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ARTICLE

The impact of influenza vaccination on morbidity and mortality in the elderly in the major geographic regions of Brazil, 2010 to 2019

O impacto da vacinação contra influenza na morbimortalidade dos idosos nas regiões do Brasil entre 2010 e 2019

El impacto de la vacunación contra la gripe en la morbimortalidad de los ancianos en regiones de Brasil entre 2010 y 2019

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Abstract

Due to the importance of annual flu vaccination in the elderly, the study aimed to analyze the impact of influenza vaccination on morbidity and mortality from influenza in the elderly from 2010 to 2019 in the major geographic regions of Brazil. This is an ecological epidemiological study with data from the Information System of the National Immunization Program, Hospital Information System, and Mortality Information System, available from the Brazilian Ministry of Health. Data referred to Brazil and its five major regions and included influenza vaccination coverage rates in the elderly and morbidity and mortality from causes related to influenza and pneumonia in the elderly. Simple linear regression models were used to study the relationship between morbidity and mortality and vaccination coverage rates. There was an increase in vaccination coverage during the period, and the target of 80% coverage was reached in all the regions since 2011. A directly proportional statistical association was identified between the study variables, and the increase in vaccination coverage was associated with an increase in morbidity and mortality from the target causes. These data may be related to reports in the literature showing that the vaccine's effect is modest in the elderly. However, the rates' calculation does not take the population's aging into account, using data from outdated census estimates. Besides, the hospitalization and mortality data may include other circulating viruses and bacteria besides influenza. The maintenance of high vaccination coverage may prevent the impact of influenza from being even higher on morbidity and mortality in the elderly.

Influenza Vaccines; Aged; Vaccination Coverage; Morbidity; Mortality Registries

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Introduction

Brazil is experiencing the phenomenon of population aging, characterized by an increase in the number of elderly Brazilians, due mainly to the reduction in the fertility and mortality rates [1].

The elderly population experiences specific physiological and pathological changes. According to data from the Hospital Information System of the Unified Health System (SIH/SUS; http://tabnet.datasus.gov.br/cgi/tabcgi.exe?sih/cnv/niuf.def, accessed on 15/May/2020) for the year 2019, the leading cause of hospitalization in the elderly population was the group of diseases of the digestive system (n = 1,208,223), followed by diseases of the respiratory system (n = 1,186,828), and of the circulatory system (n = 1,177,590). This context includes acute infectious diseases, among which influenza, commonly known as the flu [2].

Influenza is an acute viral infection, the etiological agent of which is *Myxovirus influenzae*, or influenza virus. It is highly transmissible and affects an individual's respiratory system several times over the course of life, with either mild or more serious presentations [3]. Transmission of the virus between humans occurs by the respiratory route, through secretions in the form of aerosols, droplets, or direct contact with the mucosa. The symptoms are similar to those of other viruses that affect the respiratory tract, such as fever (lasting approximately three days), cough, headache, muscle pain, coryza, and malaise [3,4,5].

These symptoms normally resolve spontaneously in a week, but the disease can evolve with complications, more frequent in individuals with cardiac and respiratory com diseases, elderly, and immunocompromised individuals [4,6]. The most common complications are bacterial pneumonia, sinusitis, otitis, dehydration, exacerbation of preexisting chronic diseases such as heart failure, asthma, and diabetes mellitus, and primary pneumonia from influenza [4]. These complications can lead to hospitalization and death [3].

Flu epidemics affect large numbers of people, and it is not possible to predict them, since they depend mainly on prevention and control measures. The World Health Organization (WHO) estimates 3 to 5 million serious influenza cases per year in the world, with 290,000 to 650,000 deaths [5].

Influenza vaccination emerged in this context as an effective national strategy to reduce morbidity and mortality from respiratory diseases in the elderly population. The WHO states that the vaccine provides protection in healthy adults. Meanwhile, among the elderly, influenza vaccination may be less effective in the prevention of diseases, but it helps reduce the severity of incidence of complications and death, directly decreasing hospitalizations and expenditures on drugs for the treatment of secondary infections [5].

In analysis of the trend in mortality and hospital morbidity rates from causes related to influenza in the elderly population from 1992 to 2006 and assessment of the impact of implementing influenza vaccination campaigns in Brazil, vaccination campaigns were found to decrease hospitalizations and deaths from influenza in that period [7].

Brazil's national public influenza vaccination policy, which is part of the National Immunization Program (PNI), began in 1999, with annual campaigns aimed at coverage of at least 70% of the target population, consisting of elderly 65 years and older (this age bracket was extended downward to 60 years in 2000). In 2010, the risk groups were expanded and reached the maximum amplitude, due to the vaccination campaign against pandemic influenza A (H1N1) during the 2009 pandemic. More than 89 million Brazilians were vaccinated at the time, corresponding to vaccination coverage of 47% of the country's total population [8].

According to Technical Report 2019 [3] on the 21st National Influenza Vaccination Campaign, the goal of 70% coverage was maintained until 2006, increasing to 80% in 2008 and 90% of the target population since 2017. This change was due to the population's intense demand for the vaccine, resulting from the high death rates from influenza, as well as the vaccination's good performance.

Various studies explain that non-adherence to annual influenza vaccination campaigns is associated with various factors, such as not considering it important to take the vaccine every year, believing that the vaccine causes reactions, fear, lack of orientation from healthcare professionals, difficult access, low schooling, age, presence of chronic diseases, life habits, and doubts as to the vaccine's efficacy, among others [9,10,11,12]. A systematic review concluded that seasonal influenza vaccination is influenced by social, structural, intermediate, and health-related determinants [13].

