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Comparison of SAW and TOPSIS Methods in Decision Support Systems for Contraceptive Selection

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Abstract: Family Planning (FP) is a crucial initiative in enhancing the quality of life and health of mothers and children. However, selecting the appropriate contraceptive method remains a significant challenge for many couples of reproductive age. This study proposes the development of a web-based Decision Support System (DSS) that integrates the Simple Additive Weighting (SAW) method and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) at Zahra Harapan Bunda Clinic. The system aims to provide accurate recommendations for selecting contraceptive methods, record data, monitor users, and remind acceptors of consultation schedules. The results indicate that the SAW method is more consistent and aligns more closely with expert recommendations compared to TOPSIS, with a higher conformity percentage ranging from 66.25% to 92.5%. In contrast, TOPSIS showed a lower conformity percentage, ranging from 25.89% to 78.03%. These findings suggest that SAW more accurately reflects expert recommendations and is therefore considered more effective for selecting contraceptive methods. The study recommends the use of the SAW method for decision-making in contraceptive method selection and suggests further research to expand and validate this approach in a broader range of applications.

Keywords: Family Planning (FP); Contraceptive Methods; Decision Support System (DSS); Simple Additive Weighting (SAW); Technique for Order Preference by Similarity to Ideal Solution (TOPSIS); Multicriteria Decision Making (MCDM).

1. Introduction

Family is the fundamental unit of a nation, where families shape individuals who will contribute to nation-building. Family Planning (FP) is an effective strategy to produce individuals of higher quality, both materially and spiritually. In the context of population control, the government seeks to slow down population growth through FP programs. Family Planning aims to enhance the health quality of mothers and children [1]. Health efforts through FP represent a primary preventive measure for women and infants, thereby forming quality families [2]. Currently, there are numerous contraceptive methods available for both women and men. However, many couples of reproductive age still face challenges in selecting the appropriate type of contraception. The selection of methods within Decision Support Systems (DSS) significantly impacts the outcomes achieved. A lack of knowledge regarding the functions and benefits of DSS methods can lead to suboptimal decisions. A common issue faced is the selection of an appropriate DSS method due to insufficient information about effective decision-making processes and the absence of tools to compare decision outcomes with mathematical calculations. Multicriteria Decision Making (MCDM), introduced in the early 1970s, has become a valuable method for evaluating, selecting, and ranking alternatives based on multiple criteria, including Simple Additive Weighting (SAW), Weighted Product (WP), and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) [3].

The SAW method's fundamental concept involves calculating a weighted sum of performance ratings for each alternative [4]. Conversely, the basic principle of the TOPSIS method is that the chosen alternative should have the shortest distance from the ideal positive solution and the longest distance from the ideal negative solution [5]. According to a study by Dwi Novia and Rostika, employing more than one method allows for comparisons, thereby increasing the validity of the decisions made. This dual-method approach is thus considered suitable for the current research [6]. To address the issue of selecting the appropriate contraceptive method, this study proposes the development of a web-based system at Zahra Harapan Bunda Clinic, utilizing both SAW and TOPSIS methods. This system aims to provide recommendations for contraceptive selection, record data, monitor users, and remind acceptors of consultation schedules. The study compares the accuracy levels of the SAW and TOPSIS methods using Euclidean Distance to offer the best recommendations to midwives for determining suitable contraceptive tools.

Previous studies have demonstrated the successful application of SAW and TOPSIS methods in various fields, such as site selection for construction, employee performance evaluation, and supplier selection. Irwan *et al.* (2018) used SAW and TOPSIS to determine the optimal factory location by considering cost, accessibility, and environmental impact [7]. Meanwhile, Putra and Handayani (2019) applied these methods to evaluate employee performance in a manufacturing company, resulting in objective and measurable decisions [8]. Additionally, Yuliana *et al.* (2020) utilized SAW and TOPSIS to select the best suppliers based on quality, price, and delivery time criteria, thereby improving supply chain efficiency [9]. Previous studies have highlighted that decision support systems based on SAW and TOPSIS methods have proven successful in various applications, which are relevant to this study. It is expected that this study will make a significant contribution to the development of reproductive health and family planning (FP). The integration of SAW and TOPSIS in DSS offers a robust framework to improve the decision-making process related to contraceptive selection, ultimately improving outcomes for users and health care providers.

