

Research Article

Received Date: June 30, 2022

Accepted Date: July 30, 2022

Published Date: August 02, 2022

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Citation

Abeynayake JI, Samaraweera K, Ranaweere M, Bothanne C, Palipana E, et al. (2022) Laboratory Based Preliminary Study on anti-SARS-Cov-2 Antibody Response Among State Sector Health Care Workers in a Single District in Sri Lanka. CEOS Family med. communi. Health, 1(1);102

Anti-SARS-Cov-2 Antibody Status Among State Sector Healthcare Workers In A Single District In Sri Lanka: Laboratory Based Preliminary Study

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Abstract

Introduction: Severe acute respiratory syndrome corona virus 2 (SARS-CoV-2) is responsible for the current COVID-19 pandemic. Healthcare workers are one of the risk groups due to their strategic role in patient management. Presence of anti-SARS-CoV-2 antibodies in serum following seroconversion could be determined through antibody ELISA assay.

This study was to analyze the laboratory identified viral markers of Anti SARS-CoV-2 antibody in blood samples of health care workers to demonstrate the seroconversion to SARS-CoV-2 virus following exposures, natural infection or vaccination and to describe the socio-demographic, and clinical parameters among them.

Material and Methods: This laboratory based retrospective study was conducted at the National Virus Reference Laboratory (NVRL), at the Medical Research Institute (MRI). The study retrospectively analyzed 235 blood samples received to the NVRL, for testing of anti-SARS-CoV-2 antibody among health care workers in July, 2021. All samples requested for anti-SARS-CoV-2 antibody were tested with SARS-CoV-2 spike protein specific IgG antibody, and with SARS-CoV-2 Total Ab ELISA. The socio-demographic data were gathered through the request forms were also analyzed.

Results: Total 235 blood samples were tested for anti-SARS-CoV-2 antibody and 234 (99.6%) were confirmed to have spike protein specific IgG antibody while 2% were confirmed to have Nucleo-capsid protein targeting antibodies. Of the positives, 100% were vaccinated with two doses of vaccine and 1% had positive PCR.

Conclusion: The current study encounters a significantly high prevalence of vaccine induces SARS-CoV-2 antibody carriers among the healthcare workers in the study community.

Keywords: SARS-CoV-2 Infection, Health Care Workers, COVID-19 vaccination, Anti-SARS-CoV-2 Antibody response, Enzyme Link Immunosorbents Assay (ELISA)

Introduction

The severe acute respiratory syndrome corona virus 2 (SARS-CoV-2) is responsible for the current COVID-19 global pandemic due to its high transmissibility around the world. This led to infecting millions of individuals with an unprecedented impact in the health care systems worldwide. Healthcare workers are one of the risk groups due to their strategic role in patient management presently, thus need to be well protected and to prevent healthcare related outbreaks. Here, we present the results of the SARS-CoV-2 seroconversion results among a group of health-care workers serving at the state sector in Sri Lanka.

Infection with SARS-CoV-2 initiates a humoral immune response that produces antibodies against specific viral antigens such as the nucleocapsid (N) protein and the spike (S) protein. Specific anti-S protein antibodies are produced targeting the spike's S1 protein subunit and receptor binding domains (RBD) [1,2,3]. Serologic tests can detect the presence of these antibodies in serum within one to two weeks following acute infection [1, 2,3].

There are different categories of vaccines which trigger immune system to produce specific antibodies. COVID-19 vaccination with whole virus vaccines trigger an immune response to produce antibodies against both nucleocapsid (N) protein and the spike (S) protein while COVID-19 Nucleic acid vaccine trigger an immune response against viral spike protein.

Thus, it can identify persons with seroconversion to SARS-CoV-2 infection and thereby help health experts better understand the epidemiology of SARS-CoV-2 and populations at higher risk of infection.

Material and Methods

The current study was formulated to analyze the laboratory identified viral markers of Anti SARS-CoV-2 antibody in blood samples of health care workers received to the Medical Research Institute (MRI) during one month period, with the intent of demonstrating the seroconversion to SARS-CoV-2 virus following exposures, natural infection or vaccination. Further, this study also aims to describe the sociodemographic, and clinical parameters among them.

