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ORIGINAL ARTICLE

Mortality of older adults with community-acquired respiratory infections associated with sepsis in the Intensive Care Unit

Mortalidade de idosos com infecção respiratória comunitária associadas à sepse em Unidade de Terapia Intensiva

Mortalidad de ancianos con infecciones respiratorias comunitarias asociadas a sepsis en una Unidad de Cuidados Intensivos

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ABSTRACT

Background and Objectives: Infections in older adults are more frequent and severe, and can lead to sepsis, an immediate cause of death in the intensive care unit (ICU). This study aimed to identify risk factors associated with the death of elderly patients with sepsis who were admitted to the ICU due to a previous community-acquired respiratory infection**. Methods:** This is an epidemiological, descriptive, and analytical study of a mixed cohort. The medical records of older adults admitted to the ICU from September 2019 to September 2020 with a diagnosis of a community-acquired respiratory infection who died due to sepsis were analyzed according to the presence or absence of SARS-CoV-2 infection. Sociodemographic and clinical data were collected. Descriptive and statistical analyses were performed**. Results:** Most patients were male and between 60 and 79 years old. Having chronic respiratory disease (RR = 1.9; p = 0.014) and a viral etiology (RR = 3.2; p < 0.001) were associated with death. **Conclusion:** These results reinforce the importance of preventing respiratory diseases in the older adults community and of early intervention to avoid deterioration and death**.**

Keywords: *Hospital Mortality. Sepsis. Aged.*

RESUMO

Justificativa e Objetivos: as infecções em idosos são mais frequentes e graves e podem gerar sepse, que pode ser causa imediata de morte na Unidade de Terapia Intensiva (UTI). O objetivo do estudo foi compreender os fatores de risco associados ao óbito de idosos com sepse

internados em UTI em decorrência de infecção respiratória comunitária prévia. **Métodos:** este é um estudo epidemiológico, descritivo e analítico. Foram analisados prontuários de idosos, internados na UTI de setembro de 2019 a setembro de 2020, com diagnóstico de infecção respiratória comunitária, que evoluíram para óbito devido à sepse, segundo a presença ou ausência de Covid-19. Foram coletados dados sociodemográficos e clínicos. Foi realizada análise descritiva e estatística. **Resultados:** a maior parte dos pacientes era do sexo masculino e possuía entre 60 e 79 anos. A presença de doença crônica respiratória (RR=1,9; p=0,014) e a etiologia viral (RR=3,2; p<0,001) estiveram associadas à morte. **Conclusão:** o resultado reforça a importância da prevenção de doenças respiratórias em idosos na comunidade, bem como a intervenção precoce para evitar o agravamento e o óbito.

Descritores: *Mortalidade Hospitalar. Sepse. Idoso.*

RESUMEN

Justificación y Objetivos: las infecciones en los ancianos son más frecuentes y graves y pueden derivar en sepsis, que puede ser causa inmediata de muerte en la Unidad de Cuidados Intensivos (UCI). El objetivo del estudio fue comprender los factores de riesgo asociados a la muerte de personas mayores con sepsis ingresadas en UCI por infección respiratoria comunitaria previa. **Métodos:** se trata de un estudio epidemiológico, descriptivo y analítico, de cohorte mixta. Se analizaron las historias clínicas de personas mayores ingresadas en UCI de septiembre de 2019 a septiembre de 2020, con diagnóstico de infección respiratoria comunitaria, que fallecieron por sepsis, según presencia o ausencia de Covid-19. Se recogieron datos sociodemográficos y clínicos. Se realizó análisis descriptivo y estadístico. **Resultados:** la mayoría de los pacientes eran varones y tenían edades entre 60 y 79 años. La presencia de enfermedad respiratoria crónica (RR=1,9; p=0,014) y etiología viral (RR=3,2; p<0,001) se asociaron con la muerte. **Conclusión:** el resultado refuerza la importancia de prevenir las enfermedades respiratorias en los ancianos de la comunidad, así como la intervención temprana para prevenir su agravamiento y muerte.

Palabras Clave*: Mortalidad Hospitalaria. Sepsis. Anciano.*

INTRODUCTION

Community-acquired respiratory infections are diseases that affect the respiratory tract and are diagnosed through samples taken during the first two days of hospitalization, when not associated with a previous hospitalization at the same healthcare facility.[1,2] Among the most common infections are acute pharyngotonsillitis, rhinopharyngitis, tonsillitis, pneumonia, and Covid-19.[1] Normally, these infections can be treated on an outpatient basis, but if the symptoms worsen, the patient should be hospitalized to control the infection and prevent it from progressing to sepsis.[3]

Between 2013 and 2017, respiratory diseases accounted for almost 6 million hospitalizations in Brazil, making them the second leading cause of hospitalization in the country during that period.[4] During the same period, they accounted for 19.5% of deaths during hospitalizations.[4] In individuals over 65 years of age, this issue becomes more relevant because,

among Brazilian older adults, there were more than 200,000 deaths from respiratory infections between 2012 and 2016.[4] Infections in older adults tend to be more frequent and severe, as their health is often weakened due to immune dysfunction, malnutrition, and physiological changes.[5]

