

A study to assess the severity and risk of COVID-19 breakthrough infection in admitted SARS-CoV-2 vaccinated individual

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ABSTRACT

Background: No vaccine is 100% effective in prevention of infection. The possibility of breakthrough infection of SARS-CoV-2 also cannot be ruled out. So, our study aimed to find out severity and risk of breakthrough infection and find association between epidemiological factors associated with it. **Methodology:** A retrospective cross-sectional study was conducted on 148 admitted SARS-CoV-2 vaccinated individual from May 2021 to January 2022 by universal sampling method. A data was collected in the form of socio-demographic, Covid vaccine, clinical details, and outcome of admitted patients. An appropriate statistical test was applied. **Results:** Out of the total 148 vaccinated individuals, 66 (44.59%) belongs to 30–59 years of age group and maximum, i.e. 95 (64.19%) were males. 64.86% patients were vaccinated with both doses and 98 (66.26%) individuals were mild cases. Only 8 (5.40%) cases were re-infected with Covid-19 infection. 70.27% individual were comorbid. Out of 148 vaccinated individuals, only 11 (7.43%) individuals were died and among those 7 (63.636%) were comorbid. **Conclusion:** Despite being vaccinated, small percentage of people are still getting infected, requires hospitalization, and die because of COVID-19. As far as pandemic continues, continuous genome sequencing and tracking of SARS-CoV-2 is essential and strategies regarding vaccination should be adjusted accordingly.

Keywords: Breakthrough infection, effective, epidemiological factors, pandemic, SARS-CoV-2, tracking

Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is the causative virus for the Coronavirus disease 2019 (COVID-19) ongoing pandemic.^[1] The pandemic has devastated the world in terms of health, economy, business, science, tourism, and many other life branches.^[2,3]

To reduce the transmissibility of the disease, most of the countries followed non-pharmaceutical interventions (NPIs)

like enforcing masks policy, hands sanitization, social distancing, travel restrictions, school's closures, and partial or complete lockdown.^[4] NPIs were able to slow down the progression of the disease.

Vaccines are one of the most reliable and cost-effective public health interventions ever implemented that are saving millions of lives each year.^[5-7] There is no such vaccine which provides 100% protection against any infection, and COVID-19 is also not an exception. Vaccines are generally to prevent severe forms of infection.

However, there are several factors affecting vaccines' effectiveness. The increased duration postvaccination had waned vaccine efficacy as well.^[8-10] Other risk factors such as age, gender,

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occupation, prior COVID-19 infections, COVID-19 variants, vaccine types, and co-existing diseases may decrease vaccine effectiveness.^[11-15]

Although vaccinations provide protection, they do not offer 100% immunity. While they are likely to reduce transmission of the virus to others, but the extent remains uncertain. Some vaccinated individuals will still become infected with SARS-CoV-2. Above risk factors, separately or together, could result in vaccine breakthrough (BT) infection. Vaccine breakthrough infection happens when a fully vaccinated individual gets COVID-19 infection.^[8]

Therefore, it is necessary to understand or identify who is at greater risk of infection and to understand the frequency of severe COVID-19 outcomes. So, the study was planned to estimate the frequency of COVID-19 admissions to hospital after receiving the first vaccine dose and to characterize the individuals in terms of demography, clinical considerations, and outcome.

Materials and Method

A retrospective cross-sectional study was conducted on admitted SARS-CoV-2 vaccinated individual. RTPCR and antigen test reports were considered to report COVID-19 status of an individual. A total of 148 COVID-19 vaccinated individual from a period of May 2021 to January 2022, admitted in COVID-19 ward of Government Medical College and hospital, Chandrapur was included in study by universal sampling method.

Over the study period, the vaccination strategy targeted more than 18 years of age population. Therefore, we included only adults. Similarly, study included only those adults who had received COVID-19 vaccine 14-days prior to admission to fulfill antibody protection criteria. Study included both doses, i.e. 1st dose and 2nd dose status of study participants. First dose gives partial protection from infection, while 2nd dose gives full protection from COVID-19 infection.

A data was collected in the form of age, sex, type of vaccine, dose of vaccine, grade of patient at the time of admission and comorbidity status of study subjects. Outcome of patient was evaluated in terms of discharge and death. Data was tabulated in MS Excel, and analysis was done by epi info. Appropriate statistical test was applied wherever possible. Permission from Institutional Ethics Committee was taken prior to study.

