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Study of Seroprevalence of COVID-19 Antibodies in Different Clinical Scenarios

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ABSTRACT

Background: Infection with Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) induces a humoral immune response, leading to the production of antibodies against viral antigens, such as the spike (S) and nucleocapsid (N) proteins. These antibodies can be detected within days to weeks following infection and may persist for months. Assessment of seroprevalence provides insight into population-level exposure, immune response, and the impact of vaccination. The present study was conducted to evaluate the seroprevalence of COVID-19 antibodies among different categories of individuals.

Methods: A total of 100 blood samples were collected from healthcare workers at King George Hospital, Visakhapatnam. The study population included five categories: COVID-19 positive <3 months, COVID-19 positive >5 months with vaccination, COVID-19 positive >5 months without vaccination, individuals with no history of COVID-19 with vaccination, and those without vaccination. All samples were tested for total antibodies against SARS-CoV-2 using the Sandwich ELISA as per the kit protocol. Statistical comparison between groups was performed.

Results: Out of 100 samples, 62 were seropositive. Seropositivity was highest in COVID-19 positive individuals <3 months (80%) and those >5 months without vaccination (80%), followed by >5 months with vaccination (75%). Among individuals without prior infection, seropositivity was 40% in the vaccinated group and 35% in the unvaccinated group.

Conclusion: Seroprevalence was higher among previously infected individuals, indicating persistence of antibodies beyond 5 months. Vaccination contributed to a detectable antibody response even in individuals without prior infection. However, serological testing should not replace virological diagnosis.

Key-words: SARS-CoV-2, Seroprevalence, Antibodies, ELISA, Vaccination, Healthcare workers

INTRODUCTION

Coronavirus disease 2019 (COVID-19), caused by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), was first identified in Wuhan, China, in December 2019 and rapidly progressed into a global pandemic, posing unprecedented challenges to healthcare systems worldwide [1,2].

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The World Health Organization declared COVID-19 a public health emergency of international concern in January 2020 and subsequently a pandemic in March 2020 due to its rapid transmission and global impact [2]. SARS-CoV-2 is an enveloped, positive-sense single-stranded RNA virus belonging to the Coronaviridae family and primarily affects the respiratory system, spreading through respiratory droplets and aerosols [1,2]. Following infection, the host immune system mounts both innate and adaptive immune responses, with humoral immunity playing a crucial role in viral clearance. Antibodies are generated against viral structural proteins, such as the spike (S) and nucleocapsid (N) proteins [3]. These antibodies can be

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detected within 1–3 weeks after infection and may persist for several months [4,5]. Immunoglobulin M (IgM) appears early during infection, followed by Immunoglobulin G (IgG), which persists longer and serves as an indicator of past exposure [3].

Serological studies play an essential role in understanding the epidemiology of COVID-19. They help estimate the true burden of infection, identify asymptomatic cases, assess vaccine-induced immunity, and guide public health strategies [6]. Unlike molecular diagnostic methods, which detect active infection, serological assays reflect past exposure and immune response.

Healthcare workers (HCWs) are at increased risk of SARS-CoV-2 infection due to occupational exposure [7]. Monitoring seroprevalence in this group provides valuable insight into transmission dynamics, infection risk, and the effectiveness of vaccination programs. Despite widespread vaccination campaigns, variability in immune response exists depending on prior infection status, time since exposure, and host factors [8].

Several studies have shown that antibody levels peak during the convalescent phase and may persist for months, although antibody titers gradually decline over time [9,10]. However, the presence of antibodies does not necessarily indicate protective immunity, and serological testing has certain limitations in predicting reinfection risk.

In this context, the present study aims to evaluate the seroprevalence of SARS-CoV-2 antibodies among different categories of individuals and to compare antibody responses across various clinical and vaccination scenarios.

MATERIALS AND METHODS

Study Design and Setting- This cross-sectional observational study was conducted at King George Hospital, Visakhapatnam.

