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# Seroprevalence Surgery of Anti-SARS-CoV-2 Antibodies Based on COVID-19 Vaccine Type in Academy Community, East Kalimantan, Indonesia

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## Abstract

**BACKGROUND:** The implementation of the vaccine on a large scale has almost reached all provinces in Indonesia. East Kalimantan, one of the provinces affected by COVID-19, has also implemented a vaccine program. Seroprevalence surveys are essential to describe the success of vaccine program based on antibody titer test.

**AIM:** This study aims to determine the anti-SARS-CoV-2 antibody titer value based on the type of vaccine received by the academic community in Samarinda, one of the cities most affected by COVID-19 in East Kalimantan.

**METHODOLOGY:** The study was population-based. The study sampled 100 people from the community. Participants must be in good health, aged 16–60, with a positive COVID-19 test, no comorbid illnesses or other chronic problems, no blood transfusions, and most importantly, have received the least initial dosage of immunization. The data will be analyzed using SPSS 26 and STATA 16. A normality test and Tobit regression test to determine the antibody distribution in each vaccine type.

**RESULTS:** The results showed that Moderna COVID-19 Vaccine provided a significant (p = 0.001) increase in antibody prediction of 1090 U/ml (95% CI: 764–1416), while Pfizer provided a significant (p = 0.000) rise of 766 U/ml (95% CI: 307–1226).

**CONCLUSION:** According to the results of a seroprevalence survey conducted among the academic community in East Kalimantan, receivers of inactivated vaccinations outnumbered those of mRNA and vector-based vaccines. It can be determined that booster immunizations for students and academic staff are required to guard against COVID-19 infection. As boosters, both Moderna's COVID-19 Vaccine and Pfizer's COVID-19 Vaccine are strongly recommended.

## Introduction

Numerous groups, particularly health professionals, have long believed that "natural infection offers more immunity than vaccination." While this is true, vaccine technology has improved where this outcome should be considered the exception rather than the rule over the last two decades. This was also the case at the start of the COVID-19 outbreak. COVID-19 has remained one of the world's public health challenges up to this day. Vaccines are critical for minimizing patient morbidity.

In the case of COVID-19, the superiority of vaccine-based immunity has been demonstrated in immunogenicity studies of frontier vaccine candidates: Post-vaccination antibody assays revealed higher neutralizing anti-S-IgG levels compared to convalescent plasma. Analysis of the mean IgG titer demonstrated that vaccines induced consistently high levels of NAb across patients, but spontaneous infection resulted in an immunological response that was very variable [1], [2]. Furthermore recently, it has been discovered that the infection can also create SARS-CoV-2-specific long-lived memory $CD4^+$ and $CD8^+$ T cells, memory B cells, and mucosal-homing IgA plasmablasts [3], [4], [5]. This shows the virus has an immunogenic antigen that can be used as an epitope to elicit neutralizing antibodies (NAbs). To eliminate pathogens through antibody mediated means, these NAbs engage with immunological components to bind the virion and physically inhibit viral fusion with target cells. The receptor-binding domain (RBD), the N-terminal domain (NTD) and the conserved portions of the S2 subunit are all present in SARS-CoV-2 [2].

In addition, the change in the status of the pandemic to endemic has relaxed social restrictions regulations. Therefore, measuring the success of vaccines as the only protection against COVID-19 becomes very important. Vaccines are considered the

oldest cost-effective and well-established preventive health strategies globally, and they are used to prevent the spread of deadly infectious illnesses. Availability of safe and efficient vaccines is a vital strategy that will aid in the eradication of the COVID-19 pandemic in the future. People apparently may possess significant preferences for a vaccination that is greatly effective and a vaccine with a low efficacy prediction may have an adverse influence on people's tendency to be vaccinated if they are exposed to it [6]. It is also likely that individuals will regard a pandemic vaccine as lower secure due to the fact that it is new or that it has undergone a lack of study [6]. Approval of vaccines may also be influenced by public opinions of their safety [7].

The use of serological testing, specifically the detection of anti-SARS-CoV-2 antibodies in a person's blood, has been proposed as a practical medical laboratory instrument in the diagnostic test of the latest or recovered COVID-19. SARS-CoV-2 seroprevalence studies also have a purpose to monitor immune responses to the COVID-19 vaccine [8].

East Kalimantan, one of the areas experiencing the impact of COVID-19 in Indonesia, also needs attention. A seroprevalence survey of anti-SARS-CoV-2 in East Kalimantan is critical to determine the success of the vaccine program in protecting from COVID-19.

## Methods

Researchers conducted a population-based observational study (community-based study). A descriptive study was chosen as the research design in this investigation. Mulawarman University Clinic serves as a sampling facility for the researcher's experiments. Everyone who wishes to participate in the study as a research subject must sign a consent letter.

Mulawarman University has 27.949 student and academic staff and the research sample consisted of 100 subjects from that population. The participants required to be in good health, between the ages of 16–60, have a positive COVID-19 test, have no comorbid disorders or other chronic conditions, have not received blood transfusions, and, most significantly, have received the minimal initial dose of vaccination. Blood will be extracted from the participant only if they meet all the criteria. The blood will next be analyzed for the antibodies using electro chemiluminescence immunoassay (ECLIA) Anti-SARS-CoV-2.

