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Implementation of TOPSIS in a Decision Support System for Selecting the Ideal Food Menu for GERD Patients

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Abstract

Gastroesophageal Reflux Disease (GERD) is a condition characterized by the repeated reflux of stomach acid into the esophagus, causing symptoms such as heartburn and regurgitation. This condition can be triggered by irregular eating habits, including improper portion sizes, frequency, or types of food. Frequent consumption of foods that are excessively hot, spicy, or acidic can exacerbate stomach problems by increasing gastric acid production, leading to GERD recurrence. This study aims to develop a web-based decision support system to determine the ideal food menu for GERD patients. The system uses five main criteria: protein, carbohydrates, fat, fiber, and calories to analyze ten food menu alternatives. The novelty of this research lies in the application of the TOPSIS method for selecting healthy food menus for GERD patients. Additionally, users can choose from several food menus, each provided with nutritional information, and have the option to propose the addition of new menus if they are not available in the database. Real-world evaluation of this system was conducted by comparing the system's calculation results with manual calculations, which showed consistent results as both produced identical preference index values. Based on these calculations, Wheat Pasta was determined to be the most ideal food menu with the highest preference index value of 0.7415. Other menus, such as Kalasan Fried Chicken, Salmon Fish, and Stir-fried Tempe, also had high preference indexes, while menus such as Stir-fried Chayote, Stir-fried Spinach, and Oatmeal ranked lower. The results of this study are expected to provide practical benefits for GERD patients by offering food recommendations that are not only nutritious but also help manage GERD symptoms, thereby improving the quality of life of its users.

Keywords: *topsis, decision support system, food, gerd*

1. Introduction

Gastroesophageal Reflux Disease (GERD) is a digestive disorder characterized by the recurrent movement of stomach contents into the esophagus, leading to various symptoms and potential complications. Common clinical symptoms of GERD include a burning sensation in the chest (heartburn), regurgitation, epigastric pain, difficulty swallowing (odynophagia), nausea, and nighttime sleep disturbances [1].

According to the 2022 revised National Consensus on the Management of Gastroesophageal Reflux Disease (GERD) by the Indonesian Society of Gastroenterology, the global prevalence of GERD ranges from 8% to 33%, while in the Asia-Pacific region, it varies between 3.1% and 25% across all age groups and genders. In 2019, global GERD cases were estimated at 784 million, showing a 78% increase over the past decade. In Indonesia, the prevalence is approximately 9.35% based on GERD questionnaire (GerdQ) responses, while studies on dyspeptic patients undergoing upper gastrointestinal endoscopy report a prevalence of 53.8% [2].

The relationship between dietary patterns and Gastroesophageal Reflux Disease (GERD) shows a strong correlation, as irregular eating habits, meal frequency, poor sleeping posture after meals, and food choices can trigger or worsen GERD symptoms through various mechanisms [3]. Difficulty in controlling dietary habits, lack of information on suitable foods, and challenges in selecting proper meals for GERD patients highlight the need for a decision support system to help choose the best menu and prevent GERD symptoms.

The method used in the decision support system for selecting the ideal food menu for GERD patients is the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS). TOPSIS is chosen because it

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calculates the closest alternative to the positive ideal solution and farthest from the negative ideal solution using Euclidean distance. This method is favored for its simplicity, ease of calculation, and effectiveness in ranking alternatives based on proximity to the ideal solutions [4]. This is supported by the research conducted by Wina and Rahayu on "Comparison of TOPSIS, SAW, and WP Methods through Sensitivity Testing for Best Supplier Selection." The study found that a company, Tiga Sekawan Sejahtera, faced losses due to receiving raw materials of poor quality, leading to delays in production. To resolve this, a decision support system using TOPSIS, SAW, and WP methods was developed to determine the most suitable method for this case. Sensitivity testing showed that TOPSIS had the highest change in ranking (1.59%) when adjusting criteria weights, concluding that TOPSIS was the most effective method for selecting the best supplier [5]. The Simple Additive Weighting (SAW) method has a limitation in its normalization stage, where it may produce estimated values that do not always reflect the actual values. On the other hand, the Weighted Product (WP) method suffers from limited usage in decision-making, as it is more mathematically oriented without statistical testing to validate the model, resulting in unclear confidence levels regarding its accuracy [6].

