JOURNAL HEALTH NPEPS

http://dx.doi.org/10.30681/252610105926 ARTIGO ORIGINAL

COVID-19 and death of older adults in the Northeast region of Brazil: a survival analysis

COVID-19 y muerte de ancianos en la región Nordeste de Brasil: un análisis de supervivencia

COVID-19 e óbito de pessoas idosas na região Nordeste do Brasil: uma análise da sobrevivência

Marcelo de Maio Nascimento[1]

ABSTRACT

***Objective**: to analyze survival and factors associated with increased risk of death for older adults diagnosed with COVID-19, living in the Northeast region of Brazil. **Method**: retrospective observational study developed with secondary data provided by the Brazilian Ministry of Health, between June 14 and December 26, 2020. The Kaplan-Meyer method, the time-dependent cox regression model was used, including covariates (age, sex, skin color, comorbidities, admission to the ICU, ventilatory support). **Results**: out of 9,306 individuals analyzed, 55.9% died and 44.1% survived. The highest risk of death was observed for those aged 80-89 (HR=1.95), brown-skinned (HR=1.99), with immunodeficiency (HR=1.259) or kidney disease (HR=1.147), admitted to the ICU (HR=1,795) and in use of ventilatory support (HR=1606). **Conclusion**: among older adults residing in the Northeast region of Brazil, there was a higher risk of death from COVID-19 for octogenarians, brown-skinned, with comorbidities, hospitalization in the ICU, followed by the use of ventilatory support. The creation of health prevention strategies that identify older adults with these profiles is suggested to prevent deaths in future pandemic situations.*

***Descriptors**: Epidemiology; Risk Factors; Coronavirus; SARS-CoV-2.*

RESUMEN

***Objetivo**: analizar la supervivencia y los factores asociados con un mayor riesgo de muerte en ancianos diagnosticados con COVID-19, residentes en la región Nordeste de Brasil. **Método**: estudio observacional retrospectivo desarrollado con datos secundarios proporcionados por el Ministerio de Salud de Brasil, entre el 14 de junio y el 26 de diciembre de 2020. Se utilizó el método de Kaplan-Meyer, modelo de regresión de Cox-*

[1]Graduação em Educação Física. Doutor em Ciências do Esporte. Docente Adjunto da Universidade Federal do Vale do São Francisco (UNIVASF). Petrolina, Pernambuco, Brasil. E-mail: marcelo.nascimento@univasf.edu.br ORCID ID: https://orcid.org/0000-0002-3577-3439 **Autor para Correspondência** - Endereço: José de Sá Maniçoba S/N, Centro, 56304-917. Petrolina (PE), Brasil.

tempo-dependiente, incluyendo covariables (edad, sexo, color de piel, comorbilidades, ingreso en UCI, soporte ventilatorio). ***Resultados****: 9.306 personas analizadas, el 55,9% falleció y el 44,1% sobrevivió. El mayor riesgo de muerte se observó en las personas de 80 a 89 años (HR=1,95), color de piel morena (HR=1,99), inmunodeficiencia (HR=1,259), enfermedad renal (HR=1,147), con ingreso en UCI (HR=1.795) y uso de soporte ventilatorio (HR=1606).* ***Conclusión****: entre los ancianos residentes en la región Nordeste de Brasil, hubo mayor riesgo de muerte por COVID-19 para los octogenarios, color de piel morena, que tenían comorbilidades, hospitalización en la UCI, seguido del uso de soporte ventilatorio. Se sugiere la creación de estrategias de prevención en salud que identifiquen a las personas mayores con estos perfiles para prevenir muertes en futuras situaciones pandémicas.*
Descriptores*: Epidemiología; Factores de Riesgo; Coronavirus; SARS-CoV-2.*

RESUMO
Objetivo: analisar a sobrevida e os fatores associados ao maior risco de morte para idosos com diagnóstico de COVID-19, residentes na região Nordeste do Brasil. **Método**: estudo observacional retrospectivo desenvolvido com dados secundários fornecidos pelo Ministério da Saúde do Brasil, entre 14 de junho a 26 de dezembro de 2020. Utilizou-se o método de Kaplan-Meyer, o modelo de regressão de cox tempo-dependente, incluindo covariáveis (idade, sexo, cor da pele, comorbidades, admissão na UTI, suporte ventilatório). **Resultados**: 9.306 indivíduos foram analisados; 55,9% morreram e 44,1% sobreviveram. O maior risco de ocorrência de óbitos foi observado para aqueles entre 80-89 anos (HR=1,95), cor da pele parda (HR=1,99), imunodeficiência (HR=1,259), doença renal (HR=1,147), com admissão em UTI (HR=1,795) e uso de suporte ventilatório (HR=1.606). **Conclusão**: entre idosos residentes na região Nordeste do Brasil, constatou-se maior risco de óbitos por COVID-19 para octogenários, cor parda, que apresentaram comorbidades, internação em UTI, seguido do uso de suporte ventilatório. Sugere-se a criação de estratégias de prevenção em saúde que identifiquem idosos com esses perfis para prevenir óbitos em futuras situações de pandemia.
Descritores: Epidemiologia; Fatores de Risco; Coronavírus; SARS-CoV-2.

INTRODUCTION

The Severe Acute Respiratory Syndrome (SARS-CoV2) responsible for COVID-19 is the most severe epidemic that humanity has ever experienced. It is known that the lethality of the virus increases considerably from age 70 and up[1]. Older adults are particularly at risk for severe viral infection[2,3] and death from infectious diseases[4]. This vulnerability stems from the greater number of comorbidities and the low immunological capacity that the older population holds. Currently, older adult cases with SARS-CoV2 are associated with admission to the intensive care unit (ICU), intubation, and a high probability of death[5,6]. The new coronavirus, besides being lethal, has been overloading the Brazilian and global health systems. In this way, conducting

studies to monitor the cases of COVID-19 in different regions of the Brazilian territory is important for the consolidation of effective strategies to reduce and/or combat the virus.

