European Journal of Medical and Health Sciences
www.ejmed.org

5th and 6th Sero Survey of Delhi: Vaccine Activated Antibodies Enhancement

Zameer Shervani, Deepali Bhardwaj, Roma Nikhat, Aiman Ibbrahim, Intazam Khan, Sadia Hasan, Umair Yaqub Qazi, Ankira Agarwal, Adil Ahmed Khan, and Abdullah Sherwani

ABSTRACT

The results of all six serosurveys of Delhi (India) have been analysed. The first serosurvey held in June-July 2020 found seroprevalence in 22.9% population. The second, third, and fourth survey conducted in August, September, and October registered 29.1%, 25.1%, and 25.5% seropositivity, respectively. The seroprevalence was increased to a larger extent of 56.1% in the fifth (January 2021) survey due to the accumulation of antibodies among the residents in three pandemic waves that hit the city in June, September, and November 2020. The last and the fourth bigger wave that hit the city in April 2021 caused almost all (97%) citizens to develop antibodies against the natural COVID-19 infection. The seroprevalence in women was marginally higher (90%) than in men (88%). The seroprevalence was highest (92%) among the individuals above 50 years of age followed by 18-49 years of age (90%) and 82% in below 18 years of age. The residents who were vaccinated with Covishield produced slightly higher antibodies (95%) than Covaxin (93%). In Delhi, one dose or two doses vaccination could increase seroprevalence to 95% that was the maximum which vaccination could generate. The unvaccinated population had seroprevalence of 85%. A maximum enhancement of 13% seroprevalence was recorded upon vaccination with one or two doses.

Keywords: Antibodies enhancement, COVID-19 vaccines, COVID-19 seroprevalence, Delhi serosurvey, herd immunity, SARS-CoV-2 spread.

Submitted: November 23, 2021

Published: January 28, 2022

ISSN: 2593-8339

DOI: 10.24018/ejmed.2022.4.1.1152

Z. Shervani*
Food & Energy Security Research & Product Centre, Sendai, Japan.
(e-mail: shervani.nanotek@gmail.com)
D. Bhardwaj
Centre for Skin and Hair Pvt. Ltd. D 305, Defence Colony, First Floor, New Delhi, India.
R. Nikhat
Food & Energy Security Research & Product Centre, Sendai, Japan.
A. Ibbrahim
Jawaharlal Nehru Medical College, Aligarh Muslim University, Aligarh, India.
I. Khan
Flushing Hospital Medical Center, Flushing, New York, U.S.A.
S. Hasan
Faculty of Law, Jamia Millia Islamia, New Delhi, India.
U. Y. Qazi
Chemistry Department, College of Science, University of Hafr Al Batin, Hafr Al Batin, K.S.A.
A. Agrawal
Ram Manohar Lohia Hospital, New Delhi, India.
A. A. Khan
Hakeem Abdul Hameed Centenary Hospital & Hamdard Institute of Medical Science & Research, Jamia Hamdard, New Delhi, India.
A. Sherwani
Interdisciplinary Unit of Nanotechnology, Zakir Husain College of Engineering and Technology, Aligarh Muslim University, Aligarh, India.

Corresponding Author

I. Introduction

Till November 1, 2021, 5 million people have lost lives from COVID-19 disease all around the globe in less than 2 years since the outbreak occurred [1]. High- and middle-income nations like the US, UK, EU countries, and Brazil have 1/8th of the world's population but witnessed half of the deaths. A total of 740,000 lives were lost in the US only. Poor vaccination is one of the main reasons for a large number of fatalities. In Ukraine and Armenia, only 17% and 7% of adults have been fully vaccinated, respectively. The rate of infection and deaths in the populous country India is much lower than in the US, Russia, and the UK. This was achieved because of antibodies developed by vaccination and virus infection combined. In India, 80-97% of the

