BAREKENG: Journal of Mathematics and Its Applications
September 2023 Volume 17 Issue 3 Page 1521–1532
P-ISSN: 1978-7227 E-ISSN: 2615-3017
https://doi.org/10.30598/barekengvol17iss3pp1521-1532

COMBINATION OF SAW-TOPSIS AND BORDA COUNT METHODS IN SEQUENCING POTENTIAL CONVALESCENT PLASMA DONORS

Nur Fadilatul Ilmiyah [1*], Salma Zahrotun Nihayah Al Hasani [2], Della Renaningtyas [3]

[1,2,3]*Mathematics Education Study Program, Faculty of Tarbiyah, IAIN Kediri*
Sunan Ampel Street, No.7, Kediri, 64127, Indonesia

*Corresponding author's e-mail: * nur.fadilatul.ilmiyah@iainkediri.ac.id*

Article History:

Received: 10th March 2023
Revised: 5th August 2023
Accepted: 15th August 2023

Keywords:

SAW;
TOPSIS;
Borda count;
Convalescent plasma donors.

ABSTRACT

Convalescent Plasma Therapy (CPT) is an additional therapy to increase the chances of recovery for patients infected with COVID-19. CPT is carried out by giving blood plasma from COVID-19 survivors to COVID-19 patients. Not all survivors of COVID-19 can become plasma donors. Several criteria must be met. Therefore, selecting and sequencing potential plasma donors can be considered an act of decision-making. This research aims to provide an overview of the application of the SAW-TOPSIS combination and the Borda Count method in selecting and ranking potential plasma donor candidates. The criteria for prospective plasma donors are limited to six aspects, namely age, weight, history of blood transfusion, gender, pregnancy status, history of being infected with COVID-19, and history of previous illnesses. Data was taken from ten COVID-19 survivors to illustrate the application of the three methods. The data is taken from a questionnaire distributed via Google Forms. This research was carried out through 3 stages: applying the SAW method, the TOPSIS method, and the Borda Count method. From the calculated results, P06 was the most potential plasma donor candidate, followed by P03, P09, P02, and P04.

How to cite this article:

N. F. Ilmiyah, S. Z. N. A. Hasani and D. Renaningtyas., " COMBINATION OF SAW-TOPSIS AND BORDA COUNT METHODS IN SEQUENCING POTENTIAL CONVALESCENT PLASMA DONORS," *BAREKENG: J. Math. & App.*, vol. 17, iss. 3, pp. 1521-1532, September, 2023.

Journal homepage: *https://ojs3.unpatti.ac.id/index.php/barekeng/*
Journal e-mail: *barekeng.math@yahoo.com; barekeng.journal@mail.unpatti.ac.id*

Research Article · Open Access

1. INTRODUCTION

COVID-19 (Coronavirus Disease 2019) is a respiratory tract infection caused by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-Cov-2) [1]. Due to its increasingly widespread, COVID-19 was declared a pandemic by the World Health Organization (WHO) on March 11, 2020 [2]. Individuals exposed to COVID-19 show several symptoms with varying degrees of severity. The severity includes asymptomatic infection, moderate symptom infection, and infection with severe symptoms followed by pneumonia and organ failure [3]. Launching from the www.ourworldindata.org page, as of March 6, 2023, there were 675.860.881 cases of COVID-19 worldwide, with 6.876.867 of them being cases of death. In Indonesia, there were 6.736.994 cases with 160.928 deaths [4].

Inadequate public health infrastructure, low vaccination coverage, and a sizeable immunocompromised population all contribute to generating novel SARS-CoV-2 subtypes [5]. WHO classifies these variants into three major groups, namely Variants of Interest (VoI), Variants under Monitoring (VUM), and Variants of Concern (VoC) [6]. The existence of VoC is a particular threat because of its higher transmission rate, the effects of the infection, which cause severe symptoms, and its ability to fend off natural and vaccine-induced immunity [7]. Because VoC is thought to cause higher cases of death, several studies have introduced Convalescent Plasma Therapy (CPT) as an additional therapy to fight it [8].

Convalescent plasma therapy administers blood plasma from COVID-19 survivors to COVID-19 patients. This therapy has been applied against various pathogens such as Ebola Virus [9], Avian Influenza Virus (H5N1) [10], SARS Coronavirus [11], and MERS Coronavirus [12]. Convalescent plasma therapy can reduce COVID-19 morbidity and mortality [13], [14]. With this therapy, the recovery rate for COVID-19 patients is hoped to increase.

Not all survivors of COVID-19 can become plasma donors. Based on research by Li et al. [15], there are several requirements that prospective plasma donors must meet: (a) aged 18-55 years, (b) meeting the requirements as a blood donor, (c) having been exposed to COVID-19, (d) having been declared cured of COVID-19 for more than two weeks, (e) is not felt symptoms of COVID-19 before donating plasma, and (f) tested negative for COVID-19 twice through a PCR swab test. Similar requirements are also explained on the Indonesian Red Cross Society (PMI) website. It is said that prospective plasma donors must meet the following criteria: (a) aged 18-60 years, (b) have a body weight of more than 55 kg, (c) male or female donors who have never become pregnant are preferred, (d) have been exposed to COVID-19 in the last three months, (e) have been declared cured and symptom-free of COVID-19 for at least 14 days, and (f) in the previous three months have not had a blood transfusion [16]. Prospective donors are also expected to have no history of infectious diseases through blood transfusions, such as hepatitis, HIV/AIDS, and so on [17].