In Brazil, from the first confirmed case of COVID-19 in the country, in February 2020, to the epidemiological week (EW) 52 (12/20/2020 to 12/26/2020), there were 195,725 deaths[7]. According to data from the Ministry of Health (MS)[8], in EW 52 the accumulated rate of deaths of older adults by age group was high, 44,023 cases (60-69 years old), 48,515 (70-79 years old), 35,916 (80-89 years old), and 9,877 deaths (≥90 years old). Parallel to this, it is known that the cases of SARS-CoV2 present different behavior in each region of the national territory[9-11].

The Northeast region, for example, which is the target of this investigation, until EW 52, showed 108,028 cases of COVID-19, exhibiting the second highest rate in Brazil, with 42,987 deaths (incidence of 3,248 cases/100 thousand inhabitants, and mortality of 83 deaths/100 thousand inhabitants)[8].

There is evidence that the new coronavirus exhibits genetic diversity and rapid evolution[12], therefore, its characteristics may vary according to the demographic and epidemiological profile of each region[13]. Thus, this study is justified by the need to access information and create procedures that summarize the factors responsible for the mortality of older adults by COVID-19 in the eight states that make up the Northeast region of Brazil. The results can contribute to the creation of specific interventions that can minimize the lethality of the virus with this population[10].

This study aimed to analyze survival and factors associated with a higher risk of death for older adults diagnosed with COVID-19, living in the Northeast region of Brazil.

METHOD

This is a retrospective observational survival analysis type study developed with secondary data provided by the Brazilian Ministry of Health (MS)[14] regarding older adults diagnosed with COVID-19 in the eight states of the national territory that make up the Northeast region. The data used were obtained from the online database Sivep-Gripe[7]. The system consolidates all notifications about COVID-19 cases in Brazil, including

deaths. The inclusion criteria were: age ≥60, both sexes, only confirmed cases of SARS-CoV-2 infection, with or without death, time cut between EW 25 (June 14 to June 20) and EW 52 (December 20 to December 26).

The severity of COVID-19 cases was established according to MS guidelines[15] specific for the diagnosis and treatment of SARS-CoV-2: a) Symptoms: dyspnea/respiratory distress or persistent pressure in the chest, or O_2 saturation <95%, bluish color of lips or face; b) Time: acute respiratory condition characterized in the last seven days by two or more signs and symptoms of fever (≥37.3°C, even if mentioned), chills, sore throat, headache, cough, runny nose, changes in smell or taste; and c) Evidence: laboratory test for SARS-CoV-2 (PCR-positive), rapid test for IgM and IgG antibodies or immunoassay. The following exclusion criteria were adopted: a) absence of one or more records considered important for survival analysis; b) death certificate with notification (1) dated on the same day of the patient's death in the MS online system, or (2) before confirmation of the first symptoms of COVID-19.

The set of information collected in the MS database belongs to patients seen in hospitals and health care units, registered in a registration form[7]. The dependent variable was established considering the (1) date of detection of the first symptoms of COVID-19 by the health system, and the (2) date of closure (date of discharge or death of the patient). The measure chosen to assess the time elapsed until the outcome was the number of days. The following independent variables were considered: a) age groups 60-69, 70-79, 80-89, and <90, b) both sexes; c) skin color; d) comorbidities (chronic cardiovascular, liver, neurological, chronic renal disease, asthma, diabetes mellitus, pneumopathy, immunodeficiency, obesity; e) ICU admission, and f) use of ventilatory support. The cases were divided into two groups, entitled as alive and deaths by COVID-19. The information from this study was collected in the MS online system between February 2 and 5, 2021.

The normality of the data was obtained by the Shapiro-Wilk test. Continuous variables were evaluated by median and interquartile range (IQR), and categorical variables were presented as counts and percentages

(%). As the variables did not present a normal distribution, comparisons between alive and those who survived were performed using the Mann-Whitney test (counting variables) and x^2 (categorical variables). The Kaplan-Meier method was used to plot the survival curves, the graphs were used to test the proportional risk assumption. To better compare the curves throughout the temporal analysis, it was decided to present the results of two or more groups using the Log-rank, Breslow, and Tarone-Ware tests.

Therefore, a Cox proportional hazards model was constructed including covariables of interest (age, sex, skin color, comorbidities, ICU admission, use of ventilatory support), using a step-by-step process, that is, from a null model: only covariates with p-value <0.20 were included in the adjusted model. Initially, the data were organized in an excel spreadsheet, afterwards, the statistical analysis was performed in the SPSS program, version 24.0. The level of confidence adopted was a = 5%.

The present study was carried out with publicly accessible secondary data, published in the online database of the Brazilian MS[14], Sivep-Gripe[7], dispensing with the approval of an Ethics Committee in accordance with the Resolution nº 466/12 and Resolution nº. 510/16, Brazil[16].

