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Research Article

SARS-COV-2 INFECTION AND ITS SYMPTOMS AMONG COVID-19 VACCINATED AND UNVACCINATED HEALTH-CARE WORKERS

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ABSTRACT

Objective: India's national coronavirus disease 2019 (COVID-19) vaccination programs started during January 2021 and prioritized health-care workers (HCWs). In this study, we are attempting to measure post-vaccination product-specific (ChAdOx1_nCoV-19/COVISHIELD) COVID-19 vaccine effectiveness among vaccinated hospital HCWs and also to assess symptoms in HCWs with reverse transcription-polymerase chain reaction (RT-PCR) confirmed severe acute respiratory syndrome-coronavirus 2 (SARS-CoV-2) infection.

Methods: This is an online web-based cross-sectional study conducted in June 2021 among vaccinated HCWs, comparing SARS-CoV-2 incidence and symptoms. In this study, demographic data such as age, gender, and profession were collected. Other data collected were vaccination status at the time of infection, the gap between COVID-19 positivity and vaccination, symptoms, hospitalization, time to recovery, and previous positive history before vaccination.

Results: A total of 1685 HCWs were vaccinated with the COVISHIELD vaccine from January 16 to March 18, 2021. Out of 1685 HCWs, 82 (4.8%) were tested positive by RT-PCR after vaccination. Out of 82 positive HCWs, 84% experienced mild symptoms, 12.2% experienced moderate symptoms, and 3.7% had severe manifestations leading to hospitalization. Among these positive HCWs, 25.6% recovered within 7 days, 35.3% recovered in 7–10 days, 15.8% recovered in 11–14 days, and 23.1% recovered after 2 weeks from the 1st day of experiencing symptoms.

Conclusion: Although COVID-19 vaccination by COVISHIELD may not fully prevent from infection by SARS-CoV-2 or its different variants, majority of positive cases present with asymptomatic/mild symptoms. Post-vaccination-positive cases may also present with severe symptoms and require hospitalization.

Keywords: COVID-19 symptoms, COVID-19 vaccination, COVISHIELD, SARS-CoV-2, Time to recovery.

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INTRODUCTION

The incidence of coronavirus disease 2019 (COVID-19) in post-vaccinated health-care workers (HCWs) necessitates that there are many critical questions that remain to be answered about the effectiveness of COVID-19 vaccines in real-world settings. These questions can only be answered in post-introduction vaccine effectiveness studies. Large-scale vaccination of risk groups and later the general population is the single most effective public health measure for mitigation of the COVID-19 pandemic. In many countries, the hospital's infection prevention and control unit conducted active and passive surveillance of vaccinated staff using daily health questionnaires, and post-vaccination web-based questionnaires are to identify and test symptomatic HCWs. In late 2019, a novel severe acute respiratory syndrome-coronavirus 2 (SARS-CoV-2), which causes COVID-19, emerged in Wuhan, China. On March 11, 2020, the World Health Organization declared COVID-19 a pandemic [1,2]. Since the spread of SARS-CoV-2 from Wuhan to all over the world, there are more than 188 million confirmed cases and more than 4 million COVID-19-associated deaths. COVID-19 symptoms can be mistaken for vaccine-related side effects during the initial days after immunization. Many countries have experienced multiple upsurges of COVID-19 and every subsequent upsurge or wave of cases is many times higher than the previous ones. Many European countries have experienced three upsurges of COVID-19 cases and many Asian countries including India have experienced 2 upsurges [3]. HCW are the frontline worriers and are at a higher risk of infection. In addition, HCW can transmit the infection to susceptible patients at high risk of severe COVID-19. The WHO roadmap for prioritizing uses of COVID-19 vaccines in the context of limited vaccine supply includes HCW as a priority group for vaccination. In our country also, HCWs were vaccinated on top priority. This study was conducted to evaluate the effectiveness of the COVID-19 vaccine in the health workers (HCWs), with a focus on tertiary care hospital-based HCWs.

