



Review Article

Immunosenescence, COVID-19, and Vaccine Efficacy in the Elderly

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ABSTRACT

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Recent research has unveiled and confirmed the deleterious age-related changes of the immune system which result in diminished ability of older adults to effectively respond to pathogens and infection. This degradation is defined by the term immunosenescence. Immunosenescence can also bring with it reduced vaccine efficacy. In an era where the population of older adults is growing exponentially, it is apparent why such dysfunction is concerning. Adding even more pertinence is the COVID-19 pandemic. Since March of 2020, older adults across the globe have borne witness to the disproportional effects of COVID-19 infection on their mortality rates versus younger adults and children. In order to bring the pandemic to an end, the global population must be inoculated. However, concerns have been raised about the effectiveness of the COVID-19 vaccines on the elderly. This article aims to provide a brief overview of immunosenescence, the COVID-19 pandemic, and what research has shown thus far about vaccine efficacy for older adults. As well, potential methods to combat immunosenescence will be explored.

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Introduction

The life expectancy of humans is rising globally as society continues to make advancements in areas of technology and medicine. According to data from the World Bank Group, the global life expectancy was 72.7 years in 2019, an increase of 38.4% from 1960 [1]. However, life expectancy reveals little about life quality and thus must be distinguished from health-adjusted life expectancy (HALE), which is the number of years an individual can expect to live in good health. As anticipated, the average HALE is often lower than the average life-expectancy for a population [2, 3]. Aging is associated with a decline in many areas of health. In the current era of COVID-19, one area of particular concern is immunity.

Immunosenescence in the Elderly

As individuals grow older, they experience immune system efficacy deterioration. Epithelial barriers in the skin, lungs, and digestive track erode and allow for easier pathogen access, antibody quality decreases, the ability of T and B cells to fend off infections is weakened, chronic inflammation damages organs in the body, and vaccine efficacy is reduced [4, 5]. Such changes are encompassed by the term immunosenescence. Immunosenescence is not only attributed to normal, primary aging but can be exacerbated by poor cumulative lifestyle choices and environmental factors [4]. It is associated with increased vulnerability to infection, disease, and possibly cancer [6].

COVID-19 and the Elderly

The COVID-19 pandemic, which disproportionately affects older adults, has demonstrated this effect. Older adults have faced higher fatality rates, with data from the Centers for Disease Control and Prevention (CDC) reporting that 8 out of 10 COVID-19 deaths have been in individuals aged 65 and older [7]. The CDC has also reported that compared to 18-29 year olds, those aged 65-74 are 90 times more likely to die from COVID-19 [8]. For individuals above the age of 85, these mortality likelihoods jump to 630 times higher [8]. This is especially worrisome when considering older adults living in long-term care facilities around other susceptible and immunocompromised older adults. According to the Canadian Institute for Health Information, 80% of all COVID-19 deaths in Canada as of May 25, 2020 were comprised of individuals living in long-term care facilities and retirement homes [9].

Vaccine Efficacy and the Aging Population

The high-risk of older adults against COVID-19 is why this group among other vulnerable populations is being given vaccination priority. However, concerns about the efficacy of vaccines in older adults have been raised as previous research has shown that immunosenescence diminishes vaccine responses in the elderly. The influenza vaccination has been found to have an efficacy of only 30-40% in vulnerable older adults [10]. However, results from SARS-CoV-2 vaccination clinical trials for older adults have been surprising and promising. In adults aged 70 and older, one dose of the Pfizer/BioNTech vaccine had an efficacy of 57-61% in the prevention of COVID-19, and one dose of the AstraZeneca/Oxford University vaccine had an efficacy of 60-73% [11]. Utilizing the method of boosting – administering a second dose of the vaccine in order to further increase immunity against an antigen –increased the efficacy of Pfizer to 85-90% [11]. Despite these encouraging results, data has still shown that compared to younger individuals, older adults are experiencing a reduced antibody response to the COVID-19 vaccines [12].

However, some methods exist for increasing the efficacy of vaccines and countering the effects of immunosenescence. Along with boosting, higher-dose vaccines and alternative routes of administration (i.e., mucosal, oral) have shown potential for increasing vaccine efficacy [13, 14]. As well, taking preventative measures such as maintaining proper nutrition and exercising can counteract the effects of immunosenescence [13, 15]. Proper nutrition will also protect against zinc deficiency, something that can be harmful as zinc has been linked with benefiting the immune system [16]. Whole thymic transplantation is another intervention that has been explored as a way to restore immune function by increasing the number of naïve T cells and

shown promising results [13]. An identified potential future strategy is rooted in cellular and genetic therapy, where immune system cells may be rejuvenated through telomere elongation [13].

Conclusion

People are living longer, but this does not necessarily mean that they are living healthier. As well, the proportion of older adults in the population continues to grow year by year and is expected to approximately triple between 2017 and 2050 [17]. Thus, there is a great need for research aimed at identifying and evaluating the immune function challenges faced by older adults as well as finding solutions for the restoration of immune function – something that has been emphasized by the COVID-19 pandemic. Currently, older adults have often been excluded from experimental drug trials, but again, the COVID-19 pandemic has propelled interest in this area forward [10, 18]. Hopefully, there will be a shift in the research community in the coming years, and studies involving older adults will not be neglected. Thus, the library of knowledge regarding successful aging can expand, and additional solutions for the problems posed by immunosenescence can be found.

Declarations

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