

Research Article

Evaluation of Humoral Response of Emergency Unit Healthcare Workers after Third Dose of COVID-19 Vaccination

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ABSTRACT

Background: Coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), is an emerging disease that has become pandemic. Healthcare workers are vulnerable persons due to SARS-CoV-2 infection. Healthcare workers are a government priority in the COVID-19 vaccine program. Antibody titer evaluation to healthcare workers as the first liner is essential due to the risk of the job. **Purposes:** The study aims to assess IgG antibody humoral response in healthcare workers in the emergency unit of Anton Soedjarwo Hospital, Pontianak, before and after the third dose of the COVID-19 vaccine. **Methods:** This study was a descriptive study with a cohort method. Twenty-two healthcare workers in the Emergency Unit in Anton Soedjarwo Hospital, Pontianak, participated in the study. Three ml venous blood samples were collected from the participants in two periods to quantify IgG antibody titer. The first period was before the third dose of the COVID-19 vaccine, and the second period was one month after the third dose of the COVID-19 vaccine. Chemiluminescent Microparticle Immunoassay (CMIA) methods were used to quantification IgG antibodies against spike-receptor binding domain (S-RBD) protein of SARS-CoV-2. **Results:** One month before the third dose of the COVID-19 vaccine, the majority of IgG antibodies show seropositivity (90.91%), with most on range 50-10,000 AU/ml (54.55%). Two participants (9.09%) show IgG antibodies less than 50 AU/ml (seronegative). One month after the third vaccination dose, all participants (100%) elicit IgG antibodies. Based on the comparison of IgG antibody titer before and after the third dose of the vaccine, the majority (68.18%) showed increasing the IgG antibody titer after the third vaccine. **Conclusion:** The third dose vaccine might effectively elevate immune response to SARS-CoV-2 infection.

Keywords: COVID-19, COVID-19 Vaccine, humoral response, IgG antibody titer

INTRODUCTION

Coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), is an emerging disease that has become pandemic nowadays. COVID-19 has exceeded 400 million cases globally, with

mortality exceeding 6 million. Healthcare workers are vulnerable persons due to SARS-CoV-2 infection. Direct or indirect interaction with patients or infectious material and non-appropriate personal protective equipment are risk factors for healthcare workers (1,2). In 2020, India

reported more than 1000 doctors had been infected with SARS-CoV-2. Indonesia is one of a country with a high healthcare workers mortality rate (6%), and the highest mortality rate is in Italy (44%) (1,3,4).

The mechanism of protection against viral infections is the immune system; therefore, the individual's immune system is crucial for determining mortality and morbidity (5). Vaccination is one way to induce the immune system, particularly humoral response, as protection against SARS-CoV-2 infection (6). In early 2021, the Indonesian Ministry of Health started a vaccination program for the community, with the priority group on healthcare workers due to their high job risk. Until the middle year of 2021, 93.15% of healthcare workers in Indonesia have received two doses of vaccine with an inactivated vaccine platform (7).

The vaccination program will elicit immunity responses, such as IgG antibody as humoral immunity response. Since some studies show humoral responses to SARS-CoV-2 are short-lived and decrease gradually, antibody titer evaluation of healthcare workers as the first liner is essential due to the risk of the job (5,8,9). Due to the delta wave in Indonesia in July 2021, the government announced the initial third dose of the COVID-19 vaccine program, with the priority group on healthcare workers. Parallel with this, antibody titer evaluation is carried out to evaluate the antibody titer before the third dose vaccination and follow-through one month after the third dose of COVID-19 vaccine.

Currently, there are S-protein-based assay methods of SARS-CoV-2 to quantify the IgG antibody in vaccinated persons (10). This quantitative assay could

determine IgM or IgG antibody titer due to vaccination or infection and long-term monitoring of antibody titer (2). The study aims to assess IgG antibody humoral response in healthcare workers in the Emergency Unit of Anton Soedjarwo Hospital, Pontianak, before and after the third dose of the COVID-19 vaccine.

METHODS

This study was a descriptive study with a cohort method. Healthcare workers who had two doses of inactivated vaccine and one dose of mRNA vaccine as a third dose vaccine were included in the study. Twenty-two healthcare workers in the Emergency Unit in Anton Soedjarwo Hospital, Pontianak, participated in the study.

Three ml venous blood samples were collected from the participants in two periods. The first is before the third dose of COVID-19 vaccination (August 2021), and the second is one month after the third dose of COVID-19 mRNA vaccination (October 2021). The venipuncture procedure was done at the standardized laboratory, and the examination of IgG antibody titer undergo within two hours.

IgG antibody titer examination was performed with Chemiluminescent Microparticle Immunoassay (CMIA) (Abbott Diagnostics, USA) for detection and quantification of IgG antibodies against spike-receptor binding domain (S-RBD) protein of SARS-CoV-2 (11,12). Serum samples were run 15 minutes on the Abbott Architect machine using the Abbot SARS-CoV-2 IgG II Quant Assay. The interpretation results of the CMIA test based on the manufacture package insert is greater than or equal to 50 AU/mL are confirmed positive for SARS-CoV-2 anti-

spike IgG antibodies. The analytical measure is 21 to 40,000 AU/ml.(11,13) Ethics Committee of the Faculty of Medicine, Universitas Tanjungpura, has approved this study, with no: 6084/UN22.9/PG/2021.

RESULTS

The total of healthcare workers who participated in this study is 22 persons. The female participant was higher than the male, 54.55% and 45.45%, respectively. The distribution of age was: 22-28 years old, 10 participants; 29-36 years old, 12 participants, with a median age of 29.5 years old.