This research not only validates the efficacy of SAW in aligning closely with expert recommendations but also highlights the potential limitations of TOPSIS. By systematically comparing these methods, the study aims to provide evidence-based guidance for the adoption of more reliable decision-making tools in contraceptive selection. Furthermore, the implementation of such a system could streamline processes in clinical settings, support healthcare professionals in delivering personalized advice, and ultimately foster better health outcomes for individuals and communities. The findings from this research suggest that future studies should continue to explore and expand the application of SAW, potentially in combination with other MCDM techniques, to further refine and enhance decision support systems in broader healthcare contexts. By doing so, the research will pave the way for more informed and precise decision-making, ultimately contributing to the success of FP programs and the overall improvement of public health.

2. Research Method

2.1 Decision Support System

The Decision Support System (DSS) is developed to assist decision-makers in analyzing complex problems and selecting optimal solutions from a range of alternatives [10]-[11]. The main objective of a DSS is to provide structured support using data, information, and analytical methods, which help decision-makers understand the potential outcomes of their choices. By incorporating these elements, DSS tools reduce uncertainty and improve decision quality, offering a systematic approach to tackle complex decision-making scenarios [12][13][14]. This study integrates two widely recognized multi-criteria decision-making methods—Simple Additive Weighting (SAW) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS)—to enhance the decision-making process in selecting contraceptive methods.

2.2 Simple Additive Weighting (SAW) Method

The SAW method is implemented by conducting a comparative analysis to determine the ranking of alternatives based on their weighted performance across various criteria. The process starts with the normalization of the decision matrix (X), which involves converting all data into a standardized ratio, allowing for fair comparison across attributes [15]. Normalization ensures that differences in scales between criteria do not influence the final evaluation, making it possible to objectively assess each alternative [16]. After normalization, weights are assigned to each criterion according to their relative importance. These weights are then applied to the normalized values, and the results are summed to generate a score for each alternative. The alternative with the highest score is deemed the most suitable, reflecting its alignment with the defined criteria.

2.3 Technique for Order Preference by Similarity to Ideal Solution (TOPSIS)

TOPSIS is a widely used method in multi-criteria decision-making due to its straightforward yet robust approach. The fundamental principle of TOPSIS is that the optimal alternative should have the shortest distance from the positive ideal solution (the best possible outcome) and the longest distance from the negative ideal solution (the least desirable outcome). The method begins by normalizing the decision matrix, followed by calculating the weighted normalized values for each criterion [5]. After this, the ideal positive and negative solutions are determined, representing the best and worst values for each criterion. The Euclidean distance of each alternative from these ideal solutions is then calculated, and a relative closeness coefficient is used to rank the alternatives. The alternative with the highest relative closeness to the positive ideal solution is considered the best option, providing a clear, quantifiable means to evaluate and rank multiple alternatives.

2.4 Research Procedure

The research procedure consisted of several structured steps to address the challenge of selecting appropriate contraceptive methods for patients with varying needs and preferences. The initial step involved identifying the primary issue: the difficulty that couples of reproductive age face in choosing the right contraceptive method due to differing patient conditions and preferences. A DSS that provides personalized recommendations based on specific patient conditions was necessary to address this variability in needs. Problem identification was crucial, highlighting the need for a decision support system capable of ranking contraceptive methods based on individual patient profiles. This system is particularly important in reproductive health, where the suitability of contraceptive options varies significantly depending on personal and medical factors. Data collection was conducted through interviews and literature reviews to gather relevant information. Interviews with midwives and experts in reproductive health and family planning provided valuable insights into the practical aspects of contraceptive selection. The interview process involved multiple steps to ensure the collection of high-quality data.