Community-acquired pneumonia (CAP) is one of the leading causes of sepsis, with a short-term mortality rate of 50% in individuals receiving care in the Intensive Care Unit (ICU), and is more prevalent in the elderly.[5,6] The older adults population accounts for approximately 30 to 40% of hospitalizations for CAP.[7]

Sepsis is caused by the host's dysregulated response to infection and progresses to organ failure, consequently posing a risk to life.[8] Thus, it is one of the leading causes of morbidity and mortality worldwide and can be the immediate cause of death in ICU patients.[8]

Septic shock, in turn, is a progression of sepsis, manifesting itself through circulatory, cellular, and metabolic instability.8 Septic shock is associated with a hospital mortality rate of > 40%.[8] To define septic shock, there must be hypotension refractory to vasopressor therapy used to increase mean arterial pressure levels to > 65 mmHg and serum lactate levels > 2 mmol/L after management of hypovolemia.[8]

Regarding sepsis in Brazil, it is estimated that there are approximately 600,000 new cases annually, with 16.5% of death certificates issued resulting from cases of this dysfunction.[9] A Brazilian study analyzed a historical series of hospitalizations for sepsis in different regions of the country and showed that the average number of hospitalizations in Brazil increased significantly between 1999 and 2016.9 Thus, it is clear that sepsis is a challenge for the healthcare system.

Risk factors that can aggravate sepsis include longer hospital stays, comorbidities, individuals over 65 years of age, and invasive procedures.[10] When analyzing deaths in the older adults in an ICU, Alves et al. (2010) concluded that sepsis is one of the main reasons for death.[11] Between 2018 and 2022, 113,059 deaths from sepsis were recorded in Brazil. Among those who died as a result of sepsis, 37.9% were aged 80 years or older, and 21% of those hospitalized for sepsis were also in this age group.[12]

Between 2010 and 2019 in Brazil, the probability of death from sepsis among older adults was 5.6 times higher when compared to the 5-9 age group.[13] These higher rates among older adults can be explained by the presence of chronic diseases and greater functional impairment in this age group.[14]

This study can benefit the formulation of public policies, especially for hospitals, by providing an in-depth look at the older adults population, benefiting the decision-making of professionals and the learning of academics in the field of public health. However, its results

reflect the reality of the older adults and the health system in a medium-sized municipality in the state of Paraná, which may be different in other locations in Brazil.

Therefore, this research was developed with the objective of understanding the risk factors associated with the death of older adults with sepsis, admitted to the ICU, resulting from a previous community-acquired respiratory infection.

METHODS

Type of study

The method chosen for the proposed analysis was an epidemiological, descriptive, quantitative, analytical and retrospective study based on medical records, carried out in an ICU at a university hospital in southern Brazil.

About the institution

The institution studied is recognized as public, offering services only to users of the Unified Health System (SUS) and provides 20 regular ICU beds and 30 ICU beds for Covid-19. In September 2019, the institution had 20 regular ICU beds. The specific beds for Covid-19 began to be implemented in March 2020, in which month there were 20 regular ICU beds and 10 Covid-19 ICU beds, with increasing progress until reaching the number mentioned in September of the same year. After the period studied, new modifications were necessary to serve society.

Participants

The study population consisted of older adults (≥ 60 years) admitted to the ICU and diagnosed with a community respiratory infection. The medical records of patients diagnosed with a community respiratory infection who died were included in the study, cases in which the infection was acquired within the hospital were excluded, and repeated medical records and duplicate medical records were identified and excluded in order to guarantee the fidelity of the information. Those with healthcare-related infections were excluded because studies on this group already constitute a more consolidated literature, as well as involving different determinants and conditions.

Data collection

The period from September 2019 to September 2020 was determined for data collection. The period selected involved six months before and after the start of the Covid-19

pandemic, so that comparisons and scientific contributions could also be made within this theme. Data was collected using data available in the electronic medical records available in the SUS Health Care Management System.

A monthly search of ICU admissions was carried out and all medical records with primary codes in the International Statistical Classification of Diseases and Related Health Problems (ICD) related to the respiratory system were selected. ICD codes referring to the diagnosis of other sepsis were also selected. In these cases, a diagnosis of sepsis with a respiratory focus could be found, depending on the signs and symptoms. Infections related to health care were excluded from the list provided by the Hospital Epidemiology and Infection Control Center.

With the remaining medical records, those corresponding to community respiratory infection were confirmed and repeated hospitalizations recorded in the system were eliminated. Before each collection, the diagnosis of community respiratory infection was confirmed using the signs and symptoms observed in the medical records. Each patient's data was collected on the first day of admission to the ICU, and when there was no diagnosis of sepsis on the first day of admission, the patient's progress was monitored and the day of diagnosis of sepsis was also collected.