The selection and ranking of potential plasma donors can be considered an act of decision-making. Mathematical decision-making methods include the Simple Additive Weighting (SAW) Method and the Technique For Others Reference by Similarity to Ideal Solution (TOPSIS). The advantages of the SAW method lie in its efficient and easy-to-understand calculations [18], its ability to make more precise judgments based on predetermined preference weights [19], [20], and its ability to select the best candidate from several alternatives [21]. SAW is a proportional linear transformation of the raw data that maintains the same relative order size of the standard score [22], [23].

The advantages of the TOPSIS method lie in its logical structure, allowing for visualization, easy calculation procedures, and consideration of simultaneous ideal and non-ideal solutions [24], [25]. Through the TOPSIS method, the different criteria for each alternative can be seen clearly [26]. The combination of the SAW and TOPSIS methods can be used to make decisions in selecting prospective plasma donors. Based on research by Lusinia et al. [27], combining these two methods provides results that are pretty efficient in determining the suitable alternative because it use simpler mathematical equations.

In the SAW and TOPSIS methods, the best candidate is the alternative with the highest rank. However, this alternative is not necessarily close to the ideal candidate. The difficulty in determining the optimal candidate is a weakness of the SAW and TOPSIS methods. On the other hand, in reality, decision-making is not only done by one person, and the preferences of each decision-maker may vary. Borda Count is a method that can accommodate the importance of all decision-makers. The results of the Borda Count sometimes violate the majority criteria, which considers the candidate with the highest ranking to be the best candidate. Selecting candidates using the Borda Count is an attempt to select candidates based on consensus. Sometimes, a widely accepted candidate is better than the candidate favoured by most decision-makers. The Borda Count considers and combines all decision-maker ratings to determine the best score.

This study aims to provide an overview of selecting and ranking potential convalescent plasma donor candidates by utilizing three mathematical methods in their decision-making. Each potential plasma donor will first be chosen using a SAW and TOPSIS combination and then classified using a Borda Count. The implementation of these three methods is expected to be able to provide the best and most appropriate alternative for prospective plasma donors.

2. RESEARCH METHODS

In this study, the criteria for prospective plasma donors are limited to 6 aspects, namely age (K_1), weight (K_2), history of blood transfusion (K_3), gender and pregnancy status (K_4), history of being infected with COVID-19 (K_5), and a history of previous illnesses (K_6). The criteria for the plasma donor candidates, along with the measurement scale, are stated in Table 1:

Table 1. Criteria and Scale of Measurement

Code	Criteria	Scale	Information
K_1	Age	0	over 60 years old or under 18 years old
		1	49.5-60 years
		2	39-49.5 years
		3	28.5-39 years
		4	18-28.5 years
K_2	Weight	0	below 55 kg
		1	55-60 kg
		2	60-65 kg
		3	65-70 kg
		4	above 70 kg
K_3	History of blood transfusions	0	Have a record of blood transfusions in less than six months
		1	Have no history of blood transfusion within 6-8 months
		2	Have no history of blood transfusion in the range of 8-10 months
		3	Have no history of blood transfusion within 10-12 months
		4	Have no history of blood transfusions in more than 12 months
K_4	Gender and pregnancy status	0	A woman who has been pregnant
		1	A woman who has not been pregnant
		2	A man
K_5	History of being infected with COVID-19	0	Have no record of being infected with COVID-19
		1	Have a history of being infected with COVID-19 and has not been declared cured
		2	Have a history of being infected with COVID-19, declared cured, and symptom-free for less than 14 days
		3	Have a history of being infected with COVID-19, declared cured, and symptom-free for 14 days
		4	Have a history of being infected with COVID-19, declared cured, and symptom-free for more than 14 days
K_6	History of previous illnesses	0	Have a history of blood-borne infectious diseases (such as HIV/AIDS, Hepatitis B, Hepatitis C, etc.)
		1	Have a history of chronic disease (such as cancer, kidney failure, coronary heart disease, etc.)
		2	Have a history of minor illnesses (such as influenza, diarrhea, allergies, etc., with mild symptoms)

***Data Source**: Author documentation*

Table 1 shows that not all data obtained from respondents are in the form of quantitative data. Therefore, the data is converted using a measurement scale. K_1, K_2, K_3, and K_5 have a measurement scale from 0 to 4. Meanwhile, K_4 and K_6 have a measurement scale from 0 to 2.

We collect data by distributing questionnaires via Google Forms. The questionnaires can be accessed via the link: https://tinyurl.com/KuesionerPenyintasCVID1. We reduce the collected data by selecting candidates who get a score of 4 on K_5 and a score of 2 on K_6. We obtained ten survivors who met the inclusion criterion. The ten survivors are assumed to have twice tested negative for COVID-19 via a PCR swab test. Next, we reduce the second data by eliminating candidates who have a value of 0 on K_1, K_2, K_3, and K_4. Data processing was performed manually using Microsoft Excel.