This laboratory based retrospective study was conducted at the National Virus Reference Laboratory (NVRL), at the Medical Research Institute (MRI), Sri Lanka which is the central facility for the viral diagnosis in the country. The study retrospectively analyzes 235 blood samples received to the NVRL, MRI, for testing of anti-SARS-CoV-2 antibody among health care workers in the month of July 2021. All blood samples which requested anti-SARS-CoV-2 antibody testing were tested and assessed, irrespective of suspected COVID-19 infection and the brief history on the request forms.

A highly specific and sensitive, FDA-EU recommended assay was employed to measure SARS-CoV-2 spike protein specific IgG antibody, paired with SARS-CoV-2 Total Ab Enzyme Link Immunosorbents Assay (ELISA) to demonstrate the SARS-CoV-2 Total Ab positive proportion, which is also recommended by the FDA-EU. Firstly, all received blood samples were tested at the NVRL with the Euroimmun Anti-SARS-CoV-2 Virus Indirect IgG antibody ELISA kit (Euro immune Luebeck, Germany) [4] and then Bio-Rad Platelia anti- SARS-CoV-2 Total Ab ELISA kit (Bio-Rad Laboratories, Inc France) [5] which targeted the spike protein S1 and Nucleo-capsid protein respectively. The test runs were validated, and results were analyzed according to the manufacturer's instructions. The anti- SARS-CoV-2 IgG and / or Total Ab detected samples were considered as serological evidence of positive anti-SARS-CoV-2 antibody cases. Blood samples which gave negative results from both testing were considered as negative for anti-SARS-CoV-2 antibody.

However, clinical and vaccination histories received in the test request forms along with the samples were carefully reviewed to identify and differentiate natural infection with positive PCR test results, significant exposures according to the National guideline [6] and vaccinated Health Care Workers among the study group. The socio-demographic data such as age, geography, and different health care categories were also gathered and scrutinized with the ELISA test results. Statistical analysis was done using descriptive statistics by the Statistical Package for Social Sciences (SPSS), version 28.

Results

During the 4-week study period, 235 blood samples received were tested for anti-SARS-CoV-2 antibody among health care workers. All the samples were tested for SARS-CoV-2 spike protein specific IgG antibody, and with SARS-CoV-2 Total Ab

(IgM/IgA/IgG) ELISA assay to demonstrate the SARS-CoV-2 Total Ab positive proportion targeting Nucleo-capsid protein. In the study population 234(99.6%) were confirmed to have SARS-CoV-2 spike protein specific IgG antibody by positive SARS-CoV-2 spike protein specific IgG antibody ELISA while 2% were

confirmed to have SARS-CoV-2 Total Ab (IgM/IgA/IgG) by SARS-CoV-2 Total Ab ELISA assay (Table 1).

Furthermore, SARS-CoV-2 spike protein specific IgG antibody positive participants were identified as, Positive with low ratio and Positive with high ratio as per the test results ratio (Table 1).

Parameter	Frequency (Percentage)
SARS-CoV-2 spike protein specific IgG antibody (n = 235)	
Negative (Ratio < 1.1)	1 (0.4%)
Positive with low ratio (Ratio 1.2 -4)	48 (15.8%)
Positive (Ratio 4.1- 9.9)	176 (57.9%)
Positive with high ratio (Ratio >10)	10 (3.3%)
Anti -SARS-CoV-2 Total Ab (IgM/IgA/IgG) (n=235)	
Positive	4 (1.7%)
Negative	231 (98.3%)

Table 1: Laboratory parameters of SARS-CoV-2 infection among the study group

In the study population the age range of positive patients was 26-66 years, with majority being females (57.7%). The samples tested were mainly from a single district of the Western Province of the country and those samples were distributed among 16 Medical Officer of Health (MOH) areas in the district. Although the study samples belonged to different health care categories based on the occupation, the highest number of samples were

from Medical Officers (20%) and Public Health Inspectors (14%) in the district (Table 2).

In addition, results reveal except one individual all the others showed seroconversion to the vaccine irrespective of the individual age. Study results also demonstrated the vaccine seroconversion of the different categories of health care workers in different medical Officer of Health areas (Table 2).

