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COMPARISON OF SARS-CoV ANTIBODY TITER LEVELS AGAINST ABO BLOOD TYPE, AGE, AND GENDER IN CONVALESCENT PLASMA DONATIONS

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Abstract

An important requirement to become a convalescent plasma donor is a standardized SARS-CoV antibody titer. However, not all Covid-19 survivors pass the plasma donor selection due to low antibody titer. This research aims to determine the comparison of SARS-CoV antibody titer levels with blood type, age and gender of Covid-19 convalescent plasma donors at blood donation unit PMI Semarang City. This study is an analytical observational study with a cross sectional design, using 300 data on convalescent plasma donors. The sampling technique used was purposive sampling. Differences in SARS-CoV antibody titer levels based on blood type, age, and gender were tested using SPSS 25. Donors involved in this study were divided based on the conversion of convalescent plasma titer levels, namely 1:80 (37%), 1:160 (4%), 1:250 (10.3%) and 1:640 (48.7%). Based on blood type data, most convalescent plasma donors have blood type O (42%) with the highest titer levels in the 1:640 category (48.7%). The highest mean titer level was found in blood group B which was 382.09. The results of the Kruskal-Wallis test showed no significant difference in titer levels by blood group, p=0.622 (>0.05). In the parameter of donor age, SARS-CoV antibody titer levels also showed no significant difference in donor age, both adolescent, adult and elderly donors with a value of p=0.598 (p>0.05). In line with these results, the chi square test of differences in antibody titres based on gender also showed no significant difference, p value=0.127 (p>0.05). High and low antibody titres of convalescent plasma donors are not determined by blood type, age and gender of the donor.

Keywords : Antibody Titer, SARS-CoV, blood type, age, gender

1. Introduction

The Covid-19 virus attack in 2019 caused acute respiratory disorders such as fever, cough and shortness of breath, pneumonia, acute respiratory syndrome, and even death almost all over the world. In Indonesia, the Covid-19 virus infects more than millions of people, with a total report of 18,354,342 cases spread across 216 countries (WHO, 2020). The high mortality rate of Covid-19 patients requires government policies to carry out controls such as the use of masks, maintaining distance and prohibiting crowding (Kemenkes, 2020). Another control that is considered very effective in reducing mortality is convalescent plasma therapy (Rajendran *et al.* 2020).

Hands are highly susceptible to the spread of infections and diseases in humans, as human hands frequently come into direct contact with the environment. Maintaining hand hygiene is one of the crucial steps in preventing the emergence and spread of diseases caused by microbial infections. Sanitation measures, such as washing hands with soap and clean water, aim to keep them clean and free from germs. Soap can be used as an alternative antibacterial agent to inhibit or even kill bacteria.(Nabiyl Ahmad Fawzy, 2024)

Convalescent plasma therapy is one of the therapies that has proven effective in the healing process of Covid-19 patients. The application of convalescent plasma therapy in patients with Covid-19 showed a decrease in mortality and viral load in patients intensively (Klassen *et al.* 2021). Clinical improvement was also reported in all patients with moderate and severe symptoms after performing convalescent plasma therapy (Yudhaputri, Johar & Bachtiar, 2021). Convalescent plasma is obtained by separating plasma from concentrated red blood or whole blood using the apheresis method (Tiberghien *et al.* 2020). However, other

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facts show that not all Covid-19 survivors can pass the plasma donor selection. The plasma used must contain specific antibodies against SARS-CoV (Janiaud *et al.* 2021).. The minimum neutralisation titer requirement used in the United States and Europe is 1: 160 for donors. This number is the same as PMI Semarang City, which is guided by BPOM, but in urgent conditions, a titer level of 1:80 is still allowed.

The Blood Transfusion Unit report shows that convalescent plasma donors are predominantly male with the age of adolescents, adults, and some early elderly. This data is in line with previous research which also shows the results of convalescent plasma donations of 293 donors with an average age of adolescence to adulthood (He *et al*. 2021). The total number of convalescent plasma donors at the Blood Transfusion Unit in July 2021 was recorded as many as 874 donors with various ages.

In this study, researchers want to prove whether or not there is a relationship between blood type, donor age, and gender with the high and low levels of convalescent plasma antibody titres used as therapy for Covid-19 patients.

2. Methods

This study is an analytical observational study with a cross sectional method. The data used in this study were antibody titer data of convalescent plasma donors at PMI Semarang City in July 2021 as many as 874 donors, which were then randomly taken 300 samples. The sampling technique used in this study was purposive sampling.

The inclusion criteria in this study were donors with a positive history of Covid-19, aged 17-65 years, negative for HbsAg, HCV, and HIV, and had antibody titer levels of at least 1:80. The examination of donor antibody titer levels was carried out using the Allinity tool, with five titer level conversions, namely 1:80, 1:160, 1:250 and 1:640. The age of convalescent plasma donors was divided into three major groups: adolescents (17-26 years), adults (27-46 years) and elderly (47-65 years). Differences in SARS-CoV antibody titer levels based on blood type, age, and gender were tested using SPSS 25.

