Technical Details

Organizations involved: NITI-Aayog, Municipal Corporation of Greater Mumbai (MCGM) and the Tata Institute of Fundamental Research (TIFR), and partner organizations viz. Kasturba Molecular Diagnostic Laboratory, Translational Health Science and Technology Institute (THSTI), A.T.E. Chandra Foundation and IDFC Institute.

Rationale of the study: As a large cross-sectional survey in India, this study aimed to estimate prevalence in the population based on random sampling methodology and to be conducted at two time points to infer epidemic trajectory. The study was designed to capture exposure to SARS-CoV2 infection in slum and non-slum areas, and from (a) age & gender stratified samples from the general population and b) Health care workers, in areas selected based on reported cases. Participants were recruited following informed voluntary consent. Anti-SARS-CoV2 IgG was detected using Chemiluminescence assay (CLIA) by Abbott, whose specificity (100%) and sensitivity (93%) has been independently validated by Public Health England (PHE)[1].

Findings from the first round:

Study period: 14 days in July 2020.

Areas selected: Three wards (R-North, M-West and F-North) in Mumbai were chosen based on the following criteria: (a) City and Suburban areas (b) East, West and North areas and (c) As representative of localities with low to high prevalence based on reported cases as on June 2nd 2020.

Sampling design: Sampling from households (in slums) or buildings (in non-slums), which were separated by at least 3 households/buildings ensured geographically separate and a systematic method for non-overlapping area coverage. In high-rises with more than 5 apartments, N/5 households were selected from separate floors (one household for every 5 apartments in a building). No more than one sample were collected per household/family and as per the age/gender stratification viz. Females and Males belonging to age brackets (a) 12-24 years (b) 25-39 years (c) 40-60 years and (d) >60 years.

Sample sizes were calculated based on statistical considerations, which took into account reported cases and population sizes in each of these wards as below (for slums and non-slums separately)[2]. No sampling was done in active containment zones (i.e. during the study period)

Name	Ward	Number infected by June 2	Population (Census 2011, in lac)	Infected per person June 2	Scaled prevalence est. (based on model)	Variance	Samples to get 1.5% half width
Matunga	FN	2726	5.29	0.52%	15.61%	13.17%	**2,249**
Chembur West	MW	1446	4.12	0.35%	10.63%	9.50%	**1,622**
Dahisar	RN	486	4.31	0.11%	3.42%	3.30%	**564**
	Total Mumbai	**41068**	**124.4**	**0.33%**	10.00%		

Table-1: Calculation of sample size (slums & non-slums) based on statistical methods

Samples analyzed in slums and non-slums

Number of participants recruited and samples analyzed are as below:

	Start date	End date	Target	Percent recruitment	Final number of samples analyzed*
FN slum	29-06-20	13-07-20	2249	101	2144
FN non slum	04-07-20	19-07-20	2249	52	1183
MW slum	29-06-20	14-07-20	1622	99	1518
MW non slum	08-07-20	18-07-20	1622	59	942
RN slum	30-06-20	09-07-20	564	103	572
RN non slum	03-07-20	16-07-20	564	101	577

* After excluding samples for (a) insufficient volume (b) not part of the study design (c) other technical errors

Strengths of the study:

- Large sample sizes to estimate prevalence with better accuracy (total 6936 from 3-wards)
- Random sampling methodology to capture prevalence in population without bias.
- The kit used in this study has been independently validated by PHE for 100% specificity and 93% sensitivity. The PHE study also suggests that the kit does not cross-react with other seasonal corona-viruses, which have been tested.
- Age and gender wise stratification to provide insights into sero-prevalence.
- Assess impact of risk factors on prevalence (analysis ongoing)
- Estimate prevalence in health care workers (analysis ongoing)
- Determination of presence of viral neutralizing antibodies (studies ongoing) again in an age-/gender-wise classification.

