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A Seroprevalence of IgG antibody against Covid-19 in children: Community based Serosurvey, Gwalior district, Madhya Pradesh

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Abstract

Background: *Reported corona virus disease 2019 (COVID-19) case counts likely underestimate the true prevalence because mild or asymptomatic cases often go untested. Here, we use a sero-survey to estimate the seroprevalence of IgG antibodies in children below 18 years.* ***Methods:*** *We did a household serosurvey among individuals aged 1to 18 years old in the 4 urban wards and 4 rural areas within Gwalior districts. Individuals aged older than 18 years and households that did not respond at the time of survey were excluded. Participants were interviewed to collect information on socio-demographics, symptoms suggestive of COVID-19, exposure history to laboratory confirmed COVID-19 cases, and history of COVID-19 illness. 3ml of venous blood was collected from each participant and blood samples were tested using the Abbott SARS-CoV-2 IgG assay. Seroprevalence was estimated after applying the sampling weights and adjusting for clustering and assay characteristics. We randomly selected one person blood sample from each household to compare the seroprevalence among children between the two groups according to high exposure to confirmed Covid19 and not exposure.* ***Findings****: Between 16 and July18, 2021, we enrolled and collected serum samples from 400 individuals from 400 households. The weighted and adjusted seroprevalence of SARS-CoV-2 IgG antibodies in individuals aged below 18 year was 76% (95%CI, 71, 4:80.4). Seroprevalence was highest in urban areas. Seropositivity was significantly lower in children of 15-18 age groups than younger age group.* ***Interpretation & Importance****: This study determined the percentages of children samples from the Gwalior district urban and rural area that had antibodies to SARS-CoV-2 in late June to mid July 2021. Approximately 76% of the tested individuals had antibodies, indicating that they had previously been exposed/infected by SARS-CoV-2. These results demonstrate that the extent of infection was about very much greater than the number of confirmed cases at that time. Furthermore, it demonstrated that by 18 years of age, children were infected to an extent similar or more to that of adults.*

Keywords: *COVID-19, IgG Antibody, Seroprevalence, Children. Serosurvey*

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I. Introduction

Corona virus disease 2019 (COVID-19) has emerged as a pandemic, and the infection due to SARS-CoV-2 has now spread to more than 200 countries[1]. Surveillance systems form the foundation stone of active case finding, testing and contact tracing, which are the key components of the public health response to this novel, emerging infectious disease[2]. There is uncertainty about the true proportion of patients who remain asymptomatic or pre-symptomatic at a given time. As per the WHO-China Joint Monitoring Mission Report, and an analysis of 21 published reports, anywhere between 5 and 80 per cent of SARS-CoV-2-infected patients have been noted to be asymptomatic[3,4]. The seroprevalence of severe acute respiratory syndrome corona virus 2 (SARS-CoV-2) antibodies is important to understand the transmission dynamics of the virus; estimate total

infections, including mild and asymptomatic individuals who might not receive testing; and inform the possibility of transmission interruption through the depletion of susceptible individuals, if seroconversion is associated with robust immunity. Population-based data can supplement case based surveillance to inform public health measures.[5] Population-based sero-epidemiological studies are useful to measure the extent of SARS-CoV-2 infection and the effect of ongoing public health responses in controlling the pandemic.[6] The key implications of a sero survey for public health experts lie in the status of the spread of an infection among a particular sample group. According to the Indian Council of Medical Research (ICMR), sero surveys can provide data on "the proportion of population exposed to the novel corona virus, including asymptomatic individuals".[7]

The Indian Council of Medical Research (ICMR), therefore, proposes to establish a community-based district-level serosurveillance system to monitor the transmission of SARS-CoV-2 infection in the general population. The initial survey would serve as a baseline to determine the seroprevalence of SARS-CoV-2 infection in the community[6].

The role of children in the spread of SARS-CoV-2 is unclear. Lower prevalence is generally reported in younger children than in adults. Asymptomatic individuals seem to account for up to 50% of SARS-CoV-2 infections, and the rate may be even higher in children. Asymptomatic individuals, including children, show evidence of high viral shedding and likely contribute to the rapid spread of the disease[8] The objectives of this serosurveillance are to estimate seroprevalence for SARS-CoV-2 infection in the younger age population i.e., below 18 years of age in the form of presence of IgG antibody, determine the socio-demographic risk factors for SARS-CoV-2 infection and delineate the geographical spread of the infection in the younger age population.

