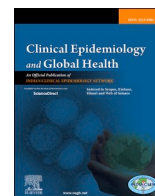




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## Original article

## A seroprevalence study of Covid 19 antibody after 1st wave of the pandemic in South Andaman district, India

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## ABSTRACT

**Background:** The seroepidemiological studies are essential to analyze spread of Covid 19 infection in the remote islands of Andaman and Nicobar. Hence, the present study was conducted to estimate the seroprevalence of Covid 19 antibodies in the South Andaman district.

**Methods:** A cross-sectional study was performed in South Andaman District after 1st wave of the Covid 19 pandemic in the island. The participants of age 18 years and above were selected by multistage cluster sampling. The blood samples were tested for IgG Covid antibodies by Erba Lisa Elisa kit. The data was analyzed by descriptive analysis and Chi Square/Fisher Exact test.

**Result:** The seroprevalence of Covid 19 in the S. Andaman district was found to be 39.3%. The COVID 19 antibody positivity was significantly higher in urban population (44.09%) as compared to rural population (34.27%) and in females of 41–60 years age group (45.5%) as compared to females of other age groups. The antibody positivity was similar among the population of containment and buffer zone (p-value 0.684).

**Conclusion:** The seropositivity in the South Andaman district was higher due to the influx of tourists on the island. The rural people in South Andaman remained less affected by the pandemic as the rural areas were far flung and thinly populated. The antibody positivity was similar in residents of containment and buffer zone because there were more social contacts and movement of the people on the island due to their extensive family linkage.

## 1. Introduction

Coronavirus disease 2019 (COVID-19) has emerged as a pandemic, and the infection has now spread to more than 200 countries.<sup>1</sup> Global data suggests that a significant proportion of SARS-CoV-2 infections are asymptomatic and remain undetected unless populations are actively screened.<sup>2,3</sup> Facility-based surveillance efforts are likely to miss mild and asymptomatic cases. The household-based antibody serosurveillance can reduce the selection biases of hospital and laboratory-based testing. The household-based antibody serosurveillance can help the scientific community in generating evidence regarding the role of asymptomatic infection in the transmission of Covid 19 and estimation of extent of this infection in the community.<sup>4,5</sup>

Indian Council of Medical Research (ICMR) first round of serosurvey in May–June 2020 found that Seropositivity of SARS-CoV-2 was 0.73% in India, 2nd round of ICMR serosurvey in August 2020 found that Seroprevalence of SARS-CoV-2 was 6.6% in India.<sup>6,7</sup> The seroprevalence

in other parts of India varied from 24.08% to 51.5%.<sup>8,9</sup> Thus, there was a lot of geographical and temporal variation in the prevalence of Covid 19 antibodies among different states in the country.<sup>6–11</sup> None of these studies covered Andaman and Nicobar islands.

The district of South Andaman, one of the three Districts of Andaman & Nicobar Islands, is located in between longitude E 92° to E 94° and latitude N 6° to N 14° in the Bay of Bengal Region. The Total Area of the South Andaman District is 2980 Sq. Km. South Andaman has a combination of rich beaches, rising hinterland, and dense equatorial forests which makes it a favorite tourist destination of India. This district has a population density of 80 per sq Km only which is far less than the Indian average of 324 persons per sq. km. South Andaman district has a unique characteristic of population and geography of its own.

Therefore, the present study was done to estimate the prevalence of Covid 19 antibodies in the South Andaman District and to find the mode of spread of Covid 19 in the community in the South Andaman District. The study also tried to assess the Covid 19 antibody level across the

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population living in the containment and buffer zone of South Andaman district as this could reveal the level of exposure and the immunity of the community.

## 2. Materials and method

A community-based cross-sectional seroprevalence study was conducted in the South Andaman district. South Andaman is the most populated district of Andaman and Nicobar Island, an archipelago in the Bay of Bengal. The three districts of Andaman and Nicobar Island are separated by sea and difficult terrains. Hence, the South Andaman district has an almost segregated and isolated population of 238,142 (2011 census).

The study was conducted in the population above 18 years living in South Andaman District. The children less than 18 years were excluded from the study since they were protected from viral exposure as the schools and colleges were closed for more than nine months due to frequent lockdowns. The individuals suffering from any immune-deficient condition or under chemotherapy were excluded from the study.

In order to contain the spread of infection in the district, the district administration of South Andaman district designated containment and buffer zone in the district according to the criteria laid down by the Government of India.<sup>12</sup> The containment zones were identified by the rapid response team based on the extent of cases listed and mapped by them. If contact listing and mapping took more than 24 h to complete then the whole area of 3 km radius surrounding the epicenter (residence of the positive case) in rural areas or administrative boundaries of the residential colony in urban areas were demarcated as containment zone. Only essential activities were allowed in the containment zones. There was no movement of people in or out of the containment zone except for medical emergencies and for maintaining the supply of essential goods and services. In addition, a 7 km radius from the containment zone in rural areas and a 5 km radius from the containment zone in urban areas were demarcated as a buffer zone for Covid 19 in the South Andaman district.