Variable	Frequency (percentage)
Age range, Mean, Mode (n=234)	26-66 years (44.26, 46)
< 30 years	19 (8.1%)
31-40 years	61 (26.1%)
41-50 years	92 (39.3%)
51-60 years	52 (22.6%)
>61 years	9 (3.8%)
Gender (n=234)	
Female	135 (57.7%)
Male	99 (42.3%)
Distribution based on occupation (n=234)	
Medical Officers	48 (20.5%)
Nursing Officers	26 (11.1%)
Public Health Inspectors	33 (14.1%)
Public Health Midwives	27 (11.5%)
Health Care Assistants	24 (10.3%)
Development Officers	20 (8.5%)
Drivers	12 (5.1%)
Entomologists	6 (2.6%)
Field Officers	5 (2.1%)
Field Assistants	10 (4.3%)

Management Service Officers	9 (3.8%)
Schools Dental Therapists	4 (1.7%)
Other	8 (3.4%)
Unknown	2 (0.9%)
Geographical distribution of MOH areas (n=234)	
MOH Area-1	13 (5.6%)
MOH Area-2	14 (6%)
MOH Area-3	11 (4.7%)
MOH Area-4	13 (5.6%)
MOH Area-5	13 (5.6%)
MOH Area-6	13 (5.6%)
MOH Area-7	20 (8.5%)
MOH Area-8	13 (5.6%)
MOH Area-9	13 (5.6%)
MOH Area-10	10 (4.3%)
MOH Area-11	30 (12.8%)
MOH Area-12	5 (2.1%)
MOH Area-13	13 (5.6%)
MOH Area-14	10 (4.3%)
MOH Area-15	13 (5.6%)
RDHS Area-16	30 (12.8%)

Table 2: Socio-demographic and epidemiological details of positive cases

Retrospective analysis of the positives revealed that 100% of the study population was vaccinated with two doses of Oxford AstraZeneca vaccine. Moreover, it was evident 1% of them had reports of confirmed positive Real time Polymerase Chain Reaction (rt-PCR) results while 6% had significant exposures according to the National guideline [6] (Table 3).

Following administration of the first dose of vaccine fever as a side effect was observed in 128(54%) while 81(34%) gave no complains, whereas 198 (84%) were silent and did not show up any side effects following the administration of the second dose of the vaccine (Table 4).

Parameter	Frequency (Percentage)
COVID-19 infection confirmed by PCR	2 (0.85%)
Exposure to confirmed COVID-19 patients	15 (6.38%)
Fully vaccinated	235 (100%)

Table 3: Clinical parameters and vaccination

Symptom	Frequency (Percentage)
After first dose (n=235)	
Fever	128 (54.46%)
Body aches	33 (14.04%)
Headache	27 (11.49%)
Myalgia	15 (6.38%)
Arthralgia	8 (3.40%)
Other (Vomiting, diarrhea, nausea, vaccine site pain, loss of appetite, sore throat)	17 (7.23%)
None	81 (34.47%)
No response	14 (5.96%)
After second dose (n=235)	
Fever	8 (3.40%)
Headache	5 (2.13%)
Body pains	4 (1.70%)
Other (pain at injection site, lethargy, allergy, diarrhea, giddiness, insomnia, arthralgia, myalgia)	7 (2.98%)
None	198 (84.26%)
No response	15 (6.38%)

Table 4: Side effects following vaccination

Discussion

Sri Lanka reported the first case of COVID-19 on 27th January 2020 and thereafter several clusters were experienced in different intensity which were controlled satisfactorily. While continuing the outbreak control activities the second wave emerged and disseminated a little faster than the first wave. By this time global vaccination program was initiated and Sri Lanka too initiated priority category-based vaccination in February 2021, with the target of prevention of community transmission, mortality and morbidity [7]. A number of studies have already been published globally regarding the antibody response to COVID-19 infection [2,3,8,9,10].