In a decision-making method with multiple criteria, weight significantly impacts the final decision and the ranking of alternatives. Changing the weight of criteria can affect decision-making outcomes [28]. This study assumes that there are three decision makers (DMs), each of whom has different considerations in composing the weights for each criterion. The consequences that the three DMs have collected are stated in **Table 2**:

Table 2. Preference Weights for Each Decision Maker

Code	DM_1	DM_2	DM_3
K_1	20%	10%	15%
K_2	20%	10%	15%
K_3	10%	20%	15%
K_4	10%	20%	15%
K_5	20%	20%	20%
K_6	20%	20%	20%

Data Source: *Author documentation*

Table 1 shows that the three decision-makers give the same preference weight for K_5 and K_6, amounting to 20%. The first decision maker considers age and weight more important than blood transfusion history and prospective plasma donor gender. Evidence in the laboratory indicates that younger blood components are preferable to older ones [29]–[33]. Donors in the heavier-weight category can donate a greater volume of plasma than those in the lightweight category [34]. The first decision maker gives a preference weight of 20% for K_1 and K_2, and 10% for K_3 and K_4. The second decision maker considers that blood transfusion history and gender of the blood donor are more important than the donor's age and weight. To prevent transfusion related acute lung injury, plasma from male donors or female donors who have never been pregnant, including through abortion, is preferred [35]. The second decision maker gives a preference weight of 20% for K_3 and K_4, and 10% for K_1 and K_2. The third decision maker assigns a 15% weight to the four criteria based on the assumption that they are of equal importance. From **Table 2**, we can construct the weight preference matrix G for each decision maker as follows:

$$\boldsymbol{G_{DM_1}} = \begin{bmatrix} \mathbf{0,20} \\ \mathbf{0,20} \\ \mathbf{0,10} \\ \mathbf{0,10} \\ \mathbf{0,20} \\ \mathbf{0,20} \end{bmatrix}, \boldsymbol{G_{DM_2}} = \begin{bmatrix} \mathbf{0,10} \\ \mathbf{0,10} \\ \mathbf{0,20} \\ \mathbf{0,20} \\ \mathbf{0,20} \\ \mathbf{0,20} \end{bmatrix}, \boldsymbol{G_{DM_3}} = \begin{bmatrix} \mathbf{0,15} \\ \mathbf{0,15} \\ \mathbf{0,15} \\ \mathbf{0,15} \\ \mathbf{0,20} \\ \mathbf{0,20} \end{bmatrix}$$

The SAW method is implemented through the following steps:

1) Determine the attribute for each criterion.
2) Recap data from all criteria assessed from each alternative.
3) Convert the data in the previous points into quantitative data based on a predetermined measurement scale, then construct a decision matrix T, compiled from the matching branch table.
4) Normalize the decision matrix T to obtain a normalized decision matrix N_1. The elements in N_1 are the values of the normalized performance r_{ab} from criteria K_b of alternative P_a. Suppose that the attribute K_b is benefit and x_{ab} is the attribute value that is owned by K_b from alternative P_a, then r_{ab} is calculated using

$$r_{ab} = \frac{x_{ab}}{\max_a x_{ab}} \tag{1}$$

Suppose that the attribute K_b is cost and x_{ab} is the attribute value that is owned by K_b from alternative P_a, then r_{ab} is calculated using

$$r_{ab} = \frac{\min_a x_{ab}}{x_{ab}} \tag{2}$$

The calculation is continued by using the TOPSIS method. This method is implemented through the following steps [27]:

1) Normalize the normalized decision matrix N_1 to obtain the normalized decision matrix N_2. The entries in the N_2 are n_{ij} which are calculated using

$$n_{ij} = \frac{r_{ij}}{\sqrt{\sum_{i=1}^{a} r_{ij}^2}} \tag{3}$$

where
n_{ij} = the entries in N_2
r_{ij} = the entries in N_1
$i = 1, 2, \dots, a$ (number of alternatives)
$j = 1,2, \dots, b$ (number of criteria)

2) Construct a normalized decision matrix Y by multiplying the matrix N_2 and the matrix G.

3) Calculating positive and negative ideal solutions using

$$y_j^+ = max\{y_{ij}\} \tag{4}$$

$$y_j^- = \min\{y_{ij}\} \tag{5}$$

where
y_{ij} = the entries in Y
y_j^+ = positive ideal solutions
y_j^- = negative ideal solutions

4) Calculate the distance between the positive and negative ideal solutions using

$$d_i^+ = \sqrt{\sum_{j=1}^{b} (y_i^+ - y_{ij})^2} \tag{6}$$

$$d_i^- = \sqrt{\sum_{j=1}^{b} (y_{ij} - y_i^-)^2} \tag{7}$$

where

d_i^+ = positive ideal solution distance
d_i^- = negative ideal solution distance

5) Specifies the preference value by using

$$v_i = \frac{d_i^-}{d_i^- + d_i^+} \tag{8}$$

where
v_i = preference value

The next step is to vote on each candidate as a plasma donor using the Borda Count method. Voting is done by weighing each candidate based on their ranking. Candidates with higher ranks will get more weight and vice versa. In this study, we chose 1 as the lowest. Data from the voting results of each decision-maker is collected and summed up. The alternative that gets the highest score will be the best candidate. The total score is also a reference in making a sequence from the best to the worst plasma donor candidates.

