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Hospital morbidity and mortality profile due to pneumonia in Brazil between 2010 and 2020

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1 INTRODUCTION

Pneumonia is a lower respiratory tract infection that affected 489 million people worldwide in the year 2019 according to data from the Global Burden of Diseases (GBD) 2019 study[1,2]. The disease was still responsible for over 2.49 million deaths in the year of the survey, surpassing other diseases such as tuberculosis and HIV, making pneumonia the leading infectious cause of death worldwide[2].

Pneumonia can be broadly categorized into aspiration pneumonia, community-acquired pneumonia (CAP) when the infection occurs outside the hospital environment, and hospital-acquired pneumonia, an infection acquired after at least 48 hours of hospitalization, considered the second most frequent hospital infection[3],4. Immunosuppressed patients, children younger than 5 years old, and adults aged 65 years or older are at risk populations5,6. In children the main risk factors are prematurity, malnutrition, and household air pollution, whereas in adults the most relevant risk factors are: COPD, diabetes mellitus, smoking, alcoholism, malnutrition, and exposure to pollution[7-9].

There are several agents capable of causing pneumonia, but the most frequent is *Streptococcus pneumoniae*[10]. Infection occurs through the migration of microorganisms from the nasopharynx to the lower respiratory tract or through contact with contaminated droplets and aerosols[11]. The most common acute symptoms (lasting up to 7 days) are cough, fever, dyspnea, chest pain, expectoration, and fatigue. Even though they are classic, they do not present a direct correlation with the outcome of the disease, unlike the lowered level of consciousness and pleuritic-type chest pain (higher risk of pleural effusion)[12]. Also, patients who are elderly or taking steroids, NSAIDs, or antibiotics may have less obvious symptoms [13].

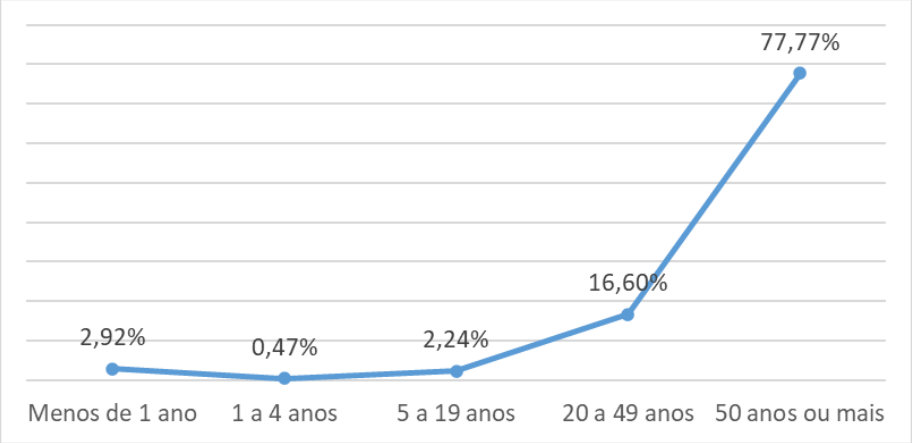
From a suggestive clinical picture, radiological confirmation of pneumonia is fundamental because imaging exams reveal the site and extent of infection, as well as associated characteristics such as pleural effusion and cavitations[14]. It is recommended to obtain sputum and blood samples from hospitalized patients for microbiological diagnosis before starting treatment[15]. Empirical therapy for pneumonia lasts 5 to 7 days and is based on the severity of illness and presence of risk factors for specific pathogens. In the

absence of special considerations, a beta-lactam and a macrolide or a respiratory fluoroquinolone is used as monotherapy[16]. Patients with respiratory failure and hypoxemia may receive mechanical ventilatory support or noninvasive ventilation[17].

