

The Effectiveness Of COVID-19 Vaccination in Protecting Older Adults Against Emerging Infectious and Virulent Strains

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Abstract. Background: With aging, older people are more vulnerable to have a severe COVID-19 infection as their immunity weakens and they are likely having chronic illnesses. As the pandemic develops, more infectious and virulent strains emerge, vaccines are a significant tool to slow the spread of COVID-19, however, there are differences in the response to vaccines among different age groups. Objective: To evaluate the COVID-19 vaccine's efficacy in protecting the elderly against emerging infectious and virulent strains. Methods: A literature search of PubMed, ScienceDirect, Frontiers and Springer Link databases was performed since the COVID-19 outbreak in December 2019 to the current time. The keywords "SARS-CoV-2", "older adults", "vaccination", "effectiveness", and "COVID-19" to filter out applicable articles and combined visual and numerical summaries to summarize the data. Results: Forty-four articles were found in the literature, and finally ten eligible articles were selected. The selected studies indicated that the elderly can be effectively protected against emerging infectious and highly virulent strains by the COVID-19 vaccination. Conclusion: The COVID-19 vaccination can reduce the incidence of serious disease and mortality in older persons, and booster shots can provide continued protection by increasing the effectiveness of the vaccine, significantly reducing infection rates, rates of serious illness, and mortality in older adults. It is necessary to prioritize the administration of COVID-19 vaccine to the elderly.

Keywords: COVID-19; SARS-CoV-2; vaccine; older adults; effectiveness.

1. Introduction

Due to the SARS-CoV-2 virus, COVID-19 has been a worldwide pandemic starting in December 2019, and its rapid and widespread pattern of transmission has had a significant negative impact on societies, economies, and health systems. Most infected individuals develop mild or moderate respiratory infections, but serious infections are more likely to occur in older individuals and in people with other underlying medical issues. To prevent the virus' transmission and reduce morbidity and mortality, reasonable and effective COVID-19 preventive measures are important. First, wearing masks in public places can reduce the spread of the virus, especially in indoor areas with poor air circulation or in crowded places. Wearing a mask can greatly minimize contact with COVID-19 patients, especially those who are asymptotically infected. And avoiding crowded places and keeping a safe distance of about one meter from others can reduce the risk of droplet transmission of the virus, thus reducing the likelihood of infection. Secondly, paying attention to hygiene can also reduce the spread of the virus, such as frequent hand washing and disinfection, frequent indoor ventilation, and frequent disinfection of objects in daily contact. In addition, there is evidence that vaccination is the most effective preventive measure against COVID-19, including initial and booster injections, which can significantly reduce the morbidity and mortality caused by COVID-19 [1].

As people age, their immune systems naturally decline, which means that the immune response to infections and vaccines is not as strong or as fast in older adults than in younger adults, and older adults may be slower to produce antibodies. Although the COVID-19 vaccine has been effective in reducing the incidence of serious illness, hospitalization rates, and the risk of death, considering the older persons may have a weakened immune response than young people, it could not be as effective in them. In addition, older people are at greater risk of health problems such as heart disease, diabetes, or respiratory disease previously, which may complicate the effectiveness of the COVID-19 vaccine. The vaccine's efficiency may also be impacted by the introduction of new SARS-CoV-2 virus strains.

All these reasons have led to increased mortality in the elderly population and are deserving of attention and exploration.

Vaccines are critical to controlling outbreaks, and the existing COVID-19 vaccine focuses on recognizing and fighting coronaviruses by stimulating the body's immune system, thereby reducing the extent of infection, or preventing infection entirely. Existing vaccine types include mRNA vaccines, viral vector vaccines, and inactivated or live attenuated vaccines, but the COVID-19 vaccine has not been specifically studied in the elderly, and most of the available data on this vaccine focuses on healthy older adults, with very little data on frail or comorbid elderly. The aim of this study was to explore the vaccine's efficacy in older persons in terms of different regions, different vaccines, and different age groups.

2. Methods

2.1. Inclusion Criteria and Exclusion Criteria

The inclusion criteria are (1) Articles published in December 2019 and later. (2) Articles with study populations of older adults. (3) Articles involving one or more COVID-19 vaccines. (4) Articles examining the efficacy of the COVID-19 vaccination (e.g. hospitalization rate, mortality). Exclusion criteria are (1) All non-English publications. (2) Papers with duplicate information.

