

ORIGINAL RESEARCH ARTICLE

PROFILE OF BREAKTHROUGH INFECTION OF COVID-19 IN A TERTIARY CARE HOSPITAL: A DESCRIPTIVE CROSS-SECTIONAL STUDY

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ABSTRACT

Background: While reports of vaccine induced immunity against COVID-19 have been around, frequency of breakthrough infections is also being reported. The study aimed to analyze breakthrough infections after a complete dose of COVID-19 vaccination.

Methods: Individual who was fully vaccinated with COVID-19 were included in this study. Nasopharyngeal and Oropharyngeal swab was collected and transported to the laboratory as soon as possible for the diagnosis of COVID-19. The specimens were transported in a viral transport medium maintaining cold chain of 2-8°C. Statistical Package for the Social Sciences (SPSS) version 20 was used for data entry and analysis.

Results: Of 8350 samples received 5494 (65.79%) were vaccinated and 2856 (34.20%) were not vaccinated. Among fully vaccinated individuals, 694 (12.63%) are post vaccination COVID-19 cases. Among the post vaccinated COVID-19 cases 264(14.15%), 95(12.70%), 44(3.19%), 28 (1.86%) breakthrough infections are seen among individuals who received Sinopharm, Oxford-Astrazeneca, Johnson and Johnson, other vaccines Pfizer, Moderna, Sputnik V respectively which were tested positive for SARS-CoV-2 RNA on reverse transcriptase polymerase chain reaction.

Conclusions: Laboratory-confirmed COVID-19 cases among vaccinated individuals after complete dose of vaccination indicates that there is still risk of COVID-19. Therefore, regular COVID-19 testing should be conducted even after vaccination.



INTRODUCTION

COVID-19 pandemic has caused high rate of morbidity and mortality, although movement restrictions, stay at home, social distancing measures were implemented in many countries.^{1,2} After large global population were susceptible to COVID-19, there was a highlight on need for an effective vaccine.³

Due to increasing burden of active cases of COVID-19, vaccine development has taken focusing on the pandemic.⁴ Vaccines that was approved by government of Nepal and deployed were Oxford-AstraZeneca, Johnson and Johnson (Janssen) and Sinopharm (Verocell).⁵ The first COVID-19 vaccines that Nepal began to administer was Oxford-AstraZeneca vaccine on 27th January 2021. Oxford-AstraZeneca is the vaccine manufactured by serum institute of India, requires two doses of 0.5ml given intramuscular (IM), and second dose is administered 4 to 6 weeks (up to 12 weeks) after first dose.⁶ Efficacy of Sinopharm vaccine was found to be 50% and is compatible with World health organization (WHO) requirements along with all safety requirement of a vaccine.^{7,8} On February 17, 2021,

Department of Drug Administration (DDA) ministry of health and population, the government of Nepal, approved the use of Sinopharm (Vero Cell) COVID 19 vaccine.⁹ Vaccine is given in 2 doses (0.5ml) intramuscularly. WHO has recommended an interval of 3-4 weeks between first and second dose.⁷ The third COVID 19 vaccine approved for public use in Nepal is Johnson and Johnson (Janssen) COVID-19 vaccine, which is a single shot vaccine and was started given to public on July, 2021.¹⁰

The aim of the study was to analyze breakthrough infections after a complete dose of COVID-19 vaccination.

METHODS

A descriptive cross-sectional study was conducted on September 10, 2021 to October 30, 2021. Ethical approval was taken from institutional review committee board of Kathmandu Medical College and Teaching Hospital (Ref no:0609202108). A detailed vaccine history was collected from the patients. Individual who was fully vaccinated with COVID-19 were included in this study. COVID-19 breakthrough infections were examined in fully vaccinated individuals. Nasopharyngeal and Oropharyngeal

swab were collected and were transported to the laboratory as soon as possible for the diagnosis of COVID-19. The specimens were transported in a viral transport medium maintaining cold chain of 2-8°C. Convenient sampling was done. Repeated thawing and freezing of specimens were avoided.¹¹

At present confirmation of cases of COVID-19 is based on the detection of viral RNA by nucleic acid amplification tests (NAAT) such as real-time reverse transcriptase polymerase chain reactions (RT-PCR). The viral genes targeted include the E, N and ORF according to SARS-CoV, GenBank NC_004718 (WHO 2020f).¹¹ Statistical Package for the Social Sciences (SPSS) version 20 was used for data entry and analysis. The results were presented in table and figure form.

RESULTS

Over the study of one and half month, out of total 8350 samples, 5494 (65.79%) were vaccinated and 2856 (34.20%) were non-vaccinated.

