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Original Research Paper

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SEROPREVALENCE OF NEUTRALIZING ANTIBODIES TO COVID-19 AMONG BLOOD DONORS IN A TERTIARY CARE HOSPITAL FROM SOUTH INDIA

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ABSTRACT

Background: In public health, monitoring COVID-19 and assessing the success of prevention and control measures are regarded as vital priorities. Therefore, the COVID-19 vaccination has gained widespread approval worldwide. Among blood donors who had various COVID-19 vaccinations, we examined the level of neutralizing antibody (NAb) against the severe acute respiratory syndrome coronavirus type 2 (SARS-CoV-2). **Methods:** The demographic information of 253 blood donors who received COVID-19 vaccinations was documented in this study. Participants' vaccination information was documented, including the type and timing of their shots. An ELISA test was used to determine the SARS-CoV-2 NAb level. **Results:** The total 253 Voluntary blood donors belonged to the age group of 21–50 years were tested. Among them, 31(11.4%) were female and 222 (88.6%) were male. The majority (76.9%) of the donors included in the study belonged to the age group of 21–30 years and 88.6% were male. According to the ELISA test results, the highest mean level of neutralizing Antibody (Nab)was found in the 21–30 age group, and the lowest mean was reported in the 41–50 age group. **Conclusion:** Our results showed that every vaccine used was effective in producing NAb. Different age groups, genders, and vaccination recipient types had varying degrees of Nab.

KEYWORDS : COVID-19, neutralizing antibody, blood donors

INTRODUCTION:

Coronavirus disease (COVID-19) was declared as a global pandemic by the World Health Organization (WHO) on 11 March 2020 [1]. Globally, more than 187 million confirmed cases of COVID-19, including 40,49,372 deaths, have been reported to WHO as of 15 July 2021 [2]. India has reported more than 30 million cases with more than with 4,11,989 deaths [3].

There has been substantial evidence that a large proportion of people infected with SARS CoV-2 are asymptomatic, but they can infect others. It has been reported based on an analysis of 21 published reports that asymptomatic cases could account from 5 to 80% [4]. It is crucial to recognize an infected person early and break the route of transmission to control COVID-19. In order to overcome this challenge, WHO and others have recommended population-based sero-epidemiological studies to generate data and to implement containment measures accordingly [5]. These surveys also can give us an estimation of the proportion of the population still susceptible to the infection as it is assumed that antibodies provide immunity.

Indian Council of Medical Research (ICMR) has conducted a nationwide serosurvey among 21 states and reported a population – weighted seroprevalenec of 0.73% between May and June 2020 [6]. The prevalence of SARS-CoV-2 infection among adults had increased10-fold, from 0.73% [95% confidence interval (CI) 0.34–1.13%] in May–June 2020 to 7.1% (95% CI 6.2–8.2%) in August–September 2020 [7].

As there can be considerable variation in the seroprevalence based on geographical setting and density of the population, knowledge of seroprevalence help us to know the burden of disease in community. Hence, this study was conducted to estimate seroprevalence of neutralizing antibodies among blood donors coming to our tertiary care hospital from various regions of Andhra Pradesh.

Aim And Objectives

Aim: To study the seroprevalence of neutralizing antibodies to COVID-19 among blood donors.

Objectives:

1. To know the seroprevalence of neutralizing antibodies among various categories of blood donors including vaccinated, infected & recovered, unvaccinated and uninfected (without a positive test report).
2. To know the antibody titer levels among various categories of donors as mentioned above.

MATERIALS & METHODS

Setting

This study was conducted in the department of Microbiology, Sri Venkateswara Institute of Medical Sciences (SVIMS), Tirupati, Andhra Pradesh in collaboration with department of Transfusion Medicine, SVIMS from March 2023 to July 2023.

Study Design And Sample Size

The study is a prospective observational study which was carried out on healthy blood donors coming for blood donation to the department of Transfusion medicine, SVIMS. Based on a multicentric sero-survey study from India a seroprevalence of around 23.2% to S1-RBD protein was reported. So, we assumed a 23% seroprevalence to S1-RBD protein and calculated a minimum sample size of 250 [8].