Even after antibacterial therapy, a considerable number of patients have their quality of life maintained or deteriorated after discharge[18]. Symptom scores in later disease are worse and long-term mortality higher than in the general population, thanks to the long-term inflammatory effect and the comorbidities often present in the infected[19]. The importance of pneumonia prevention is evident, which can be done through primary care programs related to smoking and alcohol cessation, improved oral hygiene, hand hygiene, and physical exercises[20]. However, the most effective preventive measure to reduce the pneumonia burden is vaccination, which can be done with the 23-valent pneumococcal polysaccharide vaccine (PPSV23) or the 13-valent pneumococcal conjugate vaccine (PCV13)[21]. As pneumonia is a possible complication of influenza, vaccination against*Haemophilus influenzae* is also part of the prevention strategies[22].

Since the 1950s, the Swaroop-Uemura index has been used to measure the levels of health care in certain demographic regions. To complement it, the Nelson de Moraes Curve was created, a graphical representation of proportional mortality in various age groups[23]. In the period from 2010 to 2020, Brazil showed an excellent level of health care, considering the Swaroop-Uemura index of 77.77% and the Nelson de Moraes Curve type IV, as shown in figure 1[24].

Figure 1: Nelson de Moraes curve of Brazil between 2010 and 2020[24].



Translation:
Menos de 1 ano: less than 1 year
1 a 4 anos: 1 to 4 years
5 a 19 anos: 5 to 19 years
20 a 49 anos: 20 t0 49 years
50 anos ou mais: 50 years and older

As pneumonia has a major global and local impact, it is expected that Brazil's health systems have improved the management of this disease through prevention strategies, early diagnosis and improved treatments[1,2,18,19]. Therefore, this study aims to determine the profile of hospital morbidity and mortality

from pneumonia in Brazil between 2010 and 2020 to investigate the impact of high level of health care on infection morbidity and mortality.

2 METHODOLOGY

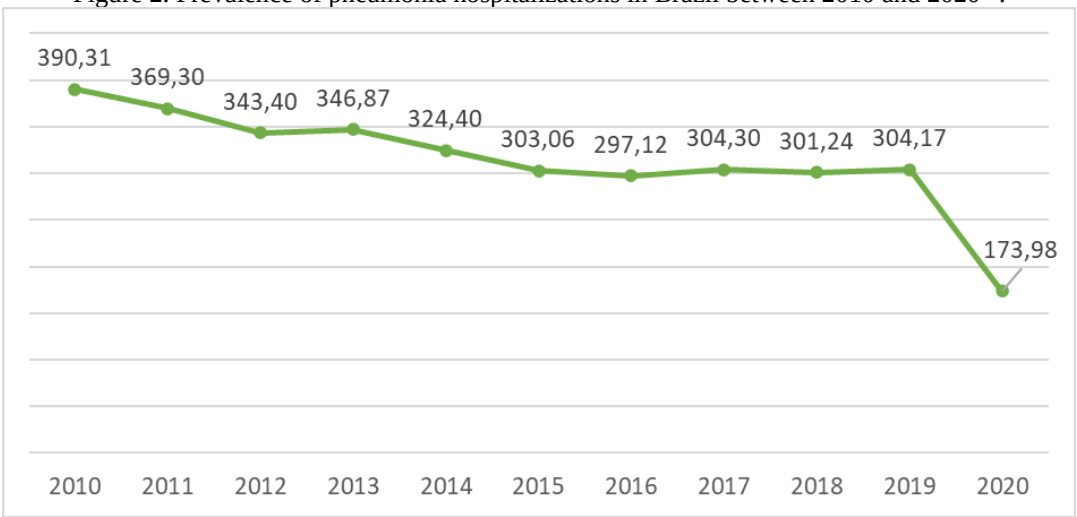
Ecological study based on databases allocated in DataSUS, including the Mortality Information System (SIM), SUS Hospital Information System (SIH/SUS), and Management of Studies and Analyses of Demographic Dynamics of the Research Directorate of IBGE. The period from 2010 to 2020 and the following ICD-10 categories were considered: J12 viral pneumonia not elsewhere classified (COP), J13 pneumonia due to *Streptococcus pneumoniae*, J14 pneumonia due to *Haemophilus influenzae*, J15 bacterial pneumonia not COP, J16 pneumonia due to other specified infectious microorganisms not COP, J17 pneumonia in COP diseases, and J18 pneumonia due to unspecified infectious microorganisms.

