COVID-19 in India: Breakthrough Infections in Delta Wave

Zameer Shervani, Roma Nikhat, Sadia Hasan, Umair Yaqub Qazi, Kehkeshan Fatma, Arif Siddiquie, Venkata Phani Sai Reddy Vuyyuru, Nudrat Jamal, Aiman Ibbrahim, Samar Siddiqui, Adil Ahmed Khan, Parangimalai Diwakar Madan Kumar, Manseej Purang, and Ankira Agarwal

ABSTRACT

The breakthrough infections (BTI) during the Delta wave in the general population have been investigated. The BTI reported in the city of Gurugram (Haryana, India) in the month of August, September, and October 2021 were studied. The monthly BTI in August, September, and October 2021 were 26%, 41%, and 76%, which caused an increase in the monthly caseload to 167, 150, and 206 cases, respectively. Mostly, the patients who had comorbidities developed BTI. However, the BTI reported in the Delta wave did not cause a surge in new cases. The surge was noticed only after the emergence of the Omicron variant of the SARS-CoV-2 virus. In Gurugram, 78.3% sero prevalence recorded in September 2021 was due to vaccination and higher infection rate of 59,921 monthly cases reported in April 2021.

Keywords: Delta variant, Omicron pathogenicity, Omicron prevalence and transmissibility, Omicron variant, SARS-CoV-2 mutation.

I. INTRODUCTION

The COVID-19 pandemic has become a medical challenge that humanity has never faced before. The world has witnessed a number of pandemics including the Spanish Flu of 1918 but the COVID-19 has been the most damaging in terms of the number of people infected and the monetary loss incurred worldwide. In the Spanish Flu, 50 million
people perished in the span of two years. In the current COVID-19 pandemic, 480 million people have fallen sick, though the number of deaths remained low at 6 million in two years of the pandemic but the worry is that there is no end in sight yet [1]. The fatalities in the COVID-19 pandemic remained low as compared to the Spanish Flu due to advances in medicine that have taken place since 1918. Till March 2022, India has reported a total of over 43 million COVID-19 cases [2], a tally second only to the US. It stands third in the death rate with more than 515,000 deaths next only to the US and Brazil. The good news is that the daily new cases currently (March 16-May 22, 2022) being reported are below the 3,000 mark, which is the lowest among the three waves. In January 2022, the country faced a third Omicron wave.

India has begun giving the coronavirus vaccine to children in the cohort of 12-14 years from March 16, 2022. More than 75% of recipients in the 15-18 age group have already received the first dose in a drive that began in January 2022. The 12-14 years age group will receive the Corbevax vaccine. Corbevax is being manufactured in India. The other vaccines available in India to use are Covaxin, Covishield, ZyCoV-D, Covovax, and Russian-developed Sputnik V. The government has also allowed the import of the Moderna vaccine. The single-dose vaccine, Sputnik Light (a component of Sputnik V) has also got government approval recently. Covishield has the major share accounting for over 90% of the doses given to adults till now. As of March 2022, India has administered more than 1.8 billion vaccine doses to its 960 million adult population since the vaccination drive began on January 16, 2021. About 94% of the eligible adult population has received at least the first shot and more than 80% of the adult population has taken both doses. Taking into account the full population, 60% have received both the doses and 71% have received at least one dose [3]. Coming to the booster shot, the inoculation of booster shot began in January 2022, since then 10 million healthcare and frontline workers and 10 million 60-plus age group individuals have received the booster dose.

Japan’s fifth novel coronavirus pandemic wave (July-September 2021) [4] arose due to the emergence of the Delta variant. The fifth wave was not as damaging since Japan has vaccinated a large population, 60% received both doses and 71% had at least one dose by September 25, 2021. Due to the strong vaccination drive, the baseline daily new infection cases after the fifth wave decreased to the lowest number below 200 cases and these were the lowest in all the previous waves. Due to vaccination the fifth wave did not prolong compared to the Omicron generated sixth wave which ended in three months. The sixth Omicron wave is still under way lingering from January 2022 and continuing till now in May 2022. The current wave (sixth wave) is more severe in terms of both the span of days it is spreading and the daily new caseload (100,952 on February 5, 2022) compared to the fifth wave (25,879; on August 20, 2021) [4]. The reason for the severe nature of the Omicron wave is Omicron being vaccine and infection generated immunity evading variant. Once the waning out of vaccine generated antibodies became evident, Japan planned the booster dose well before the fifth wave was over and Omicron induced sixth wave was yet to hit the country [5]. The minors and young children accounted for 29.6% of the total new COVID-19 infections across Japan between the period February 1-21, 2022, making up the largest age group [6]. Taking note of the large surge in Omicron infection in minors the vaccination for children aged 5 to 11 started in Japan on February 26, 2022. Around 7 to 8 million children will be covered by the vaccination drive. Pfizer’s vaccine is being given to children, two doses at three-week interval. The vaccine ingredients are one-third of the amount given to the cohort 12 years old and above. The vaccine was 90.7% effective in a clinical trial in preventing the infection after seven days of administering the second dose. The vaccine is safe and no long term major side effects were registered in the trial. The booster shots for children in cohort 12-17 years may start in April 2022 in Japan. Pfizer’s vaccine will be used for the booster dose [7].

