Original Article

Serosurveillance of COVID-19 amongst health care workers in a teaching institution – A prospective cohort study in Puducherry district

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Abstract

Introduction: The rapid spread and mutation rate of severe acute respiratory syndrome corona virus (SARS-CoV2) demands continuous monitoring in terms of genomic and serosurvival. The current study is designed to track the seroprevalence of health care workers (HCWs) postvaccination, as they may be more susceptible to contracting the SARS-CoV-2 infection compared to the general population. **Objective:** The objective was to identify the seroprevalence rate for SARS-CoV-2 immunoglobulin G (IgG) antibody (N, S1, S2) amongst HCWs of various levels of exposure working in a tertiary care teaching hospital in Puducherry. **Materials and Methods:** The present study followed a nonprobability consecutive sampling technique, which involved 216 study participants HCWs from the hospital. IgG antibody levels were measured using EUROIMMUNE Anti SARS-COV-2 ELISA KIT (IG g) ELISA at two points: firstly, 2 weeks after the second dose of vaccination, followed by 2 weeks after the booster dose. **Results:** Out of the total 216 participants enrolled in the survey, there were 140 males and 76 females, and the maximum number of candidates studied were in the 41–50 age group. Almost 46.7% of the HCWs who participated in the study were seropositive for SARS-CoV-2 in the case of those who were high-risk exposed, while only 30.4% were amongst those who were low-risk exposed. The proportion of study participants who became seropositive increased considerably after the booster dose (65.7%), from 38.0% when tested three months after infection. **Conclusion:** A significant increase in antibody titres amongst high-risk HCWs postboost vaccination demands continuous monitoring of soluble IgG levels for recommendations of vaccination schedules.

Keywords: Antibodies, COVID-19, doctors, health care workers, nurses, seroprevalence

Introduction

Severe acute respiratory syndrome corona virus (SARS-CoV-2), with its ability to spread rapidly in the human population, demands continuous serosurveys in the form of collecting information on SARS-CoV2 antibody prevalence for making effective public health decisions. Initial surveillance strategies have been focusing

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Received: 07-09-2023 **Revised:** 19-12-2023
Accepted: 22-12-2023 **Published:** 24-05-2024

Access this article online

Quick Response Code:

Website: http://journals.lww.com/JFMPC

DOI: 10.4103/jfmpc.jfmpc_1488_23

How to cite this article: Kamaludeen M, Ranganadin P, Pillai AB, Sugumaran A. Serosurveillance of COVID-19 amongst health care workers in a teaching institution – A prospective cohort study in Puducherry district. J Family Med Prim Care 2024;13:1917-21.

mainly on the use of molecular testing (RT-PCR) to measure acute infection in patients with severe disease, as these are the individuals who seek health care.[1-3] Serologic tests were introduced to identify the actual burden of the disease owing to cases missed from identification and measure the antibody response in an individual. Antibodies to SARS CoV19 are produced over days to weeks after infection with the virus. The presence of antibodies indicates that a person has been infected with the SARS CoV2, irrespective of the severity of disease and expression of symptoms by the individual.[4,5] The development of antibodies to any pathogen through natural infection is a multistep process which usually requires a period of over 1–2 weeks, but the process to develop a full-fledged immunologic response to the pathogen may require a longer duration. Most COVID-19 studies on the presence of antibodies till date show that the persons who have recovered from the COVID-19 infection have antibodies to SARS CoV2.[6] On a contrary, no study at present time has evaluated the postbooster dose antibody titres to SARS-CoV-2 infection in our body which can confer immunity against subsequent infection by SARS-CoV-2.[7] To identify the seroprevalence for SARS-CoV-2 immunoglobulin G (IgG) antibody (N, S1, S2) amongst health care workers (HCWs) between various levels of exposure working in a teaching hospital in Puducherry district, the present study is designed.

