Original Article

Estimation of anti-SARS-CoV-2 IgG titre among blood donors in Ranchi

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Abstract

Introduction: Coronavirus disease 2019 is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), also known as novel coronavirus (2019-nCoV). The disease presentation ranges from asymptomatic to severe acute respiratory failure requiring intensive care support. Anti-SARS-CoV-2 IgG antibodies are developed either by natural infection from SARS-CoV-2 or by vaccination against COVID-19. The persistence of IgG antibodies allows identification of the people who have been infected in the past, recovered from illness, and possibly become immune. [7] IgG detection and other serological assays will play an important role in research and surveillance. **Aims and Objective:** The objective of the study is to assess anti-SARS-CoV-2 IgG titre among blood donors and to assess the decreasing incidence of COVID-19 in the department of blood bank, Rajendra Institute of Medical Sciences, Ranchi, Jharkhand. **Materials and Methods**: An observational, cross-sectional study was conducted at the department of blood bank, Rajendra Institute of Medical Sciences, Ranchi, Jharkhand over a period of 2 months and 14 days from 06 February 2021 to 20 April 2021 who donated at least one unit of blood. **Results:** This study recorded a greater number of male donors with B+ blood group. The anti-SARS-CoV-2 titre were mostly young adults between 18 and 31 years of age. **Conclusion:** Seroprevalence was high in males having blood group B+ between 18 and 32 years of age.

Keywords: Anti-SARS-CoV-2 IgG antibodies, COVID-19, IgG titre

Introduction

Novel coronavirus 2019, caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) emerged as a pandemic outbreak which affected millions of people worldwide significantly. SARS-CoV-2 exhibited diverse characteristics in different communities as a result of mutational changes with change of pathogenicity among different population groups and countries. In India, more than 4.3 crore people were affected with COVID-19 and more than 5.1 lakh deaths occurred due to COVID-19.[1–4]

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In Jharkhand, more than 4.3 lakh people were affected with COVID-19 and more than 5000 deaths occurred due to COVID-19. There are many treatment modalities for COVID-19 based on signs or symptoms and severity of the disease. COVID-19 convalescent plasma under randomized clinical trial conducted by the Indian Council of Medical Research (ICMR) was used for treatment of moderate-to-severe COVID-19 cases.

The development of anti-SARS-CoV-2 IgG antibodies among diagnosed and undiagnosed COVID-19 cases reflects gradual decrease and is related to the development of immunity against COVID-19 during the first and second waves of SARS-CoV-2 infection. Anti-SARS-CoV-2 IgG antibodies are developed either via natural infection with SARS-CoV-2 or through vaccination against COVID-19. Anti-SARS-CoV-2 IgG antibodies develop against different SARS-CoV-2 antigen, becomes detectable in immunocompetent individuals after at least eight days of

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infection, and over 90% of individuals become seropositive after fourteen days of infection. The persistence of IgG antibodies allows identification of the people who were infected in the past, recovered from illness, and possibly become immune.[5] Anti-SARS-CoV-2 IgG detection and other serological assays play an important role in research and surveillance.[6]

Group protection against viral infection in a large population confers herd immunity. Herd immunity is acquired by natural infection as well as by vaccination. Now incidence of COVID-19 is gradually decreasing along with patient mortality. Even after limited vaccination due to paucity of resources, COVID-19 cases declined in both the first and second phase of COVID-19 infection. It is so herd immunity must be playing an important role in decreasing incidence of COVID-19 infection. Estimation of anti-SARS-CoV-2 IgG antibodies in blood donors is a powerful and cost-effective strategy to monitor population on exposure and to detect asymptomatic and undiagnosed SARS-CoV-2 cases. By estimating anti-SARS-CoV-2 IgG titre, one can come to know the actual burden of the infection in our state of Jharkhand.

Aim and Objective

To assess the anti-SARS-CoV-2 IgG titre among blood donors and to assess the decreasing incidence of COVID-19.