Study Population- A total of 100 blood samples were collected from healthcare workers. The study population was divided into five categories, with 20 samples in each group:

1. COVID-19 positive <3 months
2. COVID-19 positive >5 months with vaccination
3. COVID-19 positive >5 months without vaccination
4. Individuals with no history of COVID-19 with vaccination
5. Individuals with no history of COVID-19 without vaccination

Inclusion Criteria

• Blood samples from healthcare workers aged 15–60 years
• Individuals with positive and negative history of COVID-19
• Both symptomatic and asymptomatic individuals

Exclusion Criteria

• Individuals below 15 years and above 60 years

Sample Collection- Blood samples were collected under aseptic conditions and processed in the microbiology laboratory.

Serological Testing- All samples were tested for total antibodies against SARS-CoV-2 using Sandwich ELISA, following the manufacturer's kit protocol.

Statistical Analysis- Statistical comparisons between groups were performed to assess variations in seroprevalence.

RESULTS

A total of 100 samples were analyzed in the present study, of which 62 were seropositive for SARS-CoV-2 antibodies, and 38 were seronegative. This indicates an overall seroprevalence of 62% among the study population, reflecting a considerable level of exposure and/or immune response among healthcare workers (Fig. 1).

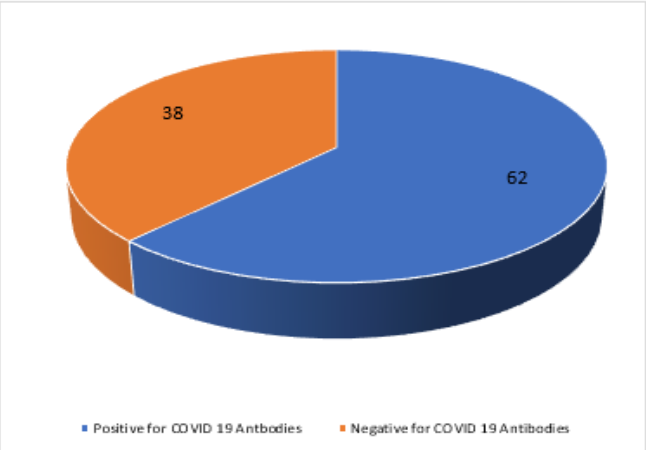

Fig. 1: Seroprevalence of COVID-19 antibodies (N=100)

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Category-wise distribution of seropositivity showed that individuals with a history of COVID-19 infection within the last 3 months had a 80% seropositivity rate (16/20). Similarly, individuals with a history of COVID-19 infection more than 5 months earlier had seropositivity rates of 75% (15/20) among vaccinated individuals and 80% (16/20) among unvaccinated individuals. Among individuals with no prior history of COVID-19, seropositivity was observed in 40% (8/20) of vaccinated individuals and 35% (7/20) of unvaccinated individuals, highlighting the role of both prior infection and vaccination in antibody development (Fig. 2).

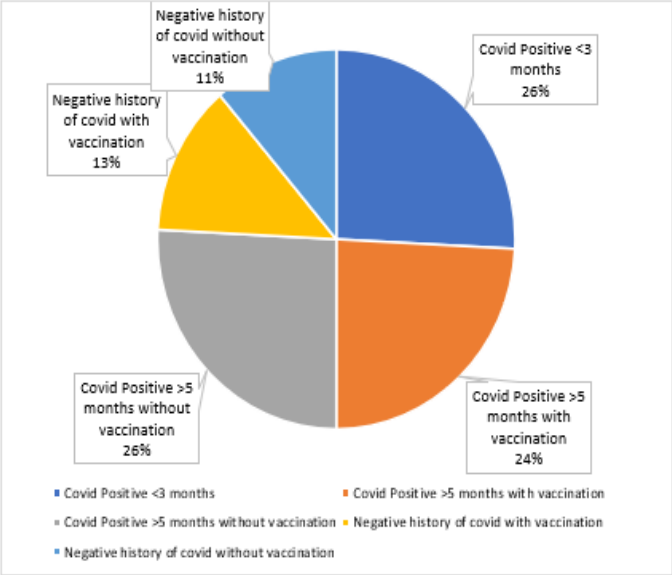

Fig. 2: Category-wise distribution of COVID-19 antibodies (N=62)

Gender-wise distribution showed that among the seropositive individuals (N=62), 32 were males and 30 were females, indicating a nearly equal distribution of seroprevalence between genders (Fig. 3, Fig. 4).