Vaccination is the only effective method to control the pandemic. However, to combat COVID-19, various steps are planned. The initial strategies followed were maintaining social distancing, using face masks, alcohol-based hand sanitizers, and implementing lockdowns and containment zones to arrest the spread of the virus. Later on, many drugs were tried to treat moderate-to-severe COVID-19 patients such as hydroxychloroquine, ivermectin, doxycycline, azithromycin, and remdesivir but to date, no effective drug has been discovered [4,5]. Now, many COVID-19 vaccines under emergency use authorization (EUA) of FDA and emergency use listing of WHO are being administered. These are mRNA vaccines (BNT162b2/tozinameran - COVID-19 mRNA vaccine by Pfizer, mRNA-1273 by Moderna, and Zorecimeran/CVnCoV/CV07050101 by CureVac); recombinant vaccines (COVISHIELD/ChAdOx1_nCoV-19 by Serum Institute of India, AZD1222/ChAdOx1-S by Pfizer, Ad26.COV2.S, Ad5nCoV by CanSinoBio, and NVX-CoV2373 by NOVAVAX); and inactivated vaccines (SARS-CoV-2 vaccine by Sinopharm and SARS-CoV-2 vaccine by Sinovac) [6,7].

The data on WHO indicated that as of June 18, more than 3.4 billion vaccine doses have been administered against COVID-19. In our country, about 100% HCWs have been vaccinated to date. However, it has been noted that in the present scenario, fully vaccinated individuals are getting infected with SARS-CoV-2. In the US, a study showed

0.05% of vaccinated people contracted COVID-19 even after being fully vaccinated [8]. Apart from the effectiveness of vaccines, the next hurdle in vaccine efficacy is mutations in SARS-CoV-2 leading to several variants. The main variants recorded are alpha, beta, gamma, epsilon, delta, and eta. In India, the variant of concern is the delta (pango lineage: B.1.617.2). The variant of concern shows evidence of increased transmissibility, more severe disease, and a significant reduction in response to antibodies generated during previous infection or vaccination and diagnostic failure [9].

In India, COVISHIELD and COVAXIN vaccines are being administered on a mass scale since January 2021. Now, Sputnik V is also available in India for vaccination. Very few studies are available which could show post-vaccination efficacy and none in India. In this study, an attempt has been made to ascertain post-vaccination positivity and symptoms of COVID-19 among HCWs of our tertiary care center.

METHODS

Settings and study population

At our tertiary care hospital, a total of 1685 HCWs were vaccinated from January 16, 2021, to March 18, 2021. HCWs with reverse transcription-polymerase chain reaction (RT-PCR) confirmed SARS-CoV-2 infection and willingness to give informed written consent to participate in the study were recruited. This study was conducted to assess the status of infection of SARS-CoV-2 among HCWs after vaccination. We conducted a cross-sectional study based on the health-care population at our tertiary care hospital.

Inclusion criteria

All categories of HCWs staff working in the hospitals. HCWs who have already been vaccinated against COVID-19 as part of the routine COVID-19 vaccine rollout and tested positive for SARS-CoV-2 infection were included, as long as the information can be collected about the date and type of the vaccine that was administered.

Exclusion criteria

HCWs who were not vaccinated against COVID-19 and tested positive for SARS-CoV-2 during the study period were not eligible to participate in the study.

Sample size and sampling technique

Considering the special situation, it was not possible to conduct a full community-based study with a representative sample. Thus, the study focused only on HCWs and a sampling technique of convenience was adopted to obtain the desired information for the study.

Data collection

Data were collected using a structured peer-reviewed questionnaire. The questionnaire was put together or drawn up in English and Hindi language. It was pre-tested among a cross-section of participants to ensure the clarity of questions and to eliminate any ambiguity.

The questionnaire included sociodemographic characteristics such as age, gender, profession, and residence. Name information was excluded to maintain anonymity. Questionnaires related to vaccination were the name of the vaccine, gap between vaccination and COVID-19 positivity, symptoms of COVID-19 post-vaccination, isolation status, duration of hospital stay, previous history of COVID-19 positivity before vaccination, and time to recovery after 1st day of experiencing the symptoms.

Statistical analysis

The categorical variables were described as numbers (%) and 95% confidence intervals. The continuous variables were presented using means. All statistical analyses were performed using SPSS.26 version; $p<0.05$ (two-tailed) was considered statistically significant.

Ethical statement

Institutional ethics committee approved this study. Letter no. ASMC/ETHICS/003, dated: April 07, 2022.

RESULTS

COVID-19 in HCWs is a major concern for health-care authorities worldwide. HCWs, especially COVID-19 care facility personnel, are at high risk for contracting SARS-CoV-2 infection and might become infected at home or while caring for patients or interacting with other staff members.