RESULTS

Among the 531,491 individuals aged ≥60 present in the database, 9,306 (1.75%) met the inclusion criteria and were analyzed. Of these, 5,204 (55.9%) died from COVID-19, and 4,102 (44.1%) survived respiratory infection (Table 1). Regarding age, comparatively, there was a greater number of deaths among those in the age groups of 70-79, 80-89, and ≥90, with rates of 34.6%, 26.9%, and 10.0% respectively (p <0.001). The observed lethality rate was higher for individuals aged ≥90 (73.3%), and 80-89 (64.5%). When compared by gender, the proportion of deaths among women was 46.5%, and 53.5% for men, with a lethality rate of 54.3% and 57.4%, respectively (p = 0.003). In terms of skin color, information used to identify the individual's race, 74.6% were classified as brown, 17.6% white, 5.8% black, 1.7% Asian, and 0.2% indigenous (p = 0.203). Lethality was higher for indigenous (57.1%), followed by brown (56.3%), black (55.4%), white (55.1%), and Asian (47.2%) individuals.

Most deaths occurred in older adults with heart disease (60.2%) and diabetes (45.7%). Among those who died from COVID-19, heart disease (60.2%), diabetes mellitus (45.7%), kidney disease (8.6%), and neurological disease (7.1%) prevailed. The highest lethality rate was found for kidney disease (67.3%), pneumopathy (64.3%), and neurological disease (63.8%). All results showed a significant difference (p <0.001). Among older adults who died, 4497 (86.4%) required ventilatory support, while, in the group of survivors, 2773 (67.6%) used ventilation (p <0.001).

Of those who died, 3432 (65.9%) were hospitalized in ICU. Among the living, the number of hospitalizations was 1176 (71.3%) (p <0.001). The length of stay of those who died was 4 (0-140) days, while in the group of those who survived it was 4 (0-142) days (p = 0.597).

Figures 1-3 show the Kaplan-Meier survival graphs for the prognostic factors statistically significant. In general, in all graphs, the assumption of proportionality of risks was satisfied because, during the periods analyzed, the survival risk curves do not cross.

In Figure 1/A, it is observed that the risk is directly proportional to the age group. Comparatively, after 20 days, individuals aged 60-69 were 51% more likely to live than those of other age groups. Individuals aged ≥90, after 20 days, had a 40% lower probability of survival than the others. Self-proclaimed Asian individuals were approximately 61% more likely to survive after 20 days than the others (Figure 1B). After 20 days, the lowest rates of survival probability indicated for brown, white, and black people were 46%, 48%, and 49% respectively.

Table 1 - Absolute and relative frequencies of older adult cases infected by COVID-19 in the Northeast region, weeks 26 to 52, considering deaths and survivors.

Variables	*Total (n = 9306) n %*	*Dead (n = 5204) n %*	*Alive (n = 4102) n %*	*p-value*
Age				*<0.001*
60-69	*2952 (31.7)*	*1345 (25.8)*	*1607 (39.2)*	
70-79	*3257 (35.0)*	*1798 (34.6)*	*1459 (35.6)*	
80-89	*2386 (25.6)*	*1540 (26.9)*	*46 (20.6)*	
≥90	*711 (7.6)*	*521 (10.0)*	*190 (4.6)*	
Sex				*0.003*
Female	*4459 (47.9)*	*2422 (46.5)*	*2037 (49.7)*	
Male	*4847 (52.1)*	*2782 (53.5)*	*2065 (50.3)*	

Continuation (Table 1)

Skin color				*0.203*
White	*1640 (17.6)*	*904 (17.4)*	*736 (17.9)*	
Black	*541 (5.8)*	*300 (5.8)*	*241 (5.9)*	
Asian	*161 (1.7)*	*76 (1.5)*	*85 (2.1)*	
Brown	*6943 (74.6)*	*3912 (75.2)*	*3031 (73.9)*	
Indigenous	*21 (0.2)*	*12 (0.2)*	*9 (0.2)*	
Comorbidities				
Heart disease				*0.774*
No	*3695 (60.3)*	*2073 (39.8)*	*1622 (39.5)*	
Yes	*5611 (39.7)*	*3131 (60.2)*	*2480 (60.5)*	
Hematological disease				*0.792*
No	*9217 (99.0)*	*5153 (99.0)*	*4064 (99.1)*	
Yes	*89 (1.0)*	*51 (1.0)*	*38 (0.9)*	
Hepatic Disease				*0.359*
No	*9193 (98.8)*	*5136 (98.7)*	*4057 (98.9)*	
Yes	*113 (1.2)*	*68 (1.3)*	*45 (1.1)*	
Asthma				*0.853*
No	*9098 (97.8)*	*5089 (97.8)*	*4009 (97.7)*	
Yes	*208 (2.2)*	*115 (2.2)*	*93 (2.3)*	
Diabetes mellitus				*0.312*
No	*5014 (53.9)*	*2828 (54.3)*	*1916 (46.7)*	
Yes	*4292 (46.1)*	*2376 (45.7)*	*2186 (53.3)*	
Neurological disease				*<0.001*
No	*8723 (93.7)*	*4832 (92.2)*	*211 (5.1)*	
Yes	*583 (6.3)*	*372 (7.1)*	*3891 (94.9)*	
Pneumopathy				*<0.001*
No	*8824 (94.8)*	*4894 (94.0)*	*3930 (95.8)*	
Yes	*482 (5.2)*	*310 (6.0)*	*172 (4.2)*	
Immunodeficiency				*0.073*
No	*8999 (96.7)*	*5017 (96.4)*	*3982 (97.1)*	
Yes	*307 (3.3)*	*187 (3.6)*	*120 (2.9)*	
Kidney disease				*<0.001*
No	*8642 (92.9)*	*4757 (91.4)*	*3885 (94.7)*	
Yes	*664 (7.1)*	*447 (8.6)*	*217 (5.3)*	
Obesity				*0.464*
No	*8800 (94.6)*	*4929 (94.7)*	*3871 (94.4)*	
Yes	*506 (5.4)*	*275 (5.3)*	*231 (5.6)*	
Ventilatory support				*<0.001*
No	*1622 (17.4)*	*475 (9.1)*	*1147 (28.0)*	
Yes	*7270 (78.1)*	*4497 (86.4)*	*2773 (67.6)*	
Not reported	*414 (4.0)*	*232 (4.5)*	*182 (4.4)*	
ICU stay				*<0.001*
No	*4698 (50.5)*	*1772 (34.1)*	*2926 (28.7)*	
Yes	*4608 (49.5)*	*3432 (65.9)*	*1176 (71.3)*	
ICU stay (days)	*4.0 (0 -142)**	*4.0 (0 – 140)**	*4.0 (4 -142)**	*0.597†*

