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# Frequency of SARS-CoV-2 Infection after Vaccination in Health Care Workers in Ardabil, 2021

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**Abstract**

**Introduction:** The effectiveness and safety of COVID-19 vaccines have been reported, but there is limited information on their real-world effectiveness and reports of breakthrough infections. This study aimed to determine the frequency of COVID-19 infections after vaccination among medical interns and personnel in Ardabil city in 2021.

**Methods:** This cross-sectional descriptive study included 330 medical interns and personnel from Ardabil city hospitals. Participants were required to provide consent, have received at least one dose of the COVID-19 vaccine, and not have hearing or speech problems. Data was collected using a researcher-made questionnaire and analyzed using SPSS software.

**Results:** Most of the individuals involved (59.7%) were aged between 20 and 30, and 58.5% were women. The majority of the participants were married (60.6%), while physicians and nurses were the most frequently observed professional groups (with 39.7% and 29.1% respectively). Sinopharm and AstraZeneca vaccines were the most commonly used (39.4% and 17.9%, respectively). The majority of participants (67.3%) received three doses of the vaccine, and 27.1% of participants (92 people) reported getting sick at least 2 months after receiving the COVID-19 vaccine. There was no significant association between demographic variables and post-vaccine infection.

**Conclusions:** Although a substantial number of participants were infected with COVID-19 following vaccination, the severity of the illness was mostly mild, demonstrating the value of vaccination in lessening the impact of COVID-19.

## INTRODUCTION

Since the 1918 influenza pandemic, the coronavirus disease of 2019 (COVID-19) has emerged as the most significant global health issue, causing more than 6 million fatalities globally [1]. Due to the COVID-19 pandemic and the fact that the SARS-CoV-2 virus developed in several lineages, there is still a significant risk to world health. Different variations of these mutations with enhanced transmissibility, severity, or immune evasion have been identified [2, 3]. COVID-19 has also been linked to diarrhea, rash, anosmia, thromboembolic disorders, vasculitis, and myocarditis [2, 4]. It has been proven that several measures such as face mask use, social distancing, and hand cleanliness are effective in reducing the effects of COVID-19 and that vaccinations are the most secure and reliable way of defending healthy people from serious illness [5]. Healthcare workers (HCWs), being the frontline caregivers for COVID-19 patients, are more likely to get the virus and, if infected, may also spread the infection to others [6]. Therefore, they should receive the vaccine first. There are four different kinds of vaccinations in use: nucleic acid (DNA and RNA), viral vector, whole virus, and protein subunit. Some vaccinations introduce the antigen to the body, whereas others use body cells to create viral antigens [7]. In Iran, there are several types of vaccines available, including those from Sinopharm,

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AstraZeneca, Sputnik, Bharat, Barkat, and PastoCovac, for groups at risk, including HCWs. Although existing COVID-19 vaccines are regarded as safe and effective, concerns have been raised about vaccine efficacy and side effects [8]. Recently, there have been reports of people contracting COVID-19 even after receiving both doses of the vaccine [9, 10]. So far, no study has been conducted in Iran regarding the rate of infection with COVID-19 after vaccination. Having more knowledge about this new virus and the effectiveness of its prevention methods improves the possibility of dealing with it. This retrospective study was conducted to discover the occurrence of SARS-CoV-2 infection among vaccinated HCWs in Ardabil City and analyze the severity of their disease. The results of our study can help identify more effective vaccines.

## METHODS

This cross-sectional study involving medical interns and staff members of educational and treatment centers in government hospitals in the city of Ardabil. The criteria for entering the research include the satisfaction of the research units to participate in the study, receiving at least one dose of the COVID-19 vaccine, and having no hearing or speech problems. Sample method Pick-up was convenience sampling. The sample size was determined using the sample size formula, taking into account the number of medical students and HCWs in the city of Ardabil. According to Cochran's formula, the sample size was calculated to be 330 individuals without attribution. The data were collected using a structured questionnaire. The validity of the questionnaire was confirmed by the method of content validity, so that the questionnaire was given to ten members of the academic staff of the university, and after collecting and applying their opinions, the final questionnaire was confirmed .This questionnaire includes data related to age, gender, marriage, BMI, occupation, chronic disease, use of a mask after vaccine injection, previous infection with COVID-19, number of vaccine doses received, and the condition of COVID-19 infection after receiving the vaccine. For those participants who contracted COVID-19 after receiving the vaccine, the following information was also collected: Severity of illness, the need for hospitalization in a special care unit, and the need for mechanical ventilation. The definitive diagnosis of COVID-19 infection is obtained through PCR or clinical symptoms and chest CT Scan findings based on the diagnosis of the participant's practitioner or therapist. The reliability of questionnaire was checked on the pilot sample and approved by alpha Cronbach with an amount of 0.85.

