics Committee of Hospital São Rafael (consubstantiated approval opinion no. 4.868.718, CAAE 48612121.3.0000.0048) and complied with resolution no. 466/2012 of the National Health Council of the Ministry of Health, which deals with research involving human beings. Due to the impossibility of contacting patients and their representatives, the non-identification of the patient, and the obligation of professional secrecy, the research ethics committee authorized the exemption of an Informed Consent Form.

Data tabulation was done using the Microsoft Excel 2016 program and R Software version 4.2.2. was used for statistical tests. For discrete and continuous quantitative variables, measures of central tendency (mean, median) and standard deviation were calculated. Frequency distribution analysis of categorical variables was also carried out to evaluate the database's consistency and the research sample's characterization with percentages.

The results of the population with discharge and death/adults and older people were compared, the relative risk for mortality was calculated, and for the association of categorical variables, the Chi-Square test, with Fisher's exact correction, with a significance level of $p \leq 0.05$. Logistic regression was used in the relationship with mortality for categorical variables.

RESULTS

One thousand three hundred thirty-nine patients hospitalized with COVID-19 were evaluated between May 2020 and March 2021; 1,266 met the inclusion criteria and were added to the study (Figure1).

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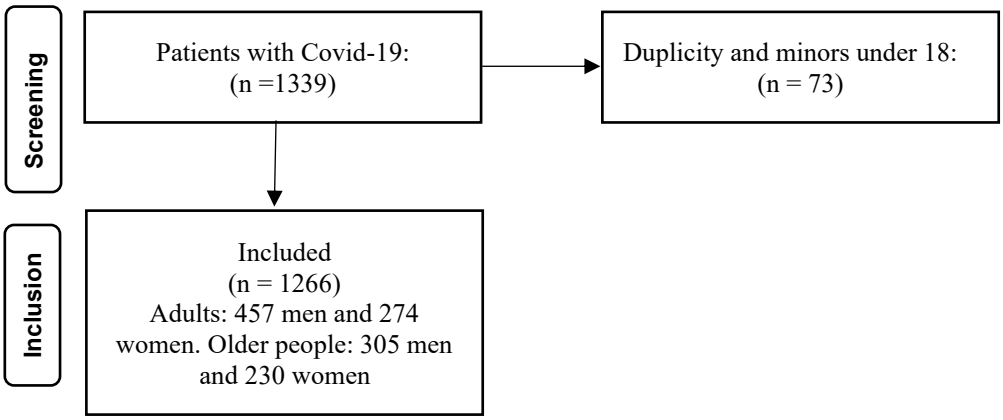
Figure 1. Selection flow diagram



The population sample was evaluated in two groups, one of adults (n=731), whose median age was 50 (41 – 57) years, and the other of older people (n=535), with a median age of 76 (70 – 83) years (p=0.000). The analysis demonstrated that more than 50% of the men admitted were adults (60.0%). The same occurred among women, whose percentage of adults was 54.4% (p=0.048) (Table.1).

Table 1. Characterization of the population hospitalized with COVID-19 from May 2020 to March 2021.

Variables	Adults (731) n (%)	Elderly (535) n (%)	Total (1266) n (%)	p
Sex				
Masculine	457 (60,0)	305 (40,0)	762 (100,0)	0,048
Feminine	274 (54,4)	230 (45,6)	504 (100,0)	
Age (years)*	50 (41 – 57)	76 (70 – 83)	60 (47 – 74)	0,000
Outcome				
High	707 (64,6)	388 (35,4)	1095 (100,0)	0,000
Death	24 (14,0)	147 (86,0)	171 (100,0)	
Length of stay (days)*	7 (5 – 11)	12 (7 – 19)	8 (5 – 14)	0,000
ICU admission				
Yes	230 (41,8)	320 (58,2)	550 (100,0)	0,000
No	501 (70,0)	215 (30,0)	716 (100,0)	
Comorbidities				
Chronic respiratory disease	11 (29,7)	26 (70,3)	37 (100,0)	0,001
COPD	5 (11,6)	38 (88,4)	43 (100,0)	0,000
Asthma	44 (71,0)	18 (29,0)	62 (100,0)	0,031
Structural lung diseases+	2 (66,7)	1 (33,3)	3 (100,0)	1,000
Cerebrovascular disease	14 (14,9)	80 (85,1)	94 (100,0)	0,000
Heart diseases	36 (18,0)	164 (82,0)	200 (100,0)	0,000
Arterial hypertension	239 (39,8)	362 (60,2)	601 (100,0)	0,000
Diabetes	139 (37,2)	235 (62,8)	374 (100,0)	0,000
Renal insufficiency	8 (10,5)	68 (89,5)	76 (100,0)	0,000
Immunosuppressed	7 (87,5)	1 (12,5)	8 (100,0)	0,177
Obesity	169 (70,1)	72 (29,9)	241 (100,0)	0,000
Insanity	2 (5,1)	37 (94,9)	39 (100,0)	0,000
Others	188 (42,0)	260 (58,0)	448 (100,0)	0,000
No comorbidities	317 (82,1)	69 (17,9)	386 (100,0)	0,000
Use of renal replacement therapy				
Yes	14 (18,4)	62 (81,6)	76 (100,0)	0,000

