The Impact of Smoking on Anti-COVID-19 Antibody Titers After Vaccination: A Narrative Review in Some Asian Countries

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Abstract

According to 2019 worldwide statistics, there were more than 1 billion tobacco smokers, making smoking one of the top significant preventable causes of disease and early death. Smoking poses a considerable problem to healthcare systems throughout the world. The coronavirus outbreak, which is now sweeping the world, is causing extensive concern. Since December 2020, several COVID-19 vaccines have been produced and approved, and an efficient immunologic response to vaccination is essential to limiting the pandemic’s harmful health effects. According to several of these research studies, smokers’ vaccine antibody (Ab) titers are lower or decrease more quickly than non-smokers. Thus, this narrative review article was conducted aiming at finding the impact of smoking on anti-severe acute respiratory syndrome coronavirus 2 immunoglobulin G Ab titers after COVID-19 vaccination in some Asian countries, including China, Japan, Jordan, and Turkey. Relevant English publications from the Web of Science, PubMed, Scopus, and Google Scholar were searched and extracted using keywords such as COVID-19, smoking, vaccination, China, Japan, Jordan, and Turkey. This review revealed that smoking is one of the significant risk factors for COVID-19 infection that emerges after vaccination. Present smoking could promote lower Ab titers, and quitting smoking before immunization increased the ability to respond to the vaccine. Moreover, cigarette smoking and the use of tobacco products could be predictors of a reduced immunological response to the COVID-19 vaccination. To develop a more individualized strategy for vaccination, additional research on the relationships between Ab titers and the thorough histories of people, including smoking history, is necessary.

Keywords: COVID-19, Smoking, Vaccination, China, Japan, Jordan, Turkey

Introduction

Smoking is one of the most frequent and hazardous habits observed all over the world (1). Despite a recent drop in cigarette smoking, there are still many people who smoke, and men and women smoke at highly different rates (32.7% for men and 6.6% for women in 2019) (2).

According to 2019 worldwide statistics, there were more than 1 billion tobacco smokers, making smoking one of the top significant preventable causes of disease and early death. Smoking poses a considerable problem to healthcare systems throughout the world (2). Smoking has a variety of harmful effects, including an increased risk of chronic obstructive pulmonary disease, lung cancer, and cardiovascular disorders, as well as bacterial and viral infections of the respiratory system (3). Smoking is correlated with immune system malfunction, which could lead to autoimmune diseases and a decreased immunological response to infections (4). The reason may be the medical conditions of the involved people and the complexity and functional diversity of the components of cigarette smoke. However, in each situation, smoking is more detrimental than being useful. Perhaps the real chemical composition of tobacco smoke produced in various regions of the nation varies. Autoimmune reactions against not only a pathogen but also self-tissue is the outcome of impaired immunity brought on by a protracted chronic infection. Moreover, cigarette smoke has varying impacts on immunity (4).

Smoking remains the most significant global contributor to avoidable mortality and disability. Given the substantial data demonstrating the detrimental effects of smoking on respiratory function and lung health (5), new research has suggested that smoking may increase the risk of COVID-19 outcomes (6). In the greatest research on COVID-19 patients, about 17% of patients with severe disease were current smokers compared to
12% of people with less severe disease (7). Another study conducted on COVID-19 patients admitted to hospitals in China represented that smoking could have a negative impact on COVID-19 prognosis since a greater percentage of smoker patients showed a rapid deterioration in health during their hospitalization than non-smokers (8). The coronavirus outbreak, which is now sweeping the world, is causing much concern (7). The following factors are among those that contribute to smokers’ susceptibility to COVID-19 and the disease tends to deteriorate (9):

1. Smoking makes it more likely for viruses to enter the body
2. Smoking alters the pulmonary mucosal epithelial barrier
3. Smoking increases the permeability of epithelial cells
4. Smoking weakens the immunological system
5. Smoking releases pro-inflammatory cytokines

Vaccines are anticipated to be crucial in containing the COVID-19 pandemic in the absence of specialized medication (10). Since December 2020, a number of COVID-19 vaccines have been produced and approved, and an efficient immunologic response to vaccination is essential to limiting the pandemic’s harmful health effects (11).

The effectiveness of several vaccination platforms includes (12):

1. Inactivated or attenuated virus: Sinopharm and Sinovac
2. Viral vector (non-replicating): Sputnik V, AstraZeneca, and Johnson and Johnson
3. Protein subunit: EpiVacCorona and Novavax
4. DNA: Inovio
5. RNA: Pfizer/BioNTech, Moderna, and Curevac

For most COVID-19 vaccines, a significant concern is related to reducing effectiveness in preventing coronavirus infection, although the prevention of severe disease cannot be explained by the antibody (Ab) titer (13). Several methods may be stimulated both adaptive and innate immunity through vaccines that protect against viral infection. There are two main mechanisms of immunity within the adaptive immune system (including humoral and cell immunity), resulting in the production of antibodies that bind to the spike protein and block the entry of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) into cells (14).

Some studies have suggested a further investigation into the effects of smoking on the humoral response to COVID-19 vaccinations by stating that smokers’ vaccine-induced Ab titers are lower or reduce more quickly than those of non-smokers (15,16). Based on some of these studies, smokers’ vaccine Ab titers are lower or decrease more quickly than non-smokers (15). Accordingly, the current narrative review article sought to find the impact of smoking on anti-SARS-CoV-2 immunoglobulin G (IgG) Ab titers after COVID-19 vaccination in some Asian countries, including China, Japan, Jordan, and Turkey.