Previous research that developed a Decision Support System (DSS) for selecting food menus for GERD (Gastroesophageal Reflux Disease) patients using the AHP method demonstrated the system's feasibility with an average score of 79% from subject matter experts, although there is still room for improvement [7]. Another study applying the TOPSIS method to select food for hypertension patients resulted in an accurate system by considering key nutritional criteria [8]. However, the system I developed has several differences and advantages, including the use of the TOPSIS method for selecting food menus for GERD patients, which provides more accurate and objective decision-making. Additionally, each recommended menu alternative is accompanied by detailed nutritional values, offering users more comprehensive information to choose a menu that meets their health needs. Moreover, this system includes a new menu request feature, allowing users to propose new food items based on personal preferences or specific needs, making the system more dynamic and adaptable. With these improvements and innovations, the developed system is expected to provide a more targeted solution for selecting food menus for GERD patients.

The purpose of this research is to implement the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method in developing a web-based Decision Support System (DSS) that provides accurate recommendations for selecting the ideal food menu for patients with Gastroesophageal Reflux Disease (GERD). This system aims to assist healthcare professionals, especially nutritionists, in determining food choices that align with the dietary needs of GERD patients, considering various nutritional factors and health-related criteria. By utilizing TOPSIS, the research intends to offer a more objective and efficient solution in guiding the selection of food menus, ensuring that patients receive appropriate meals that minimize discomfort and support their health management.

2. Research Methods

Figure 1 illustrates the research flowchart for the development of a web-based decision support system for selecting the ideal food menu for patients with Gastroesophageal Reflux Disease (GERD) using the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method.

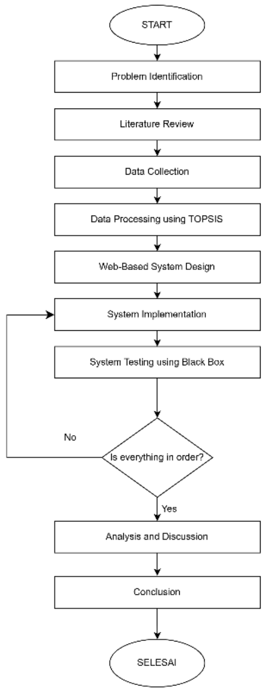


Figure 1. Research Flow Diagram

2.1. *Problem Identification*

The initial stage of this research involves identifying and formulating the problem. By reviewing existing literature and identifying issues in the surrounding context, a problem is identified that requires a solution. Once formulated, the problem is developed into a topic for discussion, leading to the selection of the appropriate method.

2.2. *Literature Review*

At this stage, literature and secondary data are collected, along with the processing of literature data for research purposes. This literature review is typically conducted during the preliminary study. The gathered data is then processed and used as a reference for writing the research.

2.3. *Data Collection*

The primary data for this research was obtained from the Indonesian Food Composition Table (TKPI) 2017, which is the latest version of the 2009 edition. This table provides a collection of data on the nutritional composition of various types of food in Indonesia. The data in TKPI comes from research reports conducted by the Research and Development Center for Nutrition and Food, Ministry of Health of the Republic of Indonesia. Additional information on food nutrient composition was also accessed from reliable online sources such as fatsecret.com and nilaigizi.com. Data on criteria, sub-criteria, and weight ranges were collected through interviews with nutritionists at the Banyumas Regional General Hospital. To improve the model's accuracy in reflecting the dietary patterns of GERD patients, the dataset can be expanded by adding primary data obtained directly from patients through three main methods: in-depth interviews with nutritionists to understand the daily eating habits of GERD patients, including types of food, portions, and consumption frequency; direct observation of patients' eating patterns in various situations, both in the hospital and in everyday environments, to gain a realistic picture of their eating habits; and literature studies from various relevant scientific sources to complement information about healthy eating patterns for GERD patients. By adding real food intake records, the decision support system model will be more accurate in depicting a healthy and suitable diet for GERD patients. This primary data also allows the system to consider each patient's unique factors, such as sensitivities to certain foods or dietary patterns influenced by other health conditions.