A pilot survey was carried out with three patients to check the applicability of the survey instrument. In addition, the data relating to the first twenty individuals was collected by two interviewers at the same time, in order to check that the information was consistent.

A semi-structured instrument was then drawn up with variables of interest to the study: gender, age, age group, skin color, weight, municipality of origin, chronic diseases, ICD-10, ICD-11, type of community respiratory infection, use of previous continuous use medication, etiological agent, treatment prior to infection, invasive devices, total length of hospitalization, score on the “Sequential Organ Failure Assessment” (SOFA), score on the “Quick Sequential Organ Failure Assessment” (qSOFA); sepsis using “Sepsis-3” consensus criteria; sepsis using “Systemic Inflammatory Response Syndrome” (SIRS) criteria according to the Latin American Sepsis Institute (ILAS); diagnosis of sepsis in medical records; septic shock.

All individuals who reported, or whose medical records described, consultation with a health professional or use of prescription medication prior to being hospitalized were considered to be users of previous treatment for infection prior to hospitalization. As early treatment for Covid-19 is not consolidated in the international literature as valid, it was decided not to verify this information among Covid-19 patients.

In this study, we described the conditions investigated among older adults whose cases of community respiratory infection progressed and died of sepsis, according to the presence or absence of Covid-19, which includes other community respiratory infections such as influenza, pneumonia, bronchitis, among others. We chose to describe the patients according to their Covid-19 status because this infection has the characteristics of viral sepsis, sometimes with the distinction of bacterial sepsis.

In this study, the diagnosis of community respiratory infection was based on the ICD-10 criteria recorded in the medical records.

Covid-19 was diagnosed according to a positive Reverse Transcription Polymerase Chain Reaction (RT-PCR) test or a characteristic chest CT scan described in the medical records.

The definition of sepsis followed the ILAS consensus, as the presence of a known disease or suspected infection and acute organ dysfunction, and also the definitions of the third international sepsis consensus (Sepsis-3), as suspected or certain infection and an acute increase ≥ 2 points in SOFA in response to an infection, representing organ dysfunction.[15, 16]

SOFA is a score that assesses respiratory, hematological, hepatic, cardiovascular and neurological functions with daily observation, its score ranges from zero to four for each item assessed, and a maximum final sum of 24 points can be obtained, with the highest score indicating greater severity of the septic condition.[16]

The qSOFA score has the following criteria: systolic blood pressure lower than 100 mmHg, respiratory rate higher than 22/min and altered mental state, such as a Glasgow Coma Scale score <15.[17] Each variable counts for one point, so the score ranges from 0 to 3, and the higher the score, the higher the risk of mortality.[18]

Data analysis

The quantitative data was organized in a Microsoft Excel® spreadsheet and then analyzed using the IBM-SPSS® statistical package, version 22. Categorical variables were expressed as frequencies and percentages, and continuous variables were expressed as medians and interquartile ranges. The Shapiro-Wilk and Kolmogorov-Smirnov tests were used to test the normality of the variables. The association between the exposure and outcome variables was assessed using the chi-square test and the relative risk association measure for categorical variables. For numerical variables, Student's t-test and the Mann-Whitney U-test were used. Results were considered statistically significant when $p<0.05$.

Ethical aspects

This study is part of the research entitled "Studies on health surveillance, mortality and hospital epidemiology". The research project was evaluated and approved by the Hospital's Institutional Research Committee and analyzed and approved by the Human Research Ethics Committee of the State University of Ponta Grossa, Uvaranas Campus (CAAE: 99995518.4.0000.0105), by opinion no. 4.110.879 on March 29, 2022.

RESULTS

The medical records selection process is described in figure 1. A total of 1,473 hospitalizations were found between September 2019 and September 2020 related to respiratory system diseases and sepsis. Of these, 893 (60.6%) were related to hospitalizations of the older adults, of which 229 (15.5%) were associated with a diagnosis of community respiratory infection. Of this sample, 125 patients died (8.5%) (Figure 1).

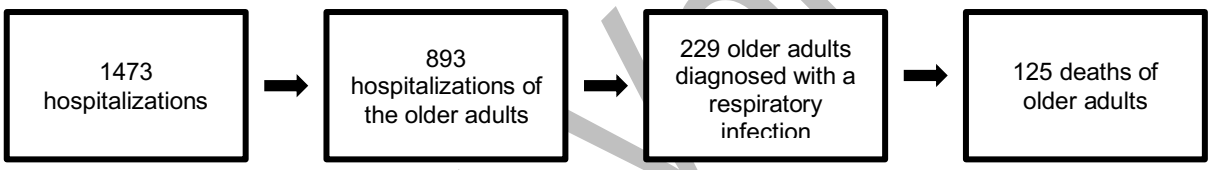

Figure 1. Process of selecting medical records, until reaching the sample studied, at a University Hospital in a municipality in southern Brazil, 2021.