2.2. Sources of Information, Search Strategy, Selection of Studies

PubMed, ScienceDirect, Frontiers and Springer Link databases were searched for articles on the effectiveness of the COVID-19 vaccine in elderly over the past four years using the following keywords: older adults, COVID-19, SARS-CoV-2, vaccine, and effectiveness. The initial literature screening step was to look at the titles, abstracts, backgrounds, and introductions of the articles and then screen them according to the inclusion criteria and exclude duplicate articles from different databases.

2.3. Data Extraction and Synthesis

Each study collected the following data: authors, year of publication, country of study, intervention, and outcome in older adults. Moreover, differences in the effectiveness of the different types of vaccines and possible adverse effects were also considered.

3. Results

This review included information from a total of 10 studies (Figure 1). Most of the studies showed that the COVID-19 vaccine is efficient among older persons, and others showed that booster ensures that the vaccine is consistently effective in older adults.

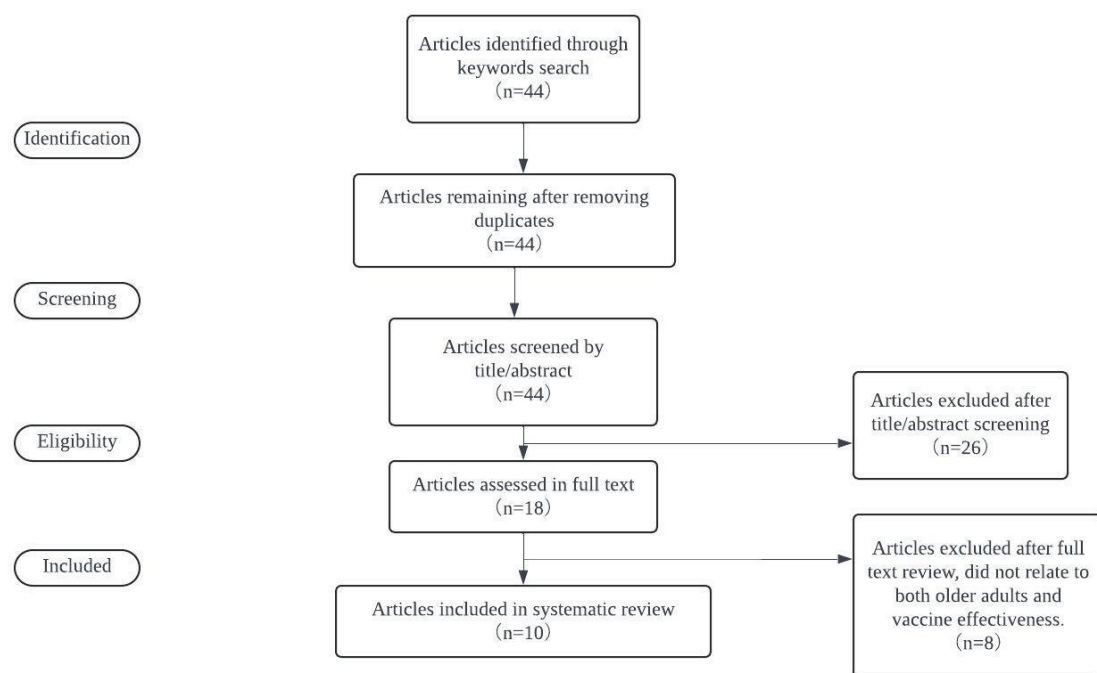


Fig. 1 PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) methodological flowchart.

Table 1 Characteristics of included studies

Author/year	Country	Population	Intervention	Control	Outcome
Bernal et al./2021	England	Older adults	BNT162b2 or ChAdOx1-S vaccination	Comparison of vaccinated and unvaccinated people	Among older people, Vaccination significantly reduces symptomatic COVID-19 and additionally avoids serious illness
Soiza et al./2020	England, USA, China, and Russia	Older adults	Various COVID-19 vaccines	Comparison of people with different COVID-19 vaccinations	Vaccines are effective and safe in most cases and rarely cause serious adverse reactions
Sadarangani et al./2021	Canada	Older adults	COVID-19 vaccination with mathematical models	Unvaccinated, or with different levels of vaccination efficacy and coverage for comparison	COVID-19 vaccine significantly reduces mortality in the elderly