### *Data analysis*

The data will be analyzed and managed using SPSS version 26 and STATA version 16. A normality test determines the distribution of antibody values in each type of vaccine. The central tendency of the data was presented using mean, standard deviation (SD), median, and interquartile range (IQR) for continuous data. In contrast, the frequency was used to explain the categorical data. Tobit regression was used to analyze antibodies titer up to >1000.

## Results

This study included 100 participants who had a history of experiencing COVID-19 and had received vaccinations, 46 (46%) were men with a median and age quartile of 33 years (23; 47.5). Most of them, 79%, received inactivated vaccines, followed by mRNA vaccines at 17% and vector-based vaccines at 4% (Table 1).

**Table 1: Distribution sex, age, and vaccine type of participants**

| Characteristics of participants | Participants (n = 100) |
|---|---|
| Female | 56 |
| % (95% CI) | 31.1 (27.7-34.5) |
| Median age (p25;p75) | 26 (21; 38.5) |
| Male | 44 |
| % (95% CI) | 35.7 (31.6–39.7) |
| Median age (p25; p75) | 33 (23; 47.5) |
| Age group | |
| 18–29 | 50 |
| 30–39 | 19 |
| 40–49 | 13 |
| 50–59 | 16 |
| ≥60 | 2 |
| Vaccine type | |
| Inactivated | 79 |
| AstraZeneca | 4 |
| Pfizer | 4 |
| Moderna | 13 |

Inactivated vaccines showed a mean of 277.726 ± 346.098 U/ml, a median of 102.45 U/ml, and an IQR of 356.49 U/ml. The Pfizer vaccine showed a mean of 758.580 ± 482.840 U/ml, a median of 1000 U/ml, and an IQR of 724.26 U/ml. Meanwhile, the Moderna vaccine showed a mean of 955.046 ± 159.153 U/ml, a median of 1000 U/ml. AstraZeneca vaccine showed mean 581.880 ± 320.489 U/ml, median 500.91 U/ml, and IQR 588.32 U/ml (Table 2).

**Table 2: Descriptive statistics of anti-SARS-CoV-2 antibodies based on vaccine type**

| Vaccine Type | Mean ± SD | Median | IQR |
|---|---|---|---|
| Inactivated | 277.726 ± 346.098 | 102.45 | 356.49 |
| AstraZeneca | 581.880 ± 320.489 | 500.91 | 588.32 |
| Pfizer | 758.580 ± 482.840 | 1000 | 724.26 |
| Moderna | 955.046 ± 159.153 | 1000 | 0 |

The boxplot comparison aims to observe the upper quartile value for each type of vaccine. Inactivated vaccines showed a lower upper quartile than the other vaccines; AstraZeneca, Moderna, and Pfizer (Figure 1).

When compared to the inactivated vaccine, Moderna vaccine provided a statistically significant increase in antibody prediction of 1090 U/ml (95% CI: 764–1416), while Pfizer provided a statistically significant rise of 766 U/ml (95% CI: 307–1226). There

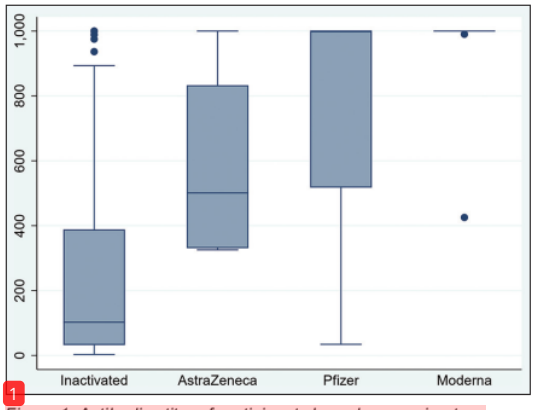


*Figure 1: Antibodies titer of participants based on vaccine type*

was no statistically significant difference between the groups in terms of the growth in antibody units when the variables of age, gender, AstraZeneca vaccination, and previous COVID-19 infection were included in the study (Table 3).

**Table 3: Tobit regression analysis**

| Variable | Value | *t* | α = 0.05 | %95 CI |
|---|---|---|---|---|
| Constanta | −30.71 | −0.17 | 0.867 | |
| Age | 5.3 | 1.54 | 0.128 | −1.6;12 |
| Sex | | | | |
| Female | 114 | 1.41 | 0.163 | −47;274 |
| Vaccine | | | | |
| Pfizer | 766 | 3.31 | 0.001 | 307;1226 |
| Modema | 1090 | 6.54 | 0.000 | 764;1416 |
| AstraZeneca | 320 | 1.56 | 0.123 | −88;728 |
| COVID-19 Inf. | 120 | 1.38 | 0.170 | −52;292 |

## Discussion

### *ACE2 receptor and young age*

A total of 50% of the participants belonged to the young age group, namely, 18–29 years. Young adults (18–40 years) have more ACE2 receptors in the nasal epithelium than children [9]. In addition to serving as an entry point for SARS-CoV-2 virus infection on host cells, the ACE2 receptor has been shown to perform a significant anti-inflammatory role in the renin-angiotensin-aldosterone system (RAAS) indicating paths by transforming the pro-inflammatory angiotensin 2 to the anti-inflammatory angiotensin 1–7 [10], [11], [12]. An age-related decline in ACE2 expression was detected in numerous organs including blood, kidney, and adrenal glands, and was also found to be lower in type 2 diabetic patients compared to healthy persons [13]. As a result, decreased ACE2 receptor expression, along with diminished immunity and comorbidities, may hamper the anti-inflammatory response, predisposing older adults to an increased inflammatory response, a feature of COVID-19 [14].

