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Original Article

SARS-Coronavirus-2 seroprevalence in asymptomatic healthy blood donors: Indicator of community spread

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ABSTRACT

Background: The Corona virus disease 2019 (COVID-19) pandemic caused by SARS -Corona virus-2 (SARS-CoV-2) has been a major concern the world over. Serological surveillance is an important tool to assess the spread of infection in the community. This study attempted to assess the prevalence of antibodies to SARS-CoV-2 among blood donors in Delhi, India during the pre-vaccination period.

Methods: Seroprevalence of SARS-CoV2-2 IgG antibodies were determined in blood donors reporting to the Department of Transfusion medicine at a tertiary care hepatobiliary center, in India from September to October 2020. The SARS-CoV-2 IgG antibodies against spike subunit 1 protein were measured using the enhanced chemiluminescence method.

Results: A total of 1066 blood donors were screened. The overall seropositivity for SARS-CoV-2 IgG antibodies was 27.57 % (294/1066). The highest seropositivity was seen in the age group 26–35 years, 46.6 % (137/492), followed by 18–25 years, 28.2 % (83/260), 36–45 years, 19.4 % (57/244), and more than 45 years, 5.8 % (17/70). The seropositivity in the donors who had donated blood previously was 26.1 % (189/723). There was no statistically significant difference amongst seroprevalence in the blood groups, AB blood group (32.6 %, 95 % CI 23.02–43.3), group B (27.2 %, 95 % CI 22.8–32.09 %), group A (27.1 %, 95 % CI 21.8–32.9 %), and group O (27.02 %, 95 % CI 22.3–32.1 %) (p 0.539).

Conclusions: There was significantly higher seropositivity for SARS-CoV-2 antibodies in the voluntary healthy blood donors indicating community spread and large number of asymptomatic cases in Delhi. Higher seroprevalence in younger adults indicated increased exposure to the virus and lack of COVID appropriate behaviour.

1. Introduction

The Corona virus disease 2019 (COVID-19) pandemic caused by SARS -Corona virus-2 has been spreading across the globe since December 2019 [1]. India is now affected with an increased surge in cases, and also increased mortality [2] since March 2021 owing to the second wave of infections predominantly by variants of the virus. Previous sero-epidemiological studies in India have shown high seroprevalence of the SARS-CoV-2 antibodies. The same is expected to reflect in the asymptomatic blood donors who have donated blood during this period. The screening of blood donors for SARS-CoV-2 is not mandatory as per the National Blood transfusion guidelines [3]. There is a rise in the total antibody specific to SARS-CoV-2, by the second week of infection in COVID-19 confirmed cases. The IgM antibodies tend to disappear soon while the IgG antibodies persist [4].

To study the seroprevalence of SARS-CoV-2 antibodies in asymptomatic voluntary blood donors in our institute, we conducted this study to evaluate the antibody levels in this group and compared it with the serological and symptomatic disease prevalence in Delhi during the same period.

2. Materials and methods

The study was conducted in the department of Transfusion medicine at a tertiary care hepatobiliary center, in India in voluntary blood donors during the period of 24th September 2020 to 31 st October 2020 after approval from the institute ethics committee. Serum samples from healthy eligible blood donors were collected after appropriate consent.

