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COVID-19 sero-surveillance report in a metropolitan city of Maharashtra

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ABSTRACT

Introduction: The WHO global research map for COVID-19 and others had recommended population-level sero epidemiological studies to generate data on the levels of infection in populations and recommended containment measures accordingly. In order to understand the extent of COVID-19 infection, as well as efficacy of vaccine administration program, the present was conducted a COVID-19 sero-survey across the city and study in relation to variables limit like demographic, environmental, social factors.
Aim & Objective: To conduct a COVID-19 sero-survey across the city and study in relation to variables limit like demographic, environmental, social factors in study population.
Materials and Methods: A total of 1571 subjects were surveyed from the 9 wards of Thane Corporation area. The random sampling method ensured almost equal distribution across these wards. Six different age groups defined to ensure a non-skewed spread across all age groups.
Results: Higher seroprevalence is seen in younger age groups. The maximum seropositivity was observed in 30-45 age group and minimum was observed in 06-17 age group. This may be attributed to the non-vaccination. Amongst the fully vaccinated population, 5.2% of participants are non-responder i.e. remains seronegative despite partial or full vaccination.
Conclusion: COVID-19 pandemic may continue to attack the mankind till all of us develop a strong immunological defense against it either by natural (clinical and sub clinical) or vaccine induced immunity against COVID-19. This sero-surveillance survey still provides us with accurate baseline figures about different socio-demographic and vaccination coverage factors released with the immunological status of participants. Further, regular surveys are necessary above this baseline seroprevalence survey to study any shift in the seropositivity status and the type of variants, so that timely intervention can be considered.

1. Introduction

The COVID-19 pandemic heavily impacted every nation's government and healthcare industry worldwide and the infection spread to more than 200 countries.[1] Looking at the natural active or passive immunity mechanism, many scientific communities accepted that only the presence of specific "neutralizing" antibodies is surrogate marker of immunological protection against viral infections which can be appeared in community post COVID -19 vaccination and post COVID-19 infection. The evidence of spontaneously clearing the symptoms of COVID-19 may be a reliable surrogate marker of individuals' immune competency regardless of its mechanism (i.e., antibody-dependent cell cytotoxicity and natural killer cells). Clearance of COVID-19 symptoms in any individual is closely followed by clearance of all viable SARS-CoV-2. However, to detect the protective antibody titre, the surveillance system formed the foundation stone of active case finding, testing, contact

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tracing and are the key components of the public health response to this novel, emerging infectious disease.[2–4]

The first nationwide SARS-CoV-2 serosurvey in India was done in May–June, 2020, when the entire country was under stringent lockdown, with the exception of conditional relaxation in areas deemed to be minimally affected. It showed a low sero-prevalence of 0·73% (95% CI 0·34–1·13) among the general adult population aged 18 years or older. Notably, this sero-survey found a high infection-to-case ratio (81·6–130·1 infections per reported COVID-19 case), suggested the need for a further expansion of testing, and a low infection-fatality ratio (0·27–15·04 deaths per 10000 infections).[4–6] The WHO global research map for COVID-19 and others had recommended population-level sero epidemiological studies to generate data on the levels of infection in populations and recommended containment measures accordingly. There are three possibilities to conduct the sero epidemiological investigation e.g. cross-sectional investigation, most apt after the peak transmission is established; repeated cross-sectional investigation in the same geographic area (but not necessarily the same individuals each time) to establish trends in an evolving pandemic.[7–10] The survey conducted by Indian Council of Medical Research (ICMR) gave an idea about a baseline to determine the seroprevalence of SARS-CoV2 infection in the community as well as high-burden cities in India. But, among all states in our country, there is definitely a variation of sero prevalence post COVID-19 vaccination and post COVID-19 infections. Other demographic factors are also responsible for different findings among different states.[3,11–13]

