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SARS-CoV-2 PCR-Positive Infection Rates and COVID-19 Vaccination Patterns Among Healthcare Workers at Imam Khomeini Hospital, Ardabil, Iran: A Cross-Sectional Study (March 2019–March 2023)

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ABSTRACT

Introduction:
The spread of the Covid-19 virus, especially among medical personnel, has caused serious concerns in the field of public health. Vaccination has been considered as a key strategy to reduce the incidence and severity of the disease. The purpose of this study is to determine the rate of PCR-positive corona and the number and type of corona vaccine received by the medical personnel of the corona department of Imam Khomeini Hospital in Ardabil during March 2019 to March 2023.

Materials and Methods:
In this study, the rate of infection with covid-19 and hospitalization in medical personnel was investigated in relation to the number and type of vaccines received. The information collected included the history of corona infection, the type and number of vaccines, and the hospitalization status.

Results:
The results showed that 70.12% of the participants were infected with Covid-19 before vaccination and 65.85% after it. People who had received more vaccines had less severe disease. Also, only 7.10% of people had a history of hospitalization due to COVID-19.

Conclusion:
This study emphasizes that vaccination is an important tool in reducing the incidence and severity of covid-19 disease. According to the results, it is suggested to pay more attention to the number and type of vaccines received in order to protect the health of medical personnel and society.

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Introduction

The emergence of severe acute respiratory infections has been regarded as one of the most recent worldwide public health threats and challenges throughout the past 20 years (1). A novel coronavirus called severe acute

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respiratory syndrome coronavirus 2 (SARS-CoV-2) surfaced in China's Hubei Province in December 2019 from an unidentified source. Coronavirus disease 19 (COVID-19) is the global illness brought on by SARS-CoV-2. A worldwide health emergency was proclaimed by WHO as a result of the viral virus spreading over the world. Two significant epidemics in the past 20 years have been caused by the coronavirus family: Middle East respiratory disease (MERS), which has a 34.4% mortality rate, and acute respiratory syndrome (SARS), which has a 10.5% fatality rate (2-3).

Numerous symptoms, ranging from asymptomatic instances to mild and severe illness and mortality, are indicative of the existence of COVID-19. Fever (not always), cough, sore throat, headache, tiredness, muscle soreness, and dyspnea are among the disease's clinical symptoms. Within a week, the illness can cause pneumonia, respiratory arrest, and mortality in a small percentage of patients. This illness can cause serious lung injury, ARDS, shock, and other complications. Elderly adults with various underlying issues and certain people with multiple disorders (50–75%) are more likely to experience negative outcomes and die. About 2-3% of people die overall (4-5). The upper respiratory tract is where the SARS-CoV-2 virus replicates most effectively. During the incubation phase, patients can spread the new coronavirus 2019 to others. It is thought to spread through droplets, close contact, aerosols, and fecal-oral transmission. The primary way that this virus spreads is through tiny particles that are created in an infected person's airways and expelled during coughing, sneezing, and regular conversation (6). Assays for the detection of viral antigens or antiviral antibodies are examples of conventional diagnostic testing techniques that have been created and applied in clinical settings. RT-PCR is one of the new diagnostic techniques that works well for tracking epidemiological indicators. Samples include nasopharyngeal swabs, sputum, lower respiratory tract secretions, blood, and feces can all of which can contain nucleic acids of the new coronavirus 2019 (7). Therefore, the creation of efficient control and treatment procedures and methods is necessary to restrict the transmission of the virus, the number of human casualties, and the extent of the pandemic. An efficient vaccination is unquestionably required to stop additional deaths in addition to several preventive measures like mask wearing, social distancing, and isolation and quarantine (8).

Humanity has been successful in creating vaccinations for several deadly illnesses throughout history, such as poliovirus, measles, tetanus, and meningitis. A vaccination is a biological agent created to shield people from bacterial and viral illnesses. Because they harness the power of our body's innate immune system to fend off infectious diseases, vaccines are also known as immunizers. In some way, vaccines teach the immune system to produce antibodies (9). Various technologies are used in the production of vaccines. Time is of the essence during this unprecedented pandemic, and a great deal of work is being done to study vaccines. Vaccine design and production are extremely expensive and heavily influenced by international regulations.

The primary objective of vaccine development is to gather concrete proof of the vaccine's effectiveness in preventing human infection with the SARS-CoV-2 virus and the COVID-19 disease, even though some nations may only create vaccines based on the criteria of being immunogenic and safe (10–11). 43 vaccines in phases 1 and 2 and 26 vaccines in phases 2 and 3 were among the 69 planned vaccinations that advanced to the clinical trial stage till January 2021.