In the period analyzed, 125 (54.58%) older adults hospitalized due to community respiratory infection died. 89 (71.2%) older adults had Covid-19 and 36 (28.8%) had other infections, of which 34 (94.4%) were classified as pneumonia, one (2.8%) as flu and one (2.8%) as bronchitis.

With regard to Covid-19, the sample was predominantly made up of men (56.2%), aged between 60 and 79 (79.8%), white (84.3%) and living in the municipality of Ponta Grossa (PR) (70.8%). Regarding clinical aspects, it was observed that the majority had some chronic disease (86.5%), with emphasis on chronic cardiovascular disease (71.9%), diabetes mellitus (34.8%) and chronic respiratory disease (22.5%). In addition, 75 (84.3%) of the older adults with Covid-19 had previously used some form of continuous medication (Table 1).

Of the patients with other community respiratory infections (except Covid-19), the data shows that the majority were male (52.8%), aged between 60 and 79 (66.7%), white-skinned (88.9%) and living in Ponta Grossa (PR) (55.6%). It was observed that 31 (86.1%) individuals had pre-existing chronic morbidity, including cardiovascular disease (66.7%),

respiratory disease (44.4%), diabetes mellitus (27.8%) and neurological disease (16.7%). It was also found that 28 (77.8%) were on continuous medication (Table 1).

Table 1. Sociodemographic and clinical characteristics of older adults who died with a diagnosis of community respiratory infection, according to the presence or absence of Covid-19 (n=125), in an Intensive Care Unit of a University Hospital in a municipality in southern Brazil, 2021.

Variable		Presence of Covid-19 n/total (%)	Absence of Covid-19 n/total (%)
Gender	Male	50 (56.2)	19 (52.8)
	Female	39 (43.8)	17 (47.2)
Age group	≥ 80 years	18 (20.2)	12 (33.3)
	60 to 79 years	71 (79.8)	24 (66.7)
Skin color	Other	14 (15.7)	4 (11.1)
	White	75 (84.3)	32 (88.9)
Municipality of origin	Ponta Grossa	63 (70.8)	20 (55.6)
	Other	26 (29.2)	16 (44.4)
Comorbidities	Yes	77 (86.5)	31 (86.1)
	No	12 (13.5)	5 (13.9)
Dyslipidemia	Yes	6 (6.7)	0 (0)
	No	83 (93.3)	36 (100)
Chronic kidney disease	Yes	2 (2.2)	1 (2.8)
	No	87 (97.8)	35 (97.2)
Chronic endocrine disease	Yes	9 (10.1)	2 (5.6)
	No	80 (89.9)	34 (94.4)
Chronic neurological disease	Yes	18 (20.2)	6 (16.7)
	No	71 (79.8)	30 (83.3)
Chronic immunological disease	Yes	1 (1.1)	0 (0)
	No	88 (98.9)	36 (100)
Obesity	Yes	1 (1.1)	1 (2.8)
	No	88 (98.9)	35 (97.2)
Chronic respiratory disease	Yes	20 (22.5)	16 (44.4)
	No	69 (77.5)	20 (55.6)
Neoplasm	Yes	3 (3.4)	1 (2.8)
	No	86 (96.6)	35 (97.2)
Diabetes mellitus	Yes	31 (34.8)	10 (27.8)
	No	58 (65.2)	26 (72.2)
Chronic cardiovascular disease	Yes	64 (71.9)	24 (66.7)
	No	25 (28.1)	12 (33.3)
Etiological agent*	Virus	83 (93.3)	1 (6.7)
	Bacteria, fungi, both	6 (6.7)	14 (93.3)
Previous continuous use medication	Yes	75 (84.3)	28 (77.8)
	No	14 (15.7)	8 (22.2)

* Information unavailable for 21 individuals (16.8%) of the study population.

We found that 76 (85.4%) older adults with Covid-19 were admitted to the ICU with ICD-10 diagnoses from Chapter I (which includes infectious and parasitic diseases), and of these, 54 (71.2%) had the primary ICD code B34.2 (coronavirus infection of unspecified location). In addition, 5 (5.6%) of them had diagnoses from Chapter X (related to diseases of the respiratory system) (Table 2).

It was noted that 88 (98.9%) individuals with Covid-19 were using a circulatory invasive device, 86 (96.6%) respiratory, 60 (67.4%) nutritional and 60 (67.4%) were using a bladder catheter. Almost all (75.3%) used up to three invasive devices simultaneously (Table 2).

As for the diagnosis of sepsis, 47 (52.8%) did not have a medical diagnosis in their medical records, but when Covid-19 patients were assessed according to the ILAS and SOFA diagnostic criteria, 89 (100%) and 87 (97.8%), respectively, met the requirements for sepsis (Table 2).