As evidenced by the existence of a high number of ACE2 receptors in children and young adults, this age group is still susceptible to infection with COVID-19. Vaccine protection has become increasingly crucial, particularly among members of the academic community.

### *Vaccine and neutralizing antibody*

In Indonesia, the food and drug supervisory agency has granted distribution permits for CoronaVac, PT Bio Farma COVID-19 vaccine, Astra Zeneca COVID-19 vaccine, Sinopharm COVID-19 vaccine, Moderna COVID-19 vaccine, and Pfizer COVID-19 vaccine. Coronovac, PT Bio Farma COVID-19 vaccine, and Sinopharm COVID-19 vaccine are inactivated vaccines. Meanwhile, AstraZeneca COVID-19 vaccine is a vector-based vaccine. The other two vaccines, Moderna COVID-19 vaccine and Pfizer COVID-19 vaccine are mRNA vaccines.

To create the similar response and memory subsets as in natural SARS-CoV-2 transmission, COVID-19 vaccine-mediated immune stimulation is intended to imitate that of wild SARS-CoV-2 infection without harming the host or causing chronic inflammatory adverse reactions [15]. Teijaro *et al.* 2021 discuss how the multiple COVID-19 vaccines generate an immunological response and so confer protection against SARS-CoV-2. Vaccines usually comprise an immunogen encoding antigenic viral peptides and an adjuvant that induces a complex immune reaction [16], [17]. Based on the composition of the vaccine, the immunogen may serve as both the immunogen and promoter [15].

COVID-19 mRNA vaccines were reported to stimulate $CD4^+$ and $CD8^+$ T-lymphocyte maturity in clinical studies [18], and higher over 70% of vaccinated people exhibit memory T-lymphocyte activation [19]. Furthermore, 8 weeks following the second dose of COVID-19 mRNA vaccine, participants generated B cells and elevated concentrations of IgM and IgG antibodies. In addition, the levels of RBD memory B-lymphocytes were comparable to those seen in people who acquired antibodies through spontaneous SARS-CoV-2 infection [20]. The latest findings indicate that memory T-lymphocyte and B-lymphocyte levels created by the COVID-19 mRNA vaccine remain rather constant for 3–6 months following vaccination [21].

In the antibody titer regression tobit test, there was a significant correlation between vaccine type and antibody titer. These results also in line with a study conducted in Thailand. This study discovered that the seropositivity rate for total antibodies against RBD was 67% in 21 days after dose 1 vaccination [9], which was smaller than the levels observed for Pfizer-BioNTech and Oxford-AstraZeneca vaccines at 99.5% and 97.1%, respectively, >14 days after dose 1 vaccination [22]. Furthermore, seroconversion rates (100%) at 1 month after dose 2 were much greater than others reported earlier for CoronaVac (Inactivated

Vaccine) (95.6–99.2%) [23]. Following 1 month after dose 2 vaccination, total antibodies against RBD were less than those elicited by Pfizer-BioNTech, 1108 U/ml and Moderna 2881 U/ml at 6–10 weeks following dose 2 vaccination [24].

Persons with a record of COVID-19 infection had a 10-to-45-fold greater neutralizing antibody titer following a single dose of either the Pfizer-BioNTech (BNT162b2) or Moderna (mRNA-1273) mRNA COVID-19 vaccines, regardless of condition intensity [25], [26]. A second dosage had no effect on this titer, indicating that a single dose of an mRNA vaccine is adequate to achieve maximum antibody and memory B-lymphocyte levels in people with a history of COVID-19 infection [25], [27]. As a result, COVID-19 vaccinations may not only facilitate the development of neutralizing antibodies but may also sustain and enhance titers in people who have previously been infected. This is comforting because neutralization titers decrease over time [28] and protective immunity acquired from past SARS-CoV-2 infection is not guaranteed due to the variable immune responses generated. However, another found that people who have protection from previous infection alone have a 13-fold reduced chance of re-infection than those who received both doses of the Pfizer-BioNTech (BNT162b2) mRNA vaccine [29].

## Conclusion

According to the results of a seroprevalence survey conducted among the academic community in East Kalimantan, receivers of inactivated vaccinations outnumbered those of mRNA and vector-based vaccines. It can be determined that booster immunizations for students and academic staff are required to guard against COVID-19 infection. As boosters, both Moderna's COVID-19 Vaccine and Pfizer's COVID-19 Vaccine are strongly recommended.

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