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The donor eligibility criteria were as per the Drug and Cosmetics Rules 1945 amended March 2020; any healthy adult 18–65 years of age, weighing more than 45 kg, with hemoglobin more than 12.5gm, with temperature, pulse, and blood pressure within normal limits as well as having no disease/risk factor which affected donor or recipient safety were eligible for the study. The blood donors who did not meet the eligibility criteria were deferred and thus excluded; additionally, those with documented prior SARS-CoV-2 infection and those who refused to give consent were excluded from the study. The routine blood donor screening tests including blood grouping and transfusion-transmitted infection screening were also done. The SARS- CoV-2 IgG antibodies were measured using the enhanced chemiluminescence method (Vitros ECi, Ortho Clinical Diagnostics, New Jersey, US). This qualitative assay is based on a recombinant form of the SARS-CoV-2 spike subunit 1 protein. It utilizes a 'signal generating' reaction using a luminol derivative in the presence of peroxide. There is generation of light when the Horseradish peroxidase (HRP) provides electrons from peroxide to luminol. The enhancer, 3-chloro 4-hydroxy acetanilide, acts as a catalyst for the luminal reaction. There is an acceleration of electron transfer and increased oxidation of luminol by HRP almost 1000 times maintaining the signal ~20 min. This signal is detected by a luminometer 16 times in 1.6 s in 'Glow' type chemiluminescence. Results are based on the sample signal-to-cut-off (S/Co) ratio, with values <1.0 as negative and ≥1.00 as positive results as per the manufacturer guide. The donor data were collected including age, gender, voluntary or replacement donors, ABO group, and whether they have donated blood more than one time (repeat donors). To compare the seroprevalence in blood donors with the case positivity rate and seroprevalence in the community, the overall COVID-19 positivity data in Delhi detected by Real-time PCR or Rapid antigen testing was obtained from the Delhi government bulletin as well as results from the periodical serosurveillance using enzyme-linked immunosorbent assays [5,6]. The data for the convalescent plasma donors were obtained from the Delhi COVID-19 Plasma Bank at our institute where the antibody testing was done for COVID-19 convalescent plasma donors by the same method as done in the study.

2.1. Data analysis

The collected data was entered in an excel spreadsheet and expressed as mean, median, or percentage. The categorical data were analysed using Chi-Square or Fisher's exact test. The statistical analysis was done using SPSS software version 22.

3. Results

A total of 1066 blood donors were included in the study. The demographic characteristics are shown in Table 1. There was a male preponderance 1048/1066 (98.31 %). The mean age of donors was 31.8 years (Range 18−59 years). We sub-grouped the donors according to age groups, Group 1:18−25 years, group 2: 26−35 years, group 3: 36−45 years, and group 4: more than 45 years. The overall seropositivity for SARS-CoV-2 IgG antibodies was 27.57 % (294/1066). The highest seropositivity was seen in Group 2, 46.6 % (137/492), followed by Group 1, 28.2 % (83/260),Group 3, 19.4 % (57/244) and Group 4, 5.8 % (17/70). The seropositivity in the donors who had donated blood previously was 26.1 % (189/723). 85 donors turned out to be reactive for transfusion-transmitted infections (73 HBc, 3 HCV, 1 each of HIV, HBV and HCV, HCV and HIV and malaria). 21/85 (24.7 %) were reactive to SARS-CoV-2 antibody. As the S/Co values reflect relative levels of anti-SARS-CoV-2 antibodies, we categorised the antibodies as category 1; S/CO 1−5 (41.8 %, 123/294), and category 2; S/CO > 5 (58.16 % 171/294). The seropositivity was maximum in AB blood group (32.6 %, 95 % CI 23.02−43.3), followed by blood Group B (27.2 %, 95 % CI 22.8−32.09 %), A (27.1 %, 95 % CI 21.8−32.9 %), and O (27.02 %, 95 % CI 22.3−32.1 %). There was no statistically significant difference amongst the blood groups (p 0.539) (Table 2 and Fig. 1) [7]. For this study, we obtained the data on confirmed COVID-19 case positivity in Delhi from the Delhi Heath bulletin which compiled the data RTPCR or rapid antigen-positive confirmed cases all over Delhi and the seropositivity among the COVID-19 convalescent donors from the Delhi Plasma bank database at our institute, during the same period (Table 3, Fig. 2). The median percentage seropositivity of COVID-19 convalescent plasma donors during the same period was 94.74 % (range 82.5–100). COVID-19 case positivity rate in Delhi during the same period was 5.87 % (range 4.99–11.42) and median seropositivity in blood donors was 27.54 % (range 4.35–50) and [5] (Table 3).