3. RESULTS AND DISCUSSION

3.1 Implementation of the Simple Additive Weighting (SAW)

3.1.1 Determine the Attributes for Each Criterion

The attributes for the six criteria in **Table 1** are stated in **Table 3**:

Table 3. Criteria and Attributes

Code	Criteria	Atribut
K_1	Age	Benefit
K_2	Weight	Benefit
K_3	History of blood transfusions	Benefit
K_4	Gender and pregnancy status	Benefit
K_5	History of being infected with COVID-19	Benefit
K_6	History of previous illnesses	Benefit

***Data Source**: Author documentation*

Table 3 explains that all criteria have benefit attributes. The higher the criterion score, the better the value. The decision maker wants to take the maximum value among all candidates in the benefit attribute.

3.1.2 Recap the Original Data and Eliminate Candidates who do not Meet the Requirements

Of the ten plasma donor candidates, the criteria of each candidate are recapitulated and arranged in **Table 4**:

Table 4. Criteria of Each Candidate

Candidate Code	Criteria					
	K_1	K_2	K_3	K_4	K_5	K_6
P01	20 years	51 kg	Have a history of blood transfusions in less than six months	A woman who has not been pregnant	Have a history of being infected with COVID-19, declared cured, and symptom-free for more than 14 days	Have a history of minor illnesses
P02	33 years	56 kg	Have no history of blood transfusions in more than 12 months	A woman who has not been pregnant	Have a history of being infected with COVID-19, declared cured, and symptom-free for more than 14 days	Have a history of minor illnesses
P03	25 years	63 kg	Have no history of blood transfusions in more than 12 months	A man	Have a history of being infected with COVID-19, declared cured, and symptom-free for more than 14 days	Have a history of minor illnesses
P04	21 years	55 kg	Have no history of blood transfusion within 10-12 months	A woman who has not been pregnant	Have a history of being infected with COVID-19, declared cured, and symptom-free for more than 14 days	Have a history of minor illnesses
P05	44 years	61 kg	Have no history of blood transfusions in	A woman who has	Have a history of being infected with COVID-19, declared cured, and	Have a history of

Candidate Code	Criteria					
	K_1	K_2	K_3	K_4	K_5	K_6
			more than 12 months	been pregnant	symptom-free for more than 14 days	minor illnesses
P06	27 years	68 kg	Have no history of blood transfusions in more than 12 months	A man	Have a history of being infected with COVID-19, declared cured, and symptom-free for more than 14 days	Have a history of minor illnesses
P07	33 years	59 kg	Have no history of blood transfusions in more than 12 months	A woman who has been pregnant	Have a history of being infected with COVID-19, declared cured, and symptom-free for more than 14 days	Have a history of minor illnesses
P08	27 years	57 kg	Have no history of blood transfusions in more than 12 months	A woman who has been pregnant	Have a history of being infected with COVID-19, declared cured, and symptom-free for more than 14 days	Have a history of minor illnesses
P09	25 years	63 kg	Have no history of blood transfusions in more than 12 months	A woman who has not been pregnant	Have a history of being infected with COVID-19, declared cured, and symptom-free for more than 14 days	Have a history of minor illnesses
P10	24 years	54 kg	Have no history of blood transfusions in more than 12 months	A woman who has not been pregnant	Have a history of being infected with COVID-19, declared cured, and symptom-free for more than 14 days	Have a history of minor illnesses

***Data Source**: Author documentation*

Table 4 shows that P01 does not meet K_2 and K_3. P05, P07, and P08 do not meet K_4. P10 does not meet K_2. Therefore, P01, P05, P07, P08, and P10 are disqualified from the next stage.

3.1.3 Construct the Decision Matrix T

Concerning the measurement scale in **Table 1**, we obtain the results of data conversion in the form of a suitability rating for each criterion of each alternative, which is written in **Table 5**:

Table 5. Rating for Each Criterion of Each Alternative

Candidate Code	Criteria					
	K_1	K_2	K_3	K_4	K_5	K_6
P02	3	1	4	1	4	2
P03	4	2	4	2	4	2
P04	4	1	3	1	4	2
P06	4	3	4	2	4	2
P09	4	2	4	1	4	2

***Data Source**: Author documentation*

The decision matrix T is constructed from **Table 5**. This matrix has an order $a \times b$, with a as the number of alternatives or candidates left and b as the number of criteria. In this case, $a = 5$ and $b = 6$. From this process, the matrix T with its entries is as follows:

$$T = \begin{bmatrix} 3 & 1 & 4 & 1 & 4 & 2 \\ 4 & 2 & 4 & 2 & 4 & 2 \\ 4 & 1 & 3 & 1 & 4 & 2 \\ 4 & 3 & 4 & 2 & 4 & 2 \\ 4 & 2 & 4 & 1 & 4 & 2 \end{bmatrix}$$