Several suggested vaccinations were shown to be 95% successful in stopping the transmission of COVID-19 in phase 3. At least one nation has approved 17 vaccinations for injectable and broad use as of April 2021. Pfizer's and Moderna's Covid-19 vaccines, two RNA vaccines, eight inactivated coronavirus vaccines, Kovaxin, Koviran Barkat, Kovivac, Minhai-Kangtai, QazVac, WIBP-CorV, and BibiBP-spherical, six Sputnik V, Sputnik Light, Johnson & Johnson, Convidecia, and Oxford-Astrazenka virus vaccines, two EpiVacCorona peptide vaccines, and their RBD-Dimer (12) are among these vaccines. Iran began vaccinating against COVID-19 on February 21, 2020, after the Ministry of Health approved the importation of the Sputnik 5 vaccine from Russia.

On February 17, 2020, it was reported that the Oxford-Astrazenka vaccine would be purchased under the Swedish vaccination name. The "Kovu Iran Barkat" vaccine, created by Barkat Pharmaceutical Group and Shafa Daru Company, was the first Iranian COVID-19 vaccine to go to the clinical trial stage. This vaccination uses inactivated viral technology, according to data released by the World Health Organization.

The Barkat vaccine cleared clinical phase 3 on May 5, 2021 (13). Here, the question that arises is, what kind of vaccines have the highest number of PCR positive corona cases and people get PCR positive covid after a few days of taking the vaccine?

Although the spread of COVID-19 has somewhat slowed down compared to earlier times, regional and international research is still required to evaluate the efficacy and efficiency of vaccines and to compare vaccines made and used globally. The findings of these studies can then be utilized to inform future treatment choices for comparable epidemics.

Furthermore, there is currently no conclusive solution to this health issue, necessitating more research in this area. Therefore, due to the importance of the subject and the lack of detailed study, we decided to conduct this study to investigate the rate of PCR- positive corona and the number and type of corona vaccine taked by the medical personnel of the corona department of Imam Khomeini Hospital in Ardabil during March 2020 to March 2022.

Materials and Methods

Study design

This cross-sectional descriptive study was conducted among 164 medical personnel working in the COVID-19 department of Imam Khomeini Hospital in Ardabil, Iran. Participants were selected via a simple random sampling method using registered employee ID codes from the hospital's personnel database. Demographic and clinical data-including age, sex, type of vaccine administered, and frequency of vaccinations-were collected using a structured checklist.

The collected data were entered into SPSS software (version 21) and analyzed using descriptive statistics. Categorical variables are presented as frequencies and percentages, while quantitative variables are expressed as mean ± standard deviation. This study received ethical approval from the Ethics Committee of Ardabil University of Medical Sciences (approval code: IR. ARUMS. MEDICINE. REC. 1402. 145).

Results

According to the results, 12.08% of the sample were male and 87.02% were female. The average age of men was 36.2 years, and the average age of women was 37.5 years. 70.12% of the sample were infected with corona virus before the vaccine injection. 78.26% of infected people had been infected once. 67.92% were infected with Corona after the vaccination, and 83.33% of the infected people were infected once. The results of the study show that 18.52% of people were infected with corona after the first dose and 58.34% after the second dose. 1/31 people were not infected with corona after the last vaccine (Table 1).

Table 1. The status of infection in people a few months after the corona vaccine

Duration	**n**	**%**
not infected	51	31.1
Less than a month	8	4.9
One to three months	19	11.6
Three to six months	44	26.8
Six to nine months	24	14.6
Nine to twelve months	10	6.1
No response	8	4.9
Total	164	100

10/7% of the people had a history of hospitalization due to COVID-19. 3.65% of them, had received one dose and 54.28% two doses of COVID-19 vaccine (Table 2).

Table 2. The number of vaccine doses received in the studied subjects

Amount of dose	n	%
0	4	2.44
1	6	3.65
2	89	54.28
3	63	38.42
4	2	1.21
Total	164	100

Of all patients, 2.45% had not received the corona vaccine at all, and Sinopharm with 29.3%, Sputnik with 28% were the most types of injectable vaccines (Table 3).

Table 3. The type of vaccine received in the study subjects

Type of vaccine	N	%
non-receipt	4	2.45
Sputnik	46	28
AstraZeneca	45	27.4
Bharat	13	7.9
Sinopharm	48	29.3
barakat	7	4.3
pastococ	1	0.61
Total	164	100

Discussion

In terms of frequency, average age, and marital status among the target people, the present study showed that the majority of the statistical sample (87.02%) were women and only 12.08% were men. This gender composition can originate from several factors. On the one hand, women are usually more present in healthcare settings as nurses, doctors, or support staff. Studies have shown that women are more involved in healthcare activities than men, especially in the face of epidemics and on the front lines of the fight against COVID-19 (Mauvais-Jarvis, 2020). which states that women are usually more willing to participate in public health studies due to greater concerns about health and greater attention to vaccination (14). The average age of women and men in this study was 37.5 and 36.2 years, respectively. These results are consistent with similar studies showing that the middle-aged population, especially in work environments such as hospitals, is at greater risk of contracting COVID-19. This age group is more exposed to viral contamination due to more interactions with patients and daily contact with different people. Also, age is one of the key factors in the severity of respiratory diseases such as COVID-19, which is consistent with our results of increased risk of hospitalization with increasing age (15).