Table 1
Characteristics of healthy voluntary Blood Donors.

Sr No	Blood Donor characteristics	Percentage (n/N)	Level of significance (p*)
1	Male	291/1048 (27.7 %)	0.296
2	Female	3/18 (16.6 %)	
3	Age (mean, range)	31.80 years (Range 18−59 years)	
4	Age group 1(18−25years)	28.2 % (83/260)	0.170
5	Age group 2 (26−35 years)	46.6 % (137/492)	
6	Age group 3 (36−45 years)	19.4 % (57/244)	
7	Age group 4 (>45, years)	5.8 % (17/70).	
8	Repeat donors	26.1 % (189/723)	
9	Antibody levels Category 1 (1-5S/CO)	41.8 %, (123/294)	
10	Antibody levels Category 2 (>5S/CO)	58.1 % (171/294)	

n – number of seropositive donors in the category, N – Total number of donors in the category, p* <0.05 is significant.

4. Discussion

The present study was conducted on the asymptomatic healthy blood donors coming as voluntary blood donors in the transfusion medicine department of the tertiary care hepatobiliary centre. The SARS-CoV-2 infections have shown a waxing and waning trend in India. The study was conducted during September - October 2020, when the caseload of infections was between the range of 4.99−11.42. Vaccination was not available during that period, hence the detection of SARS-CoV-2 antibodies was indicative of infection or asymptomatic exposure to the virus. By Sept 30, 2020, 6·3 million cases were reported from India [8]. These accounted for the second-highest number of COVID-19 cases

Table 2
Blood groupwise SARS CoV2 seropositivity.

Rh D ABO	D positive	D negative	Total	SARS CoV2 antibody Seropositivity (%)	Prevalence of blood group in community (7)
A	66/246	5/16	71/262	(27.1 %, 95 % CI 21.8−32.9 %)	20−26 %
B	95/363	9/19	104/382	(27.2 %, 95 % CI 22.8−32.09 %)	32−40 %
AB	27/82	2/7	29/89	(32.6 %, 95 % CI 23.02−43.3)	7−13 %
O	82/309	8/24	90/333	(27.0 %, 95 % CI 22.3−32.1 %)	25−34 %
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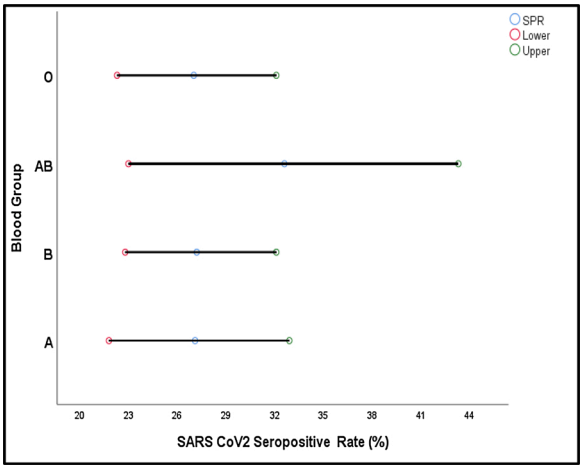

Fig. 1. Forest plot for Blood Groupwise SARS-CoV-2 seropositivity.

worldwide during that period. There was a surge in mortality with more than 97 000 deaths reported from India [8]. The seroprevalence studies conducted in Delhi 2020 have reported an adjusted seroprevalence of 24.08 % (95 % CI 23.43–24.74) in September, and 24.71 % (95 % CI 24.01, 25.42 %) in October [9].