A total of 1685 HCWs were vaccinated with the COVISHIELD vaccine from January 16 to March 18, 2021. Out of 1685 HCWs, 82 (4.8%) were tested positive by RT-PCR after vaccination. Among 82 respondents, 60 were males and 22 were females. Out of 82 respondents, 38 belonged to the 17–25 years age group, 39 were from the 26 to 45 year age group and 5 were more than 45 years of age. Among respondents, 26 were medical students, 6 residents, 5 faculties, 9 nurses, 16 lab technicians, 10 lab attendants and 10 were non-medical office staff of our institution.

Among all mild, moderate, and severe categorizations, fever was the most common symptom in 76 (93%), followed by body ache 62 (76%), cough and cold 43 (52%), and 32 (39%) headache. Other less common symptoms were weakness 18 (22%), diarrhea 14 (17%), breathing difficulty 13 (16%), sore throat 6 (7%), and 6 (7%) were asymptomatic. Other uncommon symptoms observed were loss of taste and smell. Those 3 (3.7%) patients who required hospitalization presented with dyspnea and SpO_2 <90% (Fig. 1). Only 2 (2%) respondents gave COVID-19-positive history before vaccination and both experienced mild symptoms of fever and body ache or headache.

In this study, 77% HCWs recovered from COVID-19 within 2 weeks. Time to recovery of all these positive HCWs was <7 days in 26%, 7–10 days in 35%, 16% took 11–14 days to recover, and 23% recovered in more than 14 days (Table 1 and Fig. 2).

All 82 respondents were vaccinated with COVISHIELD vaccine. Among respondents, 16 received only one dose of vaccine before being tested COVID-19 positive, 9 received both doses but they contracted COVID-19 within 14 days of the second dose, 57 got COVID-19 after more than 14 days of the second dose. Patients were classified with mild, moderate, and severe symptoms as per the WHO COVID-19 guidelines [10]. Out of total 82 participants, 69 (84.1%) respondents had only mild symptoms or asymptomatic, 10 (12.2%) had moderate symptoms, and 3 (3.7%) had severe symptoms who required hospitalization that ranged from 4 to 15 days. Among these 3 participants, 1 had only one dose of vaccine, and 2 were infected after 14 days of receiving the second dose (Table 2).

DISCUSSION

Infections among HCWs have an immediate effect on their close occupational environment and the overall health-care system. Secondary exposures, isolation, and infections of staff can substantially

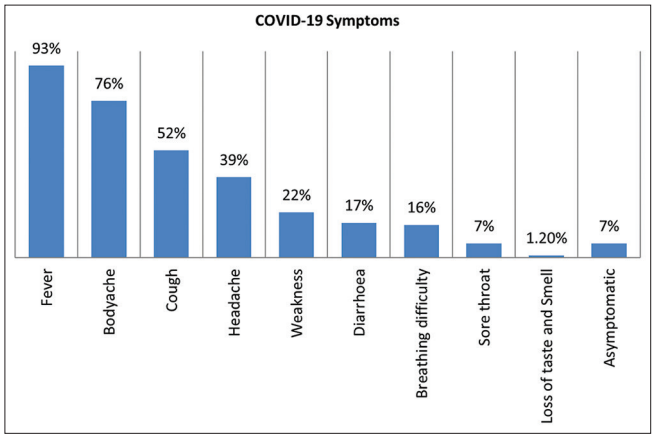

Fig. 1: Spectrum of symptoms in post-vaccination severe acute respiratory syndrome-coronavirus 2 positive health-care workers

Table 1: Demographic characteristics of vaccinated health-care workers with reverse transcription-polymerase chain reaction confirmed severe acute respiratory syndrome-coronavirus 2 infection and relation with COVID-19 symptoms and time to recovery

