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Post-vaccination SARS-COV-2 IgG Level: An evaluation study on 2 Area In Indonesia

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Abstract: Corona Virus Disease (COVID-19) caused by the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) has become a global pandemic. Currently there is no effective treatment for this disease, vaccination is one way to deal with this disease. Antibodies that are formed after vaccination are expected to provide protection for everyone. This study was to determine the levels of IgG antibodies formed after SARS-CoV-2 vaccination. 87 respondents were examined in this study using blood samples. Measurement of antibody levels using the CLIA method. The results obtained show that the average level of antibodies formed is 193.355 BAU/ml. 65 respondents who received 3 doses of vaccine (199.652 BAU/ml) had higher antibody levels than respondents who received two doses of vaccine (175.531 BAU/ml) and 1 dose of vaccine (158.365 BAU/ml). Antibody levels in respondents who were examined between 0-6 months after vaccination (202.827 BAU/ml) had higher levels than respondents with a period of more than six months (186.010 BAU/ml). From the study results, data was obtained that the antibody levels in recipients of three vaccine doses were higher so that they could provide sustainable protection against COVID-19. Therefore, the COVID-19 vaccine booster should give to all people to provide protection against COVID-19.

Keywords: *SARS-CoV-2; Vaccination; IgG COVID-19.*

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INTRODUCTION

Corona Virus Disease (COVID-19), caused by the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), has been a global pandemic since March 2020. COVID-19 is caused by the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), a single-stranded RNA Betacoronavirus, with no effective treatment available. Vaccination campaigns worldwide aim to reduce COVID-19 morbidity and mortality. The vaccination program In Indonesia, aims to reduce the number of suffering and deaths due to COVID-19 achieve group immunity in society (herd immunity) [1,2,3]. Several types of vaccines used are live attenuated vaccines, inactivated vaccines, protein subunit based vaccines, virus-vector based vaccines, and nucleic acid based vaccines [4]. Additionally, large-scale social restrictions have been implemented to limit movement and prevent transmission [5]. Ensure all facts are accurate and clearly presented. For example: "By 2020, over 30 vaccines had undergone clinical testing, using various platforms: inactivated virus (e.g., Sinovac, Sinopharm), mRNA (e.g., Moderna, BioNTech/Pfizer), protein subunits (e.g., Novavax), and viral vectors (e.g., AstraZeneca/Oxford, CanSino Bio, Johnson & Johnson, Gamaleya) [6,7]. Each type has distinct advantages and disadvantages. Inactivated virus vaccines, being the safest, use killed pathogens and pose no risk of infection, though they elicit a relatively low immune response. mRNA vaccines use genetic sequences but require specific temperature conditions for storage. Protein subunit vaccines use viral proteins or segments to induce strong humoral and cellular immunity. Viral vector vaccines can be produced on a large scale, but pre-existing immunity can reduce their effectiveness [5,7,8,9,10,11].

Vaccination-induced protection is mediated through complex interactions between innate, humoral, and cellular immunity. Among those immune responses, the humoral response is much easier to detect than others because of tis wide use and standardization[12,13]. Various tests have been developed to detect immunoglobulin M (IgM), IgA, and IgG antibodies from blood samples of patients who have been or are currently infected with COVID-19. This serological test is carried out using various viral antigens and recombinant proteins to capture specific antibodies for SARS-CoV-2 [14,15].

The Spike protein (S) expressed by SARS-CoV-2, nucleocapsid protein (NCP), and other structural proteins are known to be the main targets of antibodies. NCP is related to the viral genome, in the early stages of infection this protein is produced in large quantities. NCP's high sensitivity means no cross-reactivity even with closely related viruses. Therefore, the antibody test for NCP is quite specific[16,17]. The S-protein binds to the angiotensin-converting enzyme 2 (ACE2) receptor on the host cell surface. Protein S consists of two subunits, S1 and S2. Viral entry into the cell is mediated by a receptor binding protein (RBD) within the structure of the S protein. Since the S protein has an important role in the viral entry into cells, it is an important target in virus inactivation and the post-vaccine immune response[18]. Both of these proteins are highly immunogenic and are used as essential proteins in testing for COVID-19 [19].

After vaccination the antibody response that is formed varies depending on the type of vaccine injected. Antibody response to vaccines with inactivated viruses occurs within 14-21 days. For mRNA vaccines this occurs within 21-28 days. In the protein subunit vaccine it occurs within 21 days and in the vector virus vaccine it occurs in 28 days. Demographic characteristics gender, age, and body mass index may have an important role in the development of the immune response after vaccination[20]. The presence of co-morbidities can also affect the immune response after vaccination [21].