Among the older adults with other respiratory infections, 28 (77.8%) were diagnosed with ICD-10 Chapter X pathologies on admission, while 4 (11.1%) had ICD-10 Chapter 1 pathologies. Regarding the use of invasive devices, 35 (97.2%) of the patients used a circulatory invasive device, 35 (97.2%) used a respiratory invasive device, 24 (66.7%) used an enteral tube and 23 (63.9%) used a bladder tube. In addition, 30 (83.3%) of the patients who did not have Covid-19 used up to three invasive devices concomitantly (Table 2).

When the SOFA and ILAS scores were assessed, 35 (97.2%) of the older adults who did not have Covid-19 met the requirements for sepsis according to the Sepsis-3 consensus and 36 (100%) met the ILAS requirements (Table 2).

Table 2. Characteristics related to the care of older adults who died with a diagnosis of community respiratory infection according to the presence or absence of Covid-19 (n=125) in the Intensive Care Unit of a University Hospital in a municipality in southern Brazil, 2021.

Condition		Presence of Covid-19 n/total (%)	Absence of Covid-19 n/total (%)
Admission diagnosis (ICD-10)	XXI*	0 (0)	1 (2.8)
	X **	5 (5.6)	28 (77.8)
	I ***	76 (85.4)	4 (11.1)
	XXII****	4 (4.5)	3 (8.3)
	XVIII*****	4 (4.5)	0 (0)
Admission diagnosis (ICD-11)	24******	0 (0)	1 (2.8)
	12*******	5 (5.6)	28 (77.8)
	1********	76 (85.4)	4 (11.1)
	25*********	4 (4.5)	3 (8.3)

	21**********	4 (4.5)	0 (0)
Sepsis according to Sepsis-3 consensus criteria	Yes	87 (97.8)	35 (97.2)
	No	2 (2.2)	1 (2.8)
Sepsis by ILAS criteria	Yes	89 (100)	36 (100)
Diagnosis of sepsis in medical records	No	47 (52.8)	21 (58.3)
	Yes	42 (47.2)	15 (41.7)

* XXI - Factors influencing health status and contact with health services
** X - Diseases of the respiratory system
*** I - Certain infectious and parasitic diseases
**** XXII - Special purpose codes
***** XVIII - Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified
****** 24 - Factors influencing health status or contact with health services
******* 12 - Diseases of the respiratory system
******** 1 - Certain infectious or parasitic diseases
********* 25 - Special purpose codes
********** 21 - Symptoms, signs or clinical findings, not elsewhere classified

Older adults admitted to the ICU with a diagnosis of community respiratory infection and infected with Covid-19 had a median age of 73 years (IQR=11; p=0.175), and weighed 74 kg (IQR=30; p=0.147). The median number of days spent in the ICU was eight days (IQR=5; p=0.937). The median SOFA and qSOFA scores were eight (IQR=5; p=0.568) and one (IQR=1; p=0.366) on the first day of hospitalization respectively (Table 3).

The older adults admitted to the ICU for other respiratory infections, except Covid-19, had a median age of 75 years (IQR=14) and weighed 65.0 kg (IQR=38). The median number of days spent in the ICU was 12 days (IQR=13), and the calculated SOFA and qSOFA scores were expressed as a median of eight points (IQR=6) and one point (IQR=1), respectively (Table 3).

Table 3. Table with the bivariate analysis of the continuous variables analyzed of older adults who died with a diagnosis of community respiratory infection, according to the presence or absence of Covid-19 (n=125) in the Intensive Care Unit of a University Hospital in a municipality in southern Brazil, 2021.

Variable	Presence of Covid-19 MD* (IQR*)	Absence of Covid-19 MD (IQR)	Total MD (IQR)	*p-value*
Age (years)	73.0 (11.0)	75.0 (14.0)	75.0 (11.0)	0.175
Weight (kg)	74.0 (30.0)	65.0 (38.0)	69.5 (32.5)	0.147
Total length of stay in ICU (days)	8.0 (5.0)	12.0 (13.0)	8.0 (8.0)	0.937
SOFA score (points)	8.0 (5.0)	8.0 (6.0)	8.0 (6.0)	0.568
qSOFA score (point)	1.0 (1.0)	1.0 (1.0)	1.0 (1.0)	0.366

*MD - median
**IQR - interquartile range

The most frequent characteristics related to mortality and Covid-19 were the presence of chronic respiratory disease (55.6%) and the type of etiologic agent (98.8%). The risk of death from Covid-19 in older adults who had a previous chronic respiratory disease and were

diagnosed with sepsis at the start of hospitalization was 1.9 times higher compared to individuals without comorbidity (p=0.014). Infection by a viral etiological agent proved to be 3.2 times more fatal than other pathological agents in the presence of Covid-19 (p<0.001) (Table 4).

Table 4. Bivariate analysis of the sociodemographic and clinical characteristics of older adults who died with a diagnosis of community respiratory infection (n=125) in an Intensive Care Unit at a University Hospital in a municipality in southern Brazil, 2021.