2.4. *Data Processing using TOPSIS*

The Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) is an important method in multiple attribute decision making (MADM). It is based on the concept that the best solution is the one most similar to the positive ideal solution and farthest from the negative ideal solution. TOPSIS is popular due to its strong mathematical foundation, ease of use, and ability to solve various MADM problems across different fields, such as purchasing, service provider selection, manufacturing, finance, education, and environment. In this method, attribute weights are usually determined subjectively by decision-makers to reflect their preferences [9]. It uses Euclidean distance to measure the relative distance between each alternative and the optimal solution [10]. Here are the steps in the TOPSIS method:

1. Create a decision matrix using the formula in equation (1):

$$X = \begin{matrix} a_1 \\ \vdots \\ a_m \end{matrix} \begin{pmatrix} x_{11} & \cdots & x_{1n} \\ \vdots & \ddots & \vdots \\ x_{m1} & \cdots & x_{mn} \end{pmatrix} \quad (1)$$

Description:

a_i = (i = 1, 2, 3, …, m) possible alternatives,

x_j = attributes used to measure the performance of the alternatives,

x_{ij} = performance of alternative a_i based on attribute x_j.

2. Create a normalized decision matrix using the formula in equation (2):

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} {x_{ij}}^2}} \quad (2)$$

Description:

r_{ij} = normalized attribute value,

x_{ij} = value of each attribute,

m = value of attributes for each criterion.

3. Create the weighted normalized decision matrix:

$$v_{ij} = w_j r_{ij} \quad (3)$$

Description:
v_{ij} = weighted normalized decision matrix V,
w_j = weight of the j-th criterion,
r_{ij} = value from the normalized decision matrix.

4. Determine the matrix for the positive ideal solution and negative ideal solution using the following conditions (4) and (5):

A^+ = {max(v_{ij}), if j is a benefit attribute;
min(v_{ij}), if j is a cost attribute} (4)
A^- = {min(v_{ij}), if j is a benefit attribute ;
max(v_{ij}), if j is a cost attribute } (5)

Description:
A^+ = matrix for the positive ideal solution,
A^- = matrix for the negative ideal solution.

5. Calculate the distance of each alternative using equations (6) and (7):

$$S_i^+ = \sqrt{\sum_{j=1}^{n} v_{ij} - v_j^{+2}} \quad (6)$$

$$S_i^- = \sqrt{\sum_{j=1}^{n} v_{ij} - v_j^{-2}} \quad (7)$$

Description:

S_i^+ = distance of alternative i from the positive ideal solution,

S_i^- = distance of alternative i from the negative ideal solution,

v_{ij} = normalized weighted decision matrix v,

v_j^+ = element of the positive ideal solution matrix,

v_j^- = element of the negative ideal solution matrix.

6. Calculate the relative closeness to the positive ideal solution using equation (8):

$$c_i^+ = \frac{S_i^-}{S_i^- + S_i^+}, 0 \leq c_i^+ \leq 1 \quad (8)$$

Description:
c_i^+ = relative closeness of alternative i to the positive ideal solution,
S_i^- = distance of alternative i from the negative ideal solution,
S_i^+ = distance of alternative i from the positive ideal solution.

7. Determine the ranking of all alternatives that have been calculated.
The alternatives are ordered from the highest to the lowest value of C+.

2.5. *Web-Based System Design*

In this system design phase, the author designs a web-based application through several steps. A website is an online system that allows anyone to provide information [11]. These steps include creating the design and content layout of the website. This website will be the final output of the research. To support the system development, the author also creates use case diagrams, class diagrams, activity diagrams, and mockups as an overview of the website to be developed.

2.6. *System Implementation*

In the system implementation phase, the development process designed in the previous stage will be applied in the form of a web-based application ready for use. The purpose of this system implementation is to transform the designed system into a functional solution that can be run and tested in real-world conditions.

2.7. *System Testing using Black Box*

Testing is conducted to ensure that the system matches the design using the black box testing method [12]. Through black box testing, software engineering can utilize a set of input conditions to fully examine the functional requirements of a program.

2.8. *Analysis and Discussion*

In this phase, a comprehensive evaluation is conducted on the results obtained during the research and development of the web-based decision support system for selecting the ideal food menu for individuals with Gastroesophageal Reflux Disease (GERD).

2.9. *Conclusion*

In this final phase, conclusions are drawn from the entire process that has been carried out. At this stage, a web-based application has been developed as a solution to the identified problem.