Patient characteristics	Mild/No symptoms n (%)	Moderate symptoms n (%)	Severe symptoms n (%)	p-value	Chi-square value	Time to recovery n (%)					
						<7 days	7–10 days	11–14 days	>14 days	p- value	Chi-square
Gender											
Male (n=60)	53 (64.6)	5 (6.1)	2 (2.4)	0.228	2.960	18 (21.9)	23 (28)	9 (10.9)	10 (12.1)	0.093	6.426
Female (n=22)	16 (19.5)	5 (6.1)	1 (1.2)			3 (3.7)	6 (7.3)	4 (4.9)	9 (10.9)		
Age group											
17–25 (n=38)	32 (39)	5 (6.1)	1 (1.2)	0.589	2.819	16 (19.5)	13 (15.8)	4 (4.9)	5 (6.1)	0.019*	15.191
26–45 (n=39)	34 (41.5)	4 (4.9)	1 (1.2)			5 (6.1)	15 (18.2)	8 (9.7)	11 (13.4)		
>45 (n=5)	3 (3.7)	1 (1.2)	1 (1.2)			0 (0)	1 (1.2)	1 (1.2)	3 (3.7)		
Profession											
Student (n=26)	21 (25.6)	4 (4.9)	1 (1.2)	0.007*	27.373	7 (8.5)	11 (13.4)	4 (4.9)	4 (4.9)	0.004*	37.523
Resident (n=6)	6 (7.3)	0 (0)	0 (0)			0 (0)	5 (6.1)	1 (1.2)	0 (0)		
Faculty (n=5)	2 (2.4)	2 (2.4)	1 (1.2)			0 (0)	3 (3.7)	1 (1.2)	1 (1.2)		
Nursing staff (n=9)	4 (4.9)	4 (4.9)	1 (1.2)			1 (1.2)	1 (1.2)	2 (2.4)	5 (6.1)		
Technician (n=16)	16 (19.5)	0 (0)	0 (0)			9 (11)	3 (3.7)	2 (2.4)	2 (2.4)		
Technical assistant (n=10)	10 (12.2)	0 (0)	0 (0)			4 (4.9)	3 (3.7)	2 (2.4)	1 (1.2)		
Non-medical staff (n=10)	10 (12.2)	0 (0)	0 (0)			0 (0)	3 (3.7)	1 (1.2)	6 (7.3)		

*p-value statistically significant at <0.05

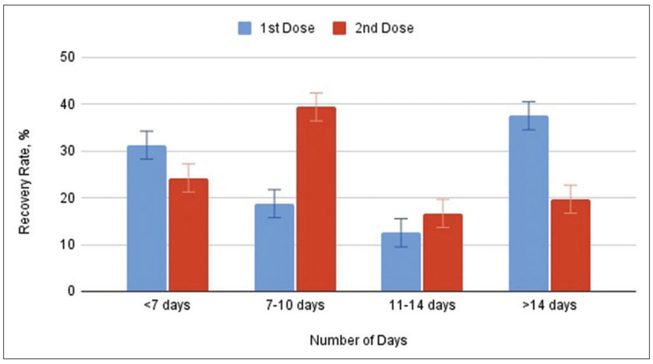

Fig. 2: Time to recovery of vaccine against severe acute respiratory syndrome-coronavirus 2 infection

impair the capacity of a single ward to care for patients, creating a snowball effect with collateral damage to both the functional resilience of the facility and the morale of staff. The COVID-19 pandemic when caused the large numbers of death toll all around the world, the scientific community started research in finding the answers in therapeutics and vaccine. In a very short span of time, many vaccine candidates were evaluated for their protective ability against COVID-19. Many countries expedited the EUA to build a safety net for the public and HCWs. FDA granted EUA) to mRNA-1273 vaccine (Moderna) and BNT162b2 vaccine (BioNTech/Pfizer) while many were in pipeline at various stages of safety and efficacy trials. As soon as authorization was granted for emergency use by the WHO and USFDA, vaccination was started in many countries including India based on available resources. The vaccinated population was tracked in many countries for safety against COVID-19 and after vaccination, few recipients were tested positive in the US in a prospective study [8]. It was thus noted that even after vaccination few people could get SARS-CoV-2 infection, although it was mild and less virulent in our study.

In the CDC weekly report of April 2021, 0.04–0.32/1000 population post-vaccination positivity was observed, although it was much lesser than among unvaccinated individuals (1.38/1000). In our study, 4.8% post-vaccination positivity was observed, which is much higher than the CDC weekly report [11]. The difference may be due to the vaccines administered in the US (mRNA-1273 vaccine and BNT162b2 vaccine) and India (ChAdOx1_nCoV-19/COVISHIELD) or SARS-CoV-2 variant circulating in India during the second upsurge of cases but in the US, these positive cases were observed during the first upsurge. Studies have shown that SARS-CoV-2 variants are avoiding recognition by vaccine-induced immunity and have also become less susceptible to neutralizing monoclonal antibodies [12].