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No	717 (60,3)	473 (39,7)	1190 (100,0)	
Use of mechanical ventilation				
Yes	59 (26,8)	161 (73,2)	220 (100,0)	0,000
No	672 (64,2)	374 (35,8)	1046 (100,0)	
VTE prophylaxis				
Yes	689 (57,8)	503 (42,2)	1192 (100,0)	0,860
No	42 (56,8)	32 (43,2)	74 (100,0)	

* Median (Q1 – Q3).
+Pearson test with Yates continuity correction.
Acronyms: VTE (Venous Thromboembolism Prophylaxis)

Regarding the outcome, discharge or death, it was found that more than half of the patients discharged after the hospitalization period were adults (64.6%), while 35.4% were elderly. On the other hand, of the patients who died, 86.0% were elderly, so mortality in this group was higher. The median length of stay was also longer among the elderly group, 12 (7 – 19) days, while in the adult group, the median was 7 (5 – 11) days (p=0.000). Most of the patients who required admission to the Intensive Care Unit (ICU) were elderly (58.2%). On the other hand, of the patients who were not transferred to the ICU, 70% were adults.

Regarding pre-existing comorbidities, elderly patients had a higher prevalence of chronic respiratory diseases, COPD, cerebrovascular diseases, heart disease, high blood pressure, diabetes, kidney failure, dementia, and other diseases than adults. At the same time, the diagnosis of asthma was more common in adults than in the elderly (p=0.000). The difference in the prevalence of immunosuppression and structural lung diseases was not statistically significant between the groups of patients evaluated (Table A.1). More patients in the elderly group used renal replacement therapy (81.6%) and mechanical ventilation (73.2%) compared to adults (Table 1).

In total, 171 patients died, while 1,095 were discharged from hospital. Only the association of obesity with mortality did not reach statistical significance. The elderly population with comorbidity admitted to the ICU and using mechanical ventilation had a high relative risk of death (Table 2).

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Table 2. Association of mortality with the characteristics of the population hospitalized with COVID-19 from May 2020 to March 2021.

Variables	Death (171) n (%)	High (1095) n (%)	RR	p (x^2)
Elderly				
Yes	147 (27,5)	388 (72,5)	8,37	0,000*
No	24 (3,3)	707 (96,7)		
Comorbidities				
Yes	171 (19,4)	709 (80,6)	-	-
No	0 (0,0)	386 (100,0)		
Obesity				
Yes	33 (13,7)	208 (86,3)	1,02	0,917
No	138 (13,5)	887 (86,5)		
ICU admission				
Yes	163 (29,6)	387 (70,4)	26,52	0,000*
No	8 (1,1)	708 (98,9)		
Use of mechanical ventilation				
Yes	147 (66,8)	73 (33,2)	29,12	0,000*
No	24 (2,3)	1022 (97,7)		
Use of renal replacement therapy				
Yes	73 (96,1)	3 (3,9)	11,66	0,000*
No	98 (8,2)	1092 (91,8)		

* Statistically significant. Acronyms: ICU (intensive care unit), RR (relative risk).

When the variables were evaluated using the logistic regression technique, age greater than or equal to 65 years, the use of IMV and ICU admission remained associated with mortality (Table 3).

Table 3. Factors associated with mortality (logistic regression) in COVID-19 patients admitted from June 2020 to March 2021.

	Coefficients	Standard Error	Z Test	p-value
Intercept	-5,8801	0,4698	-12,517	< 2e-16*
Age ≥65 years	2,0653	0,2919	7,074	1,5e-12*
Sex	0,4776	0,2695	1,772	0,07643
VMI usage	3,6612	0,3100	11,808	< 2e-16*
ICU admission	1,1812	0,4436	2,663	0,00775*

* Statistically significant. Acronyms: ICU (intensive care unit), IMV (invasive mechanical ventilation).