3. Results and Discussion

This section discusses the results of the calculation process and data analysis conducted to assess the performance of the decision support system in selecting the ideal food menu for GERD patients. Table 1 presents the criteria used in selecting the ideal food menu for GERD patients consisting of five main components protein, carbohydrates, fat, fiber, and calories. These criteria are classified based on assessment type either as benefit or cost. Benefit criteria protein, carbohydrates, fiber, and calories indicate that higher values are preferable for GERD patients. Conversely, the cost criterion fat suggests that lower values are prioritized as excessive fat consumption can trigger GERD symptoms. Each criterion is assigned a weight reflecting its importance in the decision-making process for selecting a food menu for NERD-type GERD patients where fat has the highest weight 5 as the primary risk factor followed by protein and fiber 4 and carbohydrates and calories 3.

Table 1. Criteria Used

Criteria	Type	Weight
Protein	Benefit	4
Carbohydrates	Benefit	3
Fat	Cost	5
Fiber	Benefit	4
Calories	Benefit	3

Table 2 outlines the sub-criteria for each main criterion, including protein, carbohydrates, fat, fiber, and calories, categorized based on value ranges and their respective weights. Criteria classified as benefit types (protein, carbohydrates, fiber, and calories) indicate that higher values are preferred, such as protein >15 grams with a weight of 5. Conversely, for fat, which is a cost-type criterion, lower values are prioritized, such as fat content <5 grams assigned the highest weight (5). These value ranges and weights are designed to reflect the importance of each sub-criterion in selecting the ideal meal menu for GERD patients, based on expert interviews and relevant literature.

Table 2. Sub-Criteria Used

Criteria	Sub-Criteria	Value Range	Weight
Protein	High	> 15	5
	Medium	10-15	3
	Low	< 10	1
Carbohydrates	High	> 30	5
	Medium	20 - 30	3
	Low	< 20	1
Fat	High	> 10	1
	Medium	5-10	3
	Low	< 5	5
Fiber	High	> 3	5
	Medium	1-3	3
	Low	< 1	1
Calories	High	> 250	5
	Medium	150 - 250	3
	Low	< 150	1

Table 3 describes the alternatives used in this study. The 10 food menu items selected as sample data are Oatmeal, Salmon, Boiled Chicken Breast, Stir-Fried Spinach, Stir-Fried Chayote, Seasoned Fried Tempeh, Green Bean Porridge, Whole Wheat Pasta, Mackerel, and Kalasan Fried Chicken Thigh. These menu items were chosen to represent a variety of carbohydrate, protein, and fiber sources from both traditional and modern foods. The nutritional content of these foods was analyzed based on the established criteria. The data obtained were then processed using the TOPSIS method to determine the most optimal food menu according to the predefined criteria.

Table 3. Alternatives Used

No	Menu Name	C1	C2	C3	C4	C5
1	Oatmeal	2.4	12	1.4	1.7	68
2	Salmon	19.93	0	10.43	0	179
3	Stir-fried Spinach	28.74	0	3	0	150
4	Stir-fried Chayote	1.37	17.72	0.14	2.5	76
5	Steamed Broccoli	3.2	1.9	0.2	3	23.2
6	Stir-Fried Tempeh	13.11	15.6	8.2	1.4	175
7	Mung Bean Porridge	4.24	21.31	3.68	2.3	130
8	Whole Wheat Pasta	13.1	68.9	5.8	5.9	374
9	Indian Mackerel	19.32	0	9.36	0	167
10	Fried Kalasan Chicken (Thigh)	37.4	1.3	12.2	0	275

The steps for processing data using the TOPSIS method can be explained as follows:

3.1. Decision Matrix

Table 4 shows the table containing the names of foods along with their main nutritional values, including protein, carbohydrates, fat, fiber, and calories. The values for each criterion in the table are derived from the sub-criteria weights determined based on the nutritional content of each food.

Table 4. Decision Matrix

No	Alternative	C1	C2	C3	C4	C5
1	A1	1	1	5	3	1
2	A2	5	1	1	1	3
3	A3	5	1	5	1	3
4	A4	1	1	5	3	1
5	A5	1	1	5	3	1
6	A6	3	1	3	3	3
7	A7	1	3	5	3	1
8	A8	3	5	3	5	5
9	A9	5	1	3	1	3
10	A10	5	1	1	1	5

3.2. Normalized Matrix

Each value in the normalized matrix is calculated by dividing the initial value of each alternative for a given criterion by the square root of the sum of the squares of all the alternative values for that criterion.