Potential caveats of the study:

- As with any sero-surveillance our study also captures only people who have circulating antibodies and those who were infected in the recent past. Although a caveat, this in fact puts the prevalence at a conservative lower number.
- The study has possibly missed migrant population in these wards, which may have left the city during the lockdown.
- Overall turnout in the non-slums was lower than design. Nonetheless, the sample size relative to the prevalence is adequate to draw statistically meaningful conclusions.

Key findings of the study from general population

in slum and non-slum areas of Mumbai

The sample sizes were calculated based on cases reported up to June, and predicated on expected prevalence of as described in **Table-1**. Sampling included people who may have been symptomatic and recovered or asymptomatic, without distinction and excluded those who were in institutionalized quarantine facilities (i.e. during the study period). No sampling was done in active containment zones (i.e. during the study period).

The systematically conducted study estimates around 57% prevalence in slums and 16% prevalence in non-slums, on an average, in the three wards that were studied tables in annexure below. These numbers have not been corrected for 93% sensitivity of the CLIA test used, which puts the numbers at a lower conservative estimate.

a. Prevalence across slums populations is as follows: **57.8%** (CI: 55.7-59.9%) in **F/N** (sample size: 2144); **56.7%** (CI: 54.2-59.1%) in **MW** (sample size: 1518) and **51.0%** (CI: 47-55.1%) in **RN** (sample size: 572).
b. Prevalence across non-slum populations is as follows: **17.4%** (CI: 15.3-19.6%) in **F/N** (sample size: 1183), **15.6%** (CI: 13.3-17.9%) in **MW** (sample size: 942) and **11.4%** (CI: 8.8-14.0%) in **RN** (sample size: 577).
c. Although prevalence in women was marginally higher than men, age wise prevalence in the populations was comparable.
d. The above numbers have not been adjusted for the age-bias in the sampled population. This will be corrected after further analysis.

Interpretations

- Results suggest that asymptomatic infections are likely to be a high proportion of all infections.
- Higher prevalence in slums could be possibly due to population density and shared common facilities (toilets, water points etc.).
- Taking together the current prevalence (estimated here) and records from BMC on reported deaths, and depending upon the estimates of slum and non-slum population in the three wards, the infection fatality rate (IFR) is likely to be very low (0.05-0.15%). Among others, this could be attributed to effective containment efforts and active measures to isolate symptomatic cases by MCGM.
- Lower prevalence in non-slums could be due to better social distancing and access to better hygiene in addition to interventions by MCGM to stem the spread of infection.
- These results will be valuable to learn more about herd immunity. Although it is still unclear what level of prevalence leads to herd immunity, our findings indicate that at least in slums this could be attained sooner than later, if the immunity exists and persists in a significant proportion of the population.

In summary, based on BMC records it seems that unlike the case fatality rate (CFR) (roughly 5-7%), the infection fatality rate (IFR) (0.05-0.15%) in the three wards is lower. Hence, together with relatively low prevalence in the non-slums it suggests that social distancing and related

precautions such as wearing masks are effective in slowing the infection spread and should continue as a new normal in all sections of the society independent of prevalence.

Ongoing study/analysis will provide information on (a) presence of neutralizing antibodies (b) risk factors on SARS-CoV2 infection. Planned repeat surveys will provide information about infection spread in both slums and non-slums, and could inform about herd immunity.

Investigators involved in the study

PI: Dr. Ullas Kolthur-Seetharam (TIFR)

Co-PIs: Dr. Daksha Shah (BMC) and Dr. Jayanthi Shastri (Kasturba Molecular Diagnostic Laboratory);

Co-investigators: Dr. Sandeep Juneja (TIFR), Dr. Gagandeep Kang (THSTI), Dr. Anup Malani (IDFC), Dr. Manoj Mohanan (IDFC), Ms. Gayatri Nair Lobo (ATECF), Dr. Gajanan Velhal (HOD, Community Medicine, KEM) and Dr. Mangla Gomare (EHO-BMC)

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Reference:

1. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/890566/Evaluation_of_Abbott_SARS_CoV_2_IgG_PHE.pdf
2. http://arxiv.org/abs/2006.03375