Materials and Methods

Study design and subject

We performed an observational, cross-sectional anti-SARS-CoV-2 IgG serological survey study on plasma samples from blood donors who visited the blood center at Rajendra Institute of Medical Sciences, Ranchi, Jharkhand, during the period of 06 February 2021 to 20 April 2021. Each sample was identified with numeric code for privacy protection. Donor's details were taken from the questionnaire form. All blood donors aged 18–60 years were allowed to donate and who met the criteria for blood donation as per the National Blood Transfusion Council (NBTC) and National AIDS Control Organization (NACO) guidelines (11 October 2017).

Serological analysis

For antibody testing, we performed a chemiluminescent immunoassay (CLIA) for the qualitative detection of IgG antibodies against SARS-CoV-2 nucleoprotein using an anti-SARS-CoV-2 IgG kit. Plasma samples were run in an ARCHITECT I 1000Sr system (from Abbott Diagnostics) following the manufacturer's instructions. In this study, an index sample/calibrator (S/C) threshold of 1.4 or greater was taken as a positive result. Serologic routine tests against hepatitis C virus (HCV), human immunodeficiency virus type 1 and 2 (HIV-1&2) and hepatitis B virus (HBV) were run in an ARCHITECT i1000 SR analyzer (Abbott Diagnostics). The presence of antibodies against *Treponema pallidum* (VDRL) was determined by the Rapi check RPR Test (Pathozyme Diagnostics), a rapid slide Flocculation test and Malaria Antigen by Rapid Diagnostic Test kit (Abbott Diagnostics Koreas Inc.).

Study questionnaire

Each participant was instructed to complete a written questionnaire which covered demographics (age, sex), clinical data (current symptoms, date of onset, health conditions, smoking behavior), and exposure characteristics (contacted a confirmed or suspected SARS-CoV-2 case, attended a gathering, and/or visited a healthcare setting during the last fourteen days).

Serum sample collection and serological testing

About 4 ml of blood was collected in a serum collection tube from each participant by a trained blood bank technician. All collected serum samples were stored in the refrigerator for antibody testing. Architect SARS-CoV-2 IgG chemiluminescent microparticle immunoassay (Abbott) was used for the qualitative detection of IgG antibodies to the nucleocapsid protein of SARS-CoV-2, in the donors' samples. The default result unit for the SARS-CoV-2 IgG assay is index (S/C), and the cutoff is 1.40 index (S/C). Sample index <1.40 is considered negative and a sample index >1.40 is considered positive (manufacturer-defined cutoff). The test has 99.8% sensitivity (fourteen days after a PCR-confirmed infection) and 99.5% specificity.

Result

The main characteristics of the sample group and the specific prevalence values calculated for gender, age group, blood type, and Rh blood type are shown in Table 1. A total of 5140 plasma samples from blood donors were obtained from 6 February 2021 to 20 April 2021. The majority of donors (97.55%) were males and 62.98% were aged 18–31 years. Concerning gender, 97.55% were male and 2.45% were female. For the ABO profile, it was found that 24.11% were A group, 32.90% were B group, 34.51% were O group, and 8.48% were AB group. Regarding Rh typing 5045 of the samples (98.15%) were Rh+, and 95 (1.85%) were Rh−. Among 126 female samples, 94 females were IgG positive, in comparison to 5014 male samples in which 3376 were positive for IgG antibodies. It was observed that the maximum COVID-19 IgG positivity (62.98%) was seen in the age group 18–31 years followed by 30.54% in the age group 32–45 years as shown in [Table 2]. Donors in the age group 46–60 years showed an antibody positivity of 6.48%.

According to Table 3, the odds ratio of positive in 46+ years of age was 0.79 with 95% CI: 0.63–1.00 as compared to the 18–31 age group, and it was found to be statistically significant. It means that, those of 46+ years of age have protective antibodies against COVID-19. The odds ratio of positive in males was 1.11 with 95% CI: 0.84–1.47, and it was found to be not significant. It means that there is no association between gender and prevalence of antibodies against COVID-19. Similarly, there was no association between ABO blood type and prevalence