II. Proposed Protocol/Methodology

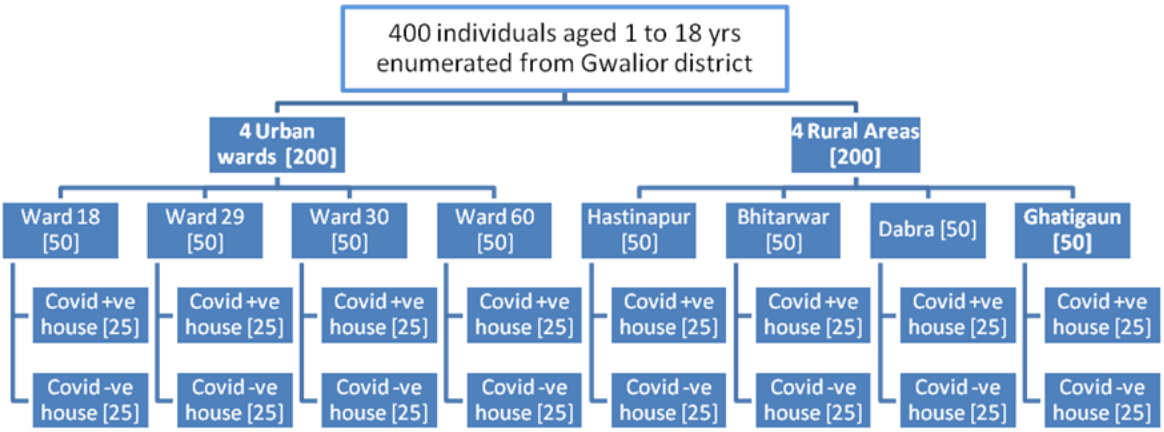
This serosurveillance is designed as a cross-sectional survey of pediatric age group 1 to 18 yr.

***Sampling strategy*:** For this purpose, 400 individuals were enrolled from district Gwalior. The district was categorized into eight strata, four wards in urban area and four rural blocks in rural area. 50 individuals were included for the survey from 8 clusters randomly. The survey team was visited houses in the selected clusters (rural block/ward) in each of the eight random locations. From each random location, at least 50 individuals were enrolled among them each 25 were selected from houses had the Covid19 patient history and simultaneously 25 were enrolled from the houses those did not had the history of Covid19 patient [Fig1. Flow Diagram of participants enrollment]. One individual of the age in between 1 to 18 yr was selected with their parents/guardian consent from selected covid19 positive patient house or negative houses. Individuals aged older than 18 years and households that did not respond at the time of survey were excluded. We obtained assent from children aged below 18 years, with written informed consent from their parents or guardians, before the survey. The study protocol was approved by the state health department (NHM) and district health committee.

Procedures

Parents/ Guardian of eligible participants were interviewed to collect information about sociodemographic details, symptoms suggestive of COVID-19 since 15 June, 2021 (e.g.,, fever, cough, shortness of breath, sore throat, new loss of taste or smell, fatigue), exposure history to laboratory confirmed COVID-19 cases, and history of COVID-19 illness. 3 ml of venous blood was collected from each participant, and samples were transported to regional virology lab of our institute G R Medical College Gwalior under cold chain. Participant serum samples were tested for the presence of SARS-CoV-2 specific IgG antibodies on the Abbott Architect i2000SR automated analyzer using the Abbott SARS-CoV-2 IgG assay. Assay results higher than or equal to the cut of index value of 1· 4 were interpreted as positive for SARS-CoV-2 antibodies.

Fig1. Flow Chart of Participants enrollment



Statistical Analysis

We described the characteristics of study participants as percentages with 95%CI, means, and SDs and applied chi square test approving difference is significant or not. We categorised the reported individual into high potent-risk and low-risk categories, on the basis of the potential risk of exposure to a known COVID-19 case. For example, persons such were living in the house of covid19 patient were considered high potent risk category and the persons those were living in non covid19 patient house was of low/non risk category. The data were analysed to estimate the seroprevalence of IgG antibodies against SARS-COV-2 with 95% CI, using a random-effects model. To estimate weighed seroprevalence of SARS-CoV-2 infections among individuals aged 1 to 18 years old, calculated seroprevalence by total participants.