A brief search of the Brazilian literature showed that although the influenza vaccine was implemented in 1999, publications on the vaccination's impact in reducing morbidity and mortality in the elderly are rare, especially since the H1N1 pandemic in 2009 [7,14,15,16]. In addition, there are various prevalence studies [9,10,11,12], but few are recent or use the Ministry of Health databases. Such analysis is relevant, since the data can evidence the benefits of annual campaigns. An increase in vaccination coverage is expected to lead to fewer hospitalizations and deaths from influenza in the elderly population. The current study aimed to analyze the impact of influenza vaccination on morbidity and mortality from influenza in the elderly from 2010 to 2019 in the major geographic regions of Brazil.

Method

Study design

This is an ecological epidemiological study [17] with a time series component analyzing the trends in mortality and morbidity rates from respiratory tract diseases, as well as influenza vaccination coverage from 2010 to 2019. Data on vaccination coverage came from the Information System of the National Immunization Program (SI-PNI), morbidity data from the SIH/SUS (http://tabnet.datasus.gov.br/cgi/tabcgi.exe?sih/cnv/niuf.def, accessed on 15/May/2020), and mortality data from the Mortality Information System (SIM; http://tabnet.datasus.gov.br/cgi/deftohtm.exe?sim/cnv/obt10uf.def, accessed on 15/Jun/2020), all available on public access official websites.

Location and population

The data refer to Brazil's five major geographic regions (North, Northeast, Southeast, South, and Central).

Variables

The study focused on the 10-year period from 2010 to 2019, due to the H1N1 pandemic in 2009, aiming to identify the post-pandemic profile of vaccination coverage and morbidity and mortality.

Data on vaccination coverage were obtained directly from the SI-PNI database, which contains information in which the numerator is the annul number of influenza vaccine doses administered to the elderly, and the denominator is the estimated elderly population (≥ 60 years), multiplied by 100, i.e., presented as percentages per year and by region of the country. Data with more than one decimal place after the period were rounded off to the nearest whole place.

Morbidity was analyzed according to the data collected from the SIH database, considering hospitalizations in Brazil's five major regions, per year. The study considers the diseases listed in the International Classification of Diseases – 10th revision (ICD-10) under influenza (flu) and pneumonia (codes ICD-10 J09, J10, J11, J12, J13, J14, J15, J16, J17, and J18) and the age brackets 60-69, 70-79, and 80 years or older. The crude data were collected and transported to Excel spreadsheets, version 2013 (https://products.office.com/), and morbidity rates were calculated per thousand inhabitants. For the rates, the numerator was the annual number of hospitalizations and the denominator was the estimated elderly population (≥ 60 years), multiplied by 1,000. The estimated elderly population was the same as in the SI-PNI for calculating vaccination coverage.

Mortality was analyzed with data from the SIM database. Data on deaths were collected for the five regions of Brazil, per year. The analysis considered ICD-10 codes J09, J10, J11, J12, J13, J14, J15, J16, J17, and J18 and the age brackets 60-69, 70-79, and 80 years or older. The crude data were collected and transported to Excel spreadsheets, version 2013, where the mortality rates per thousand inhabitants were calculated. For the rates, the numerator was the annual number of deaths and the denominator was the estimated elderly population (≥ 60 years), multiplied by 1,000. The estimated elderly population was the same as in the SI-PNI for calculating vaccination coverage. Mortality in the SIM database is only available up to the year 2018.

Data analysis

The Excel software, version 2013, was used to calculate the rates. Time trend graphs were constructed for Brazil and the five regions to explain the evolution in the indicators during the study period [18], and scatterplots with regression lines were estimated by regression equations, according to the hypothesis that vaccination coverage may affect morbidity and mortality. Simple linear regression models were used for this to study the relationship between a single dependent variable (morbidity/mortality) and the independent variable (vaccination coverage). A model was generated for each region of Brazil, plus a model for Brazil as a whole. The assumption for these models is that their residuals have a normal distribution with mean zero and constant variance, and all the assumptions were checked and verified [19,20]. We also calculated Pearson's correlation coefficient, which quantifies the association between two quantitative variables and varies between -1 and 1. Value 0 (zero) means that there is no linear relationship, a value of 1 indicates a perfect linear relationship, and value -1 also indicates a perfect linear relationship, but inverse. This value was inserted in the scatterplot with the regression equation [18].

All the analyses set significance at 5%, and the fits were obtained with the R software, version 3.5 (http://www.r-project.org).

Ethical aspects

The study uses secondary data, analyzed in aggregate form, without identification of individuals. Since these are open-access data, no authorization was necessary for their use.

Results

Figures 1 and 2 present the data on vaccination coverage, morbidity, and mortality in elderly individuals from 2010 to 2019 in Brazil and by major regions, respectively.

In the time series, 2010 was the only year in which the 80% target for vaccination coverage, set by the Ministry of Health, was not reached in the Central (79.2%), Northeast (78.9%), Southeast (76.3%), South (77.1%), and in Brazil as a whole (79.1%). In the rest of the period, all regions reached or exceeded the target.

The results showed an increase in vaccination coverage in the year 2016 (compared to 2015) in Brazil and all five regions except for the Central.

We note the vaccination coverage rates greater than 100% in the Central in 2015 (109.3%), 2016 (101.6%), 2018 (109%), and 2019 (107%), and in the North in 2019 (103%).