Table 5. Normalized Matrix

Divisor	**11.0454**	**6.4807**	**12.4097**	**8.6023**	**9.4868**
Alternative	**C1**	**C2**	**C3**	**C4**	**C5**
A1	0.0905	0.1543	0.4029	0.3487	0.1054
A2	0.4527	0.1543	0.0806	0.1162	0.3162
A3	0.4527	0.1543	0.4029	0.1162	0.3162
A4	0.0905	0.1543	0.4029	0.3487	0.1054
A5	0.0905	0.1543	0.4029	0.3487	0.1054
A6	0.2716	0.1543	0.2417	0.3487	0.3162
A7	0.0905	0.4629	0.4029	0.3487	0.1054

A8	0.2716	0.7715	0.2417	0.5812	0.5270
A9	0.4527	0.1543	0.2417	0.1162	0.3162
A10	0.4527	0.1543	0.0806	0.1162	0.5270

3.3. Weighted Normalized Matrix

The Weighted Normalized Matrix is the result of the decision matrix normalization process multiplied by the weight of each criterion. Table 6 shows the weighted normalized values for each alternative (A1 to A10) based on the five criteria (C1 to C5).

Table 6. Weighted Normalized Matrix

Alternative	C1	C2	C3	C4	C5
A1	0.3621	0.4629	2.0146	1.3950	0.3162
A2	1.8107	0.4629	0.4029	0.4650	0.9487
A3	1.8107	0.4629	2.0146	0.4650	0.9487
A4	0.3621	0.4629	2.0146	1.3950	0.3162
A5	0.3621	0.4629	2.0146	1.3950	0.3162
A6	1.0864	0.4629	1.2087	1.3950	0.9487
A7	0.3621	1.3887	2.0146	1.3950	0.3162
A8	1.0864	2.3146	1.2087	2.3250	1.5811
A9	1.8107	0.4629	1.2087	0.4650	0.9487
A10	1.8107	0.4629	0.4029	0.4650	1.5811

3.4. Positive and Negative Ideal Solutions

The Positive and Negative Ideal Solutions in Table 7 are the results of selecting the maximum and minimum values for each criterion (C1 to C5) from the Weighted Normalization Matrix. The Positive Ideal Solution (SIP) represents the best possible value that can be achieved for each criterion, while the Negative Ideal Solution (SIN) represents the worst possible value.

Table 7. Positive and Negative Ideal Solutions

Ideal Solution	C1	C2	C3	C4	C5
Ideal Positive	1.8107	2.3146	0.4029	2.3250	1.5811
Ideal Negative	0.3621	0.4629	2.0146	0.4650	0.3162

3.5. Distance to the Positive and Negative Ideal Solutions

The distance to the Positive Ideal Solution (D+) and the Negative Ideal Solution (D-) in the table above shows how far each alternative (A1 to A10) is from the positive and negative ideal solutions. This distance is calculated using the Euclidean Distance formula based on the values in the Weighted Normalized Matrix. D+ represents the distance of an alternative from the best condition (positive ideal), while D- represents the distance from the worst condition (negative ideal). The distance to the positive ideal solution is calculated using equation (6), and the distance to the negative ideal solution is calculated using equation (7).

Table 7. Distance to the Positive and Negative Ideal Solutions

Determining the Ranking Based on Preference Index			
D1+	3.2541	D1-	0.9300
D2+	2.6996	D2-	2.2574
D3+	3.1441	D3-	1.5806
D4+	3.2541	D4-	0.9300
D5+	3.2541	D5-	0.9300
D6+	2.4223	D6-	1.5617
D7+	2.8316	D7-	1.3123
D8+	1.0835	D8-	3.1084
D9+	2.8173	D9-	1.7742
D10+	2.6245	D10-	2.5091

3.6. Determining the Ranking Based on Preference Index

The Preference Index indicates how close each alternative is to the positive ideal solution, with higher values indicating better alternatives. Based on Table 4.9, Whole Wheat Pasta (V8) has the highest preference index (0.7415), placing it in the first rank, followed by Kalasan Fried Chicken Thigh (V10) and Salmon Fish (V2).