Material and Methods

The present study was conducted as a hospital-based prospective study with a quantitative component (semistructured questionnaire and antibody testing) for the development of an antibody against SARS-CoV-2 and factors responsible amongst HCWs in a teaching hospital in Puducherry, a coastal area in South India. The teaching hospital chosen for the study comprises of 51 departments in which doctors, nurses, technicians, and housekeeping staff are currently working. The study was carried out during the period starting from November 2021 to November 2022. The data collection was done for a period of six months after the approval of the Institutional Human Ethics Committee. The initial level of antibodies baseline (taken 2 weeks after the second doses of Covishield vaccine) was measured and again 2 weeks after the booster dose. IgG, in blood samples collected from individuals were tested using the EUROIMMUNE-anti SARS-COV-2 ELISA KIT (IG g) test. Individuals with IgG levels ≥1 were considered seropositive for SARS-CoV-2.[8] Considering the prevalence of HCWs with antibodies for SARS-CoV-2 as 7.6% from a previous study,[9] for an alpha error of 2%, power of 80%, and an absolute precious of 4%, the minimum required sample size was calculated to be 221. However, 5 subjects were lost to follow-up after enrolment; hence, remaining 216 HCWs were considered for data analysis in the study. Nonprobability consecutive sampling technique was used to select study participants, based on their availability.[10] HCWs who have worked for a period of less than six months before the onset of the study in the study setting were excluded. HCWs with high risk of exposure are those who worked in COVID areas (ICU, COVID wards, and OPD) and low risk of exposure are those who worked in COVID-restricted areas.[11] All eligible patients willing to participate in the study were included. Individuals who have not received two doses of the vaccine, and those who were immunosuppressed, were excluded from the study. Data entry was done using MS Excel 2016 and data analysis was done using IBM Statistical Package for Social Sciences Armonk, NY, version 26.0. Categorical variables were represented as percentages, and differences in proportions were tested for statistical significance using Chi-square test. A *P* value <0.05 was considered statistically significant.

Results

Out of the total 216 participants enrolled in the survey, there were 140 males and 76 females. Amongst the different age groups of people surveyed, it was found that the maximum number of candidates studied were in the 41–50 years age group. Maximum were doctors (47.4%), followed by staff nurses (29.6%). Nearly 35.2% reported a history of COVID-19 infection in the past [Table 1]. Almost 46.7% of the HCWs who participated in the study were seropositive for SARS-CoV-2 amongst the high-risk exposure group, while it was only 30.4% amongst the low-risk exposed group. This difference in trend was found to be statistically significant (*P* value 0.02). Similarly, the proportion of study participants who became seropositive increased considerably after the booster dose in the high-risk exposed group to 65.7%, whereas in the case of participants in the low-risk exposed group, it increased to 38.0% [Table 2]. Also, this difference was found to be statistically significant (*P* value-0.001) [Figure 1].

Discussion

The present study aimed to find the levels of SARS-COV-2 IgG antibodies, amongst HCWs in a teaching hospital, Puducherry. The presence of IgG antibodies is suggestive of past infection, either symptomatic or asymptomatic. It could have been in asymptomatic or mildly symptomatic people giving a negative history for COVID-19 infection.[9] This study found that the

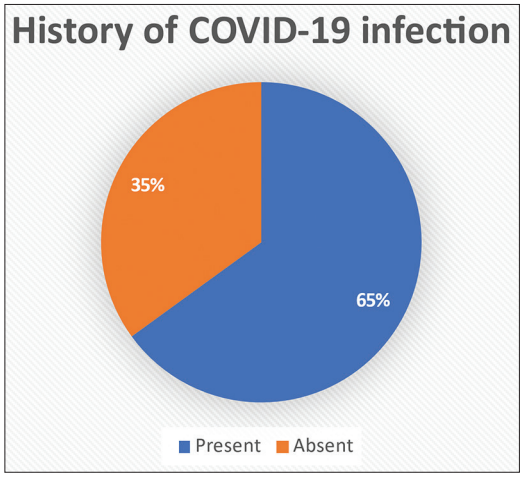

Figure 1: Distribution of study participants based on a history of COVID-19 infection in the past

overall seropositive rate was higher in males as compared to females amongst health care workers. During a serosurvey conducted across India before the introduction of vaccination, it was found that doctors had a higher prevalence of SARS-CoV-2 antibodies compared to the general population.[3,12,13] These results indicate a complex transmission mechanism of the disease, where HCWs, despite being consistently exposed to SARS-CoV-2, had lower infection rates, likely due to their strict adherence to infection prevention and control measures, particularly the use of personal protective equipment. Additionally, HCWs can potentially serve as a source of hospital-acquired infections.[14]