In relation to morbidity, the South and Central regions showed the highest rates in the time series. The lowest rates until the year 2017 were in the Northeast region; and in 2018 and 2019 in the Southeast. The lowest rate was observed in the Northeast region 2012 (8.18‰) and the highest in the South in 2018 (18.78‰).

The mortality data show that the highest rates in the study period were in the Southeast. The North and Northeast regions had the lowest mortality rates until the year 2016, when the South and Central regions showed a drop in the rates. In 2017, the mortality rates in these regions were similar (North – 2.53‰, Northeast – 2.64‰, South and Central – 2.92‰) and lower than in the Southeast region (3.9‰).

Table 1 shows the results of the linear regression analysis for morbidity and mortality rates and vaccination coverage in the elderly.

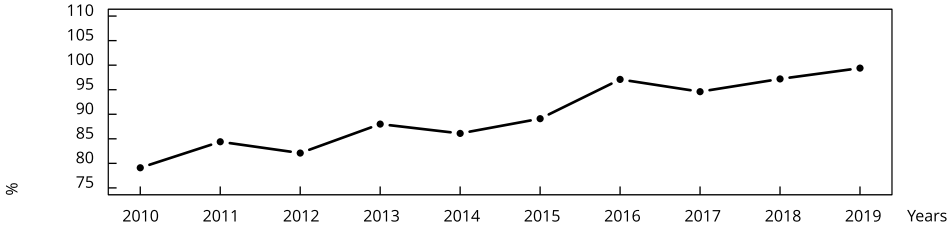
Figure 3 shows the regression lines from the regression model for morbidity rates from respiratory diseases with ICD codes J09-J18 (‰ inhabitants) and vaccination coverage (%) for the study years in the regions and Brazil.

Figure 4 shows the estimated lines from the regression model for mortality rates from respiratory diseases with IDC codes J09-J18 (‰ inhabitants) and vaccination coverage (%) for the study years in the regions and Brazil.

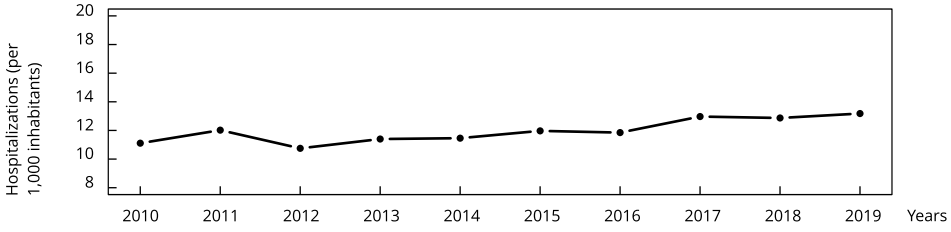
Figure 1

Morbidity and mortality rates (‰) related to the International Classification of Diseases – 10th revision (ICD-10) codes J09-J18 and vaccination coverage (%) in elderly Brazilians, 2010 to 2019.