Maharashtra was the worst hit state in India, reported daily highest number of COVID-19 cases. Thane Municipal Corporation (TMC) was at the forefront of fighting COVID-19, along with Maharashtra State and the nation. The city demonstrated intricate administrative as well as medical planning, leading to a recovery rate of more than 98%, conducting more than 21 million tests and administering more than twenty lakh vaccine doses. TMC has been proactive in setting up of jumbo COVID-19 facilities across the city, resulting in exemplary patient management during the 2nd wave. The city stands well prepared for a possible future waves, with ready-to-use jumbo facilities, enhanced oxygen supply, storage and manufacturing capacities, provision for pediatric COVID-19 wards, etc. In order to understand the extent of COVID-19 infection, as well as efficacy of vaccine administration program, TMC conducted a COVID-19 sero-survey across the city and study in relation to variables limit like demographic, environmental, social factors in study population. These findings will be instrumental in effective COVID-19 management in the city.

2. Materials and Methods

The survey was conducted in all the nine Prabhag Samitis (wards) of Thane Municipal Corporation in October 2021. As per sampling size, 1571 people were selected randomly from amongst slum and non-slum population in the city.

The Survey was a combined efforts of 3 institutions, namely:

1. Thane Municipal Corporation, which was the lead partner and principal investigator in this study. Its main role was to get Ethical Committee approval, Identification of health facility (both private and govt.) in Thane, Management of on ground phlebotomist, Test kit procurement and blood sample analysis, Faculties of a medical college in Thane analyzed and presented the data using suitable statistical package and report finalization.
2. ATE Chandra Foundation (ATECF), a philanthropic foundation which works with strategic problem-solving approach to address social issues, coordinated the efforts to secure funding for the project, and
3. IDFC Institute, a division of IDFC Foundation,which was the field and analysis participant under this MoU. It was involved in identification and coordination with external stakeholders supporting the project, technical support for questionnaire to collect data, mobile app development, and recruitment, training of field workers.

After approval of protocol by IRB & Institutional Ethics Committee, the faculties of Microbiology and community medicine conducted the training session for field workers were about interviewing participants and taking samples to ensure standardization and efficiency of process. Consent of the participants was recorded before involving them. A pre-validated and pre-tested proforma was used for recording socio-demographics and vaccination details. Collection of 5ml blood samples was done by trained phlebotomist under aseptic conditions. An unique ID was given to each sample and was sent under cold storage to the Centralized Serologylaboratory. ELISA tests were done to detect the presence of Quantitative IgG using HI-media anti bodies against spike protein. Samples were stored till end of study. All the personal, socio demographic and Laboratory data was entered in Microsoft Excel and analyzed.

2.1. Inclusion criteria

1. Residents of Thane
2. Ages 6 & above
3. One sample/family

2.2. Exclusion criteria

1. Not giving consent
2. Bleeding disorders

3. Healthcare workers of Govt. & private settings

3. Results

A total of 1571 subjects were surveyed from the 9 wards of Thane Corporation area in 3 weeks. The random sampling method ensured almost equal distribution across these wards (Table 1). Of these 1571, the non-slum population was 763 (48.56%) and from slum area, 808 (51.43%) were surveyed.

The maximum seropositivity was observed in Uthalsar Prabhag Samiti (96.07%) whereas minimum was observed in Majiwada Manpada (79.21%).Reasons could be attributed to much lower population density of Majiwada area, than other parts of Thane. This led to lesser cross infection among this population. (Table 1)

Of the 808 slum dwellers, surveyed, 712 (88.12 %) were seropositive and of the 763 non slum dwellers, 712 (93.32%) were seropositive.(Table 2)

Of the total 866 males, 776 (89.61%) were seropositive and amongst 705 women, 648 (91.9%) were seropositive.(Table 3)

Six different age groups defined to ensure a non-skewed spread across all age groups. Higher seroprevalence is seen in younger age groups. The maximum seropositivity was observed in 30-45 age group and minimum was observed in 06-17 age group. (Table 4)

Table 5 shows the relation between seropositivity and exposure to corona virus infection. Exposed means symptomatic or asymptomatic individual who has tested positive either by rapid antigen or RT-PCR test. Total of 977 subjects had exposure to Novel Corona virus of which 93.75% were seropositive and of the 580, who did not have any exposure to the virus nor vaccinated, 495 (85.3%) were seronegative.