Discarding ignored information to avoid overestimated results, we collected the number of: deaths by residence, period, and ICD-10 category according to region, age group, and sex; hospitalizations by year of care, ICD-10 morbidity list, and period; resident population by year. Then, we calculated the prevalence rates of hospitalizations (number of hospitalizations for pneumonia per 100,000 population), specific mortality (number of deaths from pneumonia per 100,000 population) and proportional mortality (percentage of total deaths attributed to pneumonia) according to region, age group and sex. The values were represented in graphs for later evaluation.

3 RESULTS

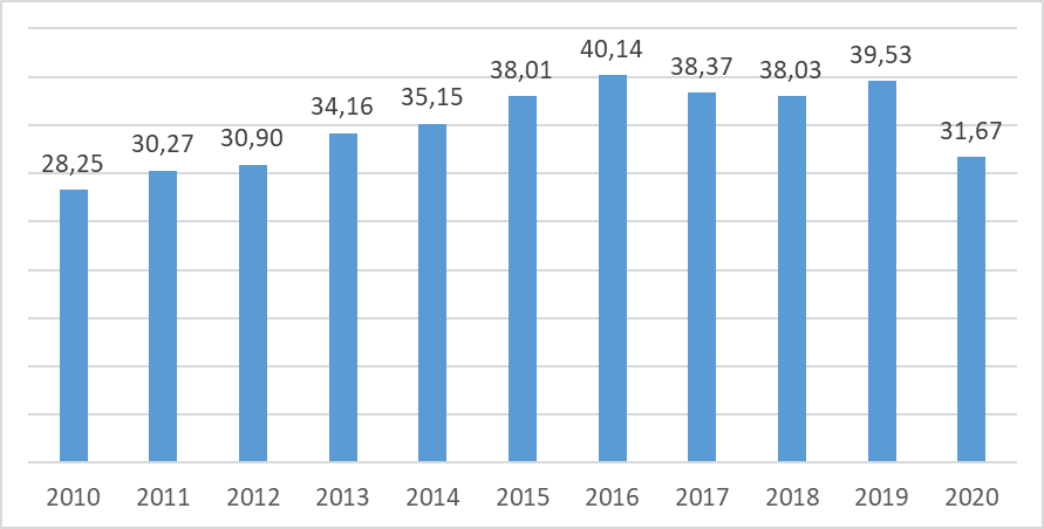
The prevalence of hospital admissions for pneumonia per 100,000 population decreased from 390.31 in 2010 to 297.12 in 2016, experiencing a slight rise from 2012 to 2013 that was soon surpassed. From 2016 to 2019, it went through small variations, until in 2020 it decreased dramatically to 173.98 hospitalizations per 100,000 population as shown in figure 2[25].

Figure 2. Prevalence of pneumonia hospitalizations in Brazil between 2010 and 2020[25].



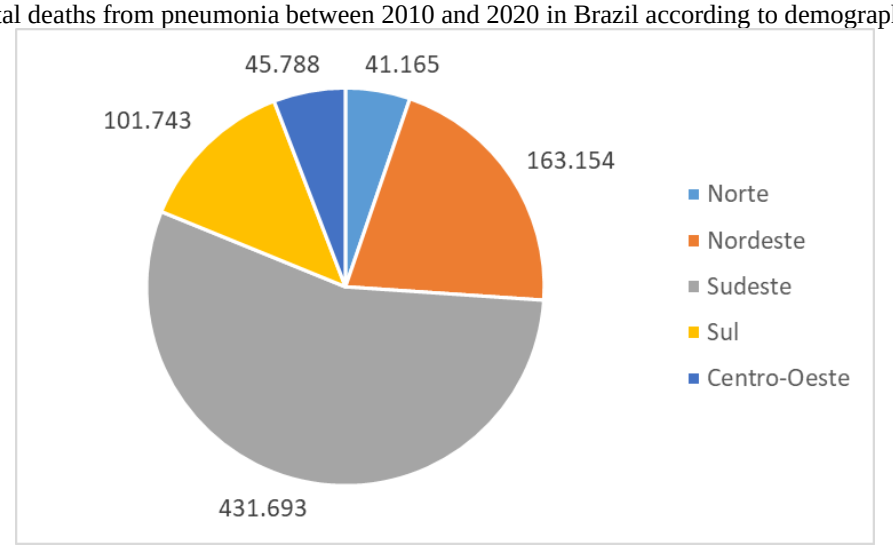
In figure 3, it is observed that the pneumonia-specific mortality rate increased from 28.25 to 40.14 between 2010 and 2016, underwent small variations in the following 3 years and decreased significantly in the year 2020 to 31.6724.26. As for proportional mortality, it varied from 5.19% in 2010 to 6.56% in 2016, also did not undergo major changes in the following years until, in 2020, it reduced to 4.43%[24].

Figure 3. Specific and proportional mortality rates for pneumonia in Brazil each year from 2010 to 2020[24,26].



There was no significant difference in the proportions of deaths between the genders and between the age groups below 50 years, which represented only 10.43% of all deaths from pneumonia, while the remaining 89.57% occurred in persons 50 years of age or older. Finally, as shown in figure 4, most deaths occurred in the Southeast region, followed by the Northeast, South, Midwest, and North in descending order[24].

Figure 4. Total deaths from pneumonia between 2010 and 2020 in Brazil according to demographic region [24].



Translation:
Norte: north
Nordeste: northeast
Sudeste: southeast
Sul: south
Centro-oeste: mid-west

4 DISCUSSION AND CONCLUSION

The study showed an overall decrease in the prevalence of hospital admissions for pneumonia, while mortality rates increased successively, and even though they decreased in the year 2020, they did not reach levels below the year 2010. There were no significant differences in mortality between the sexes, as well as between the age groups below 50 years. Moreover, the vast majority of cases of death occurred in patients aged 50 years or older. As for the demographic region, the proportions were consistent with the estimated population residing per year in each, so the descending order of absolute mortality was Southeast, Northeast, South, Midwest and North.

The overall decrease in the prevalence of hospital admissions can be attributed to the greater availability of pneumococcal vaccines, new diagnostic tests, and antibiotics, factors that also favor lower mortality in children, as well as better conditions of education, nutrition, basic sanitation, and hygiene[27]. Similar studies have shown that about 9% of hospitalizations for pneumonia occur in patients who have already had a previous episode in that same year, so the reduction evidenced may be a reflection of the lower number of primary infections and reinfections as well[28].

Overall mortality has increased over the years, reflecting deficient interventions, especially in severe forms of the disease and in the population aged 50 years or older. The behavior of mortality indicators also reflects the impact of chronic diseases, comorbidities, use of other medications, and functional disability inherent to senility on disease severity[19]. Pneumonia remains a relevant cause of mortality in the adult population, which has repercussions not only on the individual life of the patient, but also socially and economically, considering the direct and indirect health care costs due to pneumonia[29].

This ecological study had weaknesses such as possible data loss and overestimation of results by observing only absolute numbers and simple health indicators. Even so, it worked with a large number of data and a long period, making it valid for this reason.

The excellent level of health care in Brazil impacted the prevalence of hospital admissions as expected, however, it was not able to improve the mortality rates, which is alarming considering the global impact of infection. Thus, it is evident that further research is needed to identify the true causes of the variations found in order to improve the epidemiological profile of pneumonia in Brazil..

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