Antibody response to COVID-19 vaccination is considered very important for protection from this disease. In general, the antibody response to vaccination may differ depending on the population studies[22]. Antibody towards COVID-19 vaccination was higher in females compared to males as initial response up

to several weeks[23],positivity decreases with age, and positivity is lower in transplant recipients, obese individuals, smokers and those with specific comorbidities [24].

In this study we examined the levels of IgG formed against S-RBD after SARS-CoV-2 vaccination. IgG plays an important role in defending against SARS COV2 infection, including antibodies to the receptor-binding domain (RBD) of the SP, which strongly correlate with antibodies that neutralize viral replication, and play in controlling infection and in disease pathogenesis[25].

MATERIAL AND METHOD

This study is a descriptive analysis aimed at evaluating the levels of IgG antibodies formed after SARS-CoV-2 vaccination. Samples were collected from individuals who had received the SARS-CoV-2 vaccination in Denpasar, Bali, and Cimahi Regency, West Java. This research was conducted from January 2021 to December 2021. The sample size was determined using a simple random sampling technique from the population of vaccinated residents in Denpasar and Cimahi. The unit of analysis was the serum of vaccinated residents

The sampling procedure began with preparing the necessary materials and tools and using complete personal protective equipment (PPE), followed by collecting a blood sample. Samples were centrifuged for 15 minutes at 2000-3000 RPM at 2-8°C [26].

The sample examination procedure begins with the preparation of reagents. Reagents were removed from the box and checked to ensure they were in good condition, by ensuring not passed the expiry date, and still in properly sealed packaging. The reagent barcodes were scanned into the CLIA (Chemiluminescence Immuno Assay) tool system to detect the LOT number. Magnetic microbeads were resuspended and homogenized thoroughly. Perform calibration by clicking the calibration button to run the calibration operation. Then a sample test is carried out by placing the patient's serum in the "Sample Area" and clicking the button to run the test [27].

The data obtained both primary and secondary data are recorded, collected, processed, and presented in the form of narratives and tables.

RESULTS AND DISCUSSION

In this study there were 87 respondents. Of the 87 respondents, 80% of all respondents were women. All respondents had received the first, 86 respondents had received second doses of the vaccine, and only 65 respondents had received the third dose of the vaccine. The mean IgG antibody level formed was 193.355 BAU/ml. A total of 33 respondents received the same type of vaccine while 54 others received a different type of vaccine during vaccination. Respondent characteristics can be seen in the **Table 1**.

Table 1. Characteristics of Respondents

Characteristics of Respondents	Number of Respondents	%
Gender		
Men	17	19.54
Women	70	80.46
Vaccine Dosage		
First Dose	87	100
Second Dose	86	98.85
Third Dose	65	74.71

Long After Vaccination		
0-6 months	38	43.68
>6 months	49	56.32
The Type of Vaccine		
First Dose	87	100
Sinovac/Coronavac	63	72.41
Astra Zeneca	20	22.99
Pfizer	3	3.45
Moderna	1	1.15
Second Dose	86	100
Sinovac/Coronavac	63	73.26
Astra Zeneca	19	22.09
Pfizer	3	3.49
Moderna	1	1.16
Third Dose	65	100
Sinovac/Coronavac	3	4.62
Astra Zeneca	26	40
Pfizer	25	38.46
Moderna	11	16.92
Antibody Levels (BAU/ml)		
Minimum	12.422	
Maximum	394.029	
Mean	193.355	

The mean of IgG antibody levels in 65 respondents who received three doses of vaccine (199.652 BAU/ml) was higher than the respondents who received one (158.365 BAU/ml) and two doses of vaccine (175.531 BAUml). IgG antibody levels formed between 0-6 months (202.827 BAU/ml) after vaccination until the examination was carried out were higher than antibody levels formed after more than six months (186.010 BAU/ml).

Table 2. The Mean of IgG Antibody Levels

	Number of Respondents	SARS-CoV-2 IgG S-RBD Antibody Levels (BAU/ml)
Number of Vaccines		
1 time vaccine	1	158.365
2 times vaccine	86	175.531
3 times vaccine	65	199.652
Vaccine Time		
0-6 months	30	202.827
>6 months	49	186.010

After the COVID-19 vaccination the antibody response that is formed is important for a person's immunity. Vaccination is a well-known and powerful humanitarian weapon in the fight against COVID-19. Population immunity triggered by rapid vaccination is an important global strategy for controlling COVID-19. Vaccination programs must maximize initial effect so as not to face the faster spread of new variants[28]. Administration combination/heterologous vaccines (primer and booster) schedule or prolonged vaccination interval induces robust humoral immunogenicity with good tolerability. Extending the time to boost-immunization is key to both improving antibody induction and reducing ADR rate [29].