III. Result

Between 16 and 18 July, 2021, we enumerated 400 individuals aged 1 to 18 years from eligible households in the 8 clusters. Of the 400 survey participants, 115 (28.7%) were in the age group 10–14 years, 114 (28· 5%) were aged 15–18 years, 93 (23· 5%) were aged 1–6 years, and 78 (19·5%) were aged 15-18 years. Mean age of participants were 10.38 [SD: ±4.35] [P <0.02]. 211 participants (52·75%) were male, 189 (47·25%) were female and 200 (50.0%) were residing in rural areas and urban area each, and 200 (50·0%) had a high risk of exposure to people potentially infected with COVID-19. 54 participants (13·5%) reported symptoms suggestive of COVID-19 since June, 2021, of whom 191 (35·0%) reported seeking medical care. 44 individuals (11.0%) reported having been tested for SARS-CoV-2 previously, of whom 02 (4.5%) had a positive COVID-19 test (Table 1).

Table1. Participants' demographic characteristics

Demographic Characteristics	Participants (n=400) No (%)
Age (Year)	
1-6	93 (23.25)
7-10	115 (28.75)
11-14	114 (28.5)
15-18	78 (19.5)
Mean Age (Years)[SD]	**10.38 ±4.35 [P <0.02**
Sex	
Male	211(52.75)
Female	189(47.25)
Area of Residence	
Urban	200 (50.0)
Rural	200(50.0)
History of contact with a known COVID-19 case in the family	200 (50.0)
History of COVID-19-related symptoms since June 1, 2021	54(13.5)
Previously tested for COVID-19 (n=400)	44(11.0)
Previous positive COVID-19 test (n=44)	2 (0.5)

Of the 400 participants, 304(76%,[95%CI;71.4:80.4]) tested positive for the presence of IgG antibodies against SARS-CoV-2 in an unweighted seroprevalence. The seropositivity across ranged from 66% to 84% rural to urban

(Table 2).Seroprevalence was lowest among children aged 1–6 years (73.1% [95%CI, 62.7, 81.5], and same among children aged 11–14 years & 15-19 years (78.2%[95%CI, 67.1, 86.4]) and it was different significantly between age groups (p<0.001), and similarly among males 80.6%[95%CI,74.4, 85.5] and females 70.9%(95%CI63.8:77.1) had significant difference (P<0.02) in unweighed while in weighted there was no significant difference (Table2). Seroprevalence was higher in urban 158(79.0% [95%CI, 72.6, 84.3] than in rural areas 146(73.0%[95%CI,66.2,78.9]) (table 2). There was a significant difference (p<0.001) in seroprevalence between categorised as high or low risk based on potential exposure to COVID-19 patients in their house. Among individuals who reported a history of symptoms suggestive of COVID-19, seroprevalence was 81.5% [95%CI, 68.1, 90.30] compared with 75.1[95%CI, 70.2, 79.55] among individuals who did not report symptoms suggestive of COVID-19. Seroprevalence was higher among those who reported history of contact with a laboratory-confirmed COVID-19 case (90.6% [95%CI, 86.0, 93.8] and among those who had previously been tested for SARS-CoV-2 (95.4% [95%CI, 79.1, 97.3])(Table2).

Table2. Seroprevalence of Immunoglobulin g (IgG) antibody by Demographic Characteristics

	Participants tested [n]	Seropositive Participants [n]	Weighted Seroprevalence %(95%CI)	Adjusted Overall Weighed Seroprevalence %(95%CI)
Overall	400	304	76.0 (71.4:80.4)	
Sex				
Male	211	170	80.6[74.4, 85.5]	42.5[37.6, 47.5]
Female	189	134	70.9(63.8:77.1)	33.5[28.9, 38.4]
			P<0.02 (Significant)	
Age (Year)				
1-6	93	68	73.1 [62.7, 81.5]	17.0 [13.5, 21.1]
7-10	115	89	77.4 [68.5, 84.4]	22.2 [18.3, 26.7]
11-14	114	86	78.2[67.1, 86.4]	21.5[17.6, 25.9]
15-18	78	61	78.2[67.1, 86.4]	15.2[11.9, 19.2]
		P<0.01 (Significant)		
Area of Residence				
Urban	200	158	79.0[72.6, 84.3]	39.5[34.7, 44.5]
Rural	200	146	73.0[66.2, 78.9]	36.5[31.8, 41.4]
Category with high risk of exposure to Covid-19 (n=400)				
Yes	200	173	86.5[80.8, 90.8]	43.2[38.4, 48.3]
No	200	131	65.5 [58.4, 71.9]	32.7[28.2, 37.6]
			P<0.01 (Significant)	
History of COVID-19-related symptoms since June 1, 2021 (n=400)				
Yes	54	44	81.5[68.1, 90.30]	11.0[8.2, 14.6]
No	346	260	75.1[70.2, 79.55]	65.0 [60.1, 69.6]
History of contact with a known COVID-19 case (n=400)				
Yes	244	221	90.6[86.0, 93.8]	55.2[50.2, 60.2]
No	156	83	53.2[45.1, 61.2]	53.2[45.1, 61.2]
Previously tested for COVID-19 (n=244)				
Yes	44	42	95.4 [79.1, 97.3]	17.2 [13.5, 23.6]
No	196	165	84.2 [78.1, 88.8]	67.6[61.3, 73.4]
Previous COVID-19 test result (n=44)				
Positive	2	2	100.0 [19.8, 95.1]	4.5[0.8, 16.7]
Negative	42	39	92.9 [79.4, 98.1]	88.6[74.6, 95.7]