population have antibodies, a threshold value to achieve herd immunity [2]. Recently, novel coronavirus cases are surging [3] in Europe making the continent epicentre of the pandemic. On two consecutive days of 4th and 5th November 2021, Germany registered a record number of daily new infections of 33,949 and 37,000 cases, respectively. Globally, >250 million novel coronavirus infections were registered [4] till November 8. The European region has the highest number of infections reaching a tally of >76 million. Asia has the second most of >56 million COVID-19 cases. The daily new infections around the world stand to be nearly 449, 000 in past one week compared to the lower figure of over 400,000 in mid-October. Russia on 6th November 2021, registered [5] a record number (41,335) of daily new coronavirus cases, the highest daily infections since the COVID-19 outbreak occurred. A large number of daily fatalities of 1,188 in this period were also reported. The reason for a large number of cases and deaths was slow vaccination in Russia compared to other countries. Several regions in Russia including Moscow, the epicentre of Russia's outbreak, have put some restrictions on nonessential services to control the pandemic. Russia is one of the most affected countries on the globe reporting >8.7 million cumulative cases till now. New Zealand recorded [6] 206 daily new novel coronavirus cases on 6th November 2021 and past the two hundred figures for the first time due to the spread of more infectious Delta variant. Though 78% of New Zealand's population aged 12 and above has been fully and 89% partially (one dose) vaccinated. New Zealand still fared better than other countries with just 7,000 total cases and 31 deaths.

In India, on November 6; 10,929 new cases were recorded. The active caseload of 146,950 stood at 0.43% of the total caseload of India which was the lowest in 255 days. Out of 10,929 cases, on the above day, the majority of cases were from five states: Kerala (6,580), Tamil Nadu, (875), Maharashtra (802), West Bengal (763), and Mizoram (513). In the hope of ending the pandemic, the good news was from India where third pandemic wave did not appear in the last four months (July-October) and daily new cases decreased to < 11,000 twice on November 1 and 6. The cases decreased to < 11,000 from the peak infections of >400,000 recorded in the second wave. One day infections of <11,000 registered after receding the second wave were lower than the baseline cases of <12,000 after the first wave [7]-[9]. The absence of the third wave for four long months (July-October) is due to higher seropositivity (90-97%) developed in the population after a big second wave which generated antibodies and subsequent vaccination. Till November 1, 78% of the eligible Indian population was partially (one dose) vaccinated and 35% received both the shots [10]. It was established [2] that vaccination contributed to the antibody's generation in individuals in real world as detected on the ground. On the good side, Japan in 15 months did not report any fatality on November 7 [11]. On this day only 162 cases were reported. It was a big relief as Japan was devastated in the fifth wave of the pandemic.

A very recent development on the treatment front is that Britain became the first country to approve [12] COVID-19 oral antiviral drug molnupiravir developed by Merck & Co Inc. It is a big boost in the fight against the pandemic. The drug will be used for mild to moderate COVID-19 symptoms. Another drug giant Pfizer Inc. successfully developed [13], [14] COVID-19 pill, Paxlovid that reduced hospitalizations and deaths by 89%. It is said that the pill is a game changer for the COVID-19 pandemic. The company is preparing documents to US regulatory agencies for approval. The two oral pills, one developed by Merck and the other by Pfizer are very fit novel coronavirus drugs. The oral pills can be taken at home as advised by the doctor. Patients do not need to stay in hospitals. The monoclonal antibodies' treatment available till now reduce the hospitalization. Intravenous infusion therapy is difficult compared to oral drugs and only possible in hospitals. Remdesivir and dexamethasone are other treatments being used presently but they have limitations. On the vaccine front, Pfizer Inc.'s Japan branch has applied for the Japan government's approval to vaccinate children in the age group of 5-11 [15]. Japan has 7.4 million children that make about 6% of the population. The Food and Drug Administration (FDA) of the US has strong inclination to recommend Pfizer doses for 28 million children. Pfizer company has collected data of clinical trials conducted in the US, Finland, Poland, and Spain. The vaccine is safe and has an efficacy of 90.7% in preventing the disease even against the highly contagious Delta variant. The amount of vaccine content in one dose for children is one-third of that of adults.