Antibodies are formed by exposure of the immune system to vaccine antigens thereby stimulating the formation of memory B cells, which differentiate

into antibody-secreting cells. IgG molecules are produced by antibody-secreting cells and are responsible for vaccine-induced immunity. The results of this study are in line with other studies which also found that antibody titers tended to increase significantly up to day 36 or the first month after vaccination[30]. A similar study conducted by Trougakos et al. (2021) which assessed the kinetics of antibody response after administration of BNT162b2 mRNA vaccination, found that there was a sharp increase in anti-IgG S-RBD levels in vaccinated recipients after day 22 and remained high at day 50 [31].

Terpos et al. (2021) revealed that the decrease in antibodies formed after vaccination occurred on day 36 to day 111. However, the antibody response persisted in the body on day 111. This indicates that there is ongoing immune protection against COVID-19 [30]. This is in line with the results of our study. The results of our study showed that respondents with a vaccine duration of more than six months had lower IgG antibody levels compared to respondents with an examination period of 0-6 months after vaccination. Other study also stated that the efficacy of the mRNA vaccine for SARS-CoV-2 for up to six months has an efficacy of up to 73% in fully vaccinated individuals. The effectiveness rate of the vaccine in first 5 months reaches 90% and decreases to 47% after 5 months. Tartof et al. (2021) suggest that additional doses may be required up to six months after two doses of the vaccine to increase its efficacy [32].

Differences in antibody levels that are formed can also be caused by the type of vaccine. Larkin (2022) stated that different types of SARS-CoV-2 vaccines can provide different protections. This can be used as a strategy to guide coordinating vaccine variants to increase protection against new variants and can have implications for the development of future therapies [33]. Besides that, the intrinsic factors of the respondents also influence the immune response that is formed after vaccination. These factors include age, sex, genetics, and comorbidities [12]. A study showed that age has a significant effect on antibody levels after vaccination. It was found that individuals at a younger age (<50 years) maintained higher antibody levels after day 36 [30]. Other study has also consistently shown that there is an effect of age on the antibody response formed after vaccination with the mRNA-1273 vaccine [34]. Apart from the antibodies that are formed, the efficacy of the vaccine also effects the symptoms after a person is infected with COVID-19. A study conducted by Masrike et al. (2023) stated that a person who received two doses of the vaccine was reported to have a post-COVID-19 chronic cough with a lower frequency [35]. This showed that the booster of the SARS-CoV-2 vaccine is needed byb the community in tackling the COVID-19 pandemic.

Our study has several limitations. First, the number of samples was relatively small, indicate limited representativeness of results [36]. Second, the demographic skew towards women, which females were more prone to adverse reactions after vaccination. This can be influenced by hormonal factors (where the estrogen has a better immune response compared to the testosterone), as well as genetics (where the x chromosome has an immune response 10 times better than the y chromosome) [23]. Exploring the of antibody levels periodically and long-term period, vaccine combinations or the impact of booster doses in diverse populations, as well as a larger number of samples in diverse populations could be highlighted as important for the next study

CONCLUSION

The study found that the levels of IgG antibodies formed after COVID-19 vaccination increased significantly within the first 0-6 months and decreased thereafter. Specifically, the mean antibody levels were higher in respondents who had been vaccinated within the last six months (202.827 BAU/ml) compared to those vaccinated more than six months ago (186.010 BAU/ml). Additionally, respondents who received three doses of the vaccine had higher antibody levels (199.652 BAU/ml) than those

who received only one (158.365 BAU/ml) or two doses (175.531 BAU/ml). These findings underscore the necessity of booster vaccines to maintain elevated antibody levels and ensure sustained protection against COVID-19. Furthermore, the data indicates that using a mix and match strategy with different vaccine types could enhance immune protection. The majority of respondents received different vaccines for their subsequent doses, suggesting that heterologous vaccination regimens might be effective in eliciting robust antibody responses. This approach could be strategically employed to enhance immunity, particularly in light of emerging variants and the waning of antibody levels over time. Therefore, ongoing vaccination programs should consider incorporating booster doses and potentially varying vaccine types to optimize long-term immunity against COVID-19.

AUTHORS' CONTRIBUTIONS

Bekti: Conceptualization; Methodology; Investigation. Dharmawati: Data curation; Project Administration. Habibah: Visualization; Writing-Original Draft. Merdekawati: Resources; Investigation. Noviar: Resources; Investigation. Suiraoka: Methodology; Data curation. Rinawati: Resources; Writing-Original Draft. Syahniar: Writing-reviewing and editing. Ayatullah: Visualization

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DATA AVAILABILITY STATEMENT

The utilized data to contribute to this investigastion are available from the corresponding author on reasonable request

DISCLOSURE STATEMENT

There is no conflict of interest.

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