Methods

This narrative review focused on evaluating the impact of smoking on anti-COVID Ab titers after vaccination in some Asian countries. Relevant English publications from the Web of Science, PubMed, Scopus, and Google Scholar were searched and extracted using keywords such as COVID-19, vaccination, smoking, China, Jordan, Japan, and Turkey.

Results

Smoking and Coronavirus Disease 19 Vaccination in China

From December 2020 to March 2021, 164 patients, who were divided into smoking and non-smoking groups from Beijing Hospital, were recruited by Zhang et al (17). Two doses of Sinovac-CoronaVac (an inactivated COVID-19 vaccine) were given to cases, who had their serum longitudinally taken on the first day, two weeks, six weeks, and three months.

Although the dose of cigarettes in smoker groups was not investigated, the results revealed that the smoking group had lower IgG titers than the other group, which may be a particular risk factor for coronavirus infection that develops after immunization (17).

Smoking and –Coronavirus Disease 19 Vaccination in Japan

Nomura et al recruited serum samples taken from 378 healthcare workers (HCWs, 255 women and 123 men) around three months after the second dose of two Pfizer/BioNTech vaccine inoculations given in Tochigi prefecture, Japan. The findings of this study demonstrated that smoking was the most significant variable related to low Ab titers. Thus, rather than the duration or quantity of smoking, smoking itself is a risk factor for low Ab titers. Furthermore, given that they were extremely lower in present smokers than in former smokers, it is predicted that quitting smoking will dramatically raise Ab titers (18). About six months following the second dose of two Pfizer/BioNTech vaccine inoculations, Nomura et al conducted a second trial in which blood samples were taken from HCWs. Although smoking habit was a risk factor for a low Ab titer three months after the second dose, as found in the first study, smoking could not determine the attenuation of Ab titers from three to six months following the second vaccine dosage. Only women showed a substantial reduction in Ab titers between three and six months (19).

In another study, 373 cases were chosen from 485 HCWs in Fukuoka, Japan. Six months after receiving the Pfizer/BioNTech vaccine, the levels of antibodies were assessed in this study. The prospective study
demonstrated that 49 healthcare professionals’ anti-spike IgG levels significantly decreased six months after receiving the second dose of the Pfizer/BioNTech vaccination. This pattern is related to age and alcohol consumption patterns rather than smoking status (20).

Kato et al, in the first study, recruited 98 HCWs at a hospital in Japan who had completed two doses of the Pfizer/BioNTech vaccine. The blood samples were taken 180 days following the second dose of immunization (21). In the second trial, they analyzed samples from 168 Japanese HCWs who had received the Pfizer/BioNTech vaccination twice. The blood samples were taken before vaccination, then at two, four, and six weeks after the first dose (22). There was no correlation between smoking habit and the titer of IgG against the spike protein induced by the vaccination in any of the two studies by Kato et al.

Another study examined the relationship between smoking and anti-SARS-CoV-2 spike IgG Ab titers following the Pfizer/BioNTech vaccine. The study consisted of 3,457 fully immunized healthcare workers from four advanced research and medical centers in Japan who volunteered to participate. IgG titers against the anti-SARS-CoV-2 spike were assessed 64 days on average following the second vaccination. Of participants, those who received vaccinations IgG Ab titers among tobacco users (e.g., those who also smoked cigarettes) and exclusive cigarette smokers were considerably lower compared to never-smokers. There was a larger drop in IgG titers among daily smokers who smoked 11 or more cigarettes per day in comparison to those who smoked less than 11 (23).

Smoking and Coronavirus Disease 19 Vaccination in Jordan
In general, 288 Jordanian adults who had received two doses of either the Sinopharm or Pfizer/BioNTech vaccines (141 and 147 cases were administered the Pfizer/BioNTech and Sinopharm vaccine, respectively) were included in the sampling population for the prospective cohort study undertaken by Kato et al. All patients who were included in the study received two doses with an interval of 21 days, and enrollment in the study took place six weeks after the second dose had been given. They discovered that smoking habits were not significantly different between the two groups after receiving the COVID-19 vaccination (24).

Smoking and Coronavirus Disease 19 Vaccination in Turkey
A prospective, cross-sectional, single-center study was conducted among 184 HCWs in Turkey. Totally, 94 of them completed this study. Blood samples were collected three weeks following each dose of CoronaVac (the two-dose inactive SARS-CoV-2 vaccine, Sinovac, China). Non-smokers were more likely to have seropositivity than smokers, although the difference was not statistically significant (25).

In another trial conducted in Alanya, Turkey, 314 HCWs participated, who had received two doses of the CoronaVac inactivated vaccine and had never been exposed to COVID-19. When examining the association between smoking behavior and Ab response, it was revealed that 40% of those with low Ab titers had smoked before. They discovered that smokers had considerably lower Ab titers than non-smokers (26).

Conclusion
The findings of this review revealed that smoking is one of the significant risk factors for COVID-19 infection that emerges after vaccination. Present smoking promoted lower Ab titers and quitting smoking before immunization could increase the ability to respond to the vaccine. Moreover, cigarette smoking and the use of tobacco products could predict a reduced immunological response to the COVID-19 vaccination. As a limitation of this study, it should be noted that there was no standardized serologic testing protocol or fixed range for Ab titers across studies related to COVID-19. Although comparing Ab titers between smokers and non-smokers could have been informative, the use of different cutoff points for serologic tests between studies hindered the ability to draw clear conclusions regarding the differences between these groups. Finally, additional research is required on the relationships between Ab titers and the thorough histories of people like smoking history to develop a more individualized strategy for vaccination.

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Competing Interests
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