There were no reliable estimates of the prevalence of Covid 19 among containment and buffer zone of South Andaman. Therefore, considering 50% prevalence,<sup>13,14</sup> 2.5 design effect, 5% absolute precision, the following formula was used

$$n = [z^2pq/d^2] \text{ DEFF}$$

Where:  $n$  = sample size,  $z$  = linked to 95% confidence interval for cluster sampling = 2.0(1.96),  $p$  = expected prevalence (fraction of 1) = 0.5,  $q$  = 1 -  $p$  (expected non-prevalence) = 0.5,  $d$  = absolute precision = 0.05, DEFF = Design Effect = 2.5 The minimum sample size came out to be 1000. However, in the study 1015 participants participated in the containment zones and 1385 participants participated in the buffer zones.

Multistage cluster sampling was used for the study. A village in the rural area and a municipal ward in urban areas were taken as a cluster for sampling. 20 clusters each were selected randomly from the list of containment and buffer zone of South Andaman. In each cluster, 50 participants were selected randomly from the list of eligible residents of the cluster. However, some persons who approached the survey team for antibody testing other than randomly selected were allowed by the survey team for antibody testing so that the survey team got better support and participation of the community in the study area and were included in the survey according to their respective area.

1st wave of Covid 19 reached its peak with 149 cases on August 14, 2020 in South Andaman District and it receded an average of fewer than 10 cases per day from December 2020 to February 2021.<sup>15</sup> Hence, the sample collection was done from December 2020 to February 2021 as the serosurvey study during this period could give us an estimate of Covid 19 antibodies after 1st wave of infection. A predesigned and

pre-validated questionnaire was used to collect socio-demographic and other Covid 19 related information. The survey team collected 3–5 ml venous blood samples from study participants only after taking informed consent.

Detection of Covid 19 IgG antibodies was performed using Erba Lisa ELISA-based test. Erba Lisa ELISA-based test kit is based on the principle of indirect ELISA using recombinant Spike subunit antigen. The sensitivity of the kit was 95.0% and the specificity of the kit was 99.3%. Antibody index is calculated by dividing each sample OD by cutoff value and the participants were classified as follows: less than 0.9 were reported as no detectable IgG antibody to covid 19, from 0.9 to 1.1 were reported as borderline positive, more than 1.1 was reported positive. However, borderline positive results were combined with the positive case for statistical analysis because the Antibody index of 0.9–1.1 was an indication that there was a considerable amount of immune response in the participants against Covid 19 and thus showed a past episode of Covid 19 infection.

Data were analyzed in SPSS version 20. Descriptive analysis was done for sociodemographic variables. Chi-square/Fisher Exact test was used to find the association between the categorical variables. A  $p$ -value of  $<0.05$  was considered statistically significant. The study was approved by the Institutional ethical committee.

## 3. Result

A total of 238,142 (2011 census) population live in S. Andaman District. Out of this, 2400 persons resident of this district were examined for Covid 19 antibodies. Out of the study population, 49.79% belonged to 18–40 years, 38.08% belonged to 41–60 years and 12.13% belonged to  $>60$  years. The population belonging to 41–60 years had significantly high antibody positivity as compared to other age groups ( $p$ -value 0.028) which was not possible without Covid 19 infection in them (Table 1).

The study population was further divided into males and females. The males were 57.71% whereas females were 42.29%. The antibody positivity was similar in both the sexes ( $p$ -value 0.437 as shown in Table 1). It was also found that antibody positivity was similar in all age groups among males ( $p$ -value 0.624) whereas antibody positivity was higher in females of age group 41–60 years as compared to other age groups of females ( $p$ -value 0.014) as shown in Table 2.

Out of the population serosurveyed, 48.88% of people lived in rural areas whereas 51.13% of people lived in urban areas. It was observed that people living in urban areas had significantly higher antibody positivity as compared to people living in rural areas ( $p$ -value 0.0001). It was also observed that males, as well as females of urban areas, had higher antibodies as compared to males and females of rural areas (Table 3).

The above poverty line (APL) population in the study population was 91.29% whereas below poverty line (BPL) was 8.71%. The antibody positivity was similar in both groups (Table 1). The overall prevalence of COVID 19 antibodies in the South Andaman district was 39.3%. The prevalence of COVID 19 antibodies was found to be 38.82% in the containment zone and 39.64% in the buffer zone respectively and it was statistically insignificant (Chi-square  $p$ -value 0.684) (Table 4).