Table 7. Preference Index

Preference Index Value	
V1	0.2223
V2	0.4554
V3	0.3345
V4	0.2223
V5	0.2223
V6	0.3920
V7	0.3167
V8	0.7415
V9	0.3864
V10	0.4888

The TOPSIS method is then implemented in the form of code using PHP programming language with a MySQL database. In Figure 1, the main page of the L-Healthy system is designed to assist GERD patients in choosing an ideal menu that is safe and supports digestive health. With a background image of healthy food and a green dominant color, this page displays the system name, main navigation, as well as the Sign up and Sign in buttons. A welcome text provides a brief explanation of the system's purpose, accompanied by an action button to begin the menu selection process.

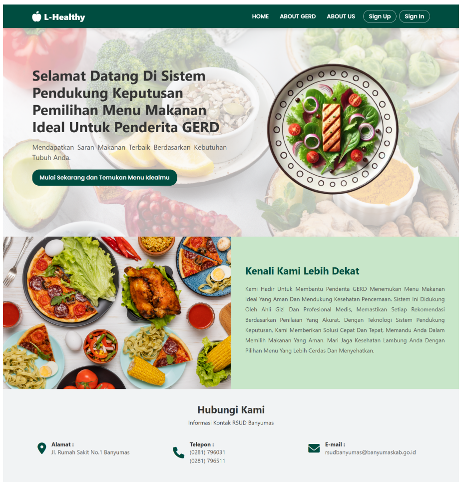
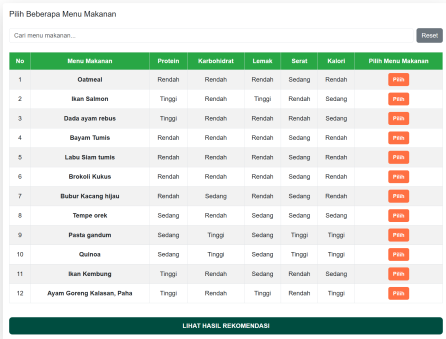


Figure 1. Landing Page View

Figure 2 is the main feature of the L-Healthy system, allowing users to select a food menu that aligns with their health needs. The page starts with a brief description of the importance of choosing foods that support digestive health, particularly to alleviate GERD symptoms. Below, there is an interactive table with columns displaying food menu names, nutritional content (Protein, Carbohydrates, Fats, Fiber, and Calories), and an "Select" button to choose the desired menu. Users can search for specific menus and reset the search with the "Reset" button. After making a selection, users can click the "VIEW RECOMMENDATION RESULTS" button to see the ranking of the chosen foods.



Pilih Beberapa Menu Makanan

Cari menu makanan...
Reset

No	Menu Makanan	Protein	Karbohidrat	Lemak	Serat	Kalori	Pilih Menu Makanan
1	Oatmeal	Rendah	Rendah	Rendah	Sedang	Rendah	Pilih
2	Ikan Salmon	Tinggi	Rendah	Tinggi	Rendah	Sedang	Pilih
3	Dada ayam rebus	Tinggi	Rendah	Rendah	Rendah	Sedang	Pilih
4	Bayam Tumis	Rendah	Rendah	Rendah	Sedang	Rendah	Pilih
5	Labu Siam tumis	Rendah	Rendah	Rendah	Sedang	Rendah	Pilih
6	Brokoli Kukus	Rendah	Rendah	Rendah	Sedang	Rendah	Pilih
7	Bubur Kacang hijau	Rendah	Sedang	Rendah	Sedang	Rendah	Pilih
8	Tempe orek	Sedang	Rendah	Sedang	Sedang	Sedang	Pilih
9	Pasta gandum	Sedang	Tinggi	Sedang	Tinggi	Tinggi	Pilih
10	Quinoa	Sedang	Tinggi	Sedang	Tinggi	Tinggi	Pilih
11	Ikan Kembung	Tinggi	Rendah	Sedang	Rendah	Sedang	Pilih
12	Ayam Goreng Kalasan, Paha	Tinggi	Rendah	Tinggi	Rendah	Tinggi	Pilih

LIHAT HASIL REKOMENDASI

Figure 2. Dashboard User

Figure 3 shows the "Food Menu Recommendation Results" page in the L-Healthy system. It displays TOPSIS calculation results, with a table listing food menus ranked by preference index. Each menu includes nutritional information like Protein, Carbohydrates, Fats, Fiber, and Calories. Action buttons such as "Back to Dashboard," "View Calculations," "Reset Preferences," and "Print" are available for user interaction.