### Statistical Analysis

The statistical analysis was performed using IBM SPSS version 26. To analyze the data, the mean, median, standard deviation, Confidence interval, frequency, and percentage were used. A chi-square statistical test to determine the correlation of COVID-19 infection after vaccination was used with different variables. A significance level of less than 0.05 was considered. Finally, the odds ratios with the respective 95% confidence intervals were reported and interpreted.

### Ethical Approval

The study was approved by the ethics committee of Ardabil Azad University (NO: IR.IAU.ARDABIL.REC.1400.086).

## RESULTS

This study involved 330 healthcare workers who had received at least one vaccine dose, with a 100% participation rate. The demographic breakdown revealed that 59.7% of participants (197 people) were aged 20-30, and 58.5% (193 people) were female. The largest occupational groups were interns (39.7% or 131 people) and nurses (29.1% or 96 people), while 60.6% (200 people) of the participants were married.

**Table 1.** Demographic and clinical characteristics of the participants

| | n | % |
|---|---|---|
| **Type of Job** | | |
| Physician | 176 | 53.3 |
| Nurse | 96 | 29.1 |
| Midwife | 22 | 6.7 |
| Radiology technician | 26 | 7.9 |
| Laboratory science technician | 10 | 3.0 |
| **Age, years** | | |
| 20-30 | 197 | 59.7 |
| 30-40 | 103 | 31.2 |
| 40-50 | 27 | 8.2 |
| >50 | 3 | 0.9 |
| **Gender** | | |
| male | 137 | 41.5 |
| female | 193 | 58.5 |
| **Marital status** | | |
| Married | 200 | 60.6 |
| Single | 130 | 30.4 |
| **BMI** | | |
| <18.5 | 68 | 20.6 |
| 18.5-25 | 119 | 36.1 |
| 25-30 | 108 | 32.7 |
| >30 | 35 | 10.6 |
| **Comorbidity** | | |
| No | 292 | 88.5 |
| Yes | 38 | 11.5 |

In terms of BMI, most of the participants were normal or overweight (36.1% (119 people) and 32.7% (108 people), respectively). In terms of comorbidity, most of the participants did not mention having a chronic disease (88.5% equals 292), 0.6% (2 people) suffering from chronic respiratory disease, 1.8% (6 people) suffering from cardiovascular disease, diabetes in 2.7% (9 people), high blood pressure in 5.5% (18 people), and kidney failure in 0.3 percent (1 person) were reported. 58.5% (193 people) of the participants used a mask after the vaccine injection on a regular basis. 28.2% (93 people) of participants used masks most of the time,

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4.5% (15 people) sometimes used masks, and 8.8% (29 people) never used the mask after they injected vaccine. Sinopharm, AstraZeneca, Bharat, Barkat, PastoCovac, and Sputnik vaccines, respectively, were reported in 39.4% (130 people), 17.9% (59 people), 5.8% (19 people), 23.6% (78 people), 1.5% (5 people), and 11.8% (39 people) of the participants. Among the participants, 67% (221 people) had experienced COVID-19 infection before receiving the vaccine. Following vaccination, the rate of COVID-19 infection dropped to 27.1% (92 people). The study found that 67.3% (222 people) of the participants received three doses of the vaccine, while 29.1% (96 people) received two doses, and 3.6% (12 people) received a single dose. Table 1 presents the demographic and clinical data of the participants (Table 1 and 2).

According to Table 2, most patients (58.5%) received the Sinopharm vaccine. There is no significant relationship between contracting COVID-19 after vaccine injection and patients' demographic variables (Table 3).