Results

Out of the total 148 vaccinated individuals, 66 (44.59%) and 50 (33.78%) patients belong to 30–59 years and >60 years age group, respectively. Maximum 95 (64.19%) were males. Age and sex wise association in vaccinated individuals was found to be statistically insignificant (P value = 0.1213) [Table 1].

Among all vaccinated individuals, 96 (64.86%) patients were vaccinated with both doses. Maximum of 70 (47.30%) patients

Table 1: Age and sex association in vaccinated individuals

Age (in years)	Male	Female	Total	Test of significance
<29 years	16 (16.84)	16 (30.19)	32 (21.62)	$\chi^2=4.22$, d.f.=2, $P=0.1213$
30-59 years	47 (49.47)	19 (35.85)	66 (44.59)	
>60 years	32 (33.68)	18 (33.96)	50 (33.78)	
Total	95 (100)	53 (100)	148 (100)	

*No in parenthesis represents percentage

were vaccinated with both doses of Covishield. In view of grade of severity of infection in admitted vaccinated individual, maximum, i.e. 98 (66.26%) individuals were mild cases, whereas 50 (33.78%) were moderate–severe cases which was found statistically significant (P value = 0.033) [Table 2].

Figure 1 demonstrates that comorbidity is present in maximum, i.e. 104 (70.27%) vaccinated individual.

Table 3 shows that only 8 (5.40%) cases were re-infected with COVID-19 infection. Out of 8 re-infected cases, maximum re-infection was seen with Covishield vaccine (first and both doses), i.e. 7 (87.5%). This could be because of maximum individual had chosen to take Covishield vaccine.

Table 4 shows that out of 148 vaccinated individuals, 11 (7.43%) individuals were died. Out of 11, 6 (54.55%) and 5 (45.45%) patients were severe and moderate cases, respectively. 10 (90.91%) patients had taken Covishield vaccine (5 had taken first dose and 5 had taken both doses). Out of the total 11 vaccinated death patients, 7 had comorbidity, whereas 4 were not comorbid.

Discussion

Out of the total 148 vaccinated individuals, maximum, i.e. 44.59% patients belong to 30–59 years and nearly 2/3rd (64.19%) were males. 2/3rd patients (64.86%) were vaccinated with both doses of COVID-19 vaccine and maximum, i.e. 2/3rd (66.26%) patients were mild by symptoms and not required oxygen supplementation. Out of the total vaccinated individuals, maximum of 94.59% were infected for the first time and only 5.40% were re-infected suggesting low rate of re-infection after vaccination. Mortality in vaccinated individual is also low, and more than 50% had comorbidity suggesting comorbidity is a risk factor for death of COVID-19.

Irit Nachtigall *et al.*^[16] conducted a study to assess the impact of gender and age on reactogenicity to three COVID-19 vaccine products in which they found that 74.1% were females and 25.9% were males. In 18–30 years of age group, 14% were females and 11.1% were males. In 31–40 years of age group, 21.4% were females and 23.5% were males. In 41–50 years of age group, 24.4% were females and 25.7% were males. In 51–60 years of age group, 31.1% were females and 28.4% were males. In more than 60 years of age group, 7.2% were females and 8.7% were males. Chandra M. S, *et al.*^[17] conducted a study in Patna in which total of 274 fully vaccinated beneficiaries [10.1% (95% CI: 9.1%, 11.4%)] were diagnosed with breakthrough COVID-19

Table 2: Grade of severity in vaccinated individual

Vaccine Type	Mild	Mod-Severe	Total	Test of significance
Covishield 1 st dose	24 (24.49)	18 (36)	42 (28.38)	$\alpha=8.726$, d.f.=3, $P=0.03316$
Covaxin 1 st dose	9 (9.18)	1 (2)	10 (6.76)	
Covishield both doses	43 (43.88)	27 (54)	70 (47.30)	
Covaccine both doses	22 (22.45)	4 (8)	26 (17.57)	
Total	98 (100)	50 (100)	148 (100)	

*No in parenthesis represents percentage

Table 3: Type of infection in vaccinated individual

Vaccine Type	New infection	Re-infection	Total
Covishield 1 st dose	40 (28.57)	2 (25)	42 (28.38)
Covaxin 1 st dose	10 (7.14)	0 (0)	10 (6.76)
Covishield both doses	65 (46.43)	5 (62.5)	70 (47.30)
Covaxin both doses	25 (17.86)	1 (12.5)	26 (17.57)
Total	140 (100)	8 (100)	148 (100)

*No in parenthesis represents percentage

Table 4: Death in vaccinated individuals

Vaccine Type	Moderate	Sever	Total
Covishield	5 (100)	5 (83.33)	10 (90.91)
Covaxin	0 (0)	1 (16.67)	1 (9.09)
Total	5 (100)	6 (100)	11 (100)

*No in parenthesis represents percentage

infection. The infections were more among males (10.4%) and the individuals aged ≤ 29 years (12.5%). This study finding is consistent with our study results.