***median and interquartile range (IQR); †p≥0.005 Mann-Whitney test**.

Individuals with immunodeficiency were 17% less likely to survive after 20 days than individuals who did not have this characteristic (Figure 2A). Chronic kidney disease patients exhibited, after 20 days, about 10% less chance of survival than individuals without this comorbidity (Figure 2B).

Finally, patients who required intubation had a 62% chance of survival after 20 days of hospitalization, compared with those who were not intubated, with a 42% chance of survival (Figure 3A). Regarding the need for admission to the ICU, individuals who did not enter this unit had a 33% lower chance of survival after 20 days of hospitalization (Figure 3B).

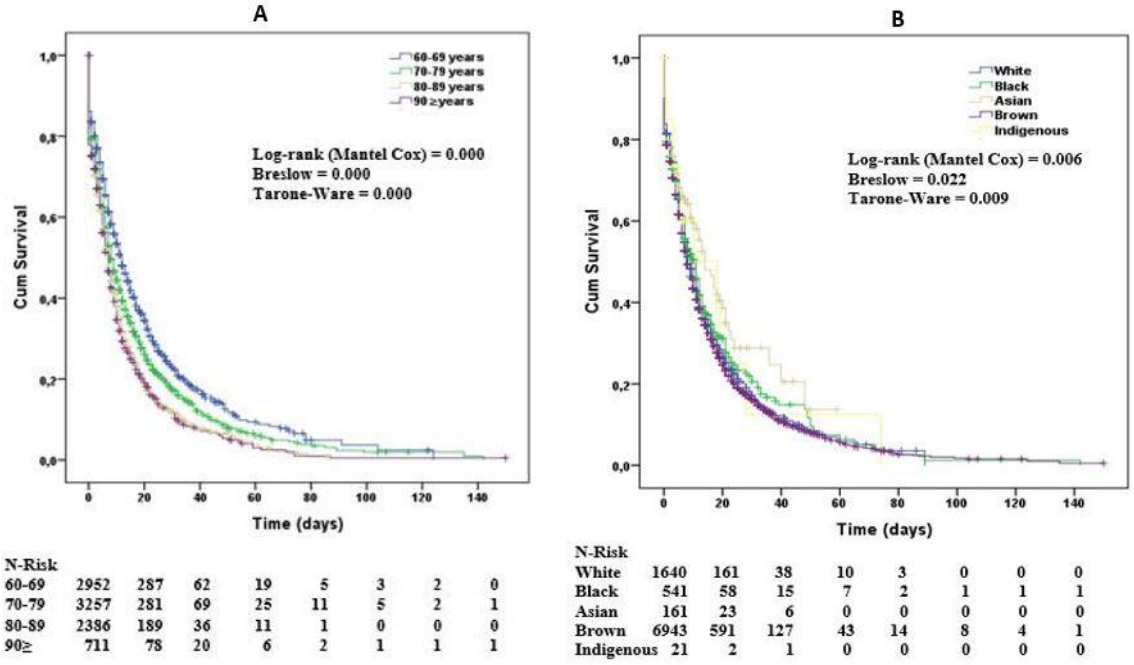

Figure 1- The Kaplan-Meier curves for older adult mortality in the Northeast region by COVID-19, according to age groups (Fig. 1/A) and skin color (Fig. 1/B). Epidemiological week 26 to 52.

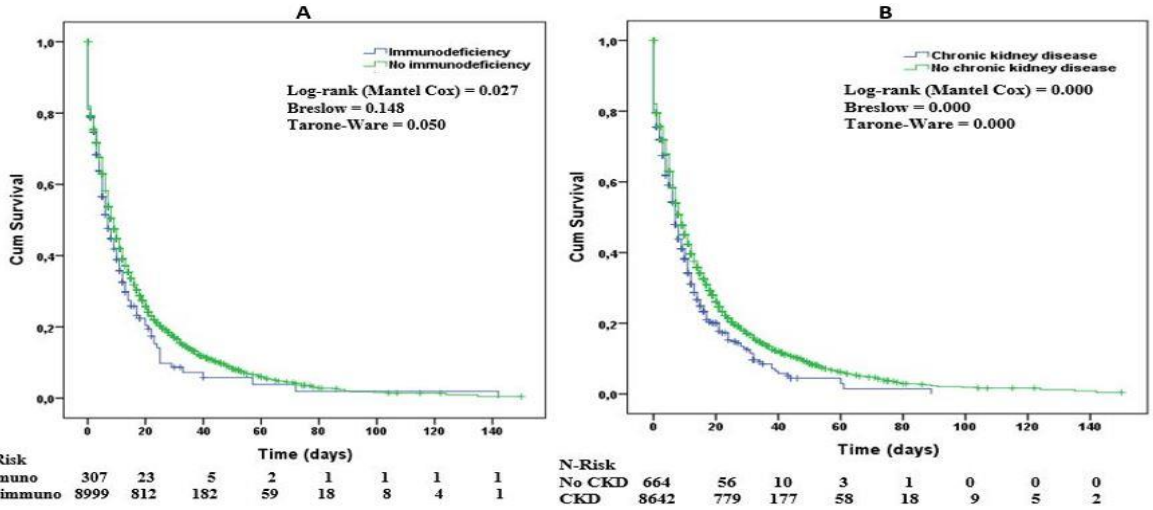

Figure 2 - The Kaplan-Meier curves for older adult mortality in the Northeast region by COVID-19, according to immunodeficiency (Fig. 1/A) and chronic kidney disease (Fig. 1/B). Epidemiological week 26 to 52.