Inclusion Criteria

1) Donors who fulfill the eligibility criteria as per Drugs and Cosmetic act (DCA), 1940 and Rules, 1945.
2) Donors who are willing to participate in the study by giving written informed consent.
3) As per Andhra Pradesh state AIDS control society (APSACS), individuals who ever completed 4 weeks after testing positive and 2 weeks after 2nd dose of vaccination will be included in the study along with DCA criteria.

Exclusion Criteria

1) Donors who will be tested reactive for HIV, Hepatitis-B, Hepatitis-C, Malaria and Syphilis.
2) Donors who are not willing to give consent to participate in the study.

Sampling & Testing Strategy:

A 3–5 ml of venous blood was collected from each study participant who is willing to participate in our study. First the samples are screened for transfusion transmitted infections (TTI) and any reacted sample will be excluded from the study.

Further, samples were transported to the department of Microbiology under the cold chain for testing. The samples are tested for the presence of neutralizing antibodies against S1 RBD of SARS-CoV2 as per the manufacturer instructions.

Covid-19 neutralizing Antibody Microlisa test is an enzyme immunoassay based on "Blocking ELISA". Specimen and controls are pre-incubated with HRPO conjugated recombinant SARS-CoV-2 RBD protein in tube and added to the microtiter wells coated with recombinant hACE2 protein, incubated and then washed to remove the unbound HRP-RBD –neutralizing Antibodies complex. Finally, substrate solution containing chromogenic and hydrogen peroxide is added to the wells and incubated. A blue color reaction is stopped by a stop solution. The enzyme substrate reaction is read by EIA reader for absorbance at a wavelength of 450 nm. Antibodies against SARS-CoV2 if present in the specimen, will bind to recombinant SARS-CoV-2 RBD protein and block the protein-protein interaction between HRPO conjugated RBD and cell receptor protein hACE2. The absorbance of the sample is inversely proportional to the titre of neutralizing antibodies against SARS-CoV-2. The percentage of inhibition was calculated and ≥ 30 was considered as positive and ≤ 30 was considered as negative.

RESULTS:

The total 253 Voluntary blood donors belonged to the age group of 21–50 years were tested. Among them, 31(11.4%) were female and 222 (88.6%) were male. The most and least frequent vaccines used were COVISHIELD (64.7 %) and COVAXIN (35.3 %), respectively. The majority (76.9%) of the donors included in the study belonged to the age group of 21–30 years and 88.6% were male, as they comprise the main workforce and move in the community. According to the ELISA test results, the highest mean level of neutralizing Antibody (Nab)was found in the 21–30 age group, and the lowest mean was reported in the 41–50 age group.

Type Of Vaccine And Immune Response

Type of vaccine	No. of donors N=253	≥30% Inhibition	<30% Inhibition
COVISHIELD	164 (64.7%)	122 (74.7%) Positive	42 (25.3%) Negative
COVAXIN	89 (35.3%)	69 (78%) Positive	20 (22%) Negative

COVID-19 Neutralizing antibody:

S.No	% Inhibition	Number of samples	Interpretation
1	≥30%	191 (75.6%)	Positive
2	<30%	62 (24.4%)	Negative

Age Wise Distribution

S.No	Age wise distribution	No. of samples%
1	21-30	194 (76.9%)
2	31-40	44(17.4%)
3	41-50	12(4.9%)
4	51-60	3 (0.8%)

DISCUSSION:

A vital component of healthcare is tracking vaccine-induced immunity since it makes it possible to evaluate the efficacy of vaccinations, identify those who need more protection, and spot any vaccine failures. Healthcare practitioners can identify vaccine coverage gaps, assess the length and intensity of protection offered by vaccines, and make well-informed decisions regarding vaccination schedules and interventions by closely monitoring immune responses, including antibody production and immune cell activation (9). The majority of participants in this study were men between the ages of 21 and 30. The SARS-CoV-2 NAb level varied significantly across genders, but not between age groups, according to our calculations. While there were no discernible gender differences, Kotsiou et al. found a correlation between higher antibody levels and older age, which is contrary to our findings. The age group of 31–40 years old had the highest mean level of NAb (10).