3.1.4 Normalize the Decision Matrix T

The normalization process in the decision matrix T is carried out by calculating the value rating of the normalized t_{ab} using **Equation (1)**. We obtain a normalized decision matrix N_1 as follows:

$$N_1 = \begin{bmatrix} 0,75 & 0,33 & 1 & 0,5 & 1 & 1 \\ 1 & 0,67 & 1 & 1 & 1 & 1 \\ 1 & 0,33 & 0,75 & 0,5 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 0,67 & 1 & 0,5 & 1 & 1 \end{bmatrix}$$

3.2 Implementation of the Technique for Others Reference by Similarity to Ideal Solution (TOPSIS)

3.2.1 Normalize the Matrix N_1 Using the Formula for Matrix Normalizing in the TOPSIS

Normalization in the matrix N_1 is carried out by determining all values n_{ij} through **Equation (3)**. We can construct the normalized decision matrix N_2 as follows:

$$N_2 = \begin{bmatrix} 0,351 & 0,229 & 0,468 & 0,302 & 0,447 & 0,447 \\ 0,468 & 0,459 & 0,468 & 0,603 & 0,447 & 0,447 \\ 0,468 & 0,229 & 0,351 & 0,302 & 0,447 & 0,447 \\ 0,468 & 0,688 & 0,468 & 0,603 & 0,447 & 0,447 \\ 0,468 & 0,459 & 0,468 & 0,302 & 0,447 & 0,447 \end{bmatrix}$$

3.2.2 Construct the Normalized Decision Matrix Y

The normalized decision matrix Y was arranged through the multiplication results of N_2 and G. Because the number of decision-makers in this study amounted to 3 people, we obtained three normalized decision matrix Y as follows:

$$Y_{DM_1} = \begin{bmatrix} 0,070 & 0,046 & 0,047 & 0,030 & 0,089 & 0,089 \\ 0,094 & 0,092 & 0,047 & 0,060 & 0,089 & 0,089 \\ 0,094 & 0,046 & 0,035 & 0,030 & 0,089 & 0,089 \\ 0,094 & 0,138 & 0,047 & 0,060 & 0,089 & 0,089 \\ 0,094 & 0,092 & 0,047 & 0,030 & 0,089 & 0,089 \end{bmatrix}$$

$$Y_{DM_2} = \begin{bmatrix} 0,035 & 0,023 & 0,094 & 0,060 & 0,089 & 0,089 \\ 0,047 & 0,046 & 0,094 & 0,121 & 0,089 & 0,089 \\ 0,047 & 0,023 & 0,070 & 0,060 & 0,089 & 0,089 \\ 0,047 & 0,069 & 0,094 & 0,121 & 0,089 & 0,089 \\ 0,047 & 0,046 & 0,094 & 0,060 & 0,089 & 0,089 \end{bmatrix}$$

$$Y_{DM_3} = \begin{bmatrix} 0,053 & 0,034 & 0,070 & 0,045 & 0,089 & 0,089 \\ 0,070 & 0,069 & 0,070 & 0,090 & 0,089 & 0,089 \\ 0,070 & 0,034 & 0,053 & 0,045 & 0,089 & 0,089 \\ 0,070 & 0,103 & 0,070 & 0,090 & 0,089 & 0,089 \\ 0,070 & 0,069 & 0,070 & 0,045 & 0,089 & 0,089 \end{bmatrix}$$

3.2.3 Calculate Positive and Negative Ideal Solutions

Positive and negative ideal solutions are obtained by comparing the maximum and minimum entries in Y_{DM_1}, Y_{DM_2} and Y_{DM_3}. The positive ideal solutions are calculated using **Equation (4)** and **Equation (5)** to determine the negative ideal solutions. The calculated results of the positive and negative ideal solution can be observed in **Table 6**:

Table 6. Positive and Negative Ideal Solutions

Criteria	Positive and Negative Ideal Solutions for DM_1		Positive and Negative Ideal Solutions for DM_2		Positive and Negative Ideal Solutions for DM_3	
	Negative	Positive	Negative	Positive	Negative	Positive
K_1	0.070	0.094	0.035	0.047	0.053	0.070
K_2	0.046	0.138	0.023	0.069	0.034	0.103
K_3	0.035	0.047	0.070	0.094	0.053	0.070
K_4	0.030	0.060	0.060	0.121	0.045	0.090
K_5	0.089	0.089	0.089	0.089	0.089	0.089
K_6	0.089	0.089	0.089	0.089	0.089	0.089

***Data Source**: Author documentation*

Table 6 contains positive and negative ideal solutions for each criterion. The positive ideal solution is the best value that each criterion can achieve, while the negative ideal solution is the worst value.

3.2.4 Calculate the Distance or Difference between the Positive and Negative Ideal Solutions

The distance or difference between the positive and negative ideal solutions values is calculated using **Equation (6)** and **Equation (7)**. The calculated results can be observed in **Table 7**:

Table 7. The Difference between Positive and Negative Ideal Solutions

Criteria	The Difference between Positive and Negative Ideal Solutions for DM_1		The Difference between Positive and Negative Ideal Solutions for DM_2		The Difference between Positive and Negative Ideal Solutions for DM_3	
	d^-	d^+	d^-	d^+	d^-	d^+
P02	0.012	0.099	0.023	0.077	0.018	0.084
P03	0.061	0.046	0.070	0.023	0.062	0.034
P04	0.023	0.097	0.012	0.079	0.018	0.084
P06	0.100	0.000	0.080	0.000	0.086	0.000
P09	0.053	0.055	0.035	0.065	0.042	0.057

Data Source: *Author documentation*

Table 7 contains the distance between alternatives with positive and negative ideal solutions. In the TOPSIS method, the best alternative is the one with the shortest distance from the positive ideal solution and the farthest distance from the negative ideal solution.