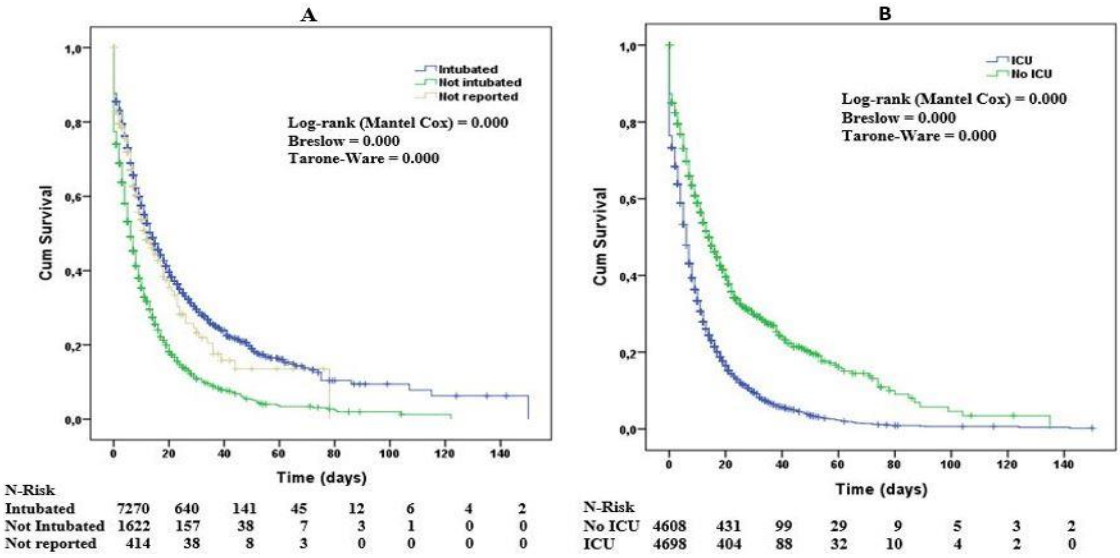

Figure 3 - The Kaplan-Meier curves for older adult mortality in the Northeast region by COVID-19, according to intubation (Fig. 1A) and ICU admission (Fig. 1B). Epidemiological week 26 to 52.

The results of the univariate analysis are shown in Table 2. The model was statistically significant (x^2 = 792,997; gl = 16; p <0.001). The analysis revealed that the ages of 60-69 (HR = 0.251; 95% CI: 0.204-0.308), 70-79 (HR = 1.364; 95% CI: 0.297-0.445), 80-89 (HR = 1,553; 95% CI: 0.450-0.679), being female (HR = 1,171; 04-0,308), presenting neurological disease (HR = 1,221; 95% CI: 1,016-1,467), pneumopathy (HR = 1,280; 1,047-1,564) , immunodeficiency (HR = 1,603; 95% CI: 1,220-2,106), kidney disease (HR = 1,529; 95% CI: 1,263-1,851), not using ventilatory support (HR = 1,436; 95% CI: 0,343-0,555), and being admitted to the ICU (HR = 4,377; 95% CI: 3,974-4,820) was significant to explain the risk of death from COVID-19 (Table 2).

Following the order of results, the Cox proportional hazards regression model (adjusted analysis) was statistically significant (x^2 = 835,186; df = 21; p <0.001). The multivariate analysis indicated a higher risk of death for individuals aged 60-69 (HR = 0.67; 95% CI: 0.601-0.743), 70-79 (HR = 1.80; 95% CI: 0.724- 0.887), and 80-89 (HR = 1.95; 95% CI: 0.702-0.961), with white skin (HR = 1.92; 95% CI: 0.507-0.673), black skin (HR = 1.85; 95% CI: 0.469-0.867), brown skin (HR = 1.99; 95% CI: 0.552-0.808), having immunodeficiency (HR = 1,259; 95% CI: 1,085-1,461), kidney disease (HR = 1,147; 95% CI:

1.040-1.265), in use ventilatory support (HR = 1.606; 95% CI: 0.517-0.710), and admited to the ICU (HR=1.795; 95% CI:0.747-0.845).

Table 2- Survival analysis of COVID-19 cases, specific for older adults, Northeast region. Adjustment made according to the Cox multiple regression model.