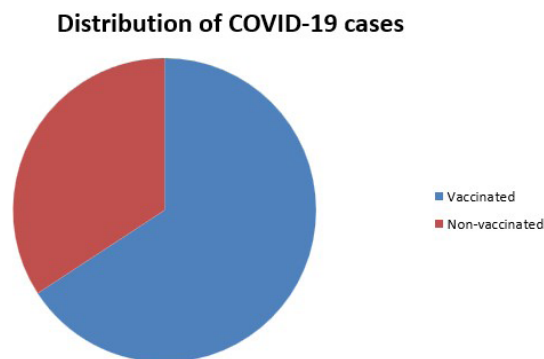


Figure 1: Distribution of COVID-19 cases among vaccinated and non-vaccinated individuals

In our study of total 5494 fully vaccinated individuals 694 (12.63%) got breakthrough infection.

Table 1: Breakthrough infection in COVID-19

Total vaccinated cases of COVID-19	Positive vaccinated cases of COVID-19
5494	694

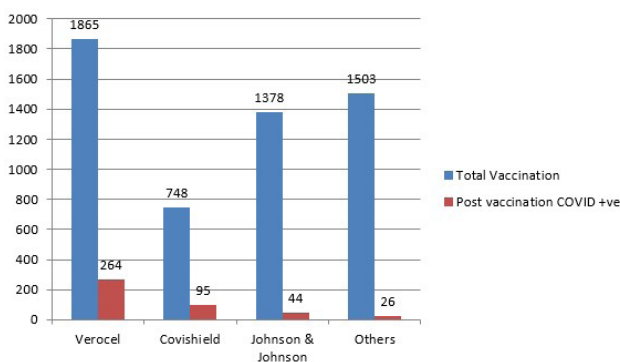


Figure 2: Vaccine received before getting COVID-19

As per the data, most of the population were fully vaccinated with Sinopharm Vaccine865 (33.94%) in which breakthrough infection was seen in 264 (14.15%). In case of Oxford-Astrazeneca vaccine administered in 748 (13.61%), breakthrough infection was seen in 95 (12.70%). In case of Johnson and Johnson administered in 1378 (25.08%), infection was seen in 44 (3.19%). Other vaccines like Pfizer, Moderna and Sputnik V as been administered among 1503 individuals and breakthrough infection was seen in 28 (1.86%).

DISCUSSION

Safe and effective vaccines change the current scenario created by COVID-19, but for future we must continue wearing mask, using sanitizer, maintaining physical distances and avoiding crowds. As all the vaccine does not show 100% effectiveness at limiting the transmission of the infection, there is a small risk of some fully vaccinated individuals getting COVID-19 infection which is known as breakthrough infection and it is entirely expected. A clear understanding of COVID-19, incidence of breakthrough infection after vaccination and role of various variant after genetic mutation are the major factors to screen for the prevention and control of ongoing pandemic. Similarly, the course of COVID-19 and durability of immunity is of more concern in this ongoing pandemic.¹²⁻¹⁶

Total number of cases reported within this period were 8350 in which 5494 (65.79%) were vaccinated and 2856 (34.20%) were non-vaccinated. When COVID-19 pandemic is far from being over, vaccine offers a lifesaving protection against the disease. As the data mentioned till 28th November, 2021 a total of 18,317,508 vaccine doses has been administered¹⁷ which conclude that more than 60% of the population in Nepal were vaccinated. Vaccine were administered following groups sequentially among health care workers, adults with comorbidities, for individuals of 65 years and above and then to individuals aged 18-64 years. In our study the post vaccinated breakthrough COVID 19 cases identified were 694 (12.63%) which is similar with one study done on Unites states which shows vaccine’s substantial impact on COVID-19 pandemic,¹⁸and this could be due to new variant. In our study,1865 were vaccinated with Sinopharm, 748 with Oxford- Astrazeneca,378 with Johnson and Johnson, 1503 with other vaccines like Pfizer, Moderna and Sputnik V. Similarly, 2856 (34.20%) were found to be non-vaccinated. Our Country was donated with vaccines like Oxford-AstraZeneca, Sinopharm and Johnson and Johnson. According to data of 16th August 2021, Covishield first dose 1875476 and second dose 866375, Sinopharm first dose 2841460 and second dose 1336325, Johnson and Johnson single dose of 1287365 has been administered among the population.¹⁹ In this study, 264(14.15%), 95(12.70%), 44(3.19%), 28 (1.86%) breakthrough infections are seen among individuals who received Sinopharm, Oxford-AstraZeneca, Johnson and Johnson, other vaccines Pfizer, Moderna, Sputnik V respectively. Out of total positive cases, 263 (9.20%) were non-vaccinated.