**Table 2.** Variables related to the vaccination

| | n | % |
|---|---|---|
| **Using a mask after vaccination** | | |
| Always | 193 | 58.5 |
| Most | 93 | 28.2 |
| Sometimes | 15 | 4.5 |
| Never | 29 | 8.8 |
| **Type of injected Vaccine** | | |
| Sinopharm | 130 | 39.4 |
| AstraZeneca | 59 | 17.9 |
| Bharat | 19 | 5.8 |
| Barkat | 78 | 23.6 |
| Sputnik | 39 | 11.8 |
| PastoCovac | 5 | 1.5 |
| **Vaccination** | | |
| Yes | 92 | 27.9 |
| No | 238 | 72.1 |
| **Dose** | | |
| One dose | 12 | 3.6 |
| Two doses | 96 | 29.1 |
| Three doses | 222 | 67.3 |

**Table 3.** Getting infected with COVID-19 after vaccination by demographic variables

| | Yes | | No | | P value |
|---|---|---|---|---|---|
| | n | % | n | % | |
| **Type of Job** | | | | | |
| physician | 57 | 62 | 119 | 50 | |
| Nurse | 22 | 23.9 | 74 | 31.1 | |
| Midwife | 7 | 7.6 | 15 | 6.3 | |
| Radiology technician | 2 | 2.2 | 8 | 3.4 | |
| Laboratory science technician | 4 | 4.3 | 22 | 9.2 | |
| **Age group** | | | | | 0.546 |
| 20-30 | 54 | 58.7 | 143 | 60.1 | |
| 30-40 | 32 | 34.8 | 71 | 29.8 | |
| 40-50 | 6 | 6.5 | 21 | 8.8 | |
| >50 | 0 | 0.0 | 3 | 1.3 | |
| **Gender** | | | | | 0.841 |
| Male | 39 | 42.4 | 98 | 41.2 | |
| Female | 53 | 57.6 | 140 | 58.8 | |
| **Marital status** | | | | | 0.488 |
| married | 53 | 57.6 | 147 | 61.8 | |
| single | 39 | 42.4 | 91 | 38.2 | |
| **BMI** | | | | | 0.507 |
| <18.5 | 14 | 15.2 | 54 | 22.7 | |
| 18.5-25 | 35 | 38.0 | 84 | 35.3 | |
| 25-30 | 33 | 35.9 | 75 | 31.5 | |
| >30 | 10 | 10.9 | 25 | 10.5 | |

**Table 4.** Getting infected with COVID-19 after the injection of the vaccine according to the number of doses received and the type of injected vaccine

| | Yes | | No | | P value |
|---|---|---|---|---|---|
| | n | % | n | % | |
| **Get the vaccine** | | | | | 0.241 |
| One dose | 3 | 3.3 | 9 | 3.8 | |
| Two doses | 33 | 35.9 | 63 | 26.5 | |
| Three doses | 56 | 60.9 | 166 | 69.7 | |
| **Type of vaccine** | | | | | 0.522 |
| Sinopharm | 39 | 42.4 | 91 | 38.2 | |
| AstraZeneca | 12 | 13.0 | 47 | 19.7 | |
| Bharat | 3 | 3.3 | 16 | 6.7 | |
| Barkat | 24 | 26.1 | 54 | 22.7 | |
| Sputnik | 12 | 13.0 | 27 | 11.3 | |
| PastoCovac | 2 | 2.2 | 3 | 1.3 | |

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Table 4 reveals that the rate of COVID-19 infection after receiving the vaccine with comorbidity, previous infection, and number of doses, did not significantly differ based on and the type of vaccine received, the rate of infection decreased with the use of a mask. After receiving the third dose of the vaccine, the number of cases decreased significantly. Examining the relationship between contracting COVID-19 after vaccination and having comorbidity (P = 0.861), using a mask (P = 0.601), contracting COVID-19 before vaccination (P = 0.142), number of injections (P = 0.241), and type of vaccine (P = 0.522) was not statistically significant.

After contracting COVID-19, the average blood oxygen level among the participants was 97.03 ± 1.50, with the lowest recorded at 89% and the highest at 100%. None of the patients exhibited pulmonary involvement of more than 50%. Furthermore, there were no cases requiring mechanical ventilation or admission to special departments, and no deaths were reported among the participants.