Table 1: Characteristics of the blood donors

Variables	Group	Seronegative Cases (< 1.4 Index)	%	Seropositive Cases (≥ 1.4 Index)	%	Total	%	χ^2	*P*
COVID-19 antibodies		1670	32.49	3470	67.50	5140			
Sex	M	1638	32.67	3376	67.33	5014	97.55	2.9630	0.6370
	F	32	25.40	94	74.60	126	2.45		
Age group	18-31	1026	31.70	2211	68.30	3237	62.98	4.6370	0.0980
	32-45	520	33.12	1050	66.88	1570	30.54		
	46-60	124	37.24	209	62.76	333	6.48		
ABO blood group	A	397	32.04	842	67.96	1239	24.11	6.6040	0.0980
	B	528	31.22	1163	68.78	1691	32.90		
	AB	130	29.82	306	70.18	436	8.48		
	O	615	34.67	1159	65.33	1774	34.51		
Rh blood type	+	1637	32.45	3408	67.55	5045	98.15	0.2230	0.0850
	−	33	34.74	62	65.26	95	1.85		

P<0.05

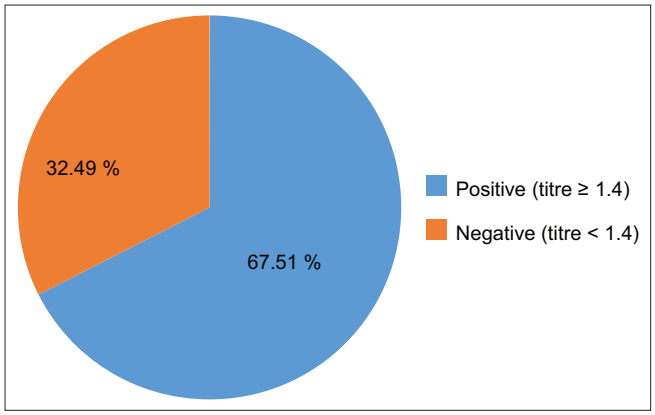

Figure 1: Prevalence of antibodies against COVID-19

of antibodies against COVID-19 in our study. The odds ratio of positive in Rh+ group was 1.90 with 95% CI: 1.90–2.53 as compared to the Rh−, group and it was found to be statistically significant. It means that there is a positive association between Rh+ blood type and prevalence of antibodies against COVID-19.

Detection of anti-SARS-CoV-2 IgG in plasma derived from blood donors

All plasma samples during the pandemic period tested positive for anti-SARS-CoV-2 IgG according to [Figure 1]. Out of 5140 samples, 3470 (67.51%) were positive, having anti-SARS-CoV-2 IgG titre ≥1.4 S/C index, whereas 1670 (32.49%) were negative, having anti-SARS-CoV-2 IgG titre <1.4 S/C index. Of the 3470 positive cases, 3376 were males (97.30%) and 94 were females (2.70%).

Discussion

The COVID-19 pandemic resulted in an economic crisis and psychological challenges everywhere in the world. The estimation of anti-SARS-CoV-2 IgG antibodies among the apparently healthy blood donors coming to the blood centre at RIMS enables us to understand the seroprevalence of COVID-19 infection in the community, which includes asymptomatic or subclinical infections who may not get themselves tested; thus it offers valuable information regarding the true magnitude of the infection.[7,8] It also interrupts the possible transmission in the community through depletion of susceptible individuals.[9] Herd immunity could be attained either through natural infection or through vaccination before the development of protective level of anti-SARS-CoV-2 antibodies transmission of COVID-19 viral infection in the population is expected to occur.[10] Return to normalcy can be achieved with adequate herd immunity.[11]

In our study, seroprevalence of SARS-CoV-2 IgG antibodies among 5140 blood donors was found to be 67.50% which showed that immunity had developed in the community resulting from COVID-19 infection. The age group of donors was between 18 and 60 years and they belonged to different socioeconomic strata. Blood donors included in this study had no history of symptomatic COVID-19 but substantial blood donors, that is, 3470/5140 (67.50%) were SARS-CoV-2 IgG seropositive, which indicates the subclinical or asymptomatic nature of the disease that missed detection. These asymptomatic COVID-19 infections can pose a high risk of spread of infection to the vulnerable population.[12] Awareness about asymptomatic infections is essential in prevention of the disease.