There is higher seropositivity in young adults ranging from 18 to 35 years as compared to elderly age groups. This could be explained by the increased mobility and outdoor exposure to the virus in the younger population whereas the elderly people were mostly restricted indoor during the period of extended lockdown. Most of the studies have shown the seroprevalence in blood donors during the early part of the pandemic and details are given in Table 4. The blood donor screening study from Kenya during April -June 2020 have documented the crude seroprevalence of 5.6 % (174 of 3098). Seroprevalence of SARS-CoV-2 antibodies in blood donors reported from Saudi Arabia from 20th to 25th May 2020, was 1.4 %. Previous studies during the same period have shown varying seroprevalence in blood donors ranging from 0 to 23 % as shown in Table 4 [10–21]. A recent study from India by H C Pandey et al. from India has shown an overall seroprevalence of 9.5 % in asymptomatic blood donors [21]. They reported seropositivity of 3.2 % in healthcare workers as compared to 10.9 % seropositivity in non-healthcare workers. The seropositivity reported from our centre is much higher, 27.57 %, indicating a high prevalence of asymptomatic spread of SARS-CoV-2 in the community. H C Pandey et al. also reported a significantly higher seroprevalence was observed in blood group A donors (12.5 %) compared O blood group (6.8 %). Forest plot of blood group data of the seropositivity for SARS-CoV-2 antibodies and 95 % confidence interval is depicted in Fig. 1. The AB blood group seems to have a slightly increased propensity to be infected with COVID-19 (32.6 %, 95 % CI 23.02−43.3). Although the data was not statistically significant and as there is a low prevalence of AB blood group in the community, recruitment of more AB group donors would be useful to draw a statistically meaningful inference. Seroprevalence in blood Group A (27.1 %, 95 % CI 21.8−32.9 %), B (27.2 %, 95 % CI 22.8−32.09 %) and O (27.02 %, 95 % CI 22.3−32.1 %) was almost identical. This is a major differentiating point from previous studies. Thus there was no significant difference in susceptibility to SARS-CoV-2 infection owing to the blood group difference in the general population and inclusion of a larger cohort is needed to study the correlation.

When we compared the data of the convalescent plasma donors, it showed that about 5 % of the COVID-19 patients may not have detectable antibody levels after recovery, hence it is could also lead to false negatives in the general population having asymptomatic exposure. There was periodicity in the positivity data (Fig. 2). According to the serosurveillance data from Delhi during September and October 2020, 4311 (n = 17,409), and 3829 (n = 15,015) positive tests indicative of the presence of IgG antibodies to SARS-CoV-2 were observed respectively [6]. The adjusted seropositivity was 24.08 % (95 % CI 23.43–24.74) in September and 24.71 % (95 % CI 24.01, 25.42 %) in October. Our findings match this community serosurvey data depicted by the periodicity in the data as shown in Fig. 2.

Our study findings indicate a widespread asymptomatic infection in

Table 3
Comparison of Seropositive donors, and COVD-19 positivity during the study period.

Date	COVID-19 Positivity in Delhi (%) [5]	Seropositive donors in the present study (%)
24/09/20	6.48	42.11
25/09/20	6.47	12.12
26/09/20	5.85	28.57
28/09/20	5.47	30.00
29/09/20	5.46	37.72
30/09/20	5.67	17.78
01/10/20	5.48	26.88
03/10/20	5.74	24.32
05/10/20	5.47	40.00
06/10/20	4.99	36.00
07/10/20	5.57	25.00
08/10/20	5.11	19.23
09/10/20	5.82	46.67
10/10/20	5.76	22.22
12/10/20	5.14	22.86
13/10/20	5.52	33.33
14/10/20	5.84	50.00
15/10/20	6.23	25.00
16/10/20	5.90	23.33
17/10/20	5.85	50.00
19/10/20	5.91	31.91
20/10/20	6.32	18.31
21/10/20	6.24	28.21
22/10/20	6.61	12.50
23/10/20	6.98	22.58
24/10/20	7.42	24.00
26/10/20	8.23	37.50
27/10/20	8.48	45.83
28/10/20	9.37	31.82
29/10/20	9.55	4.35
30/10/20	9.88	24.00
31/10/20	11.42	28.21