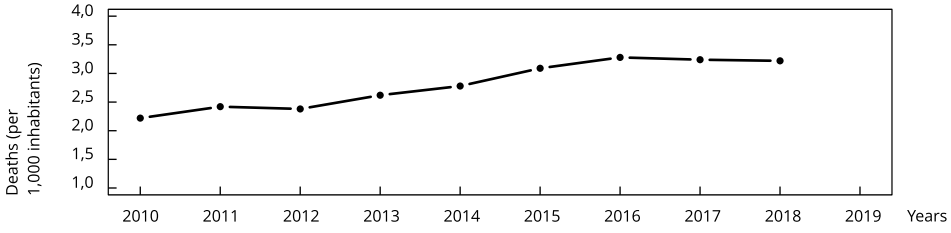
1a) Vaccination coverage



1b) Morbidity rate



1c) Mortality rate



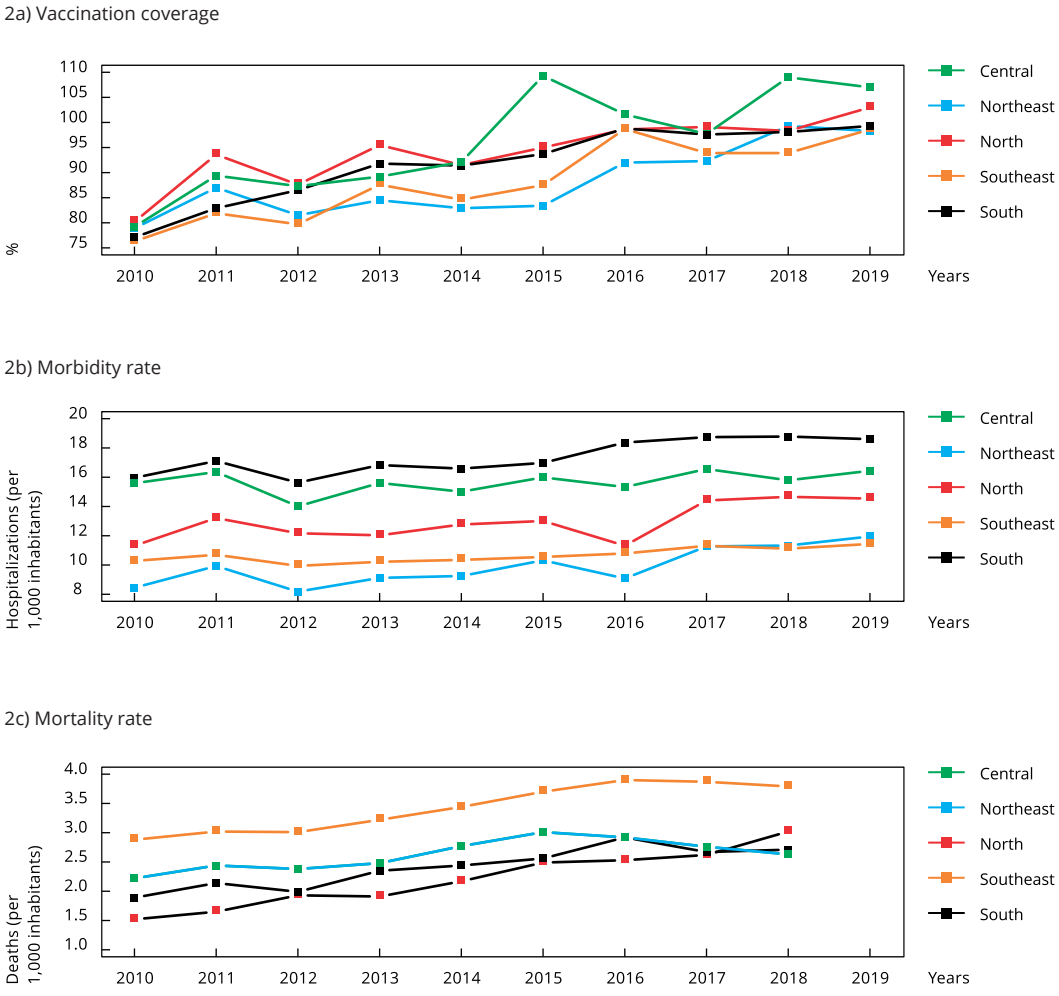
Source: National Immunization Program; Hospital Information System (http://tabnet.datasus.gov.br/cgi/tabcgi.exe?sih/cnv/niuf.def, accessed on 15/May/2020); and Mortality Information System (http://tabnet.datasus.gov.br/cgi/deftohtm.exe?sim/cnv/obt10uf.def, accessed on 15/Jun/2020).

According to the analyses, there is a directly proportional association between influenza vaccination coverage and morbidity, and between vaccination coverage and mortality. The results are statistically significant for morbidity in the Northeast, Southeast, and South regions and in Brazil. For mortality, the Northeast was the only region that did not present significant results.

We can infer statistically that the increase in vaccination coverage resulted in an increase in morbidity and mortality from diseases with ICD codes J09-J18 during the 10-year period. Therefore, the study's hypothesis was not confirmed.

Figure 2

Morbidity and mortality rates (‰) related to the International Classification of Diseases – 10th revision (ICD-10) codes J09-J18 and vaccination coverage (%) in elderly in major regions of Brazil, 2010 to 2019.



Source: National Immunization Program; Hospital Information System (http://tabnet.datasus.gov.br/cgi/tabcgi.exe?sih/cnv/niuf.def, accessed on 15/May/2020); and Mortality Information System (http://tabnet.datasus.gov.br/cgi/deftohtm.exe?sim/cnv/obt10uf.def, accessed on 15/Jun/2020).

Discussion

The current study's results show that influenza vaccination coverage in the elderly has increased in recent years, reaching or exceeding 100% in 2019. Note that the flu vaccine has not reached elderly Brazilians universally, since there is a variation in coverage over the years according to regions of the country.

Vaccination coverage rates greater than 100% are worthy of note, and we believe that they may be explained by the population's aging. According to the national census by the Brazilian Institute of Geography and Statistics (IBGE) in 2010, the country's population was 190,755,199, with 20,590,599 elderly (10.8%) [21]. The available calculations on vaccination coverage in the SI-PNI in the years 2010 and 2011 considered a total of 19,428,086 elderly. In the year 2012, the figure used was 20,590,599

Table 1

Linear regression for morbidity and mortality rates related to the International Classification of Diseases – 10th revision (ICD-10) codes J09-J18 in elderly, in relation to vaccination coverage according to major regions of Brazil, 2010-2019.

	Estimated coefficient	SE	t-statistic	p-value
Morbidity				
VC Brazil	0.089	0.027	3.295	0.013
VC Central	0.022	0.027	0.842	0.428
VC Northeast	0.133	0.043	3.088	0.018
VC North	0.108	0.062	1.744	0.125
VC Southeast	0.043	0.016	2.769	0.028
VC South	0.123	0.036	3.385	0.012
Mortality				
VC Brazil	0.060	0.007	7.888	< 0.000
VC Central	0.021	0.006	3.797	0.007
VC Northeast	0.016	0.014	1.106	0.305
VC North	0.061	0.020	3.082	0.018
VC Southeast	0.051	0.007	6.564	< 0.000
VC South	0.044	0.005	7.604	< 0.000

VC: vaccination coverage (%); SE: standard error.

(corresponding to the 2010 census). From 2013 to 2019, the number of elderly individuals for calculating the vaccination coverage rates was 20,889,849, corresponding to a population estimate published by IBGE in the year 2012, according to the SI-PNI. The number of elderly individuals has not been updated again since then.