In our study, cases of males were 3 times higher in comparison to females. The lesser positivity of females in comparison to males may be due to the ratio of male and female HCWs in our tertiary care center which is also around 3:1. Percentage of females with moderate-to-severe complications (27%) was almost double in comparison to males (12%); this is in contrast to other studies in which males were found to be 3 times more to present with complications and hospitalization but these studies evaluated non-vaccinated people only [13,14].

Among all participants, there was no significant difference noted from mild-to-severe cases among all age groups. There were no moderate or severe cases noted among technical and non-medical staff. The co-occurrence of vaccination deployment with the rapidly climbing COVID-19 spread in many parts of the world is a confusing period in which hope is mixed with great vulnerability. The phenomenon of pandemic fatigue, in which the population tires of constant safety precautions, testing, isolation, and restrictions, could lead to less social distancing and personal protection. Pandemic fatigue coupled with the availability of a vaccine, might give the population a false

Table 2: Patient characteristics on the basis of vaccination status at the time of SARS-CoV-2 infection

Patient characteristics	Vaccination status at the time of SARS-CoV-2 infection			Chi-square value	p-value
	Partial (one dose); n (%)	Complete (2 doses), COVID-19-positive within 14 days 2nd dose; n (%)	Complete (2 doses), COVID-19-positive after 14 days of 2nd dose; n (%)		
Symptoms				0.954	0.917
Mild/No symptoms	13 (15.8)	8 (9.7)	48 (58.5)		
Moderate	2 (2.4)	1 (1.2)	7 (8.5)		
Severe	1 (1.2)	0 (0)	2 (2.4)		
Time to recovery				5.722	0.455
<7 days	5 (6.1)	2 (2.4)	14 (17)		
7–10 days	3 (3.7)	3 (3.7)	23 (28)		
11–14 days	2 (2.4)	3 (3.7)	8 (9.7)		
>14 days	6 (7.3)	1 (1.2)	12 (14.6)		

SARS-CoV-2: Severe acute respiratory syndrome-coronavirus 2

sense of reassurance, and consequently, lead to a brisk increase in COVID-19 cases. As there are also asymptomatic COVID-19 cases among vaccinated HCWs, undetected COVID-19 cases could be hazardous for patients and co-workers.

If we look at the data of vaccination status, it is observed that there is no relative difference between HCWs who received single dose or both doses before getting infected. Among HCWs who got infected after 14 days of the second dose, two cases presented with severe symptoms and required hospitalization.

These data underscore the critical importance of continued public health mitigation measures (masking, physical distancing, daily symptom screening, and regular testing), even in environments with a high percentage of vaccination, until herd immunity is reached at large.

Finally, during the course of the study, it was felt that serology should be collected periodically from participants. At a minimum serology should be tested for antibodies to SARS-CoV-2 by tests that can distinguish between vaccine-induced antibodies and antibodies that result from natural infection.

Limitations of the study

The vaccinated HCWs were not followed prospectively after vaccination for COVID-19, therefore, few asymptomatic COVID-19-positive cases may have been missed. The data gathered is of limited participants, therefore, any comment of post-vaccination positivity rate or vaccine efficacy cannot be made.

In addition, if resources allow, vaccine-induced specific antisera can undergo additional laboratory testing for correlates of disease protection, and additional blood can also be collected and tested for markers of cell-mediated immunity. This will help in establishing the causes of the COVID-19 infection in the vaccinated HCWs.

CONCLUSION

The protection by COVISHIELD vaccine may not be absolute against SARS-CoV-2 infection but the symptoms among the majority of HCWs were mild grade and the recovery rate was fast among vaccinated HCWs. Post-vaccination COVID-19-positive cases may present with mild symptoms to severe manifestations leading to hospitalization.

AUTHORS CONTRIBUTION

Dr. Vinod Maurya: Conceptualization, study design, literature search, writing-original draft preparation, data collection, final approval of manuscript, supervision. Dr. Surabhi Shukla: Data interpretation, statistical analysis, writing-original draft and editing, final approval of manuscript. Dr. Archana Bora: Literature search, manuscript preparation-editing, final approval of manuscript. Dr. Laxmi Rathore: Writing original draft, data interpretation, and final approval of manuscript.

CONFLICT OF INTEREST

None to declare.

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