The Indian government has cleared [16] the first plasmid DNA vaccine (ZyCov-D) produced by Zydus for inoculation in the age group 12 to 18. The vaccine is safe and has an efficacy of 66.6% as was demonstrated in phase three trial. It is a three-dose (day zero, day 28, day 56) intradermal needle-free vaccine that is administered using a needle-free applicator. The vaccine will be available to use as early as November 2021. This is the first approved vaccine for adolescents in India. Till November 8, India has fully vaccinated 348 million people and partially vaccinated 393 million. India currently has 940 million people eligible for vaccination, which is 78.8% of the adult population who have received at least one dose and 37% fully vaccinated. Britain ahead of winter has shortened [17] the 6 month time to 5 month for the booster shot after the second dose for 50-plus population to avoid a surge in winter. The daily new coronavirus cases have exceeded over 48,000 in October 2021. Belgium has decided [18] to inoculate booster shots to all eligible citizens. Till now, only 65-plus were administered the booster shot. In Europe, Belgium has one of the highest vaccination rates, even though it is unable to contain the fourth wave. Japan has approved [19] inoculation of booster shots of Pfizer Inc. novel coronavirus vaccine to all eligible people who are 18 and 18-plus beginning from December. First healthcare workers (HCWs) will be eligible for booster shots. The recommendation was in the backdrop of the report that antibodies against the COVID-19 virus decreased over time with immunity lasted for six months after full vaccination. A study showed [20] that the Pfizer-BioNTech COVID-19 vaccine protection against the novel coronavirus eroded that may result in "breakthrough" infections. A US study showed that the Pfizer vaccine's efficacy was 88% in the first month of both

doses which fell to 47% in 5 months. The age-wise vaccine efficiency erosion was 89% to 39% for the age group 16 to 44, 87% to 50% for 45 to 64 and 80% to 43% for 65 and 65-plus. But the vaccine was 90% effective in preventing hospitalization for 6 months for all the age groups even against the Delta variant. Researchers have described different aspects of COVID-19 disease and the virus from the dynamics of the spread to seroprevalence viewpoints in several articles [21]-[28].

II. Methods

The details of SARS-CoV-2 IgG antibodies detection methods and statistical analysis have been described in a medRxiv article [29]. A brief description of the serosurvey is given below. For fifth serosurvey, the residents of five years and older were selected for COVID-19 virus IgG antibodies testing. The survey was conducted in 272 wards spread in all the 11 districts of Delhi, the capital city of India which has population of 20.5 million [30]. The survey was conducted between January 15-23, 2021, and sample size was 28,000 [31]. The sixth serosurvey was conducted in September-October 2021 and tested 28,000 blood samples collected from 280 wards of Delhi [32]-[36]. Serosurvey was done using CLIA technology which was said to be more accurate and sensitive than the ELISA technology [31]. During the testing of samples, a uniform method was used to ensure the reproducibility of the data. Samples were collected from people of all social and financial strata.

III. Results and Discussion

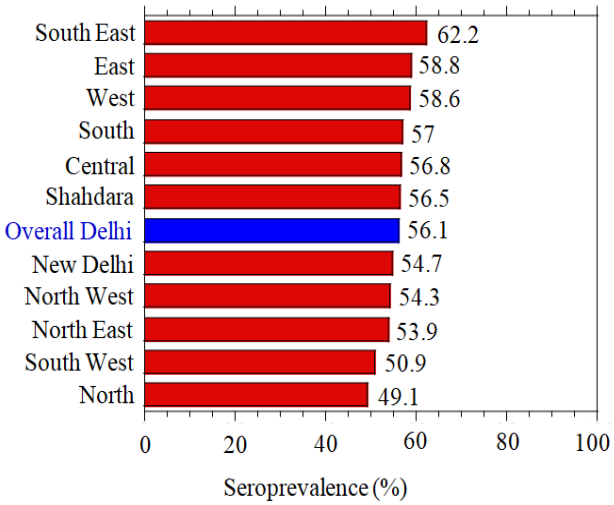

Fig. 1. District- wise seroprevalence of Delhi as recorded in fifth serosurvey.

The bars in Fig. 1 compare the seroprevalence in all the 11 districts of Delhi recorded in the fifth survey in January 2021. The overall (average) seroprevalence in Delhi was 56.1%, thereby more than half of the Delhi population was infected by the virus at some point in time. This is 30% higher than the fourth serosurvey held in October 2020 in which the seroprevalence was 25.5%. Out of 11 districts, 10 had a seroprevalence of >50%. South East district recorded the highest seroprevalence of 62.2%. The north district had the lowest of 49.1% among all the 11 districts. The antibodies were found in Delhi population in the range of 49.1% to 62.2%. In the beginning, some experts believed that the seroprevalence in more than half of the population was good enough to achieve herd immunity. But it had not happened as a severe third COVID-19 pandemic wave hit Delhi city. The seroprevalence in the range 50-60% for the SARS-CoV-2 virus seemed a threshold value but 56.1%, a value close to 60%, did not prove a herd immunity value. Herd immunity breaks the chain of transmission thus stops the virus spread. Later researchers estimated that 70-80% seroprevalence was a threshold herd immunity. But in Delhi, it was 97% that stopped the virus transmission as the daily new infections shrank to the lowest (below 50) ever when the last (April 2021) biggest wave receded. Herd immunity can only be achieved by infection or a robust vaccination drive. The seroprevalence registered in the sixth survey in all the 11 districts of Delhi has been shown by bars in Fig. 2. The survey was conducted in the last week of September and the first week of October 2021. The overall average of Delhi was 97%. East district had the highest (99.8%) followed by North East (99.7%). Shahdara district had the lowest of 94.3%. In the sixth serosurvey, the maximum difference of seroprevalence in districts narrowed down to 5.5% compared to the fifth survey where it was large up to 13.1%. This was due to over the time infection spread widely in the population and partly due to vaccination that contributed to the sixth survey and not to the fifth. In the fifth survey, the seroprevalence value might have followed the pattern of population density, higher the population density of the district, more will be the seroprevalence.