According to the projection of the Brazilian population by sex and age published by IBGE, the proportion of elderly in the year 2019 was 13.85% of the total population (https://www.ibge.gov.br/estatisticas/sociais/populacao/9109-projecao-da-populacao.html?=&t=resultados, accessed on 01/Nov/2019), corresponding to approximately 29.105.377 persons 60 years or older, thus higher than the number used to calculate vaccination coverage that same year. Considering the number of doses applied from 2013 to 2019, if the population indicators by IBGE were used, vaccination coverage in Brazil would be the following: 2013 – 79%; 2014 – 74.5%; 2015 – 74.3%; 2016 – 78%; 2017 – 73.2%; 2018 – 72.4%; and 2019 – 71.3%, and the 90% target was not reached in any of the years.

We thus believe that the high vaccination coverage rates reached by the country's regions in recent years may be due to the fact that the total population used for the calculation has been underestimated. This fact had already been discussed previously in relation to vaccination in children under one year, also indicating that besides flaws in the denominator for calculating coverage rates, there may also have been flaws in the production of data on doses applied [22]. With publication of the data from the 2020 census, we hope to know the real impact of influenza vaccination campaigns in Brazil. We highlight the importance of periodically conducting population surveys, especially in years with more time elapsed since the last estimate or census. Such periodic surveys would generate more valid and reliable information [22].

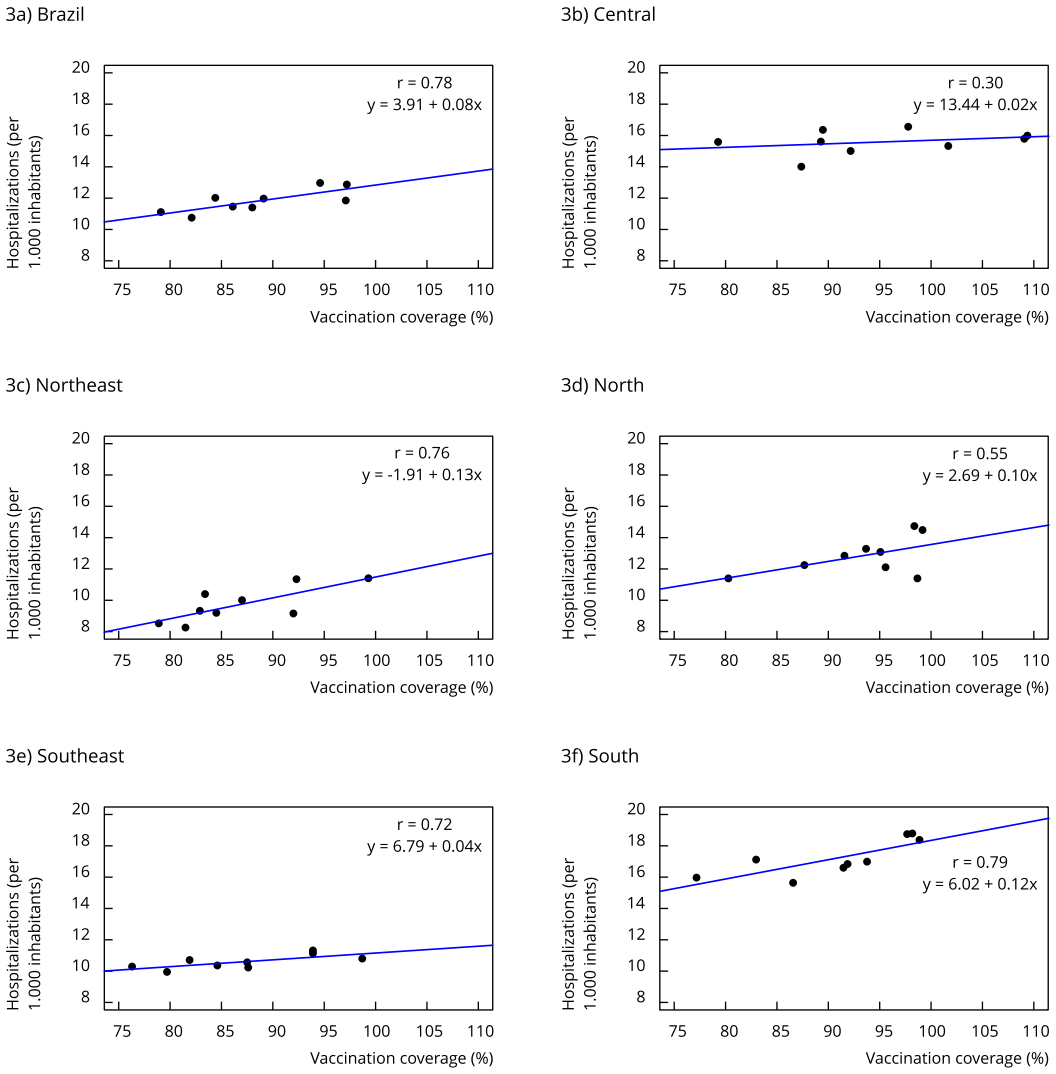
We chose to adopt the same denominator used to calculate vaccination coverage when calculating morbidity and mortality rates, aimed at standardizing them. There may be a mismatch in these rates as well, since they also showed increases.

The data showed a directly proportional relationship between vaccination coverage and morbidity and mortality.

Importantly, life expectancy in Brazil has increased in recent years, from 69.8 years in 2000 to 73.9 in 2010 and 76.3 in 2018 [23]. Studies show that the oldest seniors present a lower immune response to the influenza vaccine when compared to younger groups [24,25], making them more susceptible to more severe forms of influenza, which can lead to hospitalization and death. In addition, each individual's

Figure 3

Estimated regression lines from regression model for morbidity rates from respiratory diseases with the International Classification of Diseases – 10th revision (ICD-10) codes J09-J18 (‰ inhabitants) and vaccination coverage (%) for the study years in major regions and Brazil.