3.2.5 Calculate the Preference Value for Each Decision Maker

The data in **Table 7** are used to determine preference values. The preference value for each decision maker is calculated using **Equation (8)**. The calculated results of the preference for each decision maker can be observed in **Table 8**:

Table 8. Decision Maker Preference Value

Candidate Code	DM_1	DM_2	DM_3
P02	0.105	0.234	0.173
P03	0.570	0.752	0.643
P04	0.194	0.129	0.173
P06	1.000	1.000	1.000
P09	0.490	0.350	0.427

Data Source: *Author documentation*

The data in **Table 8** is the final data obtained from applying the TOPSIS method. Furthermore, using the Borda Count Method will give each value a weight to determine the best candidate.

3.3 Implementation of the Borda Count Method

3.3.1 Assign a Rating to Each Criterion in the Decision Maker's Preference Value Column

The ranking of each alternative is based on the condition that the candidate with more preference values will get a higher rank and vice versa. By using the value in **Table 8**, the ranking result on the preference value of each decision maker can be observed in **Table 9**:

Table 9. Rating Results from 3 Decision Makers

Candidate Code	DM_1		DM_2		DM_3	
	Preference Value	Ranking	Preference Value	Ranking	Preference Value	Ranking
P02	0.105	5	0.234	4	0.173	4
P03	0.570	2	0.752	2	0.643	2
P04	0.194	4	0.129	5	0.173	4
P06	1.000	1	1.000	1	1.000	1
P09	0.490	3	0.350	3	0.427	3

Data Source: *Author documentation*

The data in Table 9 shows that each decision maker has a different order of candidate ranking results. The various preference weights of each decision maker influence this. The candidate's ranking order according to the first decision maker's preference weight is P06, P03, P09, P04, and P02. The candidate's ranking order according to the second decision maker's preference weight is P06, P03, P09, P02, and P04. The candidate's ranking order according to the third decision maker's preference weight is P06, P03, and P09. At the same time, P02 and P04 are ranked fourth because they have the same preference value.

3.3.2 Assign a Score to Each Rank, then Determine the Total Score and Final Ranking Result

Giving scores on ratings is based on the provision that higher ratings will get more scores. In this case, the first rank will get a score of 5, the second place will get a score of 4, the third place will get a score of 3, the fourth place will get a score of 2, and the fifth place will get a score of 1. We added the scores obtained from each plasma donor candidate and then arranged a ranking order based on the total score. The results of the ranking are presented in Table 10:

Table 10. Total Score Ranking Results

Candidate Code	DM_1	DM_2	DM_3	Total Score	Rangking
P02	1	2	2	5	4
P03	4	4	4	12	2
P04	2	1	2	5	4
P06	5	5	5	15	1
P09	3	3	3	9	3

***Data Source**: Author documentation*

Table 10 shows that the best plasma donor candidate or the most potential of the ten candidates is P06. P03, P09, P02, and P04 occupy the following best ranking.

In this study, the discussion is limited to the implementation of the method and the calculation of results manually using Microsoft Excel. Given the large amount of data in the field and the limitations of human decision-making, manual decision-making methods are considered ineffective. The solution to overcome this weakness is to build an application-based decision-making system. With a decision-making support system, it is hoped that selecting and sorting prospective plasma donors can be done quickly and efficiently.

In addition, the plasma donor candidates in this study came from various regions in Indonesia. For further research, it is hoped that researchers can provide a limitation that plasma donor candidates must come from the same area. In [36], [37], it is stated that plasma donors should preferably be selected from COVID-19 survivors living in the exact location as potential plasma recipients to allow consideration of target viral antigen mutations.

4. CONCLUSIONS

This study result indicates that the SAW-TOPSIS and Borda Count methods can be applied in compiling a ranking or sequence of potential convalescent plasma donors. The SAW-TOPSIS method can accommodate decision-making involving many criteria, such as criteria for prospective plasma donors. Applying the Borda Count method can accommodate decision-making involving more than one decision maker who has given different preference weights to each criterion. We suggest that future researchers develop an application based on the SAW-TOPSIS and Borda Count methods so that the selection process for potential plasma donors can be carried out quickly and effectively.

REFERENCES

[1] A. E. Gorbalenya *et al.*, "The species Severe acute respiratory syndrome-related coronavirus: classifying 2019-nCoV and naming it SARS-CoV-2," *Nat. Microbiol.*, vol. 5, no. 4, pp. 536–544, 2020, doi: 10.1038/s41564-020-0695-z.

[2] A. Vitiello, F. Ferrara, M. Boccellino, A. M. Auti, and M. Di Domenico, "Advances in the Omicron variant development," *J. Intern. Med.*, vol. 2, pp. 81–90, 2022, doi: 10.1111/joim.13478.