The majority of participants were in the 41–50 years age group. The largest professional groups represented were doctors (47.4%) and staff nurses (29.6%). Approximately 35.2% of participants reported a history of COVID-19 infection in the past. Amongst HCWs with high exposure to the virus, 46.7% were seropositive for SARS-CoV-2, compared to only 30.4% of low-risk exposure HCWs. This difference was statistically significant (*P* value 0.02). After receiving a booster dose, the seropositivity rate increased to 65.7% for exposed HCWs and 38.0% for nonexposed HCWs. The study suggests that exposure and booster vaccination contribute to higher seroconversion rates amongst healthcare workers. Data from Srinagar and Kolkata in India indicate that the prevalence of COVID-19 amongst HCWs ranged from 0.6 to 11.94% in September 2020.[15,16] Elangovan D *et al.*[17] observed that the seroprevalence (COVID-19 IgG ELISA) amongst the vaccinated and unvaccinated HCWs was 91.7 and 38.2%, respectively. In the study by Sharma P *et al.*,[18] 51.3% (95% C.I: 47.4–55.3) HCWs were detected with SARS-CoV-2 antibodies on baseline examination. Further, out of the 245 HCWs included in the study, 35 (14.9%) who were initially seronegative converted to seropositive after a follow-up period of 21–28 days (median 24 days). The overall incidence rate of SARS-CoV-2 seropositivity was calculated to be 5.9 (95% CI 4.2, 8.2) per 1000 person-days. Amongst the seronegative HCWs at baseline who underwent follow-up, the only significant factor associated with seroconversion, indicating the presence of detectable antibodies, was the completion of two doses of either the Covishield (AZD1222) or Covaxin (BBV152) vaccine ($P < 0.001$).[19] These findings of the above study were in concordance with that of those observations noted in the present research work. However, the seroprevalence amongst HCWs was found to be lower when compared to the seroprevalence estimates observed in the general population of the state of Delhi.[20] In our study, it was found that seropositivity was the highest in the 30–39 years age group. This was probably due to the maximum exposure of this age group and the chances of being multiply exposed too. The survey conducted by Pallett SJC *et al.* on essential service workers concluded that 41% of the participants had suffered from laboratory confirmed COVID-19 infection in the past one year.[21] In the same study, COVID-19 vaccination was identified as the most significant factor associated with the seropositivity and seroconversion of HCWs. These findings provide support to the consensus that COVID-19 vaccines elicit an immune response and generate antibodies.[22] The study observed a seropositivity rate of 62% at baseline, which increased to 77.7% at the endline. This is consistent with a study conducted in Germany.[23] Recent serosurveys in India and

Table 1: Distribution of study participants based on baseline characteristics (*n*=216)

Patient Characteristics	Frequency	Percentage
Age group		
17–30 years	46	21.3
31–40 years	68	31.5
41–50 years	87	40.3
51–60 years	15	6.9
Sex		
Male	140	64.8
Female	76	35.2
Designation		
Doctors	103	47.7
Staff nurse	64	29.6
Lab technicians	22	10.2
Pharmacist	10	4.6
Attenders	17	7.9
Smoking status		
Current	25	11.6
Current (rarely)	10	4.6
Never	175	81.0
Reformed	6	2.8
History of COVID-19 infection in the past		
Yes	76	35.2
No	140	64.8
Presence of comorbidities		
Diabetes	5	2.3
Hypertension	6	2.8
Others	6	2.8
None	203	93.1

Table 2: Association between antibody titre levels and level of exposure to COVID-19 in the past (*n*=216)

	Health care workers with high-risk exposure *n* (%)	Health care workers with low-risk exposure *n* (%)	Total *n* (%)	*P*
Seroprevalence (Antibody titres)				
Positive (≥1.1)	64 (46.7)	24 (30.4)	76 (35.2)	0.02
Negative (<1.1)	73 (53.3)	55 (69.6)	140 (64.8)	
Total	137 (100.0)	79 (100.0)	216 (100.0)	
After Booster Dose				
Positive (≥1.1)	90 (65.7)	30 (38.0)	150 (69.4)	0.001
Negative (<1.1)	47 (34.3)	49 (62.0)	66 (30.6)	
Total	137 (100.0)	79 (100.0)	216 (100.0)	

a state-wide serosurvey in Delhi have reported low seropositivity rates amongst the general population. Additionally, these studies have also found that doctors have a higher risk of seropositivity compared to other healthcare workers, which aligns with the findings of the present study.[3,24]

Studies conducted worldwide have reported diverse seroconversion rates. For example, a large prospective study in the United Kingdom documented a seroconversion rate of 0.77%,[25] whereas Germany observed a seroconversion rate of 77.7% after a 12-week follow-up period.[23] In the case of H1N1 in 2009, seroconversion amongst HCWs was reported to be 6.5%.[26] These variations in seroconversion rates can be attributed to different study settings and durations. It is crucial to urgently consider the evaluation of antibody response in healthcare workers after vaccination, the detection of neutralizing antibodies in participants who have tested positive for antibodies, and the possibility of administering booster doses in cases where an adequate immune response is lacking.

Conclusion

Measuring antibody titres allows the determination of prevalence of COVID-19 infection amongst heavily exposed HCWs. A significantly higher seroprevalence was seen in HCWs with a high risk of exposure before the booster dose as compared to those with a low risk of exposure. A significant increase in the antibody titres amongst high-risk health care workers post booster dose urges a continuous monitoring of soluble IgG levels so as to see (i) if the response wanes and recommendations for further vaccinations, especially during any outbreaks and (ii) understand the antibody levels during the new variants in circulation.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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