BTI were more during the Omicron wave but in the Delta wave also BTI were recorded since vaccines do not promise 100% protection and in the patients who have comorbidities, the immunity waned out faster. Large BTI in the range of 26-76% were reported during the Delta wave [8]. Though the BTI were not severe, less than 1% of BTI patients required ICU admission or oxygen support. Deaths in these cases were rare. Severe infections and mortalities may occur if BTI individuals are very old and have comorbidities. After the Delta variant wave receded, 25% of fully vaccinated healthcare workers (HCWs) developed [9] BTI as reported in Max Hospitals in Delhi and Gurugram. It was the indication of the diminished antibodies titers produced by the hybrid immunity generated by vaccination and natural infection.

After the emergence of the Omicron variant, BA.2 a more transmissible version [10] of the Omicron variant has now become the dominant strain of COVID-19 worldwide. It is causing a surge in the new infections in many European countries (Germany and UK) and Asia (China and Japan). It may cause another surge in the US. Currently, all over the world, 86% of the genome sequenced cases are BA.2 lineage. Its transmissibility is higher than earlier reported versions (Delta and Omicron BA.1, and others). Though, it did not cause severe illness. Like BA.1 it also evades natural and vaccine-generated immunity. Protection against BA.2 also wanes out with time but protection against the virus is increased by a booster shot to prevent hospitalisation and death. Apart from the higher transmissibility and immunity evading nature, BA.2 is also slightly difficult to track thus it is called the “stealth variant”. BA.1 has a missing gene and it can be detected by a normal PCR test whereas BA.2 can be identified only by genome sequencing using an analyser which is not readily available. Some countries (UK and Germany) are experiencing a “double peak” of Omicron variant, there is a possibility of BA.2 re-infesting BA.1 infected individuals but such cases are only a few so far. Omicron re-infecting the individuals who had Delta and other infections is well known. The re-infection caused by BA.2 has yet to be established.

In this research article, the BTI that occurred among the general population in the city of Gurugram have been studied. The BTI are defined as when fully vaccinated individuals tested positive for the SARS-CoV-2 virus.
Individuals developing infection after two weeks of administering the second dose of the COVID-19 vaccine are said to have BTI.

II. METHODS

The sample size of the third sero survey of Gurgaon was 3,000 individuals. The survey was conducted by the Haryana Health Department and Community Medicine section of PGIMS (Post Graduate Institute of Medical Sciences), Rohtak in September 2021. The survey was done in 75 clusters, 45 urban and 30 rural clusters. The survey also included 1,200 children aged 6-17 years. Over 40% of the total samples were collected from urban areas and the rest were collected from rural areas. Table I was constructed from the data collected from References [11]. The IgG antibodies determination method and the sample collection detail have been given in the sero survey report prepared by the Haryana government [12], [13].

III. RESULTS AND DISCUSSION

Fig. 1 is the plots of SARS-CoV-2 antibodies prevalence (%) and monthly caseload in the city of Gurgaon. The caseload plot shows all the four waves including the Delta and Omicron variant waves appeared during the period May 2020-February 2022. The sero prevalence was recorded in the first, second, and third surveys conducted in August 2020, October 2020, and September 2021, respectively. For the third serological survey of Gurugram, 3,000 people were tested for antibodies presence and 78.3% were found to be positive. The round two survey conducted in October 2020 found that 16.5% had infection. The first round (August 2020) of survey revealed that 10.8% population was sero positive [13]-[17].

In Gurugram, the overall sero positivity in August 2020 was found to be 10.8% as shown in Table I. Sero prevalence in urban areas was more (18.5%) than in rural (5.7%) localities. Women had more (14%) sero prevalence than men (7.3%). The overall sero prevalence increased in October (round 2) to 16.5%. Out of all the urban population, 25.9% developed antibodies whereas in rural areas the sero prevalence remained low at 10.1%. The male population had slightly higher (18.7%) sero prevalence than females (15.1%). In the third round, the sero prevalence increased to 78.3%, in urban areas it was higher (80.3%) than in rural areas (77%). Women had slightly higher (78.8%) sero prevalence than the men’s population (77.8%). The age-wise sero prevalence in the children of age groups 6-9, 10-17, 6-17 years was 68.4%, 70.4%, and 69%, respectively.