	Crude analysis			Adjusted analysis		
Variables	***HR (95%CI)*****		***p-value***	***HR (95%CI)*****		***p-value***
Age						
90≥	*1*			*1*		
60-69	*0.251*	*(0.204-0.308)*	*<0.001*	*0.67*	*(0.601-0.743)*	*<0.001*
70-79	*1.364*	*(0.297-0.445)*	*<0.001*	*1.80*	*(0.724-0.887)*	*<0.001*
80-89	*1.553*	*(0.450-0.679)*	*<0.001*	*1.95*	*(0.702-0.961)*	*<0.001*
Sex						
Female	*1*			*1*		
Male	*1.171*	*(1.074-1.278)*	*<0.001*	*1.041*	*(0.984-1.101)*	*0.166*
Skin color						
Indigenous	*1*			*1*		
White	*0.732*	*(0.283-1.893)*	*0.520*	*1.921*	*(0.507-0.673)*	*0.020*
Black	*0.702*	*(0.268-1.840)*	*0.472*	*1.857*	*(0.469-0.867)*	*0.018*
Asian	*0.590*	*(0.215-1.619)*	*0.306*	*0.793*	*(0.420-1.399)*	*0.431*
Brown	*0.777*	*(0.302-2.001)*	*0.602*	*1.999*	*(0.552-0.808)*	*0.018*
Comorbidities	*1*			*1*		
Heart disease	*0.932*	*(0.846-1.026)*	*0.149*	*0.996*	*(0.941-1.055)*	*0.896*
Hematological disease	*0.642*	*(0.398-1.036)*	*0.070*	*0.905*	*(0.680-1.204)*	*0.493*
Hepatic Disease	*1.315*	*(0.856-2.022)*	*0.211*	*1.216*	*(0.95-1.557)*	*0.120*
Asthma	*0.987*	*(0.719-1.354)*	*0.936*	*0.974*	*(0.80-1.179)*	*0.787*
Diabetes mellitus	*1.055*	*(0.960-1.160)*	*0.267*	*1.003*	*(0.94-1.061)*	*0.924*
Neurological disease	*1.221*	*(1.016-1.467)*	*0.033*	*1.091*	*(0.97-1.216)*	*0.118*
Pneumopathy	*1.280*	*(1.047-1.564)*	*0.016*	*1.037*	*(0.92-1.167)*	*0.547*
Immunodeficiency	*1.603*	*(1.220-2.106)*	*<0.001*	*1.259*	*(1085-1.461)*	*0.003*
Kidney disease	*1.529*	*(1.263-1.851)*	*<0.001*	*1.147*	*(1040-1.265)*	*0.006*
Obesity	*0.823*	*(0.672-1.007)*	*0.059*	*1.048*	*(0.926-1.187)*	*0.457*
Ventilatory support						
Not reported	*1*			*1*		
No	*1.141*	*(0.918-1.419)*	*0.235*	*1.058*	*(0.927-1.208)*	*0.403*
Yes	*1.436*	*(0.343-0.555)*	*<0.001*	*1.606*	*(0.517-0.710)*	*<0.001*
ICU stay						
No	*1*			*1*		
Yes	*4.377*	*(3.974-4.820)*	*<0.001*	*1.795*	*(0.747-0.845)*	*<0.001*

ICU: Intensive Care Unit.

DISCUSSION

The present study carried out an analysis of survival particularly for the older adult population residing in the eight states in the Northeast region of Brazil, and also investigated factors associated with a higher risk of death from COVID-19. The Kaplan-Meier survival method and the Cox

multivariate regression model used to assess proportional risk indicated an increased risk of dying from COVID-19, particularly for those with dark skin, followed by older adults with either white or black skin. The analysis did not indicate significant values for individuals identified by skin color as Asian or indigenous. An increased risk of dying from COVID-19 was also attributed to those with immunodeficiency or chronic kidney disease, as well as to older adults admitted to the ICU, and who required ventilatory support.

Thus, it is observed that, for the older population in the Northeast region of Brazil, there was a set of factors that increased the risk of death from COVID-19. It was found that, compared to individuals of younger age groups, there was an increase in the risk of dying of 0.67, 1.80, 1.95 times for individuals aged 60, 70, or 80, respectively. The literature highlights that older adults with comorbidities are particularly at increased risk for serious infections[3], therefore, at greater risk of dying from this disease[17]. The older population is more susceptible to coronavirus, since SARS-CoV2 infections affect mostly patients who are aged 50 or more[18].

A systematic review and a meta-analysis study showed that men are comparatively more likely to die from COVID-19 than women[19]. However, in the present analysis, there was no difference in the result regarding sex, among the older adult residents in the Northeast region of Brazil. It is known that men and women have particularities in biological and immunological pathways, which may present different behaviors in cases of COVID-19[20].

The present analysis showed that, at any time, being brown, white, or black also meant a 1.99, 1.92, and 1.85 times greater risk of dying from COVID-19. In a study on the incidence of older adult death from COVID-19 in Brazil, there was an association between death and demographic aspects and income distribution[21]. A survival analysis study based on COVID-19 confirmed cases carried out with only inhabitants of the state of Rio Grande do Norte, also located in the Northeast region of Brazil, the authors found 1.13 times more risk of death for individuals with non-white skin[11]. UK Biobank study (England) showed that black individuals are at higher risk of dying from COVID-19 (OR = 3.17), when compared to white

individuals, South Asians, and other ethnicities, who showed intermediate risk[22].

A systematic review and a meta-analysis study showed the most prevalent comorbidities among critically ill patients infected with COVID-19 and the risk of underlying diseases compared to non-severe patients[23]. The most common comorbidities were hypertension (21.1%) and diabetes (9.7%), followed by cardiovascular disease (8, 4%) and diseases of the respiratory system (1.5%). In the present study, among those who died from COVID-19, there was a prevalence of heart disease (60.2%), diabetes mellitus (45.7%), kidney disease (8.6%), and neurological disease (7.1%). On the other hand, the main comorbidities responsible for the increased risk of death of older adults by COVID-19 were immunodeficiency and kidney disease, with values of 1.25 times and 1.14 times, respectively. Laboratory findings also serve as a prognosis, a higher urea rate and the presence of acute kidney injury are characteristics significantly associated with the worse prognosis of COVID-19 patients[1]. In a study conducted with 701 individuals admitted to a hospital in China[24], a high prevalence of kidney disease was found in patients with COVID-19, as well as a high association with in-hospital mortality. Given this, more attention was dedicated to patients with kidney diseases and COVID-19.