COVID-19 vaccines can protect the majority of people from hospitalization and deaths. Experts agree that COVID-19 will

remain as endemic, and it pose less a danger overtime. When majority of population will be either infected or vaccinated, herd immunity will kick in. Importantly COVID-19 vaccines can and do protect majority of people from hospitalization and deaths. Soon many doses need to be administered around the world.

This study has few limitations. This is a single centered study with small size of breakthrough infection in COVID-19 cases. We were unable to locate the severity of the disease. Also, we were unable to perform viral culture and genetic sequencing.

CONCLUSION

Since, COVID-19 infection is at the peak active and

passive surveillance and laboratory testing is required to identify COVID-19 cases and prevent secondary SARS-CoV-2 transmission. We aimed to find out the vaccine and breakthrough infection of COVID-19.

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CONFLICT OF INTEREST: None

FINANCIAL DISCLOSURE: None

REFERENCES:

1. Hien L, Veria K, Piotr K, Agata M, Justyna S, Jacek B et al. The positive impact of lockdown in Wuhan on containing the COVID-19 outbreak in China. *J Travel Med.* 2020;27(3). [\[PMID\]](#)
2. Flaxman S, Mishra S, Gandy A, et al. Estimating the effects of non-pharmaceutical interventions on COVID-19 in Europe. *Nature.* 2020;584:257–61. [\[LINK\]](#)
3. Seyed MM, Thomas NV, Kevin Z, Chad RW, Affan S, Burton HS et al. The impact of vaccination on COVID-19 outbreaks in the United States. *BMJ.* 2021,January 02. [\[PMID\]](#)
4. Thanh Le T, Andreadakis Z, Kumar A. The COVID-19 vaccine development landscape. *Nat Rev Drug Discov.*2020;19:305–6. [\[LINK\]](#)
5. Geddes L. COVID-19 vaccines: everything you need to know. *Gavi.* 12 August 2021. [\[LINK\]](#)
6. Shrestha S, Devbhandari RP, Shrestha A, Aryal S, Rajbhandari P, Shakya B et al. Adverse events following the first dose of ChAdOx1 nCoV-19 (COVISHIELD) vaccine from in the first phase of vaccine roll out in Nepal. *JPAHS.* 2021Apr;8(1):9-17. [\[DOI\]](#)
7. The Sinovac-CoronaVac COVID-19 vaccine: What you need to know. World health organization. 2 September 2021. [\[LINK\]](#)
8. COVID-19 advice for the public: Getting vaccinated. World health organization. 15 November 2021. [\[LINK\]](#)
9. Shah JN. The ‘Vero Cell’ COVID-19 vaccine rollout in Nepal: What we know about the Chinese vaccine development and access? *JPAHS.* 2021;8(1):1–8. [\[LINK\]](#)
10. The Janssen Ad26.COVID-19 vaccine: What you need to know. World health organization. 25 June 2021. [\[LINK\]](#)
11. Padhi A, Kumar S, Gupta E, Saxena SK. Laboratory Diagnosis of Novel Coronavirus Disease 2019 (COVID-19) Infection. *Coronavirus Disease 2019 (COVID-19).* 2020;95–107. [\[PMC\]](#)
12. Iwasaki A. What reinfections mean for COVID-19. *Lancet Infect Dis.* 2021 Jan 1;21(1):3–5. [\[PMC\]](#)
13. Vora T, Vora P, Vora F, Sharma K, Desai HD. Symptomatic reinfection with COVID-19: A first from Western India. *J Fam Med Prim Care.* 2021 Mar 1;10(3):1496-8. [\[PMID\]](#)
14. Duong D. What’s important to know about the new COVID-19 variants? *CMAJ.* 2021 Jan 25;193(4):E141–2. [\[LINK\]](#)
15. Parry J. Covid-19: Hong Kong scientists report first confirmed case of reinfection. *BMJ.* 2020 Aug 26;370:m3340. [\[LINK\]](#)
16. Durability of Responses after SARS-CoV-2 mRNA-1273 Vaccination. *NEJM.* 2021 May 21. [\[DOI\]](#)
17. Responding to COVID-19. *Gavi.* 2020. [\[LINK\]](#)
18. Moghadas SM, Vilches TN, Zhang K, Wells CR, Shoukat A et al. *Clin Infect Dis.* 2021;73(12):2257-64. [\[LINK\]](#)
19. Situation Update #70 - Coronavirus Disease 2019 (COVID-19) WHO Country Office for Nepal Reporting Date: 10 - 16 August 2021. [\[LINK\]](#)