The results of all the six serosurveys conducted in Delhi have been shown in Fig. 3. The first serosurvey done in June-July 2020 showed that 22.9% of the population developed antibodies against the SARS-CoV-2 virus. The second, third, and fourth surveys held in August, September, and October recorded 29.1%, 25.1%, and 25.5% seroprevalence against the virus, respectively.

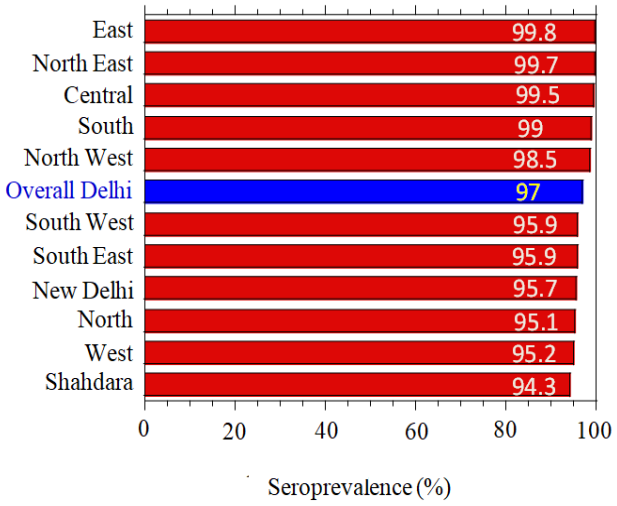

Fig. 2. District- wise seroprevalence of Delhi as recorded in sixth serosurvey.

The % seroprevalence means that at some point in time these people had COVID-19 infection which made people immune by developing antibodies against the disease. The serosurvey results might have left some infected persons undetected as the antibodies formed in different pandemic

waves (first in June, second in September, third in November 2020) might have waned out and remained undetected due to the detection limit of the test. But waning out antibodies does not mean the loss of protection from the virus since apart from detectable antibodies some other components of proactive defence materials are left in the infected humans. Fig. 4 is the linear plot of increase in seroprevalence in Delhi population versus time recorded in different months (June 2020-September-2021). The plot was constructed from the first to sixth serosurvey results described in Fig. 3. As shown in Fig. 4, there is an increase and decrease pattern in seroprevalence values as time passed from June to October 2020.

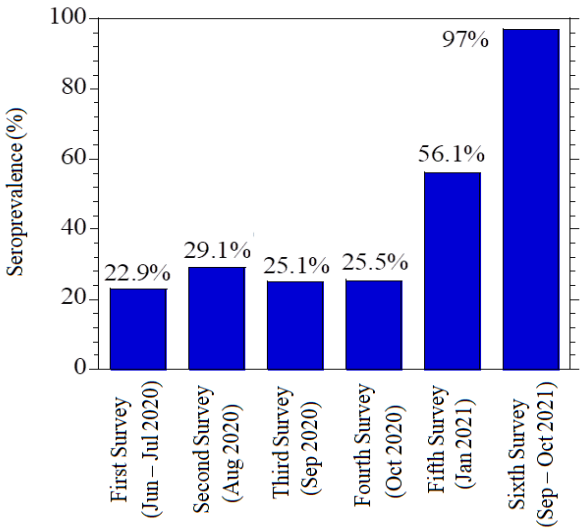

Fig. 3. Increase in seroprevalence in Delhi population with time (months).