Populational studies on COVID-19 patients have highlighted that ICU admission and intubation are significant indicators of high disease severity and increased risk of death[25-27]. Thus, the survival analysis showed that the admission of older adults to the ICU represented a 1.79 times greater probability of dying, compared to those who did not enter this unit. And those who need intubation are 1.60 times more likely to die, compared to those who did not need to be intubated. Intubation of severe COVID-19 patients is routine because cases are usually accompanied by dyspnea and/or hypoxemia one week after the onset of the disease. In severe cases, the disease can evolve quickly, generating acute respiratory symptoms with distress syndrome, septic shock, metabolic acidosis, and coagulopathy[28].

In the present study, it was found that older adults living in the Northeast region of Brazil exhibited an average length of hospital stay, from

the onset of symptoms to death, less than that reported in international studies[13,29,30]. Thus, it can be said that, when these patients arrived at the health service, they were already in a critical state of health.

Based on the period between June 14 and December 26, 2020, the analysis of data from the SIVEP-Gripe system on hospitalizations by the SRAG-COVID allowed for a deeper understanding of death cases and survival of a considerable number of older adults (n=9,306) residing in the Northeast region of Brazil. An epidemiological study also carried out in the Northeast region highlighted that approximately 75% of the older adults in Brazil lived in the Southeast and Northeast regions[31]. Thus, our results can contribute to monitoring the profile of severe cases of SARS-CoV2 infection in this region, in addition to enabling comparisons with cases of the disease in other parts of the country.

The potential limitations of this study include the possible potential bias generated by the following cases: slow release of test results for the diagnosis of the disease[32], incorrect filling in of the notification forms, or digitization errors in the system. Another limitation was the underreporting of deaths by COVID-19 due to the limited offer of RT-PCR tests in hospitals and health units across the country, in the analyzed period[33]. For this reason, there was a delay or absence of registration of the exam result. It is known that, in the case of epidemiological events, the occurrence of a single death in a given location probably indicates innumerable other cases of the disease in that population, with no identifications[32].

Finally, it should be noted that, comparatively, the results of this survival analysis indicated values of probability of death for older adults that are lower than most studies found[11,13,33]. This is due to the fact that, unlike these studies, the present analysis did not include individuals aged ≤60.

CONCLUSION

The present study performed a survival analysis particularly for the older population residing in the eight states of the Northeast region of Brazil, and also investigated factors associated with a higher risk of death from COVID-19. It was found that the increased risk of death due to COVID-19 for older

adults was associated with different factors such as increasing age, race, immunodeficiency, kidney disease, needing ventilatory support, and being admitted to the ICU. Our results summarize important data that allow us to understand the epidemiological profile of the population that, before the discovery of the vaccine against COVID-19, showed a greater risk of worsening and dying from this disease.

For this reason, it is important to carry out studies that contribute to the consolidation of strategies to combat the epidemic. Brazil is a country with a large number of inhabitants, wide territorial extension, different local, social and demographic characteristics. All of this can influence the population's access to health services, as well as the implementation of effective measures for the treatment of the new coronavirus.

REFERENCES

1. Lithander FE, Neumann S, Tenison E, Lloyd K, Welsh TJ, Rodrigues JCL, et al. COVID-19 in older people: a rapid clinical review. Age ageing. 2020; 49(4):501-515.
2. Sun H, Ning R, Tao Y, Yu C, Deng X, Zhao C, et al. Risk Factors for Mortality in 244 Older Adults With COVID-19 in Wuhan, China: A Retrospective Study. J am geriatr soc. 2020; 68(6):E19-E23.
3. Liu W, Tao Z-W, Wang L, Yuan M-L, Liu K, Zhou L, et al. Analysis of factors associated with disease outcomes in hospitalized patients with 2019 novel coronavirus disease. Chin med j. 2020; 133(9):1032-1038.
4. Damiot A, Pinto AJ, Turner JE, Gualano B. Immunological Implications of Physical Inactivity among Older Adults during the COVID-19 Pandemic. Gerontology. 2020; 66(5):431-438.
5. Wu Z, McGoogan JM. Characteristics of and Important Lessons From the Coronavirus Disease 2019 (COVID-19) Outbreak in China. JAMA. 2020; 323(13):1239.
6. Lai C, Shih T, Ko W, Tang H, Hsueh P. Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and coronavirus disease-2019 (COVID-19): The epidemic and the challenges. Int j antimicrob agents. 2020; 55(3):105924.
7. Ministério da Saúde (BR). Painel

Coronavirus. Coronavirus Brazil [accessed in March 24, 2021]. Available in: https://covid.saude.gov.br/.