[3] S. K. Das, "The Pathophysiology, Diagnosis and Treatment of Corona Virus Disease 2019 (COVID-19)," *Indian J. Clin. Biochem.*, vol. 35, no. 4, pp. 385–396, 2020, doi: 10.1007/s12291-020-00919-0.

[4] E. Mathieu *et al.*, "Coronavirus Pandemic (COVID-19)," *OurWorldInData.org*, 2020. https://ourworldindata.org/coronavirus.

[5] S. J. Gao, H. Guo, and G. Luo, "Omicron variant (B.1.1.529) of SARS-CoV-2, a global urgent public health alert!," *J. Med. Virol.*, vol. 94, no. 4, pp. 1255–1256, 2022, doi: 10.1002/jmv.27491.

[6] A. Susilo *et al.*, "Mutasi dan Varian Coronavirus Disease 2019 (COVID-19): Tinjauan Literatur Terkini," *J. Penyakit Dalam*

Indones., vol. 9, no. 1, p. 59, 2022, doi: 10.7454/jpdi.v9i1.648.

[7] S. Thakur *et al.*, "SARS-CoV-2 Mutations and Their Impact on Diagnostics, Therapeutics and Vaccines," *Front. Med.*, vol. 9, no. February, 2022, doi: 10.3389/fmed.2022.815389.

[8] E. M. Kurniawati *et al.*, "Effectiveness of convalescent plasma therapy for COVID-19 patients infected with variants of concerns," *Anaesthesia, Pain Intensive Care*, vol. 26, no. 4, pp. 535–545, 2022, doi: 10.35975/apic.v26i4.1962.

[9] O. Garraud, "Use of convalescent plasma in Ebola virus infection," *Transfus. Apher. Sci.*, vol. 56, no. 1, pp. 31–34, 2017, doi: 10.1016/j.transci.2016.12.014.

[10] D. S. Hui, N. Lee, P. K. Chan, and J. H. Beigel, "The role of adjuvant immunomodulatory agents for treatment of severe influenza," *Antiviral Res.*, vol. 150, no. December 2017, pp. 202–216, 2018, doi: 10.1016/j.antiviral.2018.01.002.

[11] J. Mair-Jenkins *et al.*, "The effectiveness of convalescent plasma and hyperimmune immunoglobulin for the treatment of severe acute respiratory infections of viral etiology: A systematic review and exploratory meta-analysis," *J. Infect. Dis.*, vol. 211, no. 1, pp. 80–90, 2015, doi: 10.1093/infdis/jiu396.

[12] Y. M. Arabi *et al.*, "Feasibility of using convalescent plasma immunotherapy for MERS-CoV infection, Saudi Arabia," *Emerg. Infect. Dis.*, vol. 22, no. 9, pp. 1554–1561, 2016, doi: 10.3201/eid2209.151164.

[13] N. Samad *et al.*, "Convalescent plasma therapy for management of COVID-19: Perspectives and deployment in the current global pandemic," *Risk Manag. Healthc. Policy*, vol. 13, pp. 2707–2728, 2020, doi: 10.2147/RMHP.S281388.

[14] M. J. Joyner *et al.*, "Safety Update: COVID-19 Convalescent Plasma in 20,000 Hospitalized Patients," *Mayo Clin. Proc.*, vol. 95, no. 9, pp. 1888–1897, 2020, doi: 10.1016/j.mayocp.2020.06.028.

[15] L. Li *et al.*, "Characteristics and serological patterns of COVID-19 convalescent plasma donors: optimal donors and timing of donation," *Transfusion*, vol. 60, no. 8, pp. 1765–1772, 2020, doi: 10.1111/trf.15918.

[16] F. Irfan, "Seputar Plasma Konvalesen," *https://pmi.or.id/*, 2021. https://pmi.or.id/17/07/2021/berita-utama/organisasi/seputar-plasma-konvalesen/.

[17] L. W. Santosa, "Anda harus sehat bila ingin jadi pendonor plasma konvalesen," *www.antaranews.com*, 2021. https://www.antaranews.com/berita/2399857/anda-harus-sehat-bila-ingin-jadi-pendonor-plasma-konvalesen.

[18] D. A. Pertiwi, B. Daniawan, and Y. Gunawan, "Analysis And Design of Decision Support System in Major Assignment at Buddhi High School Using AHP and SAW Methods," *J. Tech-E*, vol. 3, no. 1, p. 13, 2019, doi: 10.31253/te.v3i1.138.

[19] S. S. Putro, F. Adiputra, E. M. S. Rochman, A. Rachmad, M. A. Syakur, and S. B. Seta, "Comparison of saw and wp methods to determine the best agricultural land," *Commun. Math. Biol. Neurosci.*, vol. 2021, pp. 1–15, 2021, doi: 10.28919/cmbn/5820.

[20] D. W. T. Putra and A. A. Punggara, "Comparison Analysis of Simple Additive Weighting (SAW) and Weigthed Product (WP) in Decision Support Systems," *MATEC Web Conf.*, vol. 215, pp. 1–5, 2018, doi: 10.1051/matecconf/201821501003.

[21] A. Hamid *et al.*, "Determining basic food quality using SAW," *Int. J. Eng. Technol.*, vol. 7, no. 4, pp. 3548–3555, 2018, doi: 10.14419/ijet.v7i4.18835.