Variable		Presence of Covid-19 n/total (%)	Absence of Covid-19 n/total (%)	RR* (**95% CI)	*p-value*
Gender	Male	50/69 (72.5)	19/69 (27.5)	1.0 (0.8-1.3)	0.729
	Female	39/56 (69.6)	17/56 (30.4)	Ref.	
Age group	≥ 80 years	18/30 (60)	12/30 (40)	0.8 (0.5-1.1)	0.12
	60 to 79 years	71/95 (74.7)	24/95 (25.3)	Ref.	
Skin color	Other	14/18 (77.8)	4/18 (22.2)	1.1 (0.8-1.4)	0.586
	White	75/107 (70.1)	32/107 (29.9)	Ref.	
Municipality of origin	Ponta Grossa	63/83 (75.9)	20/83 (24.1)	1.2 (0.9-1.6)	0.103
	Other	26/42 (61.9)	16/42 (38.1)	Ref.	
Chronic diseases	Yes	77/108 (71.3)	31/108 (28.7)	1.0 (0.7-1.4)	0.952
	No	12/17 (70.6)	5/17 (29.4)	Ref.	
Dyslipidemia	Yes	6/6 (100)	0/6 (0)	1.4 (1.2-1.6)	0.181
	No	83/119 (69.7)	36/119 (30.3)	Ref.	
Chronic kidney disease	Yes	2/3 (66.7)	1/3 (33.3)	0.9 (0.4-2.0)	1
	No	87/122 (71.3)	35/122 (28.7)	Ref.	
Chronic endocrine disease	Yes	9/11 (81.8)	2/11 (18.2)	1.1 (0.8-1.5)	0.509
	No	80/114 (70.2)	34/114 (29.8)	Ref.	
Chronic neurological disease	Yes	18/24 (75)	6/24 (25)	1.0 (0.8-1.3)	0.647
	No	71/101 (70.3)	30/101 (29.7)	Ref.	
Chronic immunological disease	Yes	1/1 (100)	0/1 (0)	1.4 (1.2-1.5)	1
	No	88/124 (71)	36/124 (29)	Ref.	
Obesity	Yes	1/2 (50)	1/2 (50)	0.6 (0.1-2.8)	0.504
	No	88/123 (71.5)	35/123 (28.5)	Ref.	
Chronic respiratory disease	Yes	20/36 (55.6)	16/36 (44.4)	1.9 (1.1-3.3)	0.014
	No	69/89 (77.5)	20/89 (22.5)	Ref.	
Neoplasm	Yes	3/4 (75)	1/4 (25)	1.0 (0.5-1.8)	1
	No	86/121 (71.1)	35/121 (28.9)	Ref.	
Diabetes mellitus	Yes	31/41 (75.6)	10/41 (24.4)	1.0 (0.8-1.3)	0.447
	No	58/84 (69)	26/84 (31)	Ref.	
Chronic cardiovascular disease	Yes	64/88 (72.7)	24/88 (27.3)	1.0 (0.8-1.3)	0.561
	No	25/37 (67.6)	12/37 (32.4)	Ref.	
Etiologic agent	Virus	83/84 (98.8)	1/84 (1.2)	3.2 (1.6-6.4)	<0.001
	Bacteria,	6/20 (30)	14/20 (70)	Ref.	

	fungi, both				
Previous continuous use medication	Yes	75/103 (72.8)	28/103 (27.2)	1.1 (0.8-1.6)	0.388
	No	14/22 (63.6)	8/22 (36.4)	Ref.	
Number of invasive devices	4 or more	22/28 (78.6)	6/28 (21.4)	1.1 (0.8-1.4)	0.328
	Up to 3	67/97 (69.1)	30/97 (30.9)	Ref.	
Sepsis according to Sepsis-3 consensus criteria	Yes	87/122 (71.3)	35/122 (28.7)	1.0 (0.4-2.4)	1
	No	2/3 (66.7)	1/3 (33.3)	Ref.	
Diagnosis of sepsis in medical records	No	47/68 (69.1)	21/68 (30.9)	0.9 (0.7-1.1)	0.574
	Yes	42/57 (73.7)	15/57 (26.3)	Ref.	

*RR - risk ratio;
**CI - confidence interval.

DISCUSSION

In this study, 69 men (55.2%) died, compared to 56 women (44.8%). Men tend to spend more time in the ICU and receive more interventions during hospitalization, such as the initiation of antibiotics.[19] One explanation for the higher number of deaths in men could be behavioral, since men adhere less to preventive health care and visit health services less regularly.[19] Therefore, when they enter hospitals, they tend to have more serious cases that require ICU admission.