Table 1. IgG antibody titer, before and after the third dose of COVID-19 vaccination

Titer (AU/ml)	Before the Third dose		After the Third dose	
	N	%	N	%
< 50	2	9.09	0	0.00
50-10,000	12	54.55	8	36.36
10,001-20,000	0	0.00	3	13.64
20,001-30,000	1	4.55	8	36.36
30,001-40,000	1	4.55	2	9.09
>40,000	6	27.27	1	4.55

Data in Table 1. show before the third dose of the COVID-19 vaccine, IgG antibodies majority show seropositivity (54.55%) in the range of 50-10,000 AU/ml (Average: 1619.2 AU/ml). Two participants (9.09%) show anti-spike IgG antibodies less than 50 AU/ml (seronegative). After one month of the third vaccination dose, all participants (100%) showed seropositivity to anti-spike IgG antibodies. The majority of participants

have IgG antibody titer range on 50-10,000 AU/ml (36.6%) and 30,000-40,000 AU/ml (36.6%).

Based on the comparison of IgG antibody titer before and after the third dose of vaccine, the majority (68.18%) showed increasing the IgG antibody titer. The data is represented in Table 2.

Table 2. Comparison results of IgG antibody titer, before and after the third dose of COVID-19 vaccination

IgG Antibody Titer	N	%
Decrease	7	31.82
Increase	15	68.18

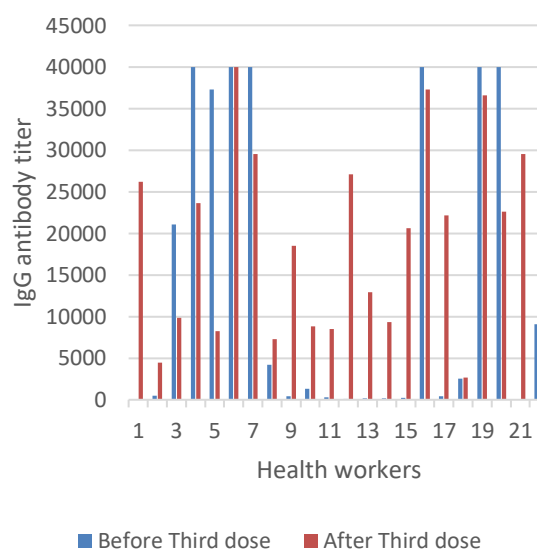


Figure 1. IgG antibody titer, before and after third dose vaccine

DISCUSSION

Healthcare workers are critically vulnerable persons during the COVID-19 pandemic. Indonesia is one of the countries with high healthcare worker morbidity and mortality rates (1,3). In Indonesia, healthcare workers are the priority group for first vaccination implementation, as one of the mechanisms to protect them from SARS-CoV-2 infection. The participants received the first

and second doses of COVID-19 vaccination in February 2021.

Indonesia's first COVID-19 vaccination program used an inactivated vaccine platform with a two-week interval. Two inactivated vaccines have been reported to effectively induce antibody responses and prevent COVID-19, including severe diseases and death (14–16). Some studies reported that antibody titer could decrease gradually over a year; meanwhile, antibodies against spike protein of SARS-CoV-2 are crucial for neutralizing the virus (16,17). Humoral response quantification is becoming important to assess the vaccine response.

During the second wave of the COVID-19 pandemic with the Delta variant, the Indonesian government announces a third dose vaccine for healthcare workers. Hence, we evaluate IgG antibody titer before and after the third dose of the COVID-19 vaccine.

The data in table 1 reported that two of 22 participants had less than 50 AU/ml of IgG antibody titer. This amount of titer is interpreted as a negative IgG antibody titer. Antibodies are a crucial defenses mechanism against viral infections. The humoral immune response acts by activating the effector cells and interfering with the viral entry mechanism into the cells. Virus-elicited antibodies could provide long-term protection from the same pathogen (18,19).

Vaccination is a key strategy for encountering viral infection, and especially there is no established therapy for the disease (19). Data in Table 2 show that most healthcare workers increased IgG antibody titer after getting the third dose of the COVID-19 vaccine (68.18%). The quantity of IgG antibody titer raised is represented in

figure 2. IgG antibodies are known to have longer persistence than IgM and IgA. IgG antibodies could remain stable for more than eight months (8,20). In contrast, 31.82% of health workers showed lower IgG antibody titers than before the third dose vaccine (Table 2). Other studies show that memory B cells towards SARS-CoV-2 spike increased between 1 to 8 months after infection (20,21). Hopefully, the IgG antibody is becoming optimal in a few months ahead.

The government uses an mRNA vaccine as a third dose or booster vaccination program. mRNA vaccines are known to be safer than other vaccine platforms (22). Study revealed that mRNA vaccine elicits antibodies and shows persistence through six months (23). Another study shows that after the third dose of the COVID-19 mRNA vaccine, the rate of confirmed infection was lower in the booster group than in the non-booster group (24).

Many factors affect individual humoral response due to vaccination, such as age, sex, genetics, nutritional factors, and even vaccine factors (5,25). A vaccine for neonatal or elderly would not elicit humoral response optimally, and the decline of antibodies during the time is high (25). Vaccine type also affects antibody-producing. Live vaccine generally produces a high titer of antibody and life-long protection. While other types of vaccines, such as inactivated or subunit vaccines, require multi doses of vaccine to get equal titer antibodies (25).

The limitations of this study are a small group that participated in the research and healthcare workers that SARS-CoV-2 has infected were not excluded.

CONCLUSION

Based on data results, the third dose COVID-19 vaccine might effectively elevate immune response to SARS-CoV-2 infection in healthcare workers.

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CONFLICT OF INTEREST

The authors declare there is no conflict of interest in this study.

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