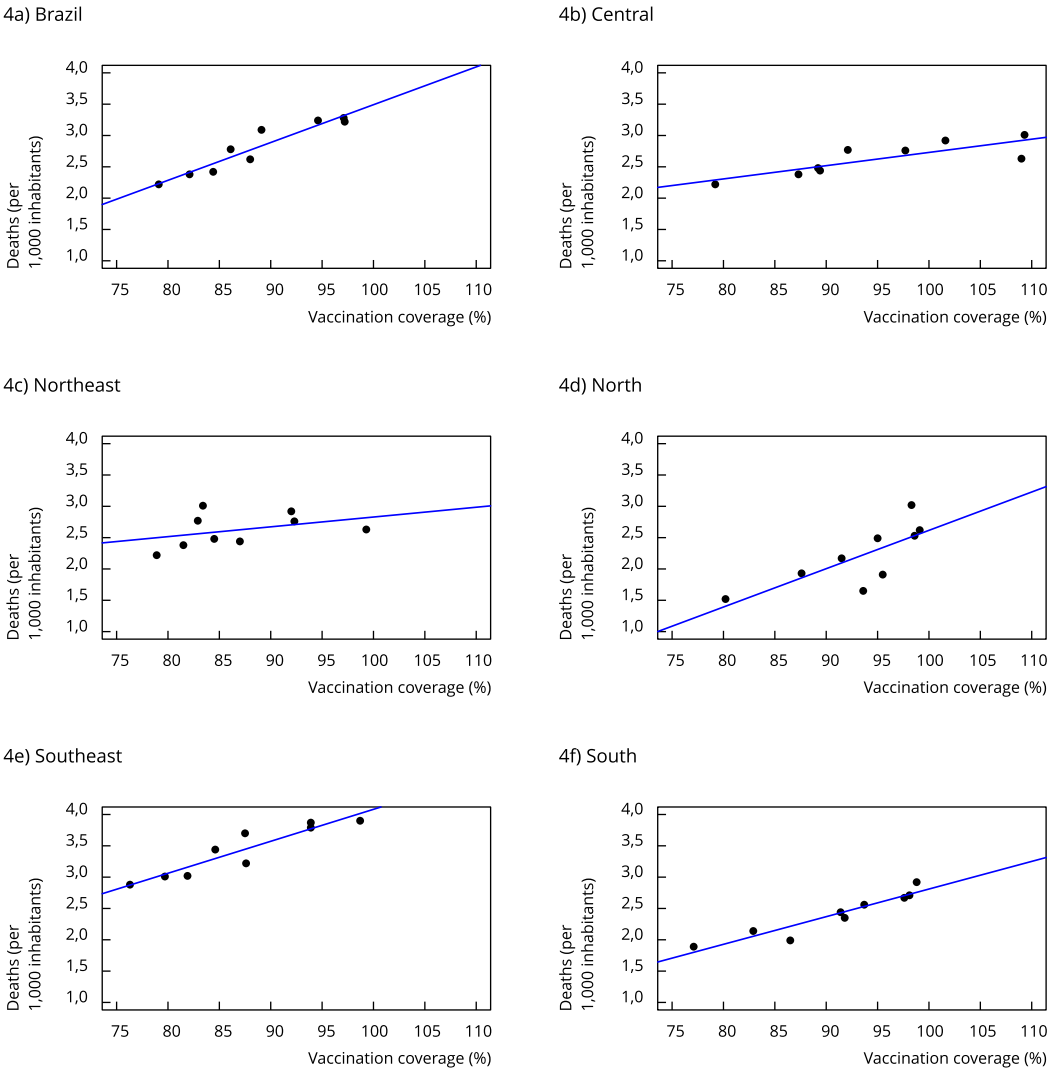


history (immunological biography) is an important component of individual variation in the capacity of elderly individuals to respond to vaccines [25].

The influenza vaccine supplied free of cost to seniors in Brazil's public health system is the trivalent vaccine, while the quadrivalent vaccine is offered in the private system. The vaccine's composition is updated yearly according to the prevalence of circulating strains in the world and is recommended by the WHO [3]. In Brazil, Sentinel Influenza Surveillance is responsible for identifying the circulation of the influenza virus and other respiratory viruses and sending the information to WHO to adjust the influenza vaccine strains [26]. Recommendation of the vaccine strains is based on a resolution by the Brazilian Health Regulatory Agency (Anvisa) in the second semester each year, containing the vaccine's composition to be applied in the Southern Hemisphere in the winter of the following

Figure 4

Estimated regression lines from regression model for mortality rates from respiratory diseases with the International Classification of Diseases – 10th revision (ICD-10) codes J09-J18 (‰ inhabitants) and vaccination coverage (%) for the study years in major regions and Brazil.



year [3]. The decision on the type of vaccine (trivalent or quadrivalent) to be supplied by the country takes into consideration both the circulating strains and the cost-benefit relationship for the general population. Despite the effort to update the information and the improvement in the surveillance program, a mismatch may occur, that it, incompatibility between the recommended vaccine strain and the circulating influenza strains [27], which may have contributed to the current study's results.