With regard to age group, there was a higher rate of community respiratory infection associated with sepsis and death in older adults aged between 60 and 79. This result is corroborated by a study carried out in a large hospital in the municipality of Fortaleza, Ceará, which showed that there was a higher number of deaths in patients aged around 60 with respiratory sepsis.[20] A possible explanation could be the higher prevalence of older adults Brazilians aged between 60 and 79, compared to those aged 80 or over. According to the Brazilian Institute of Geography and Statistics (IBGE), in 2021, 14.2% of the Brazilian population was made up of individuals aged 60-79, while 2.1% of individuals were aged 80 or over.[21]

In a study conducted in China, it was shown that, in 2018, 18% of patients with pneumonia who were discharged from hospital were over 60 years old.[5] However, when analyzing the profile of individuals hospitalized for infectious diseases between 2013 and 2017 in this same study, it was found that the older adults aged 85 to 89 had a much higher risk of respiratory diseases than those aged 60 to 64.5

Regarding clinical aspects, most patients had some associated chronic disease, the most common being cardiovascular, diabetes mellitus and chronic respiratory diseases. In the pandemic caused by Covid-19, patients with cardiovascular disease were found to be more

susceptible to the virus, as well as having a higher mortality rate.[22] Diabetes mellitus, systemic arterial hypertension and neoplasms are prevalent pathologies in patients with sepsis.[23] These diseases can cause physiological changes that culminate in endothelial dysfunction, thus affecting the condition of individuals with community respiratory infection associated with sepsis.[23] Hyperglycemia resulting from diabetes mellitus can induce oxidative stress, with a consequent increase in free radicals and endothelial dysfunction.[23] Neoplasms, in turn, can lead to an increase in nitric oxide production in the body, as well as other changes, resulting in a pro-inflammatory state with a propensity for endothelial dysfunction.[23] Systemic arterial hypertension can also lead to heart failure, which can be harmful to patients with community infection and sepsis.[23]

Airway diseases are responsible for high morbidity and mortality rates, especially at the extremes of age.[4] A study carried out in six academic hospitals in the United States, from January 2017 to March 2018, showed that deaths from sepsis in ICUs were 37.5%.[24] Patients had an average age of 60.5 years and those with pre-existing chronic diseases were 40.3%, a rate that is similar to that of this study.[24] The comorbidities that may have contributed to death were chronic heart disease (15.3%) and chronic lung disease (9.0%), among other diseases.[24]

Covid-19 infection was the most common among the other etiological agents. Covid-19 is a viral pulmonary infection that emerged in 2019 and has had a major impact worldwide.[25] It has high transmissibility and lethality, observed mainly in with underlying comorbidities and advanced age.[25] In the state of Paraná, the older adults were very affected by the infection, with a lethality rate of around 17.81% in 2020.[25]

The epidemiological bulletin published by the Paraná State Health Department (SESA) reported that, as of September 30, 2020, a period concurrent with the one studied in this research, there were 6,417 confirmed cases and 139 deaths of patients with Covid-19 in the municipalities that make up the 3rd Health Region of Paraná - the territory served by the hospital unit investigated.[26]

In addition to Covid-19, it was also highlighted that a high number of individuals entered the ICU with CAP. The study can be compared to the result found in a study carried out in Portugal between 2000 and 2014, which evaluated the hospital mortality rate due to CAP.[27] The study showed that mortality was 18.5% over the entire period, with 56.2% of individuals being male and 91.7% aged over 65.27 However, in this study, mortality due to CAP was almost double the rate found in Portugal.[27]

Infection by a viral etiologic agent was associated as a risk factor for death in the older adults with sepsis, which may be justified by the population and the period studied, coinciding

with part of the Covid-19 pandemic. In a study carried out in a network of hospitals in 30 provinces in China between 2009 and 2020, it was found that both children and the older adults had a higher rate of bacterial and viral co-infections in patients with severe community-acquired pneumonia when compared to patients without this diagnosis.[28]

The use of previous continuous medication was shown to have a high incidence among patients with community respiratory infection who died. Older adults over the age of 80 have a high percentage of ICU admissions.[29] The presence of multiple comorbidities and polypharmacy, which are common in this age group, are associated with higher long- and short-term mortality.[29] It is therefore important to encourage the rational use of medication and to encourage vaccination, in order to prevent a respiratory disease that could easily be treated in primary care from worsening and causing hospitalization.

The most frequent primary diagnoses were those contained in Chapter I - "Some infectious and parasitic diseases", and Chapter X - "Diseases of the respiratory system", of the ICD-10. This result was obtained due to the inclusion criterion in this study based on community respiratory infection and because the study was carried out during the Covid-19 pandemic period. According to the SUS Hospital Information System (SIH/SUS), the mortality rate for older adults aged 60-79 in the state of Paraná in September 2020, a period consistent with that studied in this research, for diseases contained in Chapter I of ICD-10 was 17.97%, while mortality from causes contained in Chapter X was 13.08%.[30]

The majority of older adults with sepsis and community respiratory infection met criteria according to the Sepsis-3 and ILAS consensus. A 2022 study of patients with sepsis found that the primary outcome in this population was clinical deterioration 72 hours after admission, as well as secondary outcomes such as death and ICU admission, with the SOFA score increasing by at least 2 points.[31] In this same study, it was found that patients who had clinical worsening stayed longer in the ICU.[31] The median number of days that older adults patients with community respiratory infection and sepsis spent in the ICU was 8 days in this study. It should be noted that the longer a patient stays in the ICU, the greater their exposure to the hospital environment, which increases the chances of infections and, consequently, the development of sepsis and death.