## DISCUSSION

The healthcare workers (HCWs) in the study were always accessible for health updates, ensuring that their data was reliable and free of recall bias. Considering that most countries have vaccinated their people against COVID-19, understanding vaccine efficacy and post-vaccination infection is important. A preliminary review of four randomized controlled trials conducted in the UK, Brazil, and South Africa revealed an average vaccination effectiveness of around 70.4% [11]. The total vaccination effectiveness more than 14 days after the second dose was 66.7%, and hospitalization was not necessary, as per a further pooled analysis of the previous four studies on the vaccine [12]. The effectiveness of vaccines (such as BBV152 and Oxford/AstraZeneca) in different studies has been reported differently [13]. In our study, the rate of symptomatic infection was 34.37% after two doses of vaccination and 25.22% after three doses of vaccination. This infection after vaccination was independent of the type of vaccine injected. There was no significant relationship between the infection with COVID-19 after vaccination and the gender of the individuals. Recipients of two doses and three doses of each of the vaccines were compared with people who received only one dose of the vaccine; although the rate of COVID-19 infection after vaccination was not significantly different, the number of cases was much lower. Kihnar et al. [10] conducted a study in the United States to investigate the incidence of COVID-19 after vaccination among healthcare workers. The research specifically looked at intensive care unit employees who had received the first or second dose of the Pfizer or Moderna vaccine. A limited number of these workers tested positive for COVID-19 14 days after receiving the second dose. Although Pfizer and Moderna vaccines were not examined in our study, the general results of this study are in line with our investigation. In the present study, the most common comorbidities among all participants and those infected with COVID-19, were hypertension and diabetes. In accordance with our findings, Atkins et al. [14] presented evidence that hypertension and diabetes were the most prevalent comorbidities in patients with COVID-19. These statistics may be attributed to the higher prevalence of hypertension and diabetes in the general population. To consider these two diseases as risk factors for contracting COVID-19, it is necessary to conduct more controlled studies. Common causes of death for COVID-19 patients include multiple organ failure, shock, respiratory failure, heart failure, arrhythmias, and renal failure. According to a systematic review by Nandy and colleague [15] comorbidities, particularly diabetes, raise the risk of mortality. Also, Garg et al. [16] demonstrated the correlation between diabetes and the mortality rate of patients with COVID-19 and the relation of diabetes with other comorbidities in the mortality of COVID-19 patients. The results of these meta-analyses do not correspond to our study because, in our research, the occurrence of COVID-19 was documented regardless of comorbidity. The main reason for the discrepancy between our study and the previous studies could be the small number of participants with comorbidities in our research, which makes the statistical analysis unreliable. In our study, mortality did not occur after vaccination. Mortality rates have been reported differently in various studies [17, 18]. It seems that despite the differences reported in mortality rates, similar risk factors exist for mortality from COVID-19. In terms of cases hospitalized in special care and needing mechanical ventilation, in various studies that have been conducted on the HCWs, different age ranges have been investigated, and because older age is related to an increase in cases of hospitalization in special care and intubation, it is possible that the lower mortality in our study compared to other investigations could be because of the young age of the participants in this study. Sabins et al. [9] examined the incidence of COVID-19 after vaccination among HCWs in India. The study included 461 HCWs, of whom 86 (18.65%) contracted the infection for an average of 38 days (range 14-70 days) after vaccination, indicating that the disease's severity was mild in most cases. However, even after receiving two doses of the vaccine, 19.7% of individuals had a moderate, severe, or critical illness Numerous studies conducted in recent years indicate a large difference in the mortality rate in different parts of the world [2, 19]. The differences in reporting COVID-19

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death rates among studies could be attributed to factors like genetic predisposition, nutritional status, and other influencing factors. The differences in COVID-19 death rate reporting among studies could be attributed to various factors, such as the reporting time and its proximity to the pandemic's peaks at different times. Zhou et al.'s study, for instance, only investigated critical COVID-19 patients admitted to the intensive care unit [20].

## CONCLUSION

Based on the results of our study, despite the fact that a significant percentage of the samples were infected with corona disease after the injection of the COVID-19 vaccine, the severity of the disease was low. Considering the decrease in the severity of the COVID-19 disease after the injection of the COVID-19 vaccine, it is suggested that the medical staff be fully vaccinated.

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None

### AUTHORS' CONTRIBUTIONS
Yeganeh Bahari: was responsible for statistical analysis and manuscript writing. Ghasem Abootalebidariasari: contributed to the study concept and assisted in manuscript preparation. Moharam Aghabalaii; contributed to the study concept. Mahdi Mohammadzadeh Shahla: assisted in manuscript preparation.

### ETHICAL CONSIDERATION
The study was conducted after obtaining ethical approval from the Ethics Committee of Islamic Azad University, Ardabil Branch. Informed consent was obtained from all participants at the beginning of the study. The ethical code for this study is R.IAU.ARDABIL.REC.1400.086

### CONFLICTS OF INTEREST
None

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