The study showed more asymptomatic SARS-CoV-2 infections in males than females. These individuals were exposed to COVID-19 infection and became asymptomatic carriers of disease.[13] Before blood donation, all donors had undergone a complete medical check-up and they did not give any history of COVID-19 infection.[14]

This study also indicated that COVID-19-positive antibodies were found mainly in males as compared to females. It indicates that exposure of females to COVID-19 was less due to the social and cultural structure of India. Young males are usually more socially active and females are usually confined to the household during the lockdown period. Hence, this increased the chances of exposure of males to COVID-19 during which they remained asymptomatic and, thus, resulted in the formation of antibodies.

The main finding in this study is that seroprevalence estimates are higher than other seroprevalence studies reported earlier in

the first wave from India.[15,16] Due to the relaxation of lockdown measures after May 2020, there was an increase in social activities and lack of adherence to COVID-appropriate behaviours, such as social distancing, wearing masks, etc. This led to increased exposure and hence increase in COVID-19 spread.

Seroprevalence estimate of 67.50% reported in our study was also higher than reported estimates from various countries[17–19] [Table 2]. The higher seroprevalence estimates in comparison to other studies may be due to several factors like the timing of the pandemic spread, population statistics, geographical distribution of the COVID-19 pandemic, early initiation of preventive measures, lockdown, and antibody testing strategies in respective countries. Also, our study was done later in comparison to the other studies, and thus, there was an increase in seroprevalence.

The seroprevalence estimates in the study across demographic parameters like age, sex and ABO blood groups remained similar, with no statistical difference ($P < 0.05$). Although age-dependent pattern of disease severity of COVID-19 was discussed in previous studies,[20] overall seroprevalence among the lower age group (18–31 years) was higher (62.98%) in comparison to other age groups (32–60 years). More studies may be required to understand the immunological differences among blood donors belonging to different age groups and it could help for further research.

To estimate the ABO group–specific seroprevalence, a larger sample of study may be required. Also, the other studies included the general population while our study included only blood donors.

Understanding the neutralizing antibody responses of the individuals is a key correlate to protection from reinfection, address herd immunity, vaccine efficacy studies and real-time sero surveillance for future pandemic preparedness.

Surveillance of anti-SARS-CoV-2 IgG antibodies against existing and new variants of SARS-CoV-2 might help in estimating the burden of disease and development of herd immunity in the community. Herd immunity in the population strategize vaccination for population at risk. Immunity gaps identified through multiple data sources could be used to target specific interventions to prevent the progress of the disease.

The limitations of our study

We included participants who were blood donors in the age group of 18–60 years; hence, the obtained seroprevalence might not be representative of the general population. Only asymptomatic donors were included; thus, the seroprevalence might vary over time due to decrease of antibody levels and may not represent the actual burden of the disease.

Table 2: Distribution of males and females in different age groups

Age groups	Male	%	Female	%	Total	%
18-31	3160	63.02	77	61.11	3237	62.98
32-45	1532	30.55	38	30.16	1570	30.54
46-60	322	6.42	11	8.73	333	6.48
Total	5014	100.00	126	100.00	5140	100.00

χ^2=1.0880, P=0.5800

Table 3: Multiple logistic regression analysis of prevalence of antibodies against COVID-19 by other variables

Factors	Adjusted OR	95%CI for OR		*P*
		Lower	Upper	
Age Group				
18–31	1			
32–45	0.95	0.84	1.08	0.4380
46+	0.79	0.63	1.00	0.0500*
Gender				
Male	1.11	0.84	1.47	0.4600
Female	1			
ABO Blood Type				
A	1			
B	1.07	0.91	1.25	0.4010
AB	1.17	0.93	1.48	0.1890
O	0.93	0.80	1.08	0.3510
RH Blood Type				
Rh+	1.90	1.43	2.53	0.0001*
Rh−	1			

*P<0.05

Conclusion

High seroprevalence (67.50%) of anti-SARS-CoV-2 IgG antibodies reflect the development of herd immunity. Real-time seroprevalence of anti-SARS-CoV-2 IgG antibodies and development of herd immunity might require a study of a larger population.

Ethical approval

The institutional ethical committee at Rajendra Institute of Medical Sciences, Ranchi approved the study.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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