As shown in Fig. 1, initially the monthly caseload in Gurugram in May 2020 was 720 new cases; it increased in June to 4,573 cases and started declining and in August decreased to 2,864 cases and again rose to 19,594 cases in November. The monthly new infections cases declined to 786 cases in February 2021. The cases surged again due to the emergence of the Delta variant. In April large number (59,921) of cases were recorded. In May there was a slight decrease in monthly cases (57,012) however, the decrease was more in June and the decreasing trend continued till September (September; 150 monthly cases). In October cases increased marginally to 206 cases. There was a large surge in the cases in the Omicron variant wave that hit the city Gurugram in January 2022 and caused a monthly surge of 65,289 cases. The cases decreased in February to 10,679 cases after the Omicron wave was over.

Fig. 1. Seroprevalence and monthly caseload of Gurugram.

Fig. 2. Monthly caseload recorded in Gurugram for the months mentioned in the Delta wave.

Fig. 2 is the bars showing the monthly caseload from July to October 2021 in Gurugram after the Delta wave. The monthly caseload of July was 210 new cases, the caseload decreased in August (167 cases) and September (150 cases),...
however, cases increased to 206 cases in October. For the detailed investigation the daily caseload of the baseline cases were plotted for the period June 21 to July 31 (Fig. 3) and August 1-October 31, 2021 (Fig. 4). The straight curve fit plot in Fig. 2 shows the decrease in the daily caseload from June 21 to July 31. Then in the period August 1-October 31, the cases started increasing again (Fig. 4).

Fig. 5 compares the monthly caseload versus the per cent of monthly BTI registered in Gurugram. The monthly BTI in August, September, and October were 26%, 41%, and 76%, which caused an increase in the monthly caseload to 167, 150, and 206 cases, respectively [8]. The month of October witnessed the highest number of cases (206) caused by the highest % of BTI in October (76%). Analysing the patients’ record suggested that BTI occurred mostly in patients with comorbid conditions. But the BTI were not enough to cause a big surge in the infections until the Omicron wave appeared in January 2022 when the number of the monthly caseload in the month of January 2022 rose to 65,289 cases then decreased in February to 10,679 monthly cases after the Omicron wave was over as shown in Fig. 1.

The increase of BTI with time suggested the waning out vaccine generated immunity. Also, suggesting the limitation of vaccines to offer 100% protection against the virus. However, vaccines offer a great degree of protection from developing serious symptoms or causing death. The BTI rarely developed into severe illness and death. Most of the infections can be treated at home. There was no need for hospitalisation but patients remained worried about “post-covid” syndrome and other related complications. Thus, it is advised to take precautions by observing the 3Cs protocols.

IV. CONCLUSIONS

The data analysis of three surveys conducted in Indian city Gurugram yielded many interesting facts. The overall sero prevalence was 10.1% recorded in August 2020 which increased to 78.3 % in September 2021. Sero prevalence in urban areas was more than in rural localities reported in all three surveys. The sero prevalence among women was slightly higher than men. The monthly BTI in August, September, and October 2021 were 26%, 41%, and 76%, which caused an increase in the monthly caseload to 167, 150, and 206 cases, respectively reported in Gurugram. The findings of BTI suggested that vaccine generated immunity is not long lasting and patients with comorbid conditions are more prone to BTI. Vaccination does not offer 100% protection from infection. It is highly recommended to observe 3Cs COVID-19 protocols. Despite the shortcoming of waning out the immunity generated by the vaccines, the vaccination, however, prevents severe illness and death.

V. STATEMENTS

The data and results in this article are reproducible. Author Zameer Shervani, Ph.D. is the Director of the Food & Energy Security Research & Product Center, Sendai, Japan. Co-authors contributed online. Authors have qualifications: Roma Nikhat MCA, MBA; Kehkeshan Fatma Ph.D.; Sadia Hasan, Ph.D.; Umair Yaqub Qazi Ph.D.;
Arif Siddiquie Ph.D.; Venkata Phani Sai Reddy Vuyyuru MBBS; Nudrat Jamal M.Sc.; Aiman Ibrahim MBBS, MD; Samar Siddiqui MBBS, DGO; Adil Ahmed Khan MBBS; Parangimalai Diwakar Madan Kumar BDS, MDS; Manseeb Purang MBBS; Ankira Agarwal MBBS.

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