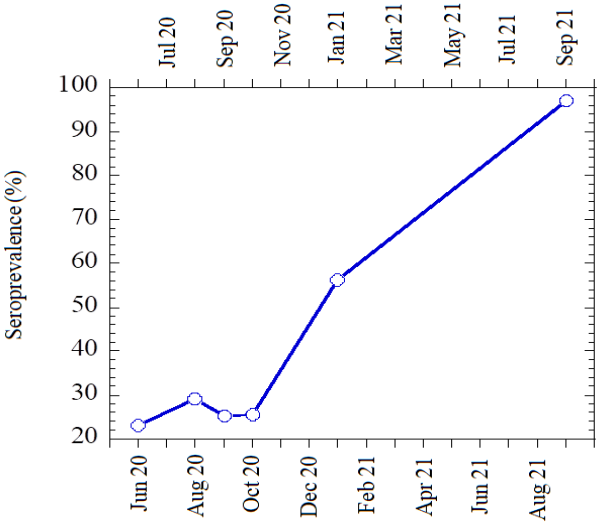

Fig. 4. Plot showing increase in seroprevalence in Delhi population with time (month).

In Delhi, the first pandemic wave appeared in June 2020 followed by the two successive waves in September and November. The formation of antibodies started in the population when the first and successive waves built up. In these waves, the spread of the virus was slower till October, thus seroprevalence remained at the same level in the range 23-29%. In third wave in November, the virus spread was faster as a result a higher seroprevalence of 56.1% was recorded in the fifth survey in January 2021. The last wave was the biggest which occurred in April 2021 and nearly infected every person in the city that gave a seroprevalence of 97%. This huge seroprevalence was the net value obtained after addition and deduction from vaccination, reinfections, and breakthrough infections. Fig. 5 shows the age- and gender-wise seroprevalence recorded in the sixth survey. The seroprevalence in women was marginally higher (90%) than in men (88%). The seroprevalence of 90% or 88% did not reach up to the average (overall) 97% because it was not adjusted for sensitivity of the testing kits. The seroprevalence was the highest (92%) among the population above 50 years of age followed by 90% in the age group 18-49 and 82% in below 18 years.

Fig. 6 compares the seroprevalence in various regimens. The seroprevalence among the participants below 18 years of age and the unvaccinated population was 82%. In one dose and two doses vaccinated people, the seroprevalence remained the same at 95%. The participants who were inoculated with Covishield (AstraZeneca-Oxford) brand vaccine made by Serum Institute of India had 95% seroprevalence whereas the Covaxin (Bharat Biotech, India) gave slightly less 93% seroprevalence in the population. The percent seroprevalence enhancement recorded on the ground in real world in various regimens has been shown in Fig. 7. An increase of 13% seroprevalence was registered on one dose and two doses of vaccine inoculation. Covaxin produced marginally less (11%) seroprevalence than Covishield (13%).

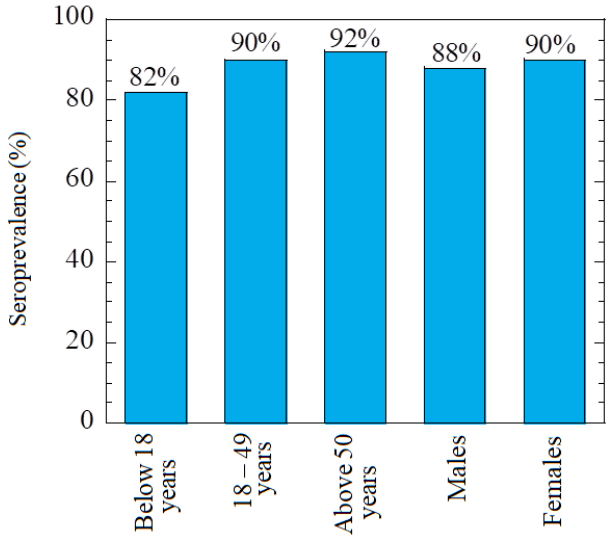

Fig. 5. Age-wise and gender-wise comparison of seroprevalence in Delhi population registered in sixth serosurvey.

