Original Research Article

Sero prevalence of SARS-CoV-2 in general population of Nagpur district

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ABSTRACT

Background: Population based sero-epidemiological studies help us to determine the burden of COVID-19 infection at the community level and to monitor the trends in transmission of SARS-CoV-2 infection. Antibody based sero-positivity indicates the extent of spread of infection in the given population and forms the basis for strengthening public health mitigation measures. The present study was carried out with the objective of conducting population level serosurvey in Nagpur district to understand the spread of SARS-CoV-2 and to help the designing and implementation of appropriate health system and policy level interventions. This cross-sectional study was carried out in Nagpur District over two weeks in October and November 2020. For the purpose of this survey the Nagpur district was divided into NMC area and Non NMC area.
Methods: House to house survey was carried out and data was collected using Google form. For detection of SARS-CoV-2 specific antibodies venous blood was collected from each participant and electrochemiluminescence immunoassay was performed. The data was cleaned, coded and analysed using EPI INFO.
Results: The total seroprevalence in Nagpur district was found to be 35.17 %. The seroprevalance in NMC area was 49.7% which was more than twice from that of Non NMC area (20.7%).
Conclusions: Considerably large numbers of infections are asymptomatic, however a sizeable proportion of population is still susceptible to the infection and thus there is no time for complacency.

Keywords: Seroprevalence, Serosurvey, COVID-19, General population

INTRODUCTION

The relentless spread of COVID-19 pandemic since its emergence in Wuhan city in China in late 2019 has created havoc globally and India is no exception. The country continues to be the third worst hit nation in the world after the first positive case was confirmed on January 30 2020 in Kerala. Currently the knowledge regarding epidemiology of COVID-19 in India is limited mainly to the study of symptomatic cases who have presented for testing and treatment, which in fact constitute only the "tip of the iceberg". Since the tests are not available to everyone, the data do not accurately reflect the extent of transmission in communities around the world.[1,2] So confirmed incidence based by and large only on positive RT-PCR tests for COVID-19 does not reflect the true underlying prevalence in the population. Many cases escape unnoticed as they are asymptomatic or have mild symptoms, and do not seek healthcare but play a major role in spread of the infection. Appropriate control of COVID-19 requires the ability to trace asymptomatic and mild infections that would not present to healthcare and would otherwise remain undetected through existing surveillance systems.[3] Seroconversion is the preferred standard for retrospectively detecting SARS-CoV infection.[4] Serosurveillance provides estimates of antibody levels against infectious diseases

and is considered the gold standard for measuring population immunity due to past infection or vaccination.[5] It is an important component of disease surveillance and complements notification, hospitalisation, mortality and immunisation coverage data.[6] SARS-CoV-2 seroprevalance studies give us an valuable insight regarding the previous infections, including mild and asymptomatic cases and those who may not have been tested during their infection. Population based sero-epidemiological studies help us to determine the burden of COVID-19 infection at the community level and to monitor the trends in transmission of SARS-CoV-2 infection. Also, surveillance of antibody based sero-positivity will indicate the extent of spread of infection in the given population and form the basis for strengthening public health mitigation measures. Such household based studies can also help in generating evidence on role of asymptomatic and mild infections in transmission. With this background the present study was carried out with the objective of conducting population level serosurvey in Nagpur district to understand the spread of SARS-CoV-2 and to help the designing and implementation of appropriate health system and policy level interventions.

METHODS

Study design, setting, and participants

It was a cross-sectional study carried out in Nagpur district over two weeks from 15 October 2020 to 5 November 2020. Nagpur is a city of Maharashtra located in central India.

Sample size calculation

Assuming the seropositivity rate of eight per cent with a relative precision of 15 per cent, confidence interval of 95 per cent and design effect of 2, estimated sample size was found to be 3,926 (rounded to 4000) individuals. For the purpose of this survey the Nagpur district was divided into Nagpur Municipal Corporation (NMC) area and the other area of the district excluding NMC area which was labelled as non NMC area.

NMC area

There are a total of 10 zones under the jurisdiction of Nagpur Municipal Corporation. A total of 40 clusters were identified for the serosurvey, by randomly selecting four areas from each of these ten zones. In order to get a representative sample from both slum and non slum areas, five entry points were identified in each of the selected cluster (2 from slum areas and 3 from non slum areas)

Non NMC area

From among the 13 talukas in Nagpur district, 3 clusters, one from taluka headquarter (urban area) and 2 from rural area for 12 talukas and 4 clusters all from rural area for

Nagpur rural were randomly selected to constitute a total of 40 clusters. Here also five entry points were chosen in each of the identified clusters. For both NMC and Non NMC areas, 10 sequential households from each entry point were selected. One individual more than 18 years of age was included in the study from each selected household as per the schema in the (Table 1). With the above-mentioned method for individual selection from each household in a cluster, 50 individuals were enrolled in each cluster (80 clusters×5 entry points×10 households from each point×1 adult from each house=4000) (Figure 1). In households with one or more persons having tested positive for RT-PCR for SARS-Cov-2, positive persons were excluded and negative persons satisfying the inclusion criteria were enrolled for the study.