3. Result & Discussion

In this study, 300 convalescent plasma donor samples were divided into blood group, age and gender with four antibody titer categories of 1:80; 1:160; 1:250 and 1:640 **(Table 1).**

Table 1. Descriptive data of convalescent plasma donors

Variable	Frequency	%
Gender		
Man	223	74.3
Woman	77	25.7
Age		
17 – 26	56	18.7
27 – 36	117	39.0
37 – 46	79	26.3
47 – 56	37	12.3
57 – 65	11	3.7
Blood Group		
A(+)	59	19.7
B(+)	86	28.7
AB(+)	29	9.7
O(+)	126	42.0
Antibody Titer		
>1:80	111	37.0
>1:160	11	3.7
>1:250	32	10.7
>1:640	146	48.7

Source: Data Processing

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Based on the data in **Table 1**, convalescent plasma donors who passed the selection consisted of males (74.3%) and females (25.7%), mostly consisting of 27-36 years of age (39%), dominated by blood type O (42%) with the highest percentage of donor antibody titer levels being >1:640 (48.7%). Convalescent plasma donors in this study were divided into adolescents, adults (early and late), and elderly (early and late). The age distribution of donors in the range of 17 years - 65 years is presented in **Table 2.**

Table 2. Characteristics of study subjects based on donor age and SARS-CoV antibody titer levels

Age Category	**F**	**Antibody SARS-CoV Titer Levels**		
		conversion	**Total**	**%**
Late teens (17–26 Tahun)	62	1:80	25	44.6
		1:160	0	0
		1:250	5	8.9
		1:640	26	46.4
Early Adulthood (27–36 Tahun)	112	1:80	44	387.6
		1:160	5	4.3
		1:250	9	7.7
		1:640	59	50.4
Late Adulthood (37–46 Tahun)	81	1:80	28	35.4
		1:160	4	5.1
		1:250	11	13.9
		1:640	36	45.6
Early Elderly (47–56 Tahun)	36	1:80	10	27.0
		1:160	1	2.7
		1:250	7	18.9
		1:640	19	51.4
Late Elderly (57–65 Tahun)	9	1:80	4	36.4
		1:160	1	9.1
		1:250	0	0
		1:640	6	54.5

Source : Data Procesing Relationship of blood type to antibody titer

The highest number of convalescent plasma donors were early adults aged 27 - 36 years as many as 117 people (39.0%), late adults aged 37 - 46 years as many as 79 people (26.3%), and late adolescents aged 17 - 26 years as many as 56 people (18.7%) **(Table 2)**. These results are in line with previous research where from 945 rapid test data of IgM and IgG of Convalescent Plasma donors at PMI Jakarta, the average age of adolescents to adults was obtained (He *et al.* 2021). This is because in adolescence - adulthood the body produces antibodies faster and the body's immunity responds quickly if there is a foreign object or virus that infects it (Aini & Syafrudin, 2022). The relationship between the age of convalescent plasma donors and antibody titer levels is presented in **Table 3.**

Table 3. Relationship between age and donor antibody titer

Age	**Antibody Titer**				**p**	**r**
	>1:80	**>1:160**	**>1:250**	**>1:640**		
17 – 26	25 (44.6%)	0 (0%)	5 (8.9%)	26 (46.4%)	0.403	0.039
27 – 36	44 (37.6%)	5 (4.3%)	9 (7.7%)	59 (50.4%)		

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37 – 46	28 (35.4%)	4 (5.1%)	11 (13.9%)	36 (45.6%)
47 – 56	10 (27%)	1 (2.7%)	7 (18.9%)	19 (51.4%)
57 – 65	4 (36.4%)	1 (9.1%)	0 (0%)	6 (54.5%)

Source : Data Procesing Relationship of blood type to antibody titer

Antibody titer levels of convalescent plasma donors are divided into four comparisons, namely 1: 80 as many as 111 people (37.0%), 1: 160 as many as 11 people (3.7%), 1: 250 as many as 32 people (10.7%) and 1: 640 as many as 146 people (48.7%). Interpretation of the results of the highest number of antibody titer levels is 1: 640 with 146 people (48.7%). These results are in line with research conducted by Hamid et al. (2021) which states that the results of antibody testing depend on several factors such as the duration of infection, clinical mordibity, the tools used for examination and the reliability of the results obtained.

The results of the analysis of the relationship between the age of convalescent plasma donors and antibody titer levels were obtained with an r coefficient of 0.039 and a p value of 0.403 (p >0.05). These results indicate that there is no significant relationship between age and antibody titer. The high and low levels of SARS-CoV antibody titres are not influenced by whether a donor is young or old. Klein *et al.* (2020) Higher antibody levels were seen in patients who were male, older, infected with SARS CoV-2 and had been hospitalised. Mehew et al. (2020) Older male donors with previous SARS-CoV-2 infection leading to hospitalisation and in studies that have been conducted are likely to have high neutralising antibody titres. Focosi & Franchini (2021) mentioned that although it has been proposed that antibody levels are higher in male and older patients, this study found that higher nAb titer levels after adjusting for hospitalisation were associated with COVID-19 severity. Convalescent plasma donors with a history of cough, fever, dyspnea, and pneumonia had significantly higher anti-SARS-CoV antibody titres compared to asymptomatic convalescent plasma donors (Wardhani *et al.* 2021).