Community respiratory infections were classified according to the primary ICD described by the physician in the medical record as the diagnosis of hospitalization, given that respiratory infections have clinical pictures that are easy to characterize. Thus, it was considered less harmful to the quality of the information to include cases with respiratory

symptoms than to exclude cases that could have been admitted for another cause diagnosed by the doctor at the time of admission.

It is suggested that future research should compare this study with others containing patients with similar characteristics who survived sepsis, so that more robust comparisons can be made on the subject.

The findings of this study reflect the impacts that the Covid-19 pandemic has had on hospital institutions, both ICUs and healthcare teams. Community respiratory infections, more specifically Covid-19, are a challenge for public health due to their complexity. Because of this, the research provides new insights into the conditions that result in sepsis in older adults with Covid-19, which could guide the implementation of new studies on the subject, as well as helping in the management of patients with Covid-19 and sepsis.

Educational practices in primary health care could encourage self-care among the older adults, mutual support between professionals and the population, and improve adherence to appointments, vaccinations and the use of medication to prevent the older adults with chronic respiratory diseases from developing infections and requiring future hospital intervention. In a study published in 2025, it was found that among the 5,296 older adults with cardiovascular diseases who took part in the research, 76.6% had been vaccinated against influenza. A high percentage of unvaccinated older adults can have an impact on the burden of morbidity and mortality. Influenza, for example, can be an aggravating factor in underlying comorbidities because it raises levels of pro-inflammatory cytokines, aggravates symptoms and contributes to an increase in overall mortality.[32]

This study has limitations regarding the lack of data on the patients studied, such as mean arterial pressure and vital signs, which were not included in electronic medical records and which were not collected in physical medical records due to the pandemic. However, it is justified that the presence of such data would not eliminate the sepsis conditions detected and would not improve the clinical picture; on the contrary, if present, they could worsen the SOFA and ILAS scores. In addition, this study was carried out in a single center, therefore, it is not possible to generalize the results found.

The results of this study indicate the need to implement and improve public policies related to immunization and general health of the older adults. The epidemiological information revealed in this research confirms the diagnosis of worse progression of septic conditions among the older adults, when admitted to the ICU. Therefore, the study is relevant for the clinical management of sepsis in a hospital environment and also for reflection on means of preventing hospitalizations due to community-acquired respiratory infections among the older

adults, since the study revealed that the incidence of mortality in older adults admitted to the ICU due to community-acquired respiratory infection with sepsis was high. The factors that were associated with mortality were: the viral etiological agent and the presence of pre-existing chronic respiratory disease. Therefore, the need for public policies that corroborate the expansion of vaccination coverage among the older adults is reinforced, given the ability to prevent severe respiratory infections.

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AUTHORS' CONTRIBUTIONS

Fernanda Pitome Weigert contributed to the conception and design or analysis and interpretation of data, writing of the article or relevant critical review of intellectual content, final approval of the version to be published, was responsible for all aspects of the work in ensuring the accuracy and integrity of any part of the work**. Helena Oles** contributed to the conception and design or analysis and interpretation of data, writing of the article or relevant critical review of intellectual content, final approval of the version to be published, was responsible for all aspects of the work in ensuring the accuracy and integrity of any part of the work**. Caroline Palogan Reginato** contributed to the conception and design or analysis and interpretation of data, writing of the article or relevant critical review of intellectual content, final approval of the version to be published, was responsible for all aspects of the work in ensuring the accuracy and integrity of any part of the work**. Erildo Vicente Müller** contributed to the conception and design or analysis and interpretation of data, writing of the article or relevant critical review of intellectual content, final approval of the version to be published, was responsible for all aspects of the work in ensuring the accuracy and integrity of any part of the work**. Taís Ivastcheschen Taques** contributed to the conception and design or analysis and interpretation of data, writing of the article or relevant critical review of the intellectual content, final approval of the version to be published, was responsible for all aspects of the work in ensuring the accuracy and integrity of any part of the work**. Pollyana Kassia de Oliveira Borges** contributed to the conception and design or analysis and interpretation of data, writing of the article or relevant critical review of the intellectual content, final approval of the version to be published, was responsible for all aspects of the work in ensuring the accuracy and integrity of any part of the work**.**

All authors approved the final version to be published and are responsible for all aspects of the work, including ensuring its accuracy and integrity.