Regarding marital status, the results showed that 80.49% of people were married and 19.51% were single. Marital status has been recognized in previous studies as one of the factors that can affect health-related behaviors. Mieke Beth Thomeer has shown during the survey that married people are more willing to take care of their health due to more social and emotional support from their partner. This point can be an explanation for the high frequency of married people in our study (16).

People who have been exposed to the coronavirus before the vaccine have natural immunity, but vaccination boosts this immunity and provides better protection, especially against new variants. Vaccines reduce the severity of the disease even if contracted after vaccination. This issue is very important for medical personnel because it reduces hospitalization and absenteeism. The results showed that before the vaccine injection, 70.12% of the medical personnel were infected with corona. This pre-vaccination infection rate indicates the widespread spread of the virus among healthcare workers in the early stages of the pandemic. Studies have shown that medical personnel are at high risk of contracting the

disease due to close and continuous contact with patients suffering from COVID-19. On the contrary, after the injection of the vaccine, 65.85% of the people were infected with corona, which indicates a significant infection even after vaccination. This finding may be due to the decreasing effectiveness of vaccines against new variants of the virus, as shown in studies such as the research of Sara Y. Tartof et al. (17).

Among the people who got infected after the vaccine, most of them got infected with corona twice (12.03%), which indicates that even after receiving the vaccine doses, people are still at risk of re-infection. These results are consistent with the findings of Pradipta Paul et al., who stated that vaccines may not be completely successful in preventing re-infection, especially in the face of new virus variants such as Delta and Omicron (18). There is still a chance of getting COVID-19 after vaccination, but vaccines significantly reduce the risk of severe cases and hospitalization. In general, vaccines play a vital role in reducing disease burden and maintaining the capacity of treatment systems. The results showed that 18.52% of people were infected with corona after the first dose, 58.34% after the second dose, and 23.14% after the third dose. In a study, they stated that COVID19 vaccines provide partial immunity after initial doses, but booster doses are needed to maintain a high level of immunity. This is especially important for medical personnel who are highly exposed to the virus (19).

Regarding hospitalization, only 10.7% of people were hospitalized after contracting the corona virus, which is less than PCR-positive infections (65.85%). This indicates the positive effect of vaccination in preventing severe disease and the need for hospitalization. According to the study of Polack et al. (2020), widespread vaccination causes a sharp reduction in hospitalizations due to COVID19, even if people are not completely immune to infection (20). Also, these results are consistent with the study of Samar Fatima et al. (2022), which showed that vaccinated people experience milder symptoms and require hospitalization less than non-vaccinated people (21).

In general, the number and type of vaccines have a direct effect on the level of immunity created and the reduction of severe disease complications. In our study, 55.6% of participants received two doses and 39.4% received three doses of vaccine. This distribution of vaccine doses indicates the widespread acceptance of vaccination among healthcare personnel. The Sinopharm vaccine was the most received type of vaccine, with 23.18%, which was consistent with the wide distribution of vaccines produced in China in developing countries and also in some countries such as Iran.

One of the limitations in this study is the use of existing documents, and it is necessary to take action to reduce this limitation and increase the accuracy of the information. Among other limitations, we can point out the difference in the level of inherent immunity of the people who entered the study. The innate immunity of people is influenced by genetics, and people who have low innate immunity may have more hospitalizations regardless of the type and number of vaccines received. This variable is out of control.

Conclusion

The results of this study showed that vaccination against COVID-19 in medical personnel is significantly related to the rate of infection and hospitalization. Considering that the highest percentage of participants were infected with COVID-19 before getting vaccinated and also after vaccination, this shows the importance of the combined immunity caused by previous infection and vaccination. In addition, the type and number of vaccinations also play an important role in reducing the severity of the disease and hospitalization. People who had gotten multiple doses of the vaccine were particularly immune to hospitalization. Also, the existence of a history of hospitalization due to COVID-19 in some people indicates the need for more monitoring of the effects of vaccination and prevention of severe complications of the disease. Finally, this study emphasizes the importance of vaccination as a key tool in controlling the spread of COVID-19 and reducing the burden on healthcare systems. It is necessary to continuously evaluate and update vaccination programs according to the type

and number of vaccines given the demographic characteristics of medical personnel to ensure maximum safety and protection against disease. Long-term safety analysis, conducting longitudinal studies to investigate the stability of immunity due to vaccination and infection with Covid-19 in medical personnel, especially in relation to the reduction of antibody levels and the need for booster doses, investigating and comparing the effect of different types of COVID-19 vaccines on the infection rate, the severity of the disease, and hospitalization in different age and population groups, especially in medical personnel, and analysis of the effects of new virus variants on the effectiveness of vaccines and checking the level of immunity in people getting different vaccines are suggested. These studies can help improve vaccination strategies and health crisis, management and contribute to a better understanding of the effects of Covid-19 on medical personnel and society.

Conflict of Interest: none

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