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

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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.

Keywords: SAW; TOPSIS; Borda count; Convalescent plasma donors.

How to cite this article:

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

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. $K_3, K_2, K_3,$ 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/KuesionerPenyintasCVID](https://tinyurl.com/KuesionerPenyintasCVID). We reduce the collected data by selecting candidates who get a score of 4 on $K_3$ 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>
<thead>
<tr>
<th>Code</th>
<th>$DM_1$</th>
<th>$DM_2$</th>
<th>$DM_3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$K_1$</td>
<td>20%</td>
<td>10%</td>
<td>15%</td>
</tr>
<tr>
<td>$K_2$</td>
<td>20%</td>
<td>10%</td>
<td>15%</td>
</tr>
<tr>
<td>$K_3$</td>
<td>10%</td>
<td>20%</td>
<td>15%</td>
</tr>
<tr>
<td>$K_4$</td>
<td>10%</td>
<td>20%</td>
<td>15%</td>
</tr>
<tr>
<td>$K_5$</td>
<td>20%</td>
<td>20%</td>
<td>20%</td>
</tr>
<tr>
<td>$K_6$</td>
<td>20%</td>
<td>20%</td>
<td>20%</td>
</tr>
</tbody>
</table>

**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:

$$G_{DM_1} = \begin{bmatrix} 0.20 & 0.10 & 0.15 \\ 0.20 & 0.10 & 0.15 \\ 0.10 & 0.20 & 0.15 \\ 0.20 & 0.20 & 0.20 \end{bmatrix}, \quad G_{DM_2} = \begin{bmatrix} 0.10 & 0.10 & 0.15 \\ 0.20 & 0.20 & 0.15 \\ 0.10 & 0.20 & 0.20 \end{bmatrix}, \quad G_{DM_3} = \begin{bmatrix} 0.15 & 0.15 & 0.15 \\ 0.15 & 0.15 & 0.15 \\ 0.15 & 0.15 & 0.15 \end{bmatrix}$$

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...
\[ r_{ab} = \frac{x_{ab}}{\max_a x_{ab}} \quad (1) \]

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

\[ r_{ab} = \frac{\min_a x_{ab}}{x_{ab}} \quad (2) \]

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

\[ n_{ij} = \frac{r_{ij}}{\sqrt{\sum_{i=1}^{a} r_{ij}^2}} \quad (3) \]

where

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

\[ y_j^+ = \max\{y_{ij}\} \quad (4) \]

\[ y_j^- = \min\{y_{ij}\} \quad (5) \]

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

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

\[ d_i^- = \sqrt{\sum_{j=1}^{b} (y_{ij} - y_i^-)^2} \quad (7) \]

where

- \( d_i^+ \) = positive ideal solution distance
- \( d_i^- \) = negative ideal solution distance

5) Specifies the preference value by using

\[ v_i = \frac{d_i^-}{d_i^- + d_i^+} \quad (8) \]
where
\[ v_i = \text{preference value} \]

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>
<thead>
<tr>
<th>Code</th>
<th>Criteria</th>
<th>Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>( K_1 )</td>
<td>Age</td>
<td>Benefit</td>
</tr>
<tr>
<td>( K_2 )</td>
<td>Weight</td>
<td>Benefit</td>
</tr>
<tr>
<td>( K_3 )</td>
<td>History of blood transfusions</td>
<td>Benefit</td>
</tr>
<tr>
<td>( K_4 )</td>
<td>Gender and pregnancy status</td>
<td>Benefit</td>
</tr>
<tr>
<td>( K_5 )</td>
<td>History of being infected with COVID-19</td>
<td>Benefit</td>
</tr>
<tr>
<td>( K_6 )</td>
<td>History of previous illnesses</td>
<td>Benefit</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Candidate Code</th>
<th>$K_1$</th>
<th>$K_2$</th>
<th>$K_3$</th>
<th>$K_4$</th>
<th>$K_5$</th>
<th>$K_6$</th>
</tr>
</thead>
<tbody>
<tr>
<td>P02</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>P03</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>P04</td>
<td>4</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>P06</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>P09</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