The current study analyzed the laboratory determined anti SARS-CoV-2 antibody in blood against different viral markers of the SARS-CoV-2 virus. We also directly observed the antibody responses of those vaccinated with two doses of vaccine and naturally infected individuals. Participants counted to this study were vaccinated 100% with the Oxford Astra Zeneca COVID-19 vaccine with an interval of above 12 weeks between two doses according to the WHO recommendations [11,12] Accordingly, assays were used to test the samples and collective interpretation was done to identify the vaccine induced immune response and naturally infected cases. The total IgG assay with the detection

of Nucleo-capsid protein helps to determine the presence of antibodies due to natural infection and inactivated SARS-CoV-2 vaccine whereas the assay with spike protein helps to determine the presence of post-infection and antibodies induced by vaccines with spike protein [8,13].

Out of the vaccinees, 234 individuals were identified as positive with this assay indicating seroconversion to vaccine. Detection of SARS-CoV-2 antibody in blood against spike protein specific IgG antibody ELISA assay is a widely used method to demonstrate vaccine induce antibody in individuals who have received S1 protein vaccine [3,14,15].

In the enlist study population only a single health care worker did not show up any antibody response in spite of vaccination with two doses accordingly in contrast to the rest of the study individuals. The history given along with the sample of the antibody negative health care worker highlighted that the individual has had chronic kidney disease and has undergone kidney transplantation three years back. Further, it was found that the individual is on triple immunosuppressive therapy since then. Hence, it was divulged seroconversion or development of detectable antibodies is poor if the individual is on immunosuppressive therapy. The fact was explained and observed in some other studies as well [16,17,18].

However, only 2% of the study population was positive with SARS-CoV-2 Total Ab (IgM/IgA/IgG) ELISA assay targeting Nucleo-capsid protein, in contrast to the spike protein specific IgG antibody ELISA assay. Since this assay targeted Nucleo-capsid protein induced antibodies and 100% of this study population was vaccinated with Oxford AstraZeneca vaccine, it could differentiate the natural infection from Oxford AstraZeneca vaccine induces immunity [9]. Thus, laboratory findings uphold the history of 2% individuals who expressed natural infection with confirmed positive rt-PCR test results.

Timing of collection of the sample is crucial to reveal the immune response and all the blood samples were collected between 4-6 weeks of the second dose of the vaccine. It was evident that the optical densities (OD value) of the Spike protein specific IgG antibody ELISA assay were significantly higher in some participants' samples. Thus, participants positive Ratio was categorized disregarding the previous SARS-CoV-2 infection. It marked out the individuals with a history of positive PCR or significant exposures demonstrated the higher IgG positive ratio indicating that those individuals have had past immunologic experience through SARS-CoV-2 natural infection than non-infected members. Similarly, a few studies have shown higher IgG Antibody titers in previously infected individuals [10,19].

Moreover, two vaccine doses achieved SARS-CoV-2 spike protein specific IgG antibody responses across all ages in the analyzed samples. However, immune response did not show any significant difference among different age groups even though the age range of the participants was 26-66 years [15, 20,21]. Although the duration of vaccination with the second dose and the sample collection was almost uniform in the participants, it was noted that low ratio and average ratio antibody responses among the study group negate to outline the waning off of individual antibodies [22].

In addition, this study also highlighted side effects following vaccination were very minimal other than fever in some participants [21,23]. Furthermore, retrospective analysis of the patient samples disclosed study samples were distributed among sixteen MOH areas representing a single district in the Western Province. This led to confirm that arrange of vaccinated health care categories in the district possess immune response to the vaccine, which is a favorable sign [24], since the health care workers being one of the front-line risk groups in this SARS-CoV-2 battle.

All in all this preliminary study results indicated the incredible vaccine seroconversion of the different categories of health care workers in different medical Officer of Health areas which would minimize healthcare related outbreaks in the community.

In conclusion, the current study encountered a significantly high prevalence of vaccine induced SARS-CoV-2 antibody carriers irrespective the age, among the healthcare workers in the study community.

Acknowledgements

Authors would like to acknowledge all the staff members at the Department of Virology at Medical Research Institute for their immense support.

Disclosure Statement

Authors would like to declare that there are no potential conflicts of interests. Further no funding sources and no financial or personal relationship with other people or organizations that could inappropriately influence the work.

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