In our study Among the 1,571 participants, 1227 were eligible for COVID-19 Vaccine as 344 were less than 8 years old and were not eligible for vaccination at the time of this study.

Seropositivity among the vaccinated population (at least one dose) was 93.2%. The variation of seropositivity is statistically significant based on vaccination doses. (Table 6)

It was also observed that among the fully vaccinated population, 5.2% of participants are non-responder i.e. remains seronegative despite partial or full vaccination.

4. Discussion

The present study was conducted to find out the seroprevalence of COVID-19 among population and associated possible risk factors.

In this study the, out of total 1571 subjects, highest number of seropositives were seen in Kalwa ward (172, 12.1%) and lowest was seen in Majiwada ward (140, 9.82%). Of the 539 slum dwellers surveyed, 469 (87%) were seropositive and of the 1033 non slum dwellers, 956 (92.55%) were seropositive. The possible reason for such variation in seroprevalence among slum & non-slum dwellers is that the high percentage of vaccination coverage in non-slum pockets. The vaccine hesitancy among the slum dwellers was due to misinformation about vaccine. However, the study conducted in Mumbai slum and non-slum areas showed that seroprevalenceare higher in slums (55·1% - 61·4%) than in non-slums (12·0% - 18·9%) across wards.[14] Another study conducted by Murhekar et al showed that seroprevalence was not different in rural, urban non-slum, and urban slum areas.[15] As per Indian Council of Medical Research (ICMR), in hotspot area of Ahmedabad, Mumbai, and Agra seroprevalence reported 49%, 37%, and 23% respectively. Even in Maharashtra, the serosurvey was conducted in Beed, Jalgaon, Parbhani, Nanded, Ahmednagar and Sangli, which showed the seroprevalence of anti-SARS-CoV-2 IgG antibody were less than 5% in all sites while as per JV Dixit et al., the seroprevalence was 11.81% from corporation area of Aurangabad.[16–18] These findings suggest that the seroprevalence can be different among population depending on the variable geographical location. The reason of such variability may be different socio-economic status, level of education and positive influence of correct information spread by social media.

In our study, seropositivity is more among females (91.9%) compared to males (89.61%). The Saple, et al study also showed similar result like us.[10] However, the Murhekar et al and Nitiayog study showed almost similar seroprevalence among male and female.[15,16]

In our study, total of 977 subjects had exposure to Novel Corona virus of which 93.75% were seropositive and of the 580, who did not have any exposure to the virus nor vaccinated, 495 (85.3%) were seronegative. The study conducted in Maharashtra also showed that individuals who had no documented history of COVID-19 infection also showed seropositivity.[19] The asymptomatic who did not tested themselves also developed antibody. So vaccination as well as exposure to infection determines the level of seropositive people in that area. This explains why the sero-positives are less in Manpada-Majiwada ward which has higher number of high rises and close gated societies compared to other wards.

In the present study, seropositivity amongst subjects with different vaccination status is seen eg. highest number is seen in those who had taken two doses of COVID-19 vaccine. The Murhekar et al study also showed that the seroprevalence is higher among vaccinated compared to unvaccinated adults, seroprevalence was significantly higher among individuals who received 1 dose (81.0%, 95% CI 79.6% to 82.3%, p = 0.001) or 2doses (89.8%, 95% CI 88.4% to 91.1%, p = 0.001) of COVID-19 vaccine.[4]

Most of the participants in our study received Covishield vaccine. The most of the study participants of Murhekar et al also received Covishield vaccine. The reason of more

Table 1: Ward-wise distribution of thesero-positive patients

Ward	Sample collected	No. of Seropositive	% Seropositive
Diva	159	144	90.57%
Kalwa	189	172	91.01%
Lokmanya Savarkar Nagar	181	170	93.92%
MajiwadaManpada	178	141	79.21%
Mumbra	179	165	92.18%
NaupadaKopri	166	150	90.36%
Uthalsar	178	171	96.07%
Vartak Nagar	167	151	90.2%
Wagle Estate	174	160	91.95%
Grand Total	1571	1424	90.6%