McMenamin et al./2022	Hong Kong - China	Older adults	BNT162b2 and CoronaVac vaccines administered in one, two, or three doses	Comparison of those who were unvaccinated or received fewer doses	Vaccination and booster doses are important, especially for the elderly
Teo/2021	Global	Older adults	Vaccination with mRNA vaccine, vector vaccine and Ad26.COV2 by Janssen Pharmaceuticals.	Comparing the vaccination group to the placebo group	Elderly people are vulnerable to SARS-CoV-2 infection and complications; however, vaccine is a preventive measure with a minimal risk of adverse effects.
Mattiuzzi & Lippi/2022	Italy	Older adults	The injection of COVID-19 booster shot	People who finished a COVID-19 vaccination process longer than 5 months compared to those who got a booster dose	In older persons, a booster dose of the COVID-19 vaccination lowers the probability of illness and death.
Xu et al./2023	Global	Older adults	administered several COVID-19 vaccine types	Randomized control group	The COVID-19 vaccination lowers mortality among older adults and is well tolerated.
Arregocés-Castillo et al./2022	Colombia	Older adults	Immunized with Ad26.COV2-S, BNT162b2 (Pfizer-BioNTech), ChAdOx1 nCoV-19 (AstraZeneca), or CoronaVac (Sinovac)	Compare unvaccinated and vaccinated populations.	Effectiveness rates vary between different vaccines, and the vaccine's effectiveness decreases for people over the age of 80.
Andryukov & Besednova/2021	Global	Older adults	Widely used COVID-19 vaccine specifically tailored for elderly	N/A	For elderly, vaccination is the most effective preventive measure, and further surveillance of

					the safety and effectiveness of the COVID-19 vaccine is required.
Zang et al./2022	China	Older adults	Get COVID-19 vaccination	N/A	The vaccination is beneficial in lowering the risk of serious disease and death in older persons, and adverse response are uncommon.

N/A, standing for "Not Applicable" or "Not Available".

3.1. Results of individual studies

The characteristics of included studies are shown in Table 1. The efficacy of the Pfizer-BioNTech (BNT162b2) and Oxford-AstraZeneca (ChAdOx1-S) vaccinations in lowering COVID-19 symptoms, hospitalization rate, and fatalities in older persons has been shown in related research [2]. Vaccines are effective and safe in most cases and rarely cause serious adverse effects, but there are limited data on efficacy and safety in older populations with comorbidities and frailty [3]. According to the study on efficacy of the COVID-19 vaccine for the older individuals, the vaccine has significantly reduced mortality rates and that it is crucial to increase vaccine coverage in the elderly to reduce the population's overall risk of infection [4]. Based on a population-based observational study in Hong Kong, old adults who received any of the three COVID-19 vaccinations had extremely strong protection against serious or deadly outcomes [5]. A review of the role of the COVID-19 vaccination for the elderly demonstrated the vulnerability of the elderly to SARS-CoV-2 infection and complications, and older people are a target population for COVID-19 immunization efforts, helping to reduce the emergence of severe disease [6]. An Italian efficacy study of a booster dose of COVID-19 vaccination concluded that a booster dose of COVID-19 vaccine reduced the morbidity and mortality in older adults [1]. To prevent SARS-CoV-2 infection and accompanying mortality in older persons, COVID-19 vaccination is advised, according to a systematic review and meta-analysis of the vaccine's efficacy and safety in this population [7]. Research on the COVID-19 vaccine's efficacy in older persons in Colombia has demonstrated that while the vaccination is successful in reducing mortality in older adults, but its efficacy decreases in those over the age of eighty [8]. An examination of the COVID-19 vaccination landscape indicates that vaccination is an important strategy for preventing the COVID-19 in older persons and provides a framework for continuing safety and effectiveness assessments of the COVID-19 vaccine [9]. In studies of COVID-19 vaccination in Chinese older adults, the COVID-19 vaccine was effective in reducing the likelihood of serious illness and death in older adults, and vaccine coverage should be increased in Chinese older adults [10].

3.2. Synthesis of Results

Studies consistently show that mRNA vaccines and viral vector vaccines are more effective in older adults, and that they reduce hospitalization, readmissions, and mortality to a greater extent than inactivated and attenuated vaccines. There are also differences in the response to vaccines among older adults of different ages, even if they receive the same vaccine in a timely manner. About the COVID-19 vaccine that is presently in use, there is a low likelihood of serious side effects, meaning

that vaccination safety is generally guaranteed, although data are lacking for older adults who are frail or have comorbidities. The COVID-19 vaccination is effective in protecting older persons, however, due to the immune system ages, vaccine is less effective in older adults than in younger adults, especially in those over eighty. To address this situation, booster shots are essential for targeting older adults, especially those who have been unvaccinated for a long period of time, to increase the effectiveness of the vaccine and thus achieve sustained protection. In addition, increased vaccine coverage and continuous monitoring of the vaccine's security and effectiveness of the vaccine are necessary to stabilize the disease while producing a more effective vaccine.