Vaccination by one dose or two doses could only contribute a maximum 13% increase in seroprevalence. Since the fifth COVID-19 pandemic wave has not appeared in Delhi, 95% seroprevalence was the threshold seroprevalence. In Fig. 8a and 8b, the district-wise results of all the six surveys of Delhi have been shown by stacked bars. Fig. 8a shows the serosurvey results of South West, New Delhi, East, South, and South East. In South West district, in the first (June) survey 13% of residents had antibodies. Antibodies were registered to be 17.4% in second, 14.6% in third, 18.5% in fourth, 50.9% in fifth, and 95.9% in the sixth survey. There is an increasing pattern of

European Journal of Medical and Health Sciences
www.ejmed.org

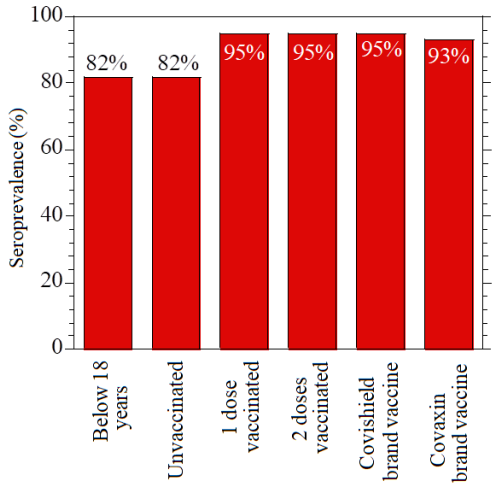

Fig. 6. Comparison of seroprevalence in vaccinated and unvaccinated population of Delhi recorded in sixth serosurvey.

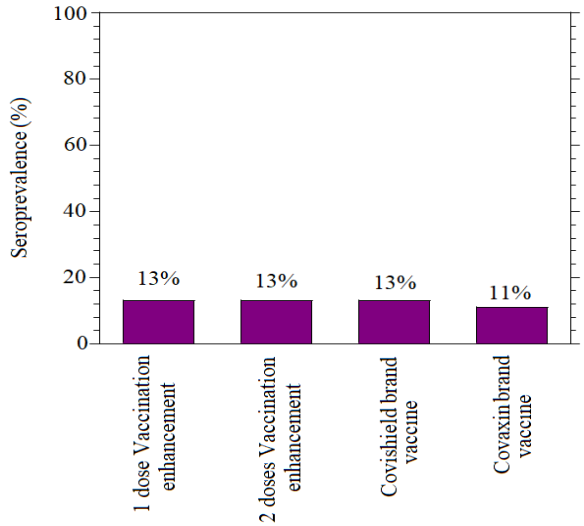

Fig. 7. Enhancement in seroprevalence in Delhi population by vaccination in different conditions.

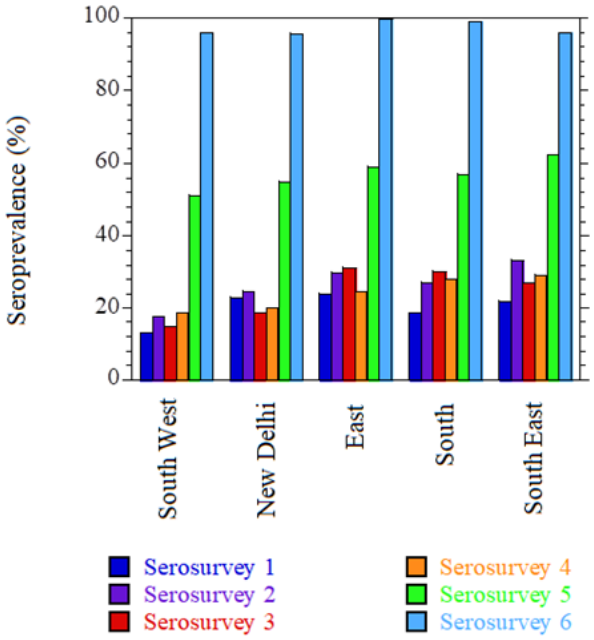

Fig. 8a. Comparison of seroprevalence in different districts of Delhi (South West, New Delhi, East, South, South East).

seroprevalence with time from June 2020-September 2021 except in the third (September) survey where seroprevalence decreased slightly.