Table 1: Schema for selection of individuals from selected household in the cluster.

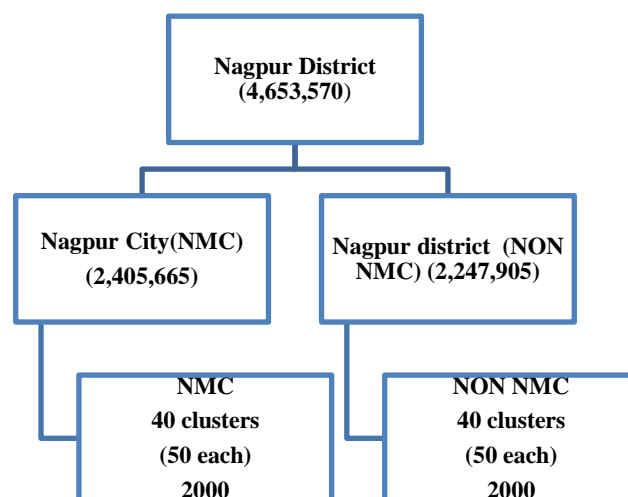| Number of adult females in household	Number of adults in the household			
	1	2	3	4
0	Male	Youngest male	Youngest male	Oldest male
1	Female	Female	Oldest male	Female
2		Oldest female	Male	Oldest male
3			Youngest female	Oldest male
4 or more				Oldest female

Figure 1: Flowchart for selection of clusters and households.

Study procedures

Approval was taken from Institutional ethics committee of Government medical college, Nagpur was taken prior to onset of data collection. Each study team constituted of

four members which included a medical officer, nurse, lab technician and a security guard. The teams were trained extensively for data collection procedures and appropriate use of personal protective equipment. The study team visited the randomly selected households and briefed them about the nature and purpose of the study. Written informed consent was obtained and basic demographic information, history of exposure to laboratory-confirmed COVID-19 cases, symptoms suggestive of COVID-19 and history of comorbidities like diabetes, hypertension etc was enquired and noted. Data was collected using Google forms and the excel sheet thus obtained was used for further analysis. In case of nonavailability of eligible individual in a household, the team moved on to the next household and completed the survey till the required numbers of households as per the sample size were surveyed. The duration of data

collection was from 15 October 2020 to 5 November 2020.

Blood sample collection

Five mmilliliter of venous blood was collected from each participant. Samples were transported to laboratories in the local health facility (GMC, Nagpur) taking all appropriate precautions. Detection of SARS-CoV-2 specific antibodies was performed using electrochemiluminescence immunoassay (ECLIA) by Ms Roche. Elecsys Anti SARS-CoV-2 is an immunoassay for the in vitro qualitative detection of antibodies (including IgG) to SARS-CoV-2 in human serum and plasma. In all, 1,992 samples were collected from NMC area and 2000 samples from non NMC area and tested.

Table 2: Estimated ratio of cases: infections.

Area	Population size	Seroprevalence rate	Infected population	Dates of data collection	Cases	Ratio cases: infections
NMC	24,05,665	49.70%	11,95,615	26/10/20 to 05/11/20	93006 (11/10/20) 98002 (20/10/20)	1:13 1:12
Non-NMC	22,47,905	20.70%	4,65,316	15/10/20 to 31/10/20	15939 (01/10/20) 17729 (09/10/20)	1:29 1:26

Statistical analysis

The data was cleaned, coded and analysed using EPI INFO version 7.2.2.6.

RESULTS

In non NMC area there was 100 percent coverage of sample, whereas in NMC area the coverage was 99.6 %. Males and females were represented almost equally in the study sample. Of the 2000 study participants from non NMC area 942 (47.1%) were male and 1058 (52.9%) were female and amongst 1992 study subjects from NMC area 983 (49.35%) were male, whereas 1009 (50.65%) were female. Majority of the study subjects belonged to the age group of 21 to 50 years. One hundred thirty one (6.5%) of study subjects were of more than 70 years of age. The total seroprevalence in Nagpur district was found to be 35.17% (1404), 95% CI (32.7-37.7). The seroprevalance in NMC area, 49.7% (990), 95% CI (46-56.2) was more than twice from that of non NMC area, 20.7% (414), 95% CI (16.9-25) (Figure 2). In NMC area the seroprevalence in slum (48.99%) and non slum (50.33%) areas was almost equal.