In the identification of respondents, midwives and experts with extensive knowledge and experience in family planning and contraception were selected. Respondents were chosen from various clinics and hospitals to capture diverse perspectives on contraceptive practices and decision-making criteria. Preparing the questions required developing a comprehensive list of open-ended questions designed to explore the respondents' knowledge, experiences, and opinions regarding different contraceptive methods and the factors influencing their selection. The questions also examined the respondents' views on the effectiveness of SAW and TOPSIS methods in aiding decision-making. Conducting the interviews was done either face-to-face or through online platforms, depending on the respondents' availability and preferences. Each interview was recorded, with consent from the respondents, to ensure the accuracy of the data collected. The interviews were transcribed and analyzed using thematic analysis to identify key themes and categorize relevant information. This analysis provided a solid foundation of expert insights that were instrumental in developing the DSS.

In addition to interviews, a literature review was performed to complement the data obtained from expert interviews. This involved identifying relevant sources, including academic journals, books, and research reports that discussed contraceptive methods, reproductive health, and the application of SAW and TOPSIS in decision-making. Each source was carefully evaluated for credibility and relevance, with only high-quality sources being included in the study. The data collection from literature involved extracting critical information, such as statistics on contraceptive usage, effectiveness of different methods, and case studies where SAW and TOPSIS had been successfully applied. These data points were then synthesized with the information gathered from the interviews, creating a robust knowledge base that served as the input for the DSS. The method application was carried out by integrating the SAW and TOPSIS methods into the DSS framework. The system was designed to provide tailored recommendations to healthcare providers, guiding them in selecting the most appropriate contraceptive methods based on individual patient profiles. By leveraging both SAW and TOPSIS, the DSS aimed to combine the strengths of both methods, offering a decision-making tool capable of handling the complexities of contraceptive selection.

3. Result and Discussion

3.1 Results

3.1.1 Alternative Data

The alternative data for contraceptive methods are presented in Table 1 below. This table lists various contraceptive options identified for evaluation within the decision support system, each assigned an alternative code for easy reference in subsequent analysis.

Table 1. Contraceptive Alternatives

Alternative	Name of Alternative
A1	LNG Intrauterine Contraceptive Device
A2	Copper Intrauterine Contraceptive Device
A3	Combination Pills
A4	Progestin Pills
A5	Combination Injection
A6	Progestin Injection
A7	Implant
A8	Patch/ Koyo
A9	Condom

Table 1 provides a list of contraceptive methods used as alternatives in the study. Each method is represented by a code (A1 to A9), which serves as a unique identifier throughout the analysis. The alternatives include a range of methods such as intrauterine devices (IUDs), hormonal pills, injectables, implants, patches, and condoms. These alternatives are evaluated using the SAW and TOPSIS methods to determine their suitability based on specific criteria relevant to the decision-making process for contraceptive selection. The inclusion of diverse methods ensures that the decision support system can cater to the varying needs and preferences of individuals seeking family planning options.

3.1.2 Criteria and Sub-Criteria Data

The data for the criteria and sub-criteria used in evaluating the contraceptive alternatives are presented in Table 2 below. This table outlines the various factors considered in the decision-making process, including each criterion's specific sub-criteria, category, and assigned weights, which influence the evaluation of each contraceptive method.

Table 2. Criteria and Sub-Criteria Data

Criteria	Name of Criteria	Name of Sub-Criteria	Category	Weight
C1	Lactation	None	Cost	15%
		< 6 Weeks Postpartum		
		6 Weeks - < 6 Months Postpartum		
		> 6 Months Postpartum		
C2	Age	18 Years	Benefit	15%
		18 - 35 Years		
		> 35 Years		
C3	Medical Eligibility	None	Cost	35%
		Nullipara		
		Multipara		

		Uterine Fibroids		
		Cervical Neoplasia		
		Cervical Cancer		
		Vaginal Bleeding		
		Liver Tumor		
		Sepsis		
		Sexually Transmitted Infections (STIs)		
		HIV/AIDS		
		Smoking		
		Pelvic