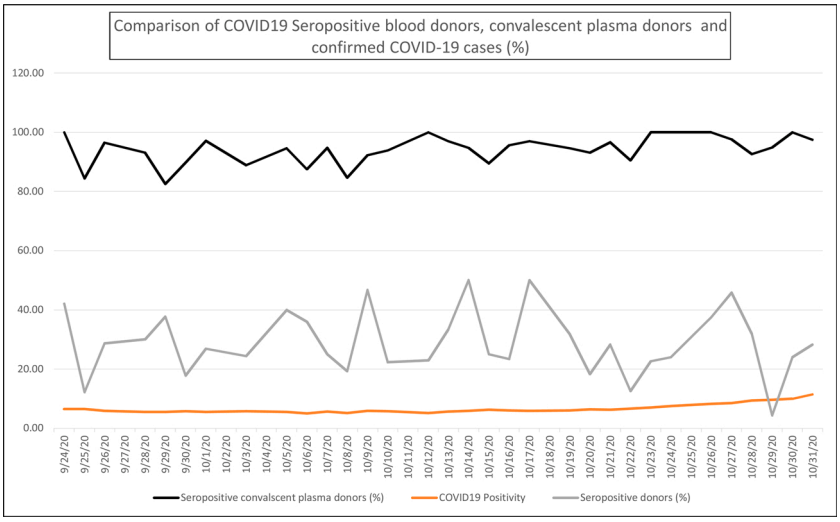

Fig. 2. Comparison of COVID-19 Seropositive blood donors, convalescent plasma donors and confirmed COVID-19 cases (%).

Table 4
Studies showing the SARS CoV2 seroprevalence in blood donors.

Study	Country	SARS-CoV-2 seroprevalence in blood donors
Sughayer et al. [10]	Amman city, Jordan	0
Ng et al. [11]	San Francisco Bay Area, California, USA	0.1 %
Fischer et al. [12]	North Rhine-Westphalia, Hesse and Lower Saxony in Germany	0.9 %
Erikstrup et al. [13]	Denmark	1.9 %
Slot et al. [14]	Netherlands	2.7 %
Gallian et al. [15]	France	2.7 %
Fontanet et al. [16]	Clermont and Noyon cities, Oise, France	3.0 %
Thompson et al. [17]	Scotland	3.2 %
Filho et al. [18]	State of Rio de Janeiro, Brazil	4.0 %
Valenti et al. [19]	Milan metropolitan area, Lombardy, Italy	7.1 %
Percivalle et al. [20]	Lodi Red Zone (Lombardy region) in Italy	23.0 %
Hem Chandra Pandey et al. [21]	India	9.5 %

the community leading to high seropositivity in healthy voluntary blood donors. Thus, a large proportion of COVID-19 cases are asymptomatic leading to an antibody response that may contribute to herd immunity. This data is peculiar as the samples were just after the peak cases in Delhi in 2020 (Fig. 2, Table 3). Previous studies during the early part of the pandemic may not be truly representative of the seroprevalence in healthy blood donors. The plasma from the blood donors having high titres could be used for plasma therapy in COVID-19. Our study also shows similar seroprevalence in all blood groups. Thus we hypothesize that there could be no difference any blood for increased susceptibility to infection with SARS-CoV-2. With the beginning of vaccination for the general population, there will be seropositivity, so this study is important to study the seropositivity in the vaccine naïve population. As RNA testing for voluntary blood donors or a healthy asymptomatic population was not recommended, we do not have the data on the viral load in such population.

4.1. Conclusion

There was high seropositivity for SARS-CoV-2 antibodies in the voluntary healthy blood donors indicating community spread and a large number of asymptomatic cases in Delhi. The higher seroprevalence in younger adults indicated increased exposure to the virus and lack of COVID appropriate behaviour. This also reiterates the need to emphasize preventive measures like universal masking, hand hygiene, and social distancing to prevent the silent spread of infection.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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