DISCUSSION

The present study showed that, if diagnosed with COVID-19, older people are at greater risk of hospitalization, remaining in the hospital for a more extended period, and progressing to the need for ICU admission, renal replacement therapy, and mechanical ventilation. Except for asthma, most of the comorbidities assessed in the study were more prevalent in the elderly. Elderly patients had a higher prevalence of chronic respiratory diseases, chronic obstructive pulmonary disease (COPD), cerebrovascular diseases, heart disease, high blood pressure, diabetes, kidney failure, dementia, and other diseases.

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Furthermore, mortality from the disease studied was related to age greater than or equal to 65 years, the use of IMV, and admission to the ICU.

Studies show that males are more affected by COVID-19, with higher hospitalization and mortality rates.[13,14] This condition of the general population was reflected in the study sample, in which the number of men exceeded the number of women hospitalized among adults and the elderly. This is also in line with the total number of suspected and hospitalized cases reported up to Epidemiological Week 147 in Brazil, in which there was a higher incidence in men.[3]

Among the cases computed in 2023, Brazil's most affected age group was 60 to 79..[3] It is known that age over 50 is an independent predictor of in-hospital mortality.[15] The present study corroborated these data in the condition that led to hospital discharge or death, so being elderly contributed to both more significant mortality and more extended hospitalization.

The hypothesis that age over 50 is an independent risk factor for admission to the ICU was confirmed by the data obtained in the study in question, in which the elderly group had a higher rate of admission to the ICU.[15] The more extraordinary occurrence of ICU admission can be explained by the high prevalence and overlap of comorbidities in this studied sample, which may have contributed to the clinical worsening of the infection, with a greater need for intensive support.

As expected for this age group, older people had a higher prevalence of chronic respiratory diseases, such as COPD, cerebrovascular diseases, heart disease, high blood pressure, diabetes, kidney failure, dementia, and other diseases. According to literature data, chronic conditions, such as hypertension and DM, lead to a worse prognosis for patients hospitalized for COVID-19.[13,16] The high prevalence of these comorbidities in the studied sample increases the risk of adverse outcomes. It is also noteworthy that these data highlight the need for interventions in primary health to control these conditions in the population and reduce their severity, in addition to improving the survival of these patients.

COVID-19 can either make it difficult to treat patients who already have kidney damage and increase their mortality rate or cause new kidney damage, so treatment needs to be done as early as possible.. [17] Furthermore, kidney disease is one of the independent risk factors for in-hospital mortality.. [15] A similar result was found in the present study (or in the population studied), in which individuals who required renal replacement therapy had a greater chance of death.

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Patients with COVID-19 have a high probability of developing thromboembolic complications, so screening procedures and antithrombotic strategies should be applied whenever possible.[18] The high number of patients who used prophylaxis against venous thromboembolism (VTE), with rates close to 100%, similar between groups and adults and older people, reflects the adequacy of the hospital protocol to the situation encountered

International studies demonstrate that advanced age is associated with a higher risk of mortality.[13] In Brazil, in addition to the current study, in which there was a more significant occurrence of deaths among the elderly (89.02% of total deaths), this brightness was also found in research carried out at a university hospital in Rio de Janeiro in which age was one of the main factors associated with death, in addition to neoplasia and invasive ventilatory support.[19]

The present study was carried out by collecting and evaluating digitalized and physical medical records, which presents limitations inherent to retrospective studies, such as the possibility of confounding factors, as other factors may be present and not have been measured. In this type of study, there is also the possibility of selection and classification biases and the need for prior delimitation of the data to be collected, temporal relationships that are difficult to assess, and a lower level of evidence compared to prospective studies.

Furthermore, the study focused on just one center, which was private, allowing for geographic and socioeconomic selection biases. Therefore, caution is recommended when analyzing and extrapolating the data to the general population. It is also suggested that prospective studies be carried out to evaluate better the epidemiological profile of patients hospitalized for COVID-19 in Brazilian public or private treatment centers.

CONCLUSIONS

In addition to characterizing the population hospitalized with COVID-19 in a hospital in Bahia, the data from the present study allow us to verify essential predictors for the mortality of these patients. Older people are at greater risk of hospitalization, remaining in the hospital for more extended periods, and progressing to the need for ICU admission, renal replacement therapy, and mechanical ventilation. Knowledge of this clinical-epidemiological profile is an essential source of information for planning and monitoring activities carried out by public and private institutions that aim to modify adverse outcomes related to the disease.

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