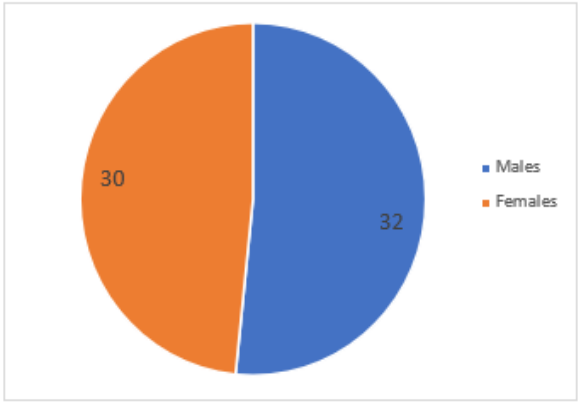

Fig. 3: distribution of sex wise seroprevalence of COVID-19 (N=62)

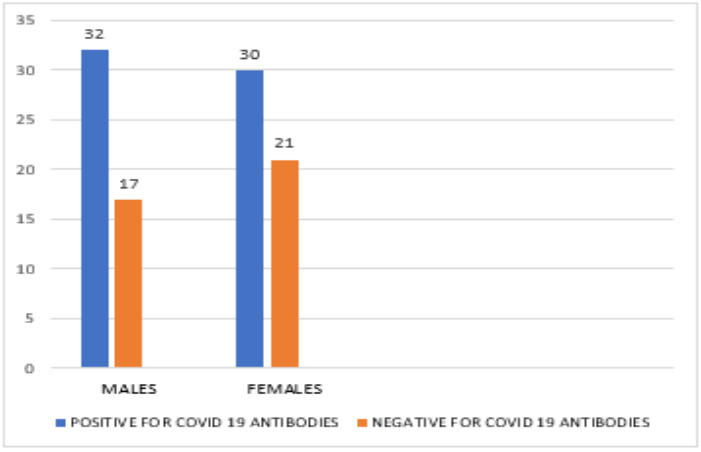

Fig. 4: Seroprevalence of COVID-19 in males and females (N=100)

Age-wise analysis demonstrated that the majority of seropositive individuals belonged to the 16–30 years age group (37 cases), followed by the 31–45 years (15 cases) and 46–60 years (10 cases) age groups. No seropositive cases were observed in the extreme age groups (<15 and >60 years), as these were excluded from the study population (Fig. 5).

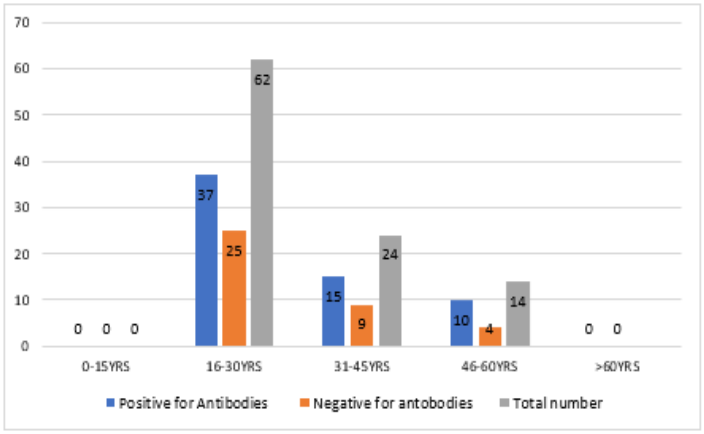

Fig. 5: Age-wise distribution of COVID19 seroprevalence (N=100)

DISCUSSION

The present study evaluated the seroprevalence of SARS-CoV-2 antibodies among healthcare workers across different clinical and vaccination categories. The overall seropositivity rate in this study was 62%, indicating substantial exposure and/or immune response within the study population. Similar findings have been reported in previous studies, where a high seroprevalence was observed among healthcare workers due to increased occupational exposure [11,12].