## 4. Discussion

This Covid 19 seroprevalence study was conducted in the South Andaman District of this remote Andaman and Nicobar group of islands. South Andaman district has the highest population density among the three districts of Andaman and Nicobar Island. It has the only airport (Port Blair) in the archipelago. The whole of the island is served by only one tertiary care hospital located in Port Blair. South Andaman district is located in between longitude E 92° to E 94° and latitude N 6° to N 14° in the Bay of Bengal Region. It is only connected by airport and seaport to mainland and rest of world. It has a captive population of 238,142

**Table 1**  
COVID 19 antibody in different socio-demographic groups.

		Antibody positive		Antibody negative		Total		Chi square p value
		n	%	N	%	N	%	
Age	18–40	451	37.7	744	62.3	1195	49.79	0.028
	41–60	389	42.6	525	57.4	914	38.08	
	>60	103	35.4	188	64.6	291	12.13	
Sex	Male	535	38.63	850	61.37	1385	57.71	0.437
	Female	408	40.20	607	59.80	1015	42.29	
Residence	Rural	402	34.27	771	65.73	1173	48.88	0.0001
	Urban	541	44.09	686	55.91	1227	51.13	
Poverty line	APL	857	39.11	1334	60.89	2191	91.29	0.565
	BPL	86	41.15	123	58.85	209	8.71	
Total		943	39.3	1457	60.7	2400	100	

APL = above the poverty line, BPL = below the poverty line.

**Table 2**  
Age distribution of Covid 19 antibodies in males and females of South Andaman District.

Sex		COVID 19 Antibody				Total	P value (Chi-Square test)
		Positive		Negative			
		N	%	n	%		
Female	age	18–40	187	37.4	313	62.6	0.014
		41–60	184	45.5	220	54.5	
		>60	37	33.3	74	66.7	
	Total	408	40.2	607	59.8		
Male	age	18–40	264	38.0	431	62.0	0.624
		41–60	205	40.2	305	59.8	
		>60	66	36.7	114	63.3	
	Total	535	38.6	850	61.4		

**Table 3**  
Covid 19 antibodies in males and females in the rural and urban population of South Andaman District.

Sex	Area	COVID 19 Antibody				Total	P value(Chi-Square test)
		Positive		Negative			
		N	%	n	%		
Female	Rural	188	35.2	346	64.8	534	0.001
		220	45.7	261	54.3		
	Total	408	40.2	607	59.8		
Male	Rural	214	33.5	425	66.5	639	0.0001
		321	43.0	425	57.0		
	Total	535	38.6	850	61.4		

(2011 census). Hence, the only way to spread of Covid 19 on the island is through tourists and travelers.

The percentage of seropositive participants in the South Andaman District was 39.3% which was higher as compared to the Indian Council of Medical Research (ICMR) national serosurvey and also the serosurvey report of Delhi and Chennai.<sup>7,8,11</sup> The seropositivity in South Andaman District was statistically different from these areas on applying Z test for two proportion. The higher seroprevalence of Covid 19 in South Andaman District might be due to high air and sea travel of tourists and islanders in South Andaman District. There was an average inflow of 670 passengers per day in the South Andaman District in the last year (From

**Table 4**  
COVID 19 antibody among containment and buffer zones of South Andaman District.

		Antibody positive		Antibody negative		Total		Chi square p value
		N	%	N	%	n	%	
COVID Zone	Containment	394	38.82	621	61.18	1015	42.29	0.684
	Buffer	549	39.64	836	60.36	1385	57.71	
Total		943	39.3	1457	60.7	2400	100	

May 25, 2020, to June 3, 2021).<sup>16</sup> The majority of these passengers came to Andaman district from East and South India through airports of Kolkata and Chennai respectively which were accounting for huge surge of cases in the country. These passengers might have spread the Covid 19 infection on the island.

The movement or migration of people from one state to another state had spread the covid 19 infections in other parts of India. The interstate and intrastate migration of people had resulted in an increase in seroprevalence in various states of India such as Bihar, Kerala, Kamrup Metropolitan district in Assam, Ganjam district in Orissa as there was the migration of laborers from metro cities in India to their hometown during lockdown phase of Covid pandemic in India in 2020.<sup>7</sup> This migration of people resulted in the spread of the Covid 19 infection from metro cities to interior areas. However, no such migration was seen in the Andaman group of the island as most of them were residents of these islands for generations. The food and other essential requirements were taken care of by Andaman and Nicobar administration.