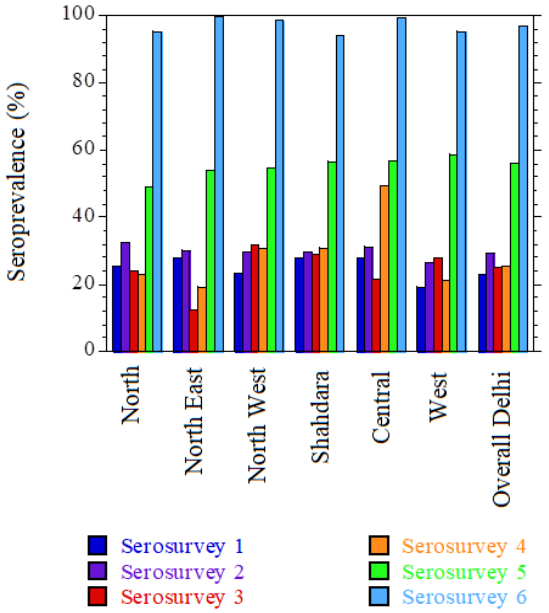

Fig. 8b. Comparison of seroprevalence in different districts of Delhi (North, North East, North West, Shandara, Central, West, Overall Delhi).

In New Delhi, 22.8% of residents had antibodies in the first survey, in the second survey antibodies increased to 24.6% while the third and fourth surveys showed a decreased pattern of 18.6% and 19.8% prevalence, respectively. In the fifth and the sixth survey, 54.7% and 95.7% population had antibodies, respectively. There is an increasing trend in seroprevalence in East district of Delhi, seroprevalence increased 23.9%, 29.8%, 31.1% in the first, second, and third survey, respectively. In the fourth survey, it decreased to 24.7%. In fifth and sixth surveys, 58.8% and 99% population had antibodies, respectively. South district followed the same pattern as of East. In first, second, and third surveys seroprevalence increased then in the fourth it decreased and in fifth and sixth increased again. The trend in South East district was seroprevalence increased in the second survey and then in third and fourth survey it decreased followed by increase in fifth and six surveys. The variation of seroprevalence in another six districts of Delhi (North, North East, North West, Shahdara, Central, West) registered in all six serosurveys has been plotted in bar diagram in Fig. 8b. The overall seroprevalence in Delhi city has also been shown. The seroprevalence increased from 25.2% to 32.4% in first and second survey, respectively. It decreased to a value of 24.1% in third and 23.1% in fourth survey. In fifth and sixth survey the seropositivity increased to 49.1% and 95.1%, respectively. From first to fourth serosurvey the seroprevalence showed an increase-decrease trend though in a small range. However, fifth and sixth serosurveys always showed a large increase in seroprevalence in all the districts of Delhi. The fifth serosurvey conducted in January 2021 had antibodies accumulated in three COVID-19 pandemic waves that occurred in June, September, and November 2020. Thus, a large population of 56.1% showed seroprevalence. The sixth

serosurvey recorded 97% population had antibodies which was the result of large fourth wave that hit the city in April 2021 and share from vaccine generated antibodies.

STATEMENTS

The data and results in this article are very reproducible. Author (Zameer Shervani, Ph.D.) is Director of Food & Energy Security Research & Product Center, Sendai, Japan. Authors have qualifications; Deepali Bhardwaj MBBS, MD, DVDL, M.Phil.; Abdullah Sherwani B.Tech.; Intazam Khan MBBS; Umair Yaqub Qazi Ph.D.; Sadia Hasan, Ph.D.; Roma Nikhat MCA; Ankira Agarwal MBBS; Aiman Ibbrahim MBBS; Adil Ahmed Khan MBBS.