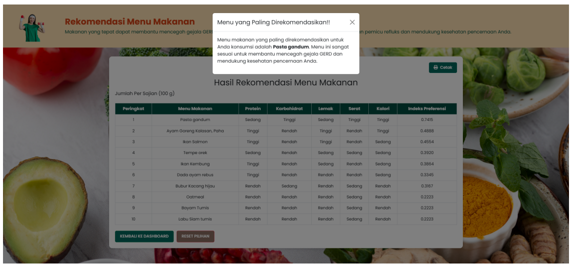


Figure 3. Recommendation Results View

Figure 3 shows the final calculation results of the system, while Table 4 presents the manual calculation results using similar steps. The consistency of these results demonstrates that the system has high accuracy in performing calculations, making it reliable for supporting efficient and accurate decision-making.

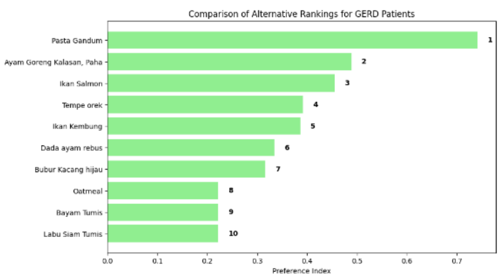


Figure 3. Comparison of Alternative

Whole wheat pasta stands out as the best choice for GERD patients due to its high fiber content, which aids digestion and reduces reflux symptoms. Additionally, its high calorie content provides dense nutritional value, while the moderate fat level balances the needs of GERD patients, avoiding excessive fat intake that could worsen symptoms. This combination makes whole wheat pasta a better option compared to other foods in the TOPSIS decision-making system. This experiment compares the results of calculations using the TOPSIS and SAW methods to select the ideal food for GERD patients. The results show that Pasta Gandum ranks at the top in both methods, indicating consistency between them. However, there are significant differences in the rankings of other foods such as Ayam Goreng Kalasan, Paha and Ikan Salmon, which are ranked lower in the SAW method compared to TOPSIS. These differences reflect how each method considers the criteria and weights given. Nutritional recommendations from experts take into account additional factors such as more specific nutritional content and the individual conditions of each patient.

To ensure the effectiveness of the system's recommendations in helping GERD patients, a field trial was conducted on one GERD patient. In this test, the patient was asked to follow the meal plan recommended by the system for a full week. Each day, the patient recorded the meals consumed and their health condition. The results of the trial showed that during this period, no GERD symptoms appeared. The patient reported feeling comfortable, with no complaints such as heartburn, acid reflux, or other digestive disorders. This indicates that the system's recommendations can be relied upon to help manage a diet suitable for GERD patients. As part of the evaluation, the metrics used included the reduction of daily symptoms recorded in the patient's health journal and the patient's compliance with the recommended meals. The reduction in the frequency and intensity of symptoms became the primary indicator of the system's success in providing the right and healthy menu. With these positive results, this decision support system is expected to be an effective tool in improving the quality of life for GERD patients through better food management.

Sensitivity analysis has been conducted with various weight variations to test the stability of the results. Based on the testing, changes in weights did not cause significant ranking changes, indicating that the results remain stable. This demonstrates that the TOPSIS method used in this system has resilience to weight changes within certain limits.

This research can be further developed by adding a personalization feature that allows users to input specific preferences, such as allergies or dietary restrictions, so that menu recommendations better align with individual needs. Additionally, behavioral and economic factors can be integrated into the decision support model, such as considering users' eating habits, estimating food costs, and providing more economical menu alternatives. With these enhancements, the system is expected to increase user adoption and provide more relevant recommendations that can be effectively applied in daily life.

4. Conclusion

Based on the research results, it can be concluded that the TOPSIS method is effective in determining the optimal food menu for GERD patients, with the system's calculation results consistent with manual calculations. The analysis, which involved 10 food menu options based on five main nutritional criteria, showed that Whole Wheat Pasta was the best choice with the highest preference index. The developed website enables users, including GERD patients and medical professionals, to easily select menus that meet the defined health criteria, providing quick and accurate recommendations without the need for manual calculations. For future development, the system can incorporate personalization features for allergies and dietary restrictions, along with behavioral and economic factors like eating habits and food costs. These enhancements aim to improve user adoption and provide more relevant, practical recommendations.

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