According to Ishaq et al., there was no discernible difference between males and women's production of IgM and IgG antibodies. They found no correlation between age and IgG in men, but a slight correlation between age and IgM levels. Women, on the other hand, displayed a marginally positive trend, suggesting that females' IgM and IgG levels may modestly rise with age (11). Research showed that women with higher antibody levels had better patient outcomes and higher survival rates. Environmental and genetic variables may be responsible for this variation in antibody response. The precise cellular and molecular processes underlying this difference are still unknown, though (12).

Our results showed that people between the ages of 21 and 30 had a mean level of SARS-CoV-2 antibody inhibition of around > 30. According to Yang et al., youngsters (ages 1–10) had the highest antibody levels, which then decreased during adolescence. The lowest levels were found in young adults (ages 19 to 30), and although antibody levels in adults rose somewhat with age, they never attained the peak seen in children (13). As we age, we usually anticipate that earlier exposure to different infections will strengthen our immunological memory and improve our response. Later in life, when the aging immune system loses its ability to fend off new infections, the inflection points where the immune response diminishes were also predicted. Our results showed that participants' levels of NAb and age trends varied. After controlling for gender, age, race, and the interval between the beginning of symptoms and testing, Racine-Brzostek et al. demonstrated that a greater antibody level was associated with a higher body mass index (BMI); however, our investigation did not take BMI into account (14).

Three to six months following the Covishield vaccine, we observed the highest NAb level (89.32 ng/ml). According to Soylu et al., antibody levels decreased with time but were still detectable for at least six to eight months. Initially, nucleocapsid antibody levels were higher in those who received the CoronaVac vaccine alone than in those who received a combination of vaccinations (15). According to a study on immunological memory after SARS-CoV-2 infection, some memory B cells form in three to five months. After six to eight months, these cells stabilise, giving recovered people a long-term system for producing antibodies (16). According to Menni et al., the vaccine's effectiveness against infection is still strong 5–8 months after the second dosage, particularly in healthy individuals under the age of 55 (17).

More than five months following the vaccination injection, most participants in the current trial still had antibodies exceeding the inhibition rate ≥ 30. According to Ulinici et al., Sinopharm generated more NAb than convalescent plasma (18). According to reports, the AstraZeneca vaccination provides stronger protection against contracting COVID-19, despite the possibility of additional adverse effects. On the other hand, the Sinopharm vaccination may be less efficient at preventing illness but has less side effects. In the end, both vaccines considerably lessen the severity of COVID-19, and the optimal option is contingent upon personal traits (19).

Numerous variables, such as vaccine composition, injection timing and dosage, targeted virus strain, immunological response, and individual health, might affect NAb levels. All COVID-19 vaccines considerably lower the risk of serious illness, hospitalisation, and disease-related death, notwithstanding these differences. The current study had certain limitations even if it produced a useful result on the

NAb level by vaccine type, age, gender, and underlying disorders. This study's small sample size, and recruitment of participants from a particular region were among its drawbacks. It is crucial to recognise that these antibodies only represent one aspect of the complex immune system, even though we used comparisons of average NAb levels to gauge immunological response. In order to identify the best kinds, we recommended that future research assess the effectiveness of various COVID-19 vaccines in terms of NAb generation and maintenance across homogeneous groups of age, gender, dosage, and medical circumstances.

CONCLUSIONS:

The current study demonstrated how different COVID-19 vaccinations can cause variations in NAb levels. Notwithstanding these variations, every vaccination under investigation produced NAbs efficiently, demonstrating their capacity to provide protection. The observed drop in antibody levels made it clear that vaccination strategies, such as booster shots or modified formulations, require ongoing monitoring and modification.

Ethics Approval And Consent To Participate

The study was approved by the ethical committee of the Sri Venkateswara Institute of Medical Sciences, Tirupati, and all participants and all individuals were fully informed about the objective of the study and the voluntary nature of participation.

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