For containment of the infection, the South Andaman district was divided into containment and buffer zones as per guidelines of the Ministry of Health & Family Welfare, Government of India.<sup>12</sup> This division had no impact on the seropositivity of the South Andaman population as the COVID 19 Antibody positivity was similar in residents from containment and buffer zone. In contrast, in a serosurvey in Delhi, participants who lived in the containment zone had higher Covid 19 antibodies as compared to people who never lived in the containment zone.<sup>8</sup> This difference might be because people on the island had extensive family linkage with each other leading to unrestricted social contacts and movement. The close relatives of the various family lived in different zones in the S. Andaman district which led to comparatively more social contacts and movement of the people across different zones and social strata before the restriction of movement came into force.

This unrestricted and uninhibited movement of people across different zones and social strata spread almost uniformly across the geographical areas of the South Andaman district. Hence, no difference in antibody positivity was found between males and females which was in agreement with national and international studies.<sup>7,9,17,18</sup> On the contrary, antibody positivity was found higher in females in Delhi and Orissa because of the large numbers of females who worked as manual laborers in factories in these areas.<sup>8,19</sup> In a serosurvey from Orissa, an eastern state of India, higher antibody positivity was found in females workers in manufacturing sectors.<sup>19</sup>

The spread of the virus was seen more in the working-age group as reflected by high antibody positivity in 41–60 years of the female population. The higher prevalence of Covid 19 antibodies among 41–60 years of the female population was due to the unique socio-cultural characteristics of the island. The females belonging to 41–60 years were mainly working in South Andaman district whereas females of younger age groups worked in lesser proportion due to household responsibilities and elderly population worked in lesser proportion due to age-related health and socio-cultural issues in the island. The spread of the virus was similar in all age groups among males because the proportion of the working population was almost similar among different age groups in males. In contrast to this, in the Indian Council of Medical Research (ICMR) study and Spanish study, the seropositivity was similar across all age groups and gender as the level of exposure were almost the same in all age group and gender during lockdown phase.<sup>7,18</sup> However, in Greece, seroprevalence was higher among persons >60 years of age.<sup>20</sup> This might be because the average working-age of people in Greece was comparatively higher than the average working-age of people in S. Andaman District.

The population density of the South Andaman district was high (80 per sq. Km). But, the rural areas of the South Andaman district were far-flung and spread across very vast forest land and sea. These areas were thinly populated with fewer transport facilities. This acted as a natural barrier to the spread of Covid 19 in rural areas of the district. This resulted in lower prevalence in rural areas (30.26%) as compared to urban areas. In the rural part of South Andaman, the population mainly worked on the farms for fulfilling their needs. As the rural people mostly remained in their village so there was less intermingling of these people with urban people. Therefore, the rural people in South Andaman remained less affected by the pandemic. Similar findings were also observed in other parts of India though the difference was much higher in S. Andaman as compared to the rest of India.<sup>7</sup>

Only 1% of the population of South Andaman was below the poverty line (BPL) which was far below the poverty status of India because a large section of people had landed property and government jobs in South Andaman.<sup>21</sup> There are also high government subsidies to the people in the S. Andaman district. Therefore BPL population was marginally below the poverty line and comparatively better off than the rest of India. This was also reflected in similar seropositivity between APL and BPL population in S. Andaman district. In contrast, antibody positivity was found higher in participants with low per capita income in the survey report of Delhi.<sup>8</sup> The high seroprevalence in Delhi was probably because the people with low per capita income lived in overcrowded slum areas in Delhi which resulted in a higher spread of Covid 19 in them. However, no slum area exists in the South Andaman district.

The current study has limitation that it is only a cross-sectional study and it reflects only about the point prevalence of Covid 19 antibodies in the South Andaman district and it does not show the secular trend of Covid 19 antibodies. The current study did not reflect the seroprevalence of Covid 19 antibodies in children less than 18 years of age as this group was excluded from the study.

In conclusion, the overall prevalence of COVID 19 antibody in the general population of the South Andaman district was 39.3% which was comparatively higher to seroprevalence conducted in the rest of the country. The higher seroprevalence could be due to the influx of a large number of tourists in this island from various parts of the country as tourism is the main source of living in the South Andaman district. The antibody positivity was similar in containment and buffer zone due to ill-defined boundaries of these zones and frequent movement of the working class people.

The antibody positivity in 41–60 years of the female population was high because the females of this age group were working in higher proportion as compared to other age groups. The antibody positivity was also higher in urban areas as compared to rural areas because most of the urban people worked in service sectors like tourism which involved high movement and intermingling of people particularly the tourists and

travelers as compared to rural people who worked mainly in the farming sector where movement and intermingling of people were considerably lesser and there was the cutoff of rural areas from urban areas by geographical barriers such as sea and dense forest.

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## Declaration of competing interest

The authors declare no conflict of interest.

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