**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:

$$
N_1 = \begin{bmatrix}
3 & 1 & 4 & 1 & 4 & 2 \\
4 & 2 & 4 & 2 & 4 & 2 \\
4 & 1 & 3 & 1 & 4 & 2 \\
4 & 3 & 4 & 2 & 4 & 2 \\
4 & 2 & 4 & 1 & 4 & 2 
\end{bmatrix}
$$
3.2 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>
<thead>
<tr>
<th>Criteria</th>
<th>Positive and Negative Ideal Solutions for ( DM_1 )</th>
<th>Positive and Negative Ideal Solutions for ( DM_2 )</th>
<th>Positive and Negative Ideal Solutions for ( DM_3 )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Positive</td>
<td>Negative</td>
<td>Positive</td>
</tr>
<tr>
<td>( K_1 )</td>
<td>0.070</td>
<td>0.094</td>
<td>0.035</td>
</tr>
<tr>
<td>( K_2 )</td>
<td>0.046</td>
<td>0.138</td>
<td>0.023</td>
</tr>
<tr>
<td>( K_3 )</td>
<td>0.035</td>
<td>0.047</td>
<td>0.060</td>
</tr>
<tr>
<td>( K_4 )</td>
<td>0.030</td>
<td>0.060</td>
<td>0.060</td>
</tr>
<tr>
<td>( K_5 )</td>
<td>0.089</td>
<td>0.089</td>
<td>0.089</td>
</tr>
<tr>
<td>( K_6 )</td>
<td>0.089</td>
<td>0.089</td>
<td>0.089</td>
</tr>
</tbody>
</table>

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>
<thead>
<tr>
<th>Criteria</th>
<th>The Difference between Positive and Negative Ideal Solutions for $DM_1$</th>
<th>The Difference between Positive and Negative Ideal Solutions for $DM_2$</th>
<th>The Difference between Positive and Negative Ideal Solutions for $DM_3$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$d^-$</td>
<td>$d^+$</td>
<td>$d^-$</td>
</tr>
<tr>
<td>P02</td>
<td>0.105</td>
<td>0.234</td>
<td>0.173</td>
</tr>
<tr>
<td>P03</td>
<td>0.570</td>
<td>0.752</td>
<td>0.643</td>
</tr>
<tr>
<td>P04</td>
<td>0.194</td>
<td>0.129</td>
<td>0.173</td>
</tr>
<tr>
<td>P06</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>P09</td>
<td>0.490</td>
<td>0.350</td>
<td>0.427</td>
</tr>
</tbody>
</table>

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>
<thead>
<tr>
<th>Candidate Code</th>
<th>$DM_1$</th>
<th>$DM_2$</th>
<th>$DM_3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>P02</td>
<td>0.105</td>
<td>0.234</td>
<td>0.173</td>
</tr>
<tr>
<td>P03</td>
<td>0.570</td>
<td>0.752</td>
<td>0.643</td>
</tr>
<tr>
<td>P04</td>
<td>0.194</td>
<td>0.129</td>
<td>0.173</td>
</tr>
<tr>
<td>P06</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td>P09</td>
<td>0.490</td>
<td>0.350</td>
<td>0.427</td>
</tr>
</tbody>
</table>

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>
<thead>
<tr>
<th>Candidate Code</th>
<th>Preference Value</th>
<th>Ranking</th>
<th>Preference Value</th>
<th>Ranking</th>
<th>Preference Value</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>P02</td>
<td>0.105</td>
<td>5</td>
<td>0.234</td>
<td>4</td>
<td>0.173</td>
<td>4</td>
</tr>
<tr>
<td>P03</td>
<td>0.570</td>
<td>2</td>
<td>0.752</td>
<td>2</td>
<td>0.643</td>
<td>2</td>
</tr>
<tr>
<td>P04</td>
<td>0.194</td>
<td>4</td>
<td>0.129</td>
<td>5</td>
<td>0.173</td>
<td>4</td>
</tr>
<tr>
<td>P06</td>
<td>1.000</td>
<td>1</td>
<td>1.000</td>
<td>1</td>
<td>1.000</td>
<td>1</td>
</tr>
<tr>
<td>P09</td>
<td>0.490</td>
<td>3</td>
<td>0.350</td>
<td>3</td>
<td>0.427</td>
<td>3</td>
</tr>
</tbody>
</table>

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>
<thead>
<tr>
<th>Candidate Code</th>
<th>( DM_1 )</th>
<th>( DM_2 )</th>
<th>( DM_3 )</th>
<th>Total Score</th>
<th>Rangking</th>
</tr>
</thead>
<tbody>
<tr>
<td>P02</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>P03</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td>P04</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>P06</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>P09</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>9</td>
<td>3</td>
</tr>
</tbody>
</table>

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


[34] 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,
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