A systematic review and meta-analysis that aimed to assess the efficacy and effectiveness of the different types of influenza vaccine found that the currently available vaccines may offer moderate overall protection against the disease, but there is no evidence of high-level protection, especially in individuals at risk of medical complications or 65 years of age or older [28]. Another review also found that the vaccine's effect against influenza is only modest in the elderly [29].

Nevertheless, vaccination with any type of recommended vaccine is still an important tool in the prevention of influenza and its complications. With time, a better understanding of the changes resulting from the aging process may result in adaptation of the available vaccines in order to generate good humoral and cellular responses, also considering the inflammatory component and leading to ideal protection for the elderly [24,25,30].

Another study highlights not only the importance of obtaining high vaccination coverage rates in the groups that most need them and the development of high-level vaccines, but also the relevance of elaborating more comprehensive strategies aimed at avoiding transmission of acute respiratory diseases, with preventive interventions that involve the context (water and food supply, basic sanitation, electricity, etc.) and the adoption of habits like hand-washing [29].

The Brazilian literature reports the relationship between influenza vaccination and morbidity and mortality rates. A study in 496 municipalities (counties) in the southernmost state of Rio Grande do Sul found that in municipalities that reach the target for influenza vaccination coverage, the mortality rate from respiratory tract diseases was significantly lower [31]. Another study in the South of Brazil identified a reduction in hospitalizations in the first quarter of the year and an increase in the third trimester, revealing the impact of seasonality on influenza-related diseases. Still another study found that a 1% increase in vaccination coverage represents a 0.1% reduction in the hospitalization rate [32]. Note the high morbidity rate in the South of Brazil in the current study, which may be related to the region's climate, cooler than the other regions of the country, favoring survival of the virus [5].

A study that aimed to assess the impact of influenza vaccination campaigns in Brazil analyzed the trend in hospital morbidity rates (HMR) from causes related to influenza in the elderly from 1992 to 2006 and found downward trends in HMR in Brazil and in the major geographic regions, except for the North. The regions with the largest reductions were the South, Central, and Southeast. The HMR showed a reduction when comparing the periods before (1992-1998) and after (1999-2000) the beginning of the influenza vaccination campaigns [14]. The data for the North of Brazil are similar to those of the current study.

A publication that aimed to analyze mortality from respiratory diseases from 1980 to 2004 in the state of São Paulo found a reduction in mortality in the two years after the start of the vaccination campaigns (2000 and 2001), followed by a rebound in the rates, similar to previous years [15]. Another study in the state of São Paulo investigated the relationship between mortality from respiratory diseases from 1980 to 2000 and implementation of the influenza campaigns and identified a drop in mortality in 1999 and 2000, following the campaign's implementation [16]. Interestingly, although Southeast Brazil has one of the lowest morbidity rates, it has the highest mortality rates, which may be related to the health system's case-resolution capacity, as well as the profile of elderly in the region. This fact needs to be investigated in greater depth in future studies.

Some seniors are more aware of the vaccine's importance, and thus the increase in adherence to the campaign. Studies show that increasing age, not smoking, and presence of chronic noncommunicable diseases increase adherence to the vaccine [10,33]. Meanwhile, socioeconomic inequalities, characteristics of health system access and use, cultural beliefs, and behavioral factors can also be related to vaccination [13] and may have influenced the current study's results. It is also possible that health education does not reach the entire population, since the reasons claimed by the elderly for not vaccinating are mostly fear of reactions, not wanting or not liking the vaccine, and rarely having the flu [11,33]. Thus, since health workers are the preferred source of information on the vaccine [34] these professionals play an essential role in recommending vaccination, answering controversial questions on adverse events, and publicizing the benefits of influenza vaccination [35,36].

We highlight the fact that we used the hospital (SIH) and mortality (SIM) databases with ICD-10 codes J09-J18 (influenza and pneumonia), which may have overestimated the cases and deaths, since the classifications may encompass other viruses related to lung infections and their complications. In addition, the circulation of other respiratory viruses, bacteria, and other pathogens, besides environmental factors, may interfere in the data [15]. For the type of study, the SIH and SIM databases were adequate for the objective. However, further studies aimed at assessing cases of acute respiratory distress syndrome (ARDS) and outbreaks of flu syndrome (FS) can be conducted with data from the SINAN/SIVEP-gripe database.

In addition, although the SIH and SIM databases are widely used in Brazil, both have limitations, such as gaps in the coverage of data on hospitalizations and deaths [37,38,39]. The main problem with the SIH database is diagnosis at hospital admission, since many patient charts have incomplete data on this item [37]. The SIM database is increasingly complete and accurate but still presents gaps in physicians' recording of causes of death [38], with many deaths recorded as resulting from ill-defined causes [40], besides gaps in data coding [39]. Thus, there may be hospitalizations and deaths that are not recorded or are recorded incorrectly in these systems, which limits the data's generalization. It is also possible that the same person is admitted to hospital more than once, which may generate duplicate data in the SIH, unlike the mortality and vaccination coverage rates, which are calculated per person rather than per event.

The data show that morbidity and mortality rates vary by region of the country, thus underlining the need to design specific strategies for follow-up of seniors from diagnosis through hospitalization in the different regions.

The maintenance of high and homogeneous vaccination coverage rates is essential for maintaining and reducing morbidity and mortality from vaccine-preventable diseases. Considering that the results were unfavorable, lower vaccination coverages could result in even more hazardous data from the epidemiological point of view, with higher morbidity and mortality rates.