Table 2: Distribution among slum & non-slum area

Type of Area	Population Analyzed	Positive	Seropositivity (%)
Slum	808 (51.43%)	712	88.12 %
Non-slum	763 (48.56%)	712	93.32 %
Total	1571	1424	90.64%

Table 3: Gender wises eropositivity

Gender	Total No	Positive	Seropositivity (%)
Female	705	648	91.9%
Male	866	776	89.61%
Total	1571	1424	90.64%

Table 4: Sero prevalence in different Age groups in the survey sample

Age Group (years)	Total No.	No. of Seropositive	% Seropositivity
06 up to 18	344	287	83.43 %
18 up to 30	346	312	90.17%
30 up to 45	298	281	94.3%
45 up to 60	287	267	93.03%
60+	296	277	93.6%
Total	1571	1424	90.64%

Table 5: Sero positivity rate & vaccination

Status	Number	Sero Positive	%
Exposed to infection, Not vaccinated	7	6	85.71
Not exposed to infection, vaccinated	970	910	93.81
Not infected,Vaccinated	15	14	93.33
Not Infected, Not vaccinated	579	494	85.31
Total	1571	1424	

Table 6: Seropositivity after different vaccination levels

Vaccination Doses	Total No	No of Seropositive	Sero Negative	% Seropositivity
0 dose	437	392	45	89.7%
1 dose	790	232	17	93.2%
2dose	344	513	28	94.8%
Total	1571	1137	90	92.7%

population coverage by COVID -19 vaccine could be that the vaccine launched at first and widely available by Govt. and private bodies in vvaccination camps. hence, by the time we have conducted the study, already most of the population took one shot or two shot of Covishield. [4]

One of the significant findings in our study was amongst 437 who did not receive vaccine, 344 were less than 8 years old and were not eligible for vaccination at the time of this study suggesting that COVID-19 vaccination has a role in seroconversion and we can assume that vaccination has a role to play in protection against COVID-19 infection. Herd immunity is a stage of an epidemic of any infectious disease in which some members of the community develop immunity for that particular disease because of previously infected or recovered or either through vaccination and ,also help in decreasing the severity of the disease. Various studies suggested that to develop herd immunity for COVID-19, minimum 55–70% of the total population were previously infected to develop herd immunity. [20]

In our study among the fully vaccinated population, 5.2% of participants are non-responder i.e. remains seronegative despite partial or full vaccination. This may be attributed to the fact that they have been vaccinated a long time ago and their antibodies have decayed but they have produced T-cells and have memory cell immunity.

The COVID-19 pandemic came in different waves (till now four waves), different variants and were primarily responsible for these waves. The 2^{nd} wave was caused by DELTA variant.

Thus, it can be predicted that the COVID-19 pandemic may continue to attack the mankind till all of us develop a strong immunological defense against it either by natural (clinical and sub clinical) or vaccine induced immunity against COVID-19. The sero-surveillance was conducted in Thane Municipal Corporation limits in October-November 2021 and the sample sero-surveillance showed a seropositivity rate of over 90% in both slums & non-slums areas. This sero-surveillance survey still provides us with accurate baseline figures about different socio-demographic and vaccination coverage factors released with the immunological status of participants. Further, regular surveys are necessary above this baseline seroprevalence survey to study any shift in the seropositivity status and the type of variants, so that timely intervention can be considered.

5. Conclusions

The sero-conversion rate in Thane City corporation limits was 90.65%. It is more in males than in female population. It is highest in low economic status areas of Kalwa and Mumbra. The seropositivity is highest in those who have taken 2 doses than those who did not take any dose. Some exposure to the virus in the form of infection or vaccination has offered higher sero conversion in these people. Therefore, to protect the population from further surges in the infection levels with different covariants like omicron and others, it is a must to maintain a high level of seropositivity and to develop herd immunity by maintaining a high vaccination coverage in the population.

6. Source of Funding

None.

7. Conflict of Interest

None.

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