8. Ministério da Saúde (BR). Ministry of Health Surveillance. Boletim Epidemiológico Especial, COVID-19 [accessed in 2020 dec 28]. Available in: https://www.gov.br/saude/pt-br.
9. Batista SR, Souza ASS, Nogueira J, Andrade FB, Thumé E, Teixeira DSC, et al. Comportamentos de proteça□o contra COVID-19 entre adultos e idosos brasileiros que vivem com multimorbidade: iniciativa ELSI-COVID-19. Cad saúde pública. 2020; 36(suppl 3):e00196120.
10. Escobar AL, Rodriguez TDM, Monteiro JC. Letalidade e características dos óbitos por COVID-19 em Rondônia: estudo observacional. Epidemiol serv saúde. 2021; 30(1):e2020763.
11. Galvão MHR, Roncalli AG. Fatores associados a maior risco de ocorrência de óbito por COVID-19: análise de sobrevivência com base em casos confirmados. Rev bras epidemiol. 2020; 23:E200106.
12. Phan T. Genetic diversity and evolution of SARS-CoV-2. Infect gent evol. 2020; 81(January):104260.
13. Salinas-Escudero G, Carrillo-Vega MF, Granados-García V, Martínez-Valverde S, Toledano-Toledano F, Garduño-Espinosa J. A survival analysis of COVID-19 in the Mexican population. BMC public health. 2020; 20(1):1616.
14. Bustamante-Teixeira MT, Faerstein E, Latorre MR. Técnicas de análise de sobrevida. Cad saúde pública. 2002; 18(3):579-594.
15. Ministério da Saúde (BR). Covid-19 no Brasil. Ministério da Saúde [accessed in March 24, 2020]. Available in:https://www.gov.br/saude/pt-br.
16. Ministério da Saúde (BR). National Health Council (CONEP) [accessed in March 10, 2020]. http://conselho.saude.gov.br/normativas-conep?view=default.
17. Gao L, Jiang D, Wen X, Cheng X, Sun M, He B, et al. Prognostic value of NT-proBNP in patients with severe COVID-19. Respir res. 2020; 21(1):83.
18. Liu K, Chen Y, Lin R, Han K. Clinical features of COVID-19 in

elderly patients: A comparison with young and middle-aged patients. J infect. 2020; 80(6):e14-e18.

19. Galbadage T, Peterson BM, Awada J, Buck AS, Ramirez DA, Wilson J, et al. Systematic Review and Meta-Analysis of Sex-Specific COVID-19 Clinical Outcomes. Front med (lausanne). 2020; 7(June):1-15.

20. Salvati L, Biagioni B, Vivarelli E, Parronchi P. A gendered magnifying glass on COVID - 19. Clin mol allergy. 2020; 18(14).

21. Barbosa IR, Galvão MHR, Souza TA, Gomes SM, Medeiros AA, Lima KC. Incidence of and mortality from COVID-19 in the older Brazilian population and its relationship with contextual indicators: an ecological study. Rev bras geriatr Gerontol. 2020; 23(1):200171.

22. Atkins JL, Masoli JAH, Delgado J, Pilling LC, Kuo C-L, Kuchel GA, et al. Preexisting Comorbidities Predicting COVID-19 and Mortality in the UK Biobank Community Cohort. J gerontol: series A. 2020; 75(11):2224-2230.

23. Yang J, Zheng Y, Gou X, Pu K, Chen Z, Guo Q, et al. Prevalence of comorbidities and its effects in patients infected with SARS-CoV-2: a systematic review and meta-analysis. Int j infect dis. 2020; 94(April):91-95.

24. Cheng Y, Luo R, Wang K, Zhang M, Wang Z, Dong L, et al. Kidney disease is associated with in-hospital death of patients with COVID-19. Kidney int. 2020; 97(5):829-838.

25. Zareifopoulos N, Lagadinou M, Karela A, Platanaki C, Karantzogiannis G, Velissaris D. Management of COVID-19: the risks associated with treatment are clear, but the benefits remain uncertain. Monaldi arch chest dis. 2020; 90(2):242-245.

26. Zhou F, Yu T, Du R, Fan G, Liu Y, Liu Z, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. Lancet. 2020; 395(10229):1054-1062.

27. Yuan Y, Wang N, Ou X. Caution should be exercised for the detection of SARS-CoV-2, especially in the elderly. J med virol. 2020; 92(9):1641-1648.

28. Zuo M, Huang Y, Ma W, Xue Z, Zhang J, Gong Y, et al. Expert

Recommendations for Tracheal Intubation in Critically Ill Patients with Noval Coronavirus Disease 2019. Chin med sci j. 2020; 35(2):105-109.

29. Linton NM, Kobayashi T, Yang Y, Hayashi K, Nishiura H. Incubation Period and Other Epidemiological Characteristics of 2019 Novel Coronavirus Infections with Right Truncation: A Statistical Analysis of Publicly Available Case Data. J clin med. 2020; 9(2):538.

30. Du Y, Tu L, Zhu P, Mu M, Wang R, Yang P, et al. Clinical Features of 85 Fatal Cases of COVID-19 from Wuhan. A Retrospective Observational Study. Am j respir crit care med. 2020; 201(11):1372-1379.

31. Coelho Filho JM, Ramos LR. Epidemiologia do envelhecimento no Nordeste do Brasil: resultados de inquérito domiciliar. Rev saúde pública. 2016; 50(5):1-1.

32. Corrêa PRL, Ishitani LH, Abreu DMX de, Teixeira RA, Marinho F, França EB. A importância da vigilância de casos e óbitos e a epidemia da COVID-19 em Belo Horizonte, 2020. Rev bras epidemiol. 2020; 23:1-12.

33. Cavalcante JR, Cardoso-dos-Santos AC, Bremm JM, Lobo AP, Macário EM, Oliveira WK, et al. COVID-19 no Brasil: evolução da epidemia até a semana epidemiológica 20 de 2020. Epidemiol serv saúde. 2020; 29(4):e2020376.

Financiamento: O autor declara que não houve financiamento.

Conflito de interesses: O autor declara não haver conflito de interesses.

Participação dos autores:
- **Concepção:** Nascimento MM.
- **Desenvolvimento:** Nascimento MM.
- **Redação e revisão:** Nascimento MM.

Como citar este artigo: Nascimento MM. COVID-19 and death of older adults in the Northeast region of Brazil: a survival analysis. J Health NPEPS. 2021; 6(2):56-72.

Submissão **(*Fast Track* COVID-19)**: 19/10/2021
Aceito **(*Fast Track* COVID-19)**: 31/10/2021
Publicado **(*Fast Track* COVID-19)**: 01/11/2021