Strategies for uptake of the elderly and health education should be intensified in the search for excellent quality of services. When permanent measures are taken to recruit the target public, a valuable tactic is achieved for the health indicators, considered essential for prevention of the disease throughout the country.

Health administrators and professionals face various challenges in planning and operationalizing vaccination campaigns. They need to be informed and updated in relation to the programs' processes and results for the services' continuous improvement. The professionals involved in the health process must be familiar with the data on influenza to assist the development of tools for continuous actions in the improvement of care for the population.

It is essential for the data to be updated continuously, in step with the Brazilian population's aging, since the use and publication of outdated data can produce a false sense of protection in the population.

Given that the mortality data are only available up to 2018 in the SIM database, the current study presents a gap, since it was not possible to analyze whether the upward trend in the mortality rate was maintained in 2019, a point that can be explored in future studies.

Conclusion

Influenza vaccination coverage rates in elderly Brazilians have remained above the target set by the Ministry of Health in all regions of the country since 2011. An increase was observed in the morbidity and mortality rates from causes related to influenza and pneumonia during the period analyzed here. However, the rates' calculation was seen not to take the population's aging into account, using data from outdated census estimates. In addition, the data on hospitalizations and deaths may have included other circulating viruses and bacteria besides influenza.

Importantly, data on vaccination coverage, mortality, and morbidity are essential for orienting public health interventions and thus need to be adequately calculated and analyzed. Finally, we highlight the importance of encouraging vaccination among elderly people as a way of promoting healthy aging and the development of more effective vaccines, considering the particularities of elderly persons and the co-circulation of influenza strains.

Contributors

H. C. S. Azambuja and B. M. Luchesi participated in the article's conception, data analysis and interpretation, and writing and revision of the article. M. F. Carrijo and T. C. R. Martins collaborated in the data analysis and interpretation and critical revision of the content. All the authors approved the manuscript's final version and are responsible for the study's integrity.

Additional informations

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Resumo

Devido à importância da vacinação anual contra a gripe em idosos, objetivou-se analisar o impacto da vacinação contra gripe na morbimortalidade por influenza nos idosos no período de 2010 a 2019 nas regiões do Brasil. Trata-se de um estudo epidemiológico ecológico, com dados do Sistema de Informações do Programa Nacional de Imunizações, do Sistema de Informações Hospitalares e do Sistema de Informação sobre Mortalidade, disponíveis por intermédio do Ministério da Saúde. Os dados foram referentes ao Brasil e regiões, e contemplaram as taxas de cobertura vacinal contra gripe em idosos e de morbidade e mortalidade por causas relacionadas à influenza e pneumonia em idosos. Modelos de regressão linear simples foram utilizados para estudar a relação entre as taxas de morbidade e mortalidade e a cobertura vacinal. Houve um aumento da cobertura vacinal no período, e a meta de 80% de cobertura foi atingida em todas as regiões a partir de 2011. Identificou-se uma relação diretamente proporcional entre as variáveis estudadas, sendo que o aumento da cobertura vacinal resultou no aumento da morbimortalidade pelas causas avaliadas. Esses dados podem estar relacionados com a literatura, que mostra que o efeito da vacina é modesto em idosos. Porém, foi visto que o cálculo das taxas não leva em consideração o envelhecimento da população, utilizando dados com estimativas censitárias desatualizadas, e que os dados de internação e óbito podem incluir outros vírus e bactérias circulantes que não a influenza. A manutenção da cobertura vacinal elevada pode prevenir que o impacto da gripe seja ainda maior na morbimortalidade em idosos.

Vacinas contra Influenza; Idoso; Cobertura Vacinal; Morbidade; Registros de Mortalidade

Resumen

Debido a la importancia de la vacunación anual contra la gripe en ancianos, el objetivo fue analizar el impacto de la vacunación contra la gripe en la morbimortalidad en ancianos durante el período de 2010 a 2019 en las regiones de Brasil. Se trata de un estudio epidemiológico ecológico, con datos del Sistema de Información del Programa Nacional de Inmunizaciones, del Sistema de Información Hospitalaria y del Sistema de Información de Mortalidad, disponibles gracias al Ministerio de Salud. Los datos se refirieron a Brasil y regiones, y contemplaron las tasas de cobertura de vacunación contra la gripe en ancianos, así como de morbilidad y mortalidad por causas relacionadas con la gripe y neumonía en ancianos. Se utilizaron modelos de regresión lineal simple para estudiar la relación entre las tasas de morbilidad y mortalidad y la cobertura de vacunación. Hubo un aumento de la cobertura vacunación durante el período, y la meta de un 80% de cobertura se alcanzó en todas las regiones a partir de 2011. Se identificó una relación directamente proporcional entre las variables estudiadas, siendo que el aumento de la cobertura de vacunación resultó en un aumento de la morbimortalidad por las causas evaluadas. Estos datos pueden estar relacionados con la literatura, que muestra que el efecto de la vacuna es modesto en ancianos. No obstante, se observó que el cálculo de las tasas no tiene en consideración el envejecimiento de la población, utilizando datos con estimaciones censales desactualizadas, y que los datos de internamiento y óbito pueden incluir otros virus y bacterias circulantes que no son gripe. El mantenimiento de una cobertura de vacunación elevada puede prevenir que el impacto de la gripe sea todavía mayor en la morbimortalidad en ancianos.

Vacunas contra la Influenza; Anciano; Cobertura de Vacunación; Morbilidad; Registros de Mortalidad

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