4. Discussion

4.1. Summary of Evidence

This review is based on 10 studies that explored the efficacy of various COVID-19 vaccines. Regarding vaccine type, the mRNA vaccine is the most effective vaccine for older adults, and the most common mRNA vaccines are those produced by Pfizer and Moderna, which use mRNA to stimulate the immune system to produce antibodies that can prevent disease. However, due to the weakened immune system of the elderly, some may prefer inactivated and attenuated vaccines for safety reasons. In fact, the occurrence of serious adverse reactions to these vaccines is a small probability, with the most frequent reaction being muscle pain at the site of the injection, and the inactivated and attenuated vaccines are less effective than the mRNA vaccines. For example, two doses of BNT162b2 were 91.1% effective, while two doses of CoronaVac were 79.3% effective. Moreover, the immune system response becomes weaker with age, and the vaccine is less effective in the elderly than in the young, and the effectiveness decreases significantly with age. To counteract this, the selection of a COVID-19 vaccine with a high efficacy rate is necessary for the elderly, and a booster vaccination after five months of vaccination can significantly reduce morbidity and mortality in the elderly. Countries with low COVID-19 vaccine coverage in older adults can increase public education campaigns on vaccine topics, work with local communities, and improve vaccine accessibility to increase vaccine coverage while reducing the burden of disease on economic, social, and health systems.

The COVID-19 vaccination significantly mitigates the rates of fatal disease, hospitalization, and mortality among elderly, including those who are frail and have comorbidities, and the reduced likelihood of developing serious illnesses can in some ways prevent more serious complications, and there is no evidence that the COVID-19 vaccine is ineffective in elderly with comorbidities. Also, studies showing that older adults with comorbidities who have high likelihood of developing severe COVID-19 are more likely to benefit from direct vaccination than from indirect protection, demonstrating that the vaccine is highly effective in vulnerable populations. However, as there is little data on frail and comorbid older people, it is important to continuously monitor the effectiveness of the vaccine to minimize the risk that the vaccine poses to comorbid older people, based on the stratification of different age groups and different comorbid groups of older people. In addition to this, the vaccination sector can focus on the reactions to vaccination in frail or comorbid older people to prevent irreversible consequences of adverse reactions. Besides vaccination, this group of elderly people also need to pay attention to daily preventive measures, such as wearing masks, maintaining specific socialization, and avoiding crowded places, etc., to achieve a better preventive effect.

4.2. Limitation

Limitations of the study include the persistent lack of data on frail or comorbid older adults, the need for detailed analysis and ongoing research to obtain more experimental data, and the need to continually monitoring the effectiveness and safety of the vaccine and make timely improvements. Moreover, the effectiveness of vaccines may be overestimated in studies, and vaccine proponents may exaggerate the effectiveness of vaccines, leading to biased data. Individual differences and gender differences may also affect vaccine effectiveness. Regarding vaccine coverage, cultural

differences may affect vaccine prevalence and coverage, which is not conducive to the comprehensiveness of the data.

5. Conclusions

Ten studies examining the efficacy of several COVID-19 vaccinations emphasized the efficacy and safety of the shot in older persons. The Pfizer BioNTech (BNT162b2) COVID-19 vaccine, Moderna COVID-19 (mRNA-1273) vaccine and Oxford-AstraZeneca (ChAdOx1-S) were found to be more effective. However, the data from this study were not representative, and data on frail or comorbid older adults were missing, requiring ongoing evaluation of efficacy and safety. Public health authorities around the world can develop nationally appropriate vaccination policies that prioritize older adults and increase vaccine coverage. Policies should also consider cultural and human differences and flexibility is desirable. Regarding community psychosocial service policies, effective communication can help to address vaccine hesitancy, the benefits and risks of vaccines can be more widely publicized, and in the case of COVID-19 susceptible populations, psychosocial counselling services can alleviate their psychological burden and allow them to cope better with the disease.

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