IV. Discussion

We used a serological assay to identify SARS-CoV-2 antibodies in children and observed seroprevalence rates of 76.0% among children of 1 year to 18 year. The survey assumes significance in the face of a possible third wave of Covid-19, which experts believe may affect children primarily. The role of children in the spread of SARS-CoV-2 is unclear. Lower prevalence and higher seroprevalence of IgG antibody is generally reported in younger children than in adults. This general trend was also observed in Gwalior district in late June to July 2021.There is evidence that children may be infected at lower rates than adults and that they are

less likely to experience severe symptoms[9,10], although the relative contribution of lower reported rates is unclear. Asymptomatic individuals seem to account for up to 50% of SARS-CoV-2 infections, and the rate may be even higher in children. Asymptomatic individuals, including children, show evidence of high viral shedding and likely contribute to the rapid spread of the disease [11, 12] The goal of our sero-prevalence study was to determine the extent of SARSCoV-2 and our findings from this serosurvey indicate that nearly 76% of Gwalior's pediatric population aged 1 year to 18 year had been exposed to SARS-CoV-2 infection up to last week of June, 2021. Similarly An interim sero survey being carried out by the PGI Hospital Chandigarh[13] has shown that at least 69 per cent of children have IgG antibody and also in the survey carried out in Mumbai[14] recently has found that more than 50 per cent of the pediatric population in health care settings has antibodies to Covid-19. High level of seropositivity among pediatric group indicates widespread infection in urban as well as rural area of study districts. Similar relative frequencies of seropositivity were observed in children ≥5 years of age (21/39, 53.8%) and in those less than 5 years (7/14, 50%) ($p > .05$) in the study of Rome,Italy[15] A seroprevalence results revealed by sex and age similar to our study has been reported from serosurveys was carried in Santa Clara County[16] and Spain,[17] but a serosurvey in Geneva, Switzerland[18] showed a higher seroprevalence among females than males. The higher seroprevalence in urban areas observed in our study is consistent with that of other serosurveys in densely populated urban areas, where the prevalence was 51·5% [16]. The seroprevalence was also higher in urban areas of Mumbai (54· 1%) compared with non urban areas (16· 1%) [14].Our findings also indicate substantial transmission among the rural pediatric population later in the 2nd wave of epidemic, by contrast with the first serosurvey.

Seroconversion was also documented among individuals without a history of known contact with a COVID-19 case, and among those without any previous SARS-CoV-2 testing. These data support the expansion of testing strategies to include individuals who do not have known exposure or symptoms of Covid19.Only 3% of seropositive individuals reported symptoms suggestive of COVID-19, highlighting the limitations of symptom-directed testing and the importance of universal prevention methods. An improved understanding of general seroprevalence in pediatric populations is critical to implementing public safety guidelines especially for expected third wave of covid19 pandemic. Our results indicate that children are susceptible to SARS-CoV-2 infection and develop antibody responses. Serological studies such as this provide essential information on the risk for transmission and the immunological state of the population.

V. Conclusion

It found that over 75 per cent of the children participants had antibodies against Covid-19, which means 3 out of 4 children of age 1 to 18 year had an infection and recovered. One conclusion of the survey is that children are likely to not be severely affected by the disease as most of the participants had an asymptomatic infection. 76% of the pediatric population in Gwalior district is showing immunized to SARS-CoV-2 infection. Findings suggest that major transmission is not expected to continue as presumed for suspected third wave in wards as well as rural areas among pediatric population. In addition, periodic serosurveys would help monitor the trend of infection and assess the effects of varying containment measures in the city. There is high seroprevalence trend in urban, as well as rural areas, not presents many forthcoming challenges as likely presumed ahead of third wave.

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