[22] A. Afshari, M. Mojahed, and R. Yusuff, "Simple additive weighting approach to personnel selection problem," *Int. J. Innov. Manag. Technol.*, vol. 1, no. 5, pp. 511–515, 2010, [Online]. Available: http://www.researchgate.net/publication/256031272_Simple_Additive_Weighting_Approach_to_Personnel_Selection_Problem/file/e0b49524c34debf7b5.pdf.

[23] A. Kumar, V. Swaroop, A. K. Sharma, S. P. Lai, and V. Bist, "Sustainable raw material selection for pulp and paper using SAW multiple criteria decision making design," *IPPTA Q. J. Indian Pulp Pap. Tech. Assoc.*, vol. 27, no. 1, pp. 67–76, 2015.

[24] İ. Durak, H. M. Arslan, and Y. Özdemir, "Application of AHP–TOPSIS methods in technopark selection of technology companies: Turkish case," *Technol. Anal. Strateg. Manag.*, vol. 34, no. 10, pp. 1109–1123, 2022, doi: 10.1080/09537325.2021.1925242.

[25] E. Roszkowska, "Multi-Criteria Decision Making Models by Applying the Topsis Method to Crisp and Interval Data," in *Multiple Criteria Decision Making '10-11*, 2011, pp. 200–230.

[26] M. Collan, M. Fedrizzi, and P. Luukka, "A multi-expert system for ranking patents: An approach based on fuzzy pay-off distributions and a TOPSIS-AHP framework," *Expert Syst. Appl.*, vol. 40, no. 12, pp. 4749–4759, 2013, doi: 10.1016/j.eswa.2013.02.012.

[27] S. A. Lusinia, N. Rahmansyah, and A. I. Jamhur, "Determining the feasibility of coconut coir suppliers using a combination of decision support system methods," *Int. J. Dyn. Enginering Sci.*, vol. 7, no. 2, pp. 178–181, 2022.

[28] A. T. Eshlaghy and E. N. Farokhi, "Measuring the Importance and the Weight of Decision Makers in the Criteria Weighting Activities of Group Decision Making Process," *Am. J. Sci. Res.*, vol. 24, no. 24, pp. 6–12, 2011.

[29] F. S. Loffredo *et al.*, "Growth differentiation factor 11 is a circulating factor that reverses age-related cardiac hypertrophy," *Cell*, vol. 153, no. 4, pp. 828–839, 2013, doi: 10.1016/j.cell.2013.04.015.

[30] X. Zeng *et al.*, "Association between recipient survival and blood donor age after blood transfusion in a surgery intensive care unit: a multicenter randomized controlled trial study protocol," *Trials*, vol. 21, no. 1, pp. 1–9, 2020, doi: 10.1186/s13063-020-04452-6.

[31] S. A. Villeda *et al.*, "Young blood reverses age-related impairments in cognitive function and synaptic plasticity in mice," *Nat. Med.*, vol. 20, no. 6, pp. 659–663, 2014, doi: 10.1038/nm.3569.

[32] G. S. Baht *et al.*, "Exposure to a youthful circulaton rejuvenates bone repair through modulation of β-catenin," *Nat. Commun.*, vol. 6, no. May, pp. 1–10, 2015, doi: 10.1038/ncomms8131.

[33] I. M. Conboy, M. J. Conboy, A. J. Wagers, E. R. Girma, I. L. Weissman, and T. A. Rando, "Rejuvenation of aged progenitor cells by exposure to a young systemic environment Irina," *Nature*, vol. 433, no. 7027, pp. 760–764, 2005, [Online]. Available: http://www.nature.com/nature/journal/v433/n7027/abs/nature03260.html%0Afile:///Users/andrewmckay/Dropbox/Papers Library/Library.papers3/Articles/2005/Conboy/Nature 2005 Conboy.pdf%0Apapers3://publication/uuid/FCAE9822-AEEE-426B-83D2-FB86BFB6327D.

[34] G. A. Jerrard *et al.*, "Implications of Weight and Body Mass Index for Plasma Donation and Health," *ISRN Hematol.*, vol. 2012, no. May 2010, pp. 1–5, 2012, doi: 10.5402/2012/937585.

[35] J. Seghatchian and F. Lanza, "Convalescent plasma, an apheresis research project targeting and motivating the fully recovered COVID 19 patients: A rousing message of clinical benefit to both donors and recipients alike," *Transfus. Apher. Sci.*, vol. 59,

no. 3, p. 102794, 2020, doi: 10.1016/j.transci.2020.102794.
[36] D. Focosi, A. O. Anderson, J. W. Tang, and M. Tuccori, “Convalescent plasma therapy for covid-19: State of the art,” *Clin. Microbiol. Rev.*, vol. 33, no. 4, pp. 1–17, 2020, doi: 10.1128/CMR.00072-20.
[37] T. Burnouf and J. Seghatchian, “Ebola virus convalescent blood products: Where we are now and where we may need to go,” *Transfus. Apher. Sci.*, vol. 51, no. 2, pp. 120–125, 2014, doi: 10.1016/j.transci.2014.10.003.