V.K.M. Niyas *et al.*^[18] conducted a study which shows that the breakthrough COVID-19 infections occurring after vaccination with two doses of ChAdOx1 nCoV-19 vaccine were mild in most of the healthcare worker (HCW). 7 (6.4%) patients were asymptomatic and 6 (55%) required hospital admission for mild to moderate symptom. No one required supplemental oxygen during hospitalization. Kanika Tyagi *et al.*^[19] conducted a study in New Delhi in which they reported mild symptomatic breakthrough infections as seen in their health care facility.

Kanika Tyagi *et al.*^[19] conducted a study in New Delhi in which they found that out of 123 employees, 113 were vaccinated (Covaxin, 28, Covishield, 85). Second dose was completed in 107 (94.7%) and first dose in 6 persons (5.3%). Sachin Dhumal *et al.*^[20] carried out a study in which a total of 1806 individuals with median age of 32 (18-64) years, 1483 (82.1%) with at least one vaccine dose, 1085 (60.1%) with 2 vaccine doses, 408 (22.6%) with at least one episode of SARS-CoV-2 infection, and 6 (1.47%) with 2 episodes of infection were included in the analysis.

Chandra M. S, *et al.*^[17] conducted a study in Patna in which the majority of the individuals with breakthrough infections were asymptomatic, and no death was reported among them. According to CDC, out of the total BCVs reported till April 2021, 27% were asymptomatic, 10% required hospitalization, and 2% died.^[21]

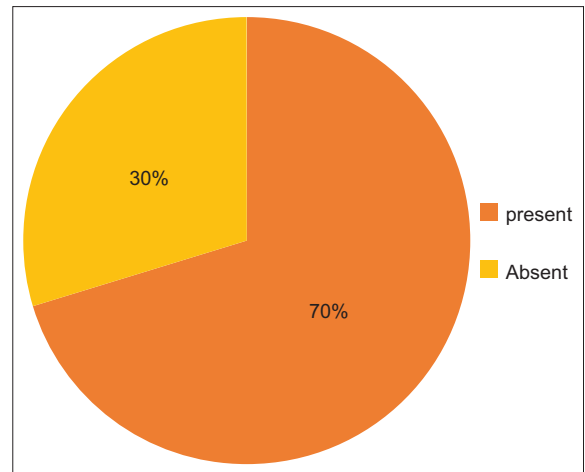


Figure 1: Comorbidity status in study subjects

Francois Watkins LK *et al.*^[22] in their study found that out of 8084 fully vaccinated persons with reported COVID-19 during the surveillance period, 245 (3.0%) died.

Manoj Verma *et al.*^[23] conducted a study in which diabetes was the most common comorbidity found in 17.1% of the deaths, followed by hypertension. Cardiovascular disease and renal disease were other common comorbidities seen in 8.7% and 4.83% deaths, respectively.

The prevalence of severe or critical cases in vaccinated COVID-19 patients occurs in 10.8%.^[24]

According to the results obtained from the present study, family physician can prescribe and increase awareness about COVID-19 vaccine for the people in society, especially comorbid individuals. Vaccination for elderly and comorbid individual can be a step to reduce burden on primary healthcare system.

Breakthrough infections are matter of concern after adequate vaccinations, but data regarding these infections are not available in real-world setting. Vaccination decreases the risk of getting COVID-19 infection by 70–90% and also shields from severe infection. It is possible, therefore, some people who are fully vaccinated against COVID-19 can get COVID-19 infection.

Conclusion

Despite being vaccinated, small percentage of people are still getting infected, require hospitalization, and die because of COVID-19. As far as pandemic continues, continuous genome sequencing and tracking of SARS-CoV-2 is essential and strategies regarding vaccination should be adjusted accordingly.

Key messages

Though some people can get COVID-19 infection after fully vaccinated but COVID-19 vaccination shield individuals from severe infection.

So the managers of the primary healthcare system can consider this in the planning of the health care system and emphasize this issue.

As the family physicians are the first point of contact with community, they can consider this issue and increase awareness for COVID-19 vaccination especially in case of elderly and comorbid individual.

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Conflicts of interest

There are no conflicts of interest.

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