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In the present study, individuals with a recent history of COVID-19 infection (<3 months) showed a high seropositivity rate (80%), suggesting a robust humoral immune response during the early convalescent phase. Comparable observations have been reported in earlier studies, in which antibody levels were found to peak within weeks of infection [13,14]. Additionally, individuals with a history of infection beyond 5 months also demonstrated high seropositivity, indicating antibody persistence over time, although variability in antibody levels has been reported [15].

An interesting observation in the present study was comparable or slightly higher seropositivity among previously infected individuals without vaccination (80%) compared with those vaccinated (75%). This may be attributed to natural infection-induced immune response, which has been shown to contribute significantly to antibody development [16]. However, vaccination also played an important role, as evidenced by detectable antibody levels in individuals without prior infection: 40% of vaccinated individuals were seropositive, compared with 35% in unvaccinated individuals. Similar trends have been observed in other studies evaluating vaccine-induced immune responses [17,18].

The gender-wise distribution in the present study showed nearly equal seroprevalence among males and females, suggesting no significant gender difference in antibody response. This observation is consistent with previous studies reporting comparable immune responses across genders [19].

Age-wise distribution showed that the majority of seropositive individuals were in the younger age group (16–30 years), followed by the middle-aged group. This may be due to higher exposure levels and increased mobility among younger individuals. Similar age-related trends have been reported in earlier studies [20].

The findings of the present study highlight the importance of serological surveillance in understanding the spread of infection and immune status in high-risk populations such as healthcare workers. However, it is important to note that antibody presence does not necessarily confer complete protection against reinfection, and antibody levels may decline over time. Therefore, continued adherence to infection control measures and vaccination strategies remains essential [6].

Overall, the study emphasizes that both natural infection and vaccination contribute to antibody development, and seroprevalence studies provide valuable insights into population-level immunity and disease dynamics.

CONCLUSIONS

The present study demonstrates a considerable seroprevalence of SARS-CoV-2 antibodies among healthcare workers, reflecting both prior infection and vaccination-induced immune response. Higher seropositivity was observed among individuals with a recent history of COVID-19 infection, indicating a strong humoral response during the early convalescent phase. Persistence of antibodies beyond five months was also noted, although variability exists depending on individual factors and exposure history. Vaccination contributed to detectable antibody levels even among individuals without prior infection, highlighting its role in enhancing population immunity. However, the presence of antibodies does not necessarily ensure complete or long-term protection against reinfection. Serological studies are useful for understanding exposure patterns and immune status, but should not replace diagnostic testing for active infection. Continuous monitoring of antibody responses, along with vaccination and adherence to preventive measures, remains essential for effective control of COVID-19.

CONTRIBUTION OF AUTHORS

Research concept- Nama Padmaja, Jangam Sushma Rekha
Research design- Nama Padmaja, Mounica Pedapalli
Supervision- B Manjula, P Kamala
Materials- Mounica Pedapalli, Jangam Sushma Rekha
Data collection- Nama Padmaja, Mounica Pedapalli, Jangam Sushma Rekha
Data analysis and interpretation- B Manjula, P Kamala
Literature search- Mounica Pedapalli, Jangam Sushma Rekha
Writing article- Nama Padmaja, Jangam Sushma Rekha
Critical review- B Manjula, P Kamala
Article editing- Nama Padmaja, Mounica Pedapalli
Final approval- B Manjula, P Kamala

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