Tabel 4. Relationship of blood type to antibody titer

Blood type	Antibody Titer				∑	p
	>1:80	>1:160	>1:250	>1:640		
A(+)	21 (35.6%)	0 (0%)	9 (15.3%)	29 (49.2%)	59	0.612
B(+)	32 (37.2%)	4 (4.7%)	6 (7%)	41 (51.2%)	86	
AB(+)	14 (48.3%)	1 (3.4%)	3 (10.3%)	11 (37.9%)	29	
O(+)	44 (34.9%)	6 (4.8%)	14 (11.1%)	62 (49.2%)	126	

Source : Data Procesing Relationship of blood type to antibody titer

The frequency distribution of blood type of convalescent plasma donors is presented in **Table 4.** Based on the distribution of donor blood types presented in the table, the number of donors with blood type A was 59 people (19.7%), blood type B was 86 people (28.7%), blood type O was 126 people (42%) and blood type AB was 29 people (9.7%). The most frequent donors of convalescent plasma were donors with blood type O and the least frequency of plasma donors was donors with blood type AB. The test of the relationship between blood type and antibody titer using the Kruskal Wallis alternative test obtained a p value = 0.612 (p>0.05)**.**

Tabel 5. Mean antibody titer levels by blood type

Blood type	N	Mean	Min	Max
A	59	374.58	1:80	1:160
B	86	382.09	1:80	1:160
O	126	378.25	1:80	1:160
AB	29	312.76	1:80	1:160

Source : Data Procesing Mean antibody titer levels by blood type

The results of the analysis between blood type and high and low levels of donor antibody titer also showed no significant relationship, that blood type was not proven to affect the antibody titer of the donors. The high rate of O blood group as a donor is due to the fact that

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O blood group is the most common in the world with 64.3% of the world population while AB blood group is 7.1% of the world population. In the results of this study, high antibody titer levels (1:640) were detected in 146 convalescent plasma donors with 44 donors with blood type B. These results are in line with the research of Bloch *et al.* (2021) which states that donors with blood type B have relatively higher neutralizing antibody titers (nAb) compared to blood type O. It is not certain why blood type B has relatively higher antibody titer levels compared to other blood groups. However, one possibility that has been speculated is the reactivity between the virus and the B antigen, which stimulates antibody production. Viral antigens may appear more foreign to individuals with blood type B compared to blood types O and A. This is evidenced by a study from Mehew *et al.* (2020) which states that donors with blood type A may have lower neutralizing antibodies (nAb) compared to groups with blood types B and O. Meanwhile, according to the results of research by Hayes *et al.* (2021) blood type O has relatively lower neutralizing antibodies than blood type B.

When viewed from the mean values of antibody titer levels presented in **Table 5**, the mean antibody titer of blood group A is 374.58, blood group B 382.09, blood group O 378.25, and blood group AB 312.76. Based on these results, it can be concluded that blood group B has a higher average antibody titer than blood groups A, O and AB. Blood group AB has the lowest average antibody titer compared to blood groups A, B and O (B>O>A>AB).

Tabel 6. Differences in antibody titer by gender

gender	Antibody Titer				p
	>1:80	>1:160	>1:250	>1:640	
Man	83 (37.2%)	11 (4.9%)	26 (11.7%)	103 (46.2%)	0.127
Women	28 (36.4%)	0 (0%)	6 (7.8%)	43 (55.8%)	

Source: Data Procesing Differences in antibody titer by gender

Based on the results of the chi square test, the difference in antibody titers based on gender showed a value of p=0.127 (p>0.05). This value also shows that there is no significant relationship between antibody titer levels from male donors or female donors **(Table 6)**. Ishaq *et al.* (2021) reported similar result, that there was no significant difference in IgM and IgG production in male participants compared to females. The median of IgM antibodies in the male group had on average a non-significant difference (P-value=0.410) than the female group. The number of plasma donors is dominated by men. There are several influencing factors, one of which is that women have several reasons, such as menstruation, which can affect Hb levels, and women who have been pregnant have the opportunity for HLA (human leukocyte antigen) and HPA (human platelet antigen) to appear if they donate. Both of these things can trigger transfusion reactions in patients who receive donor plasma.

4. Conclusion

The study demonstrated that the high and low levels of SARS-CoV antibody titers in each convalescent plasma donor are not influenced by the blood type, age and gender of the donor. In all age categories, teenagers, adults and the elderly can produce antibodies, although the highest percentage of successful donors is in the teenagers and adults group. This research can be continued by adding other parameters such as duration of infection, range of donors, and tracing the possibility of other accompanying diseases.

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