REFERENCES

[1] Covid-19 global death toll tops 5 million in under 2 years. [Internet] [cited November 1, 2021] The Times of India.
[2] Shervani Z, Bhardwaj D, Nikhat R, Ibbrahim A, Khan I, Qazi UY, et al. 4th National Sero Survey of India: Vaccine Generated Antibodies Enhancement, *European Journal of Health and Medical Sciences*. 2021 (in press).
[3] WHO raises alarm over fresh Covid surge in Europe: All you need to know. [Internet] [cited November 6, 2021] Hindustan Times.
[4] Global Covid-19 tally crosses 250 million: Report. [Internet] [cited November 9, 2021] Hindustan Times.
[5] Russia sees record daily Covid-19 cases despite paid holiday. [Internet] [cited November 6, 2021] Hindustan Times.
[6] New Zealand's daily coronavirus cases cross 200 for first time in pandemic. [Internet] [cited November 6, 2021] Reuters.
[7] At 10,929, India sees less than 11,000 fresh Covid-19 cases for 2nd time this week. [Internet] [cited November 6, 2021] Hindustan Times.
[8] Coronavirus (COVID-19)-Google News-India.
[9] India's COVID-19 cases hit 9-month low. [Internet] [cited November 6, 2021] The Hindu.
[10] Covid-19:78% people received first dose of vaccine, 35% fully jabbed, says Mandaviya. [Internet] [cited November 1, 2021] Hindustan Times.
[11] Japan reports no COVID-related deaths for the first time in 15 months. [Internet] [cited November 7, 2021] The Japan Times.
[12] Britain approves Merck's COVID-19 pill in world first. [Internet] [cited November 5, 2021] Reuters.
[13] Pfizer develops COVID-19 pill that cuts hospitalizations and deaths by 89%. [Internet] [cited November 5, 2021] The Japan Times.
[14] COVID-19 drugs will change the way we live with the virus. [Internet] [cited November 7, 2021] The Japan Times.
[15] Pfizer to seek OK for use of COVID-19 shot in children in Japan age 5 to 11. [Internet] [cited October 28, 2021] The Japan Times.
[16] Zydus jab cleared for kids to cost govt ₹265. [Internet] [cited November 9, 2021] Hindustan Times.
[17] UK allows early booking of booster shots to ramp up vaccine rollout. [Internet] [cited November 6, 2021] Hindustan Times.
[18] Belgium plans COVID-19 booster shot for all. [Internet] [cited November 10, 2021] Toronto Star.
[19] Japan Oks administration of Pfizer COVID-19 vaccine booster shots. [Internet] [cited November 10, 2021] The Japan Times.
[20] Pfizer vaccine's protection wanes over time, and not because of Delta, study says, [Internet] [cited October 4, 2021] Los Angeles Times.
[21] Shervani Z, Bhardwaj D, Nikhat R. Dharavi Slums (Mumbai, India): The Petri Dish of COVID-19 Herd Immunity. *European Journal of Medical and Health Sciences.* 2021; 3(3): 38-41.
[22] Shervani Z. COVID-19 in Kerala: Health Index Theory. *European Journal of Medical and Health Sciences.* 2021; 3(2): 21-24.
[23] Shervani Z. COVID-19 in Kerala: The Dynamics of Spread and Health Index Theory. *RAS Medical Science.* 2021; 1(2): 1-3.
[24] Shervani Z, Khan I, Siddiqui NY, Khan T, Qazi UY.Viability of SARS-CoV-2 and Sanitization Methods. *European Journal of Medical and Health Sciences.* 2021; 3(1): 22-27.
[25] Shervani Z, Khan I, Siddiqui NY, Khan T, Qazi UY. Risk of SARS-CoV-2 Transmission from Humans to Pets and Vice Versa. *European Journal of Medical and Health Sciences.* 2021; 3(1): 34-38.
[26] Shervani Z, Khan I, Qazi UY. Sars-cov-2 delayed Tokyo 2020 Olympics: Very recent advances in covid-19 detection, treatment, and vaccine development useful conducting the games in 2021. *Advances in Infectious Diseases.* 2020; 10(3): 56-66.
[27] Shervani Z, Khan I, Qazi UY. COVID-19 vaccine. *Advances in Infectious Diseases.* 2020; 10(3): 195-210.
[28] Shervani Z, Khan I, Khan T, Qazi UY. World's fastest supercomputer picks COVID-19 drug. *Advances in Infectious Diseases.* 2020; 10(3): 211-225.
[29] Sharma N, Sharma P, Basu S, Bakshi R, Gupta E, Agarwal R, et al. Second wave of the Covid-19 pandemic in Delhi, India: high seroprevalence not a deterrent? *Cureus.* 2021; 13(10).
[30] https://www.indiaonlinepages.com/population/delhi-population.html.
[31] Over 50% exposer to Sars-Cov-2 in 10 of 11 city districts: serosurvey in Delhi. [Internet] [cited February 3, 2021] Hindustan Times.
[32] Delhi 6th Sero-survey: 97% of People Have COVID Antibodies, Says Health Minister. [Internet] [cited October 28, 2021] The Quint
[33] Delhi 6th sero-survey: More than 90% have antibodies. [Internet] [cited October 27, 2021] The Hindu.
[34] Herd Immunity for Delhi? As Sixth Sero Survey Finds Over 90% Have Antibodies, Here`s What it Means. [Internet] [cited October 28, 2021] News 18.
[35] Covid antibodies found in 97% of Delhi residents. [Internet] [cited October 29, 2021] Times of India.
[36] 6th Delhi sero survey shows 97% prevalence of antibodies. [Internet] [cited November 13, 2021] Hindustan Times.