As per the observed seroprevalence rate the estimated number of infected persons considering the population size (as per 2011 census) was much greater than the actual reported cases in both NMC and non NMC area with cases to infections ratio of around 1:12 and 1:26 respectively (Table 2). Of the 2000 study participants surveyed in Non NMC area, 942 (47.1 %) were male and

1058 (52.9%) were female and amongst 1992 study subjects from NMC area 983 (49.35%) were male, whereas 1009 (50.65%) were female. Seropositivity was maximum in the age group of 21 to 50 years in both NMC and Non NMC area (Figure 3). However there was no remarkable gender wise difference in the seroprevalence.
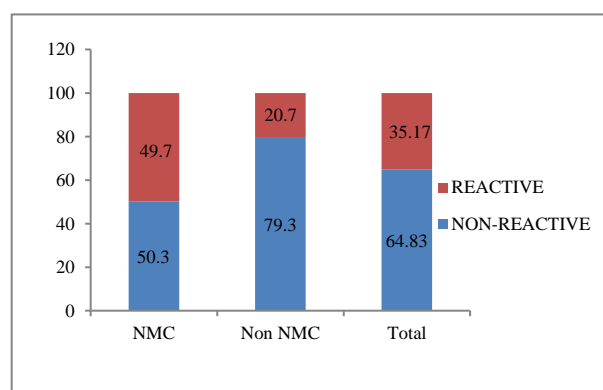

Figure 2: Seroprevalence in NMC and non NMC area.

Though total sero prevalence in the area under the jurisdiction of Nagpur Municipal Corporation (NMC) was 49.7%, the prevalence varied across zones and clusters. Gandhibag and Ashi Nagar zones had 65% and 64.5% prevalence respectively. They were followed closely by Satranjipura zone with 62% prevalence. This means, much of the population in these zones had already contracted SARS-CoV-2 infection sometime in the past. The lowest prevalence was seen in Hanuman Nagar with

35.8%, followed by Dharampeth zone 40.5%. 5 clusters each from different zones with highest and lowest seroprevalence is shown in (Table 4).

It was noted that 80% surveyed candidates in Vinoba Bhave Nagar, and 75% in Tandapeth had antibodies while Janaki Nagar was the cluster with lowest sero-prevalence of 16%.
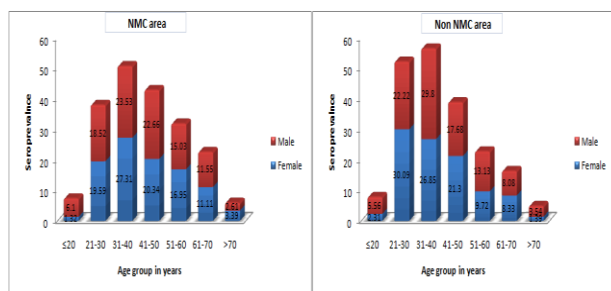

Figure 3: Age and Gender wise Seroprevalence in NMC and non NMC area.

Table 3: Zonewise seroprevalence in NMC area.

Zone	Population surveyed	Reactive	Prevalence (%)
Gandhibagh	200	130	65.00
Ashinagar	200	129	64.50
Satranjipura	200	124	62.00
Mangalwari	200	100	50.00
Dhantoli	200	96	48.00
Lakadganj	194	93	47.90
Nehru Nagar	200	84	42.00
Laxmi Nagar	200	82	41.00
Dharampeth	200	81	40.50
Hanuman Nagar	198	71	35.86

Similarly of the 13 talukas surveyed from non NMC area, Kamptee (37.33%) and Mouda (26.67%) topped the list followed by Nagpur Rural with 24%, and Hingna with 23.33% whereas Kuhi and Narkhed with least seroprevalence of 14.67% and 8.67% respectively were the bottom two.

Table 4: Top 5 and bottom 5 clusters in NMC area as per seroprevalence.

Highest seroprevalence			Lowest seroprevalence		
Zone	**Cluster**	**Prevalence (%)**	**Zone**	**Cluster**	**Prevalence (%)**
Ashinagar	Vinobabhave nagar	80	Hanuman nagar	Jankinagar	16
Satranjipura	Tandapeth	74	Dhantoli	Narendra nagar	24
Gandhibagh	Mominpura	70	Laxmi nagar	Somalwada	32
Gandhibagh	Bhankheda	68	Nehru nagar	Ramanamaroti nagar	32
Dhantoli	Shaniwari	66	Hanuman nagar	Ayodhya nagar	33.3

Table 5: Talukawise seroprevalence in non NMC area.

Taluka	Population surveyed	Reactive	Prevalence %
Kamptee	150	56	37.33
Mauda	150	40	26.67
Nagpur Rural	200	48	24.00
Parseoni	150	35	23.33
Hingna	150	35	23.33
Kalameshwar	150	33	22.00
Ramtek	150	28	18.67
Umred	150	28	18.67
Katol	150	26	17.33
Saoner	150	25	16.67
Bhiwapur	150	25	16.67
Kuhi	150	22	14.67
Narkhed	150	13	8.67

Clusters with highest and lowest prevalence are seen in (Table 6). As far as clusters in various talukas are concerned, Kamptee Urban was the worst affected in rural areas with a sero prevalence of 44%. Majority of the subjects who tested positive for antibodies were asymptomatic i.e. 99.6% in NMC area and 96.9% in Non NMC area. The commonest symptoms observed were cough, fever and headache. Of the seropositive individuals from NMC area 911 (92.0%) and from those of non NMC area 1376 (86.8%) had no co morbidities, the commonest co morbidities observed being diabetes and hypertension.

Table 6: Top 5 and bottom 5 clusters in Non NMC area as per seroprevalence.

Highest seroprevalence			Lowest seroprevalence		
Taluka	**Cluster**	**Prevalence (%)**	**Taluka**	**Cluster**	**Prevalence (%)**
Kamptee	Kamptee (U)	44	Ramtek	Deolapar	4
Mauda	Mauda (U)	38	Narkhed	Mahendri	4
Parseoni	Parseoni (U)	38	Narkhed	Mendhala	4
Kamptee	Bina	36	Kuhi	Ambhora kh.	6
Kamptee	Mahalgaon	32	Bhiwapur	Mandawa	8

DISCUSSION

In this serosurvey from Nagpur district the overall prevalence of antibodies to SARS-CoV-2 was 35.17 %. In the NMC area the seroprevalence was 49.7% which was more than twice that of Non NMC area i.e. 20.7%. This survey result translates to approximately 11,95,615 adults from NMC and 4,65,316 from non NMC area having been exposed to novel corona virus resulting in the development of SARS-CoV-2 antibodies. This estimate as per 2011 census population of Nagpur district implies that substantially greater numbers of persons were actually infected than the cumulative number of confirmed infections reported during the month of October and November 2020 in Nagpur district. Also if we take into account the actual population in the year 2020 these figures of infected persons will increase manifold and thereby further decrease the reported case fatality rate. Another thing requiring special mention is that a large proportion of the population (64.83%) is still susceptible to the infection and thus there is no time for complacency.

The first National sero-prevalence survey, by Indian council of medical research (ICMR) conducted over May and June 2020 reported a seroprevalence of 0.73%.[7] Serosurveillance carried out in Pune (51.5%) showed a high seroprevalence similar to the present study.[8] However lesser seroprevalence was reported in studies carried out at Srinagar (3.6%), Ahmedabad (23.24%) and Aurangabad (5.8%) as well as in Delhi (serosurveys I and II) (23% and 29%).[9-13] Also similar studies carried out in other countries reported a seroprevalence ranging from 1% to 22%.[14-20] Another implication of this finding of high sero prevalence is that the reported fatality rates based on confirmed cases may be higher than actual rates based on number of infections. A large proportion of infections remain unknown. For every RT-PCR confirmed case, there are about 12 infections in the population going unnoticed in NMC area and 29 infections in non NMC area. This figure is similar to that reported from Switzerland.[14] However study carried out by Salim et al in Srinagar reported 46 infections per case which was considerably higher as compared to the present study.[9] Serosurveys carried out in Mumbai and Aurangabad showed a higher seroprevalence in slum areas as compared to the non slum areas. No significant difference between slum and non slum areas was detected in present study.[11,12]

Results of present serosurvey suggest that a large number of infections are asymptomatic and these are likely to be much higher than actually reported cases. Taking together the current prevalence (estimated here) and records from health authorities from the respective area on reported deaths, the reported fatality rate is likely to be very low. Among other things, this could be attributed to effective containment efforts and active measures to isolate symptomatic cases. High seropositivity in certain areas must not generate a false sense of security in the common people. The clusters having lower seroprevalence including the entire non NMC area is more vulnerable for the second wave of the pandemic if any. So COVID appropriate behaviour i.e. wearing mask, hand hygiene and social distancing remain the mainstay of control. It is recommended to conduct such serosurveys at regular intervals to gauge the trend of infection in this region.

CONCLUSION

Considerably large numbers of infections are asymptomatic, however a sizeable proportion of population is still susceptible to the infection and thus there is no time for complacency.

ACKNOWLEDGEMENTS

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