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Influenza Vaccination And Mortality In The Elderly: Evidence From A Northeastern State Of Brazil (2012-2022)

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Abstract:
Background*: Vaccination in older adults is an essential strategy for preventing severe influenza complications, particularly among vulnerable populations. In the State of Alagoas, located in northeastern Brazil, socioeconomic conditions and often limited access to healthcare services underscore the need for comprehensive immunization campaigns.*
Materials and Methods: *This study analyzes mortality data due to Influenza and all causes, as well as vaccine administration in individuals over 60 years of age in Alagoas between 2012 and 2022, using data from the National Immunization Program Information System (SI-PNI) and the Mortality Information System (SIM), extracted from the DATASUS platform.*
Results*: A considerable increase in vaccine administration was observed, with notable peaks in 2013 and 2020, reflecting intensive vaccination campaigns. In terms of mortality, the percentage of deaths due to Influenza varied, showing significant peaks in 2015–2016 and 2018–2019, followed by a reduction during the COVID-19 pandemic, when preventive measures restricted viral transmission. Comparative analysis suggests that while vaccination contributes to mitigating Influenza-related mortality, factors such as strain virulence and non-pharmacological interventions are also determinants. Furthermore, years with significant declines in Influenza-related mortality coincide with large-scale public health campaigns, highlighting the importance of comprehensive policies.*
Conclusion: *It is concluded that vaccination should be maintained and reinforced, especially in years with increased viral circulation, and that preventive measures implemented during pandemics play a crucial role in reducing deaths from respiratory diseases.*
Key Word: *Influenza; Vaccination; Mortality; Elderly; Alagoas.*

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I. Introduction

Influenza remains a significant public health concern worldwide, particularly among older adults, who are at higher risk for severe complications and mortality. Vaccination is a crucial strategy in mitigating the burden of influenza-related morbidity and mortality. In Brazil, the National Immunization Program (*Programa Nacional de Imunizações* - PNI) has been instrumental in promoting influenza vaccination among priority groups, including the elderly population[1]. However, despite the widespread availability of vaccines, mortality rates due to influenza continue to fluctuate across different years, influenced by factors such as viral strain virulence, vaccine efficacy, and public health interventions[2].

Despite the well-established benefits of influenza vaccination, coverage rates among older adults vary considerably, often falling short of the recommended targets. Multiple factors contribute to this variability, including individual perceptions of vaccine effectiveness, fear of adverse reactions, and misinformation regarding influenza severity[3]. Additionally, structural and logistical barriers, such as inadequate access to healthcare services in remote areas, socioeconomic disparities, and inconsistencies in vaccination campaigns, may hinder equitable vaccine uptake among the elderly population. Understanding these determinants is essential for designing targeted interventions to enhance immunization coverage.

The Northeastern region of Brazil, including the state of Alagoas, presents unique challenges regarding influenza prevention among older adults. Characterized by significant socioeconomic disparities, limited healthcare infrastructure in rural areas, and variations in public health resource allocation, this region often experiences lower vaccination coverage compared to more developed areas of the country[4]. Additionally, climatic conditions, with seasonal shifts distinct from temperate regions, may influence the transmission patterns of influenza, affecting both vaccine demand and effectiveness[5]. Understanding how these regional factors impact vaccination uptake and influenza-related mortality is essential for tailoring public health policies to address the specific needs of vulnerable populations in Alagoas.

Furthermore, the relationship between influenza vaccination and mortality outcomes is influenced by broader epidemiological trends, including seasonal variations, shifts in circulating viral strains, and the presence of comorbid conditions that exacerbate the severity of influenza infections. Studies have indicated that while vaccines significantly reduce hospitalization and death rates, their effectiveness can vary depending on factors such as immune response in older adults and antigenic match between the vaccine and predominant viral strains[6,7]. Investigating these dynamics within specific populations is crucial to optimizing vaccination policies and ensuring better protection for vulnerable groups.

This study aims to evaluate the impact of influenza vaccination on mortality among individuals aged 60 and over in the state of Alagoas between 2012 and 2022. By analyzing trends in vaccine administration and mortality rates, this research seeks to identify patterns and correlations that can inform future public health strategies.

II. Material And Methods

This study utilized secondary data extracted from two national databases: the *Sistema de Informação do Programa Nacional de Imunizações* (SI-PNI) for vaccination coverage and the *Sistema de Informações sobre Mortalidade* (SIM) for mortality data, both available on the DATASUS platform. Data were collected, processed, and analyzed to identify temporal trends and correlations between vaccination rates and influenza-related mortality in the elderly population.

Study Population:
Individuals aged 60 and over residing in Alagoas, Brazil.

Study Period:
Data from 2012 to 2022.

Variables Analyzed:
Percentage of deaths attributed to influenza among total deaths in the elderly.
Annual number of influenza vaccine doses administered.

Data Analysis:
Trends in mortality and vaccination rates were examined through graphical representations.

Peaks in mortality were analyzed in relation to vaccination coverage and possible epidemiological factors such as viral virulence.
The impact of the COVID-19 pandemic on influenza-related deaths was also considered.

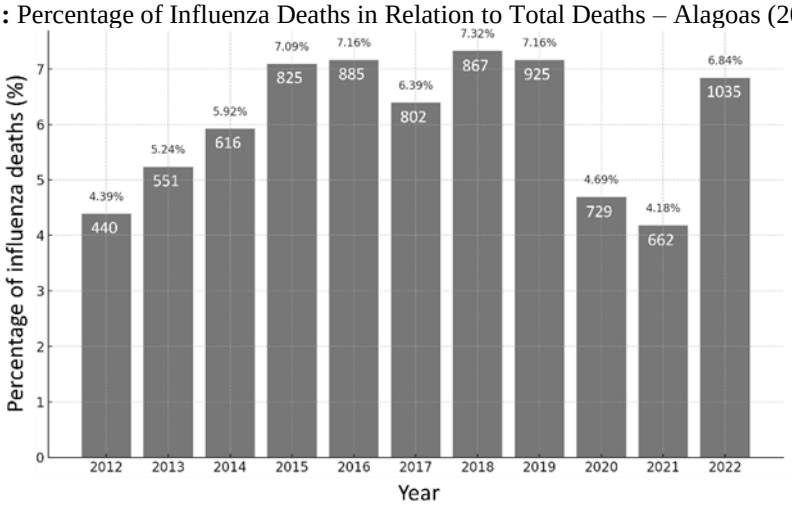
III. Results

The analysis revealed distinct patterns in both influenza mortality and vaccination rates over the study period.

Influenza Mortality Trends:

Influenza-related deaths exhibited significant variations over the years, with notable peaks in 2015-2016 and 2018-2019. These years coincided with the circulation of more virulent influenza strains, which led to higher complications and fatality rates (Graph 1).

Graph 1: Percentage of Influenza Deaths in Relation to Total Deaths – Alagoas (2012-2022)

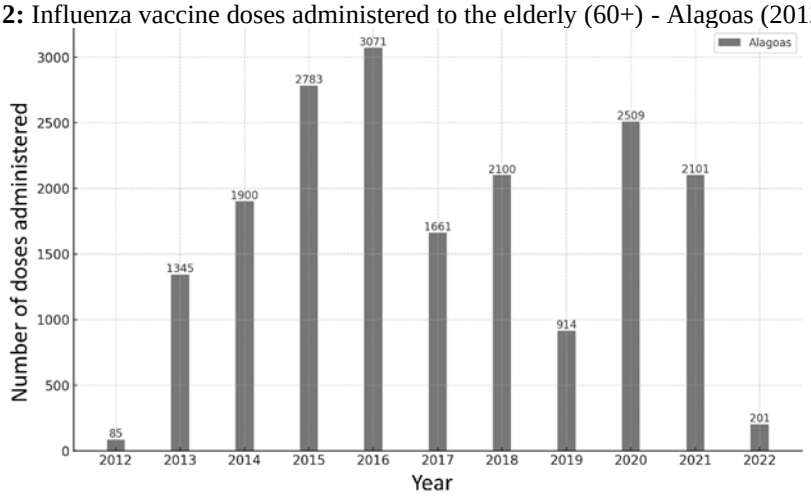


In contrast, mortality percentages declined substantially during 2020-2021, coinciding with the COVID-19 pandemic, during which preventive measures such as mask-wearing, social distancing, and lockdowns may have limited influenza transmission. In 2022, mortality rates increased again, potentially due to the relaxation of preventive measures and the return to pre-pandemic social interactions.

Vaccination Trends:

The number of vaccine doses administered increased considerably between 2012 and 2016, reaching a peak in 2015. This growth reflects intensified vaccination campaigns and efforts to expand coverage (Graph 2).

Graph 2: Influenza vaccine doses administered to the elderly (60+) - Alagoas (2012-2022)



From 2017 onwards, vaccine administration fluctuated, with notable peaks in 2020 and 2021, possibly due to heightened awareness of respiratory diseases during the COVID-19 pandemic. A sharp decline in vaccination was observed in 2022, which may be attributed to changes in public health priorities and reduced participation in immunization programs.

IV. Discussion

The findings of this study highlight the importance of influenza vaccination in mitigating mortality among the elderly while also revealing the influence of external factors, such as viral virulence and non-pharmaceutical interventions. The correlation between increased vaccination rates and lower mortality in certain years suggests that immunization plays a crucial role in protecting older adults[8]. However, despite high vaccine coverage in some periods, mortality peaks were still observed in years when the circulating virus exhibited greater virulence. This indicates that vaccine effectiveness may vary depending on the match between the administered vaccine and the predominant viral strain, reinforcing the need for continuous surveillance and adaptation of vaccine formulations[9].

The COVID-19 pandemic (2020-2021) had a significant impact on influenza mortality trends. The drastic reduction in influenza-related deaths during this period suggests that preventive measures, such as mask-wearing, social distancing, and restricted social interactions, contributed to limiting the transmission of the influenza virus[10]. These findings underscore the potential benefits of incorporating certain public health strategies during seasonal influenza outbreaks to reduce mortality among high-risk groups. However, in 2022, influenza mortality rates increased again, likely due to the relaxation of these preventive measures and the resumption of pre-pandemic social behaviors. This emphasizes the continued vulnerability of the elderly population and the necessity of maintaining robust surveillance and preparedness strategies[11].

Another critical finding is the fluctuation in vaccination coverage over the years. The increase in vaccine doses administered between 2012 and 2016 reflects the success of intensive immunization campaigns, while the variations in subsequent years indicate challenges in sustaining high coverage. The peak in vaccinations observed in 2020 and 2021 suggests that heightened awareness of respiratory infections during the COVID-19 pandemic may have positively influenced influenza immunization efforts. However, the sharp decline in vaccine administration in 2022 raises concerns about potential gaps in immunization programs. Reduced vaccination uptake in this period could be attributed to shifting public health priorities post-pandemic, vaccine hesitancy, or logistical challenges in distribution and outreach[12].

The adherence of older adults to influenza vaccination can be influenced by various factors. Some studies indicate that older individuals, non-smokers, and those with chronic diseases are more likely to get vaccinated, demonstrating a greater awareness of the importance of immunization and active participation in vaccination campaigns[13,14]. These individuals recognize the risks of influenza and its potential complications. However, barriers such as socioeconomic inequalities, difficulties in accessing healthcare services, cultural beliefs, and behavioral factors can negatively impact vaccination rates, leading to annual fluctuations in coverage. Moreover, misinformation contributes to vaccine hesitancy, with the most commonly reported reasons for refusal being concerns about possible adverse reactions, the perception that they rarely contract influenza, and a lack of interest in immunization. In this context, healthcare professionals play a crucial role in guiding the population, addressing doubts, correcting misconceptions about vaccine effects, and reinforcing its importance in preventing severe influenza-related complications[15].

Overall, the study findings emphasize the need for sustained and reinforced influenza vaccination programs, particularly in years with higher viral circulation. The observed mortality fluctuations suggest that, while vaccination is a critical tool in reducing the burden of influenza, additional factors such as the virulence of circulating strains and the implementation of preventive health measures also play a decisive role. Strengthening public health campaigns, ensuring vaccine accessibility, and maintaining awareness of the risks of influenza among the elderly are essential strategies to mitigate the impact of the disease[16].

V. Conclusion

This study demonstrates that influenza vaccination remains a fundamental strategy in reducing mortality among the elderly, although its effectiveness is influenced by multiple factors such as viral strain variability, vaccine efficacy, and public health interventions. The observed peaks in mortality during 2015-2016 and 2018-2019 suggest that years with more virulent circulating strains pose a greater risk to the elderly population, even when vaccination coverage is high. This underscores the necessity of continuous epidemiological surveillance and the adaptation of vaccine formulations to better match predominant viral strains.

The significant decline in influenza-related deaths during the COVID-19 pandemic (2020-2021) highlights the role of non-pharmaceutical interventions in controlling viral transmission. Preventive measures such as mask use, social distancing, and mobility restrictions likely contributed to the suppression of influenza spread during this period. However, the increase in mortality in 2022, following the relaxation of these measures, reinforces the ongoing vulnerability of older adults to respiratory infections. These findings suggest that integrating some of these preventive strategies into seasonal influenza prevention plans could be beneficial in reducing mortality.

The analysis of vaccination coverage reveals important trends that should inform future immunization policies. The increasing number of vaccine doses administered from 2012 to 2016 reflects successful public health campaigns, whereas fluctuations in subsequent years indicate potential challenges in sustaining high coverage. The sharp decline in vaccinations in 2022 is particularly concerning and highlights the need for renewed efforts in public awareness, vaccine accessibility, and policy reinforcement.

In conclusion, influenza vaccination must be maintained and strengthened, particularly in years of increased viral circulation, to protect the elderly population from severe complications and mortality. Public health policies should aim not only to expand vaccine coverage but also to incorporate additional preventive measures during epidemic seasons. By reinforcing vaccination programs and ensuring comprehensive public health strategies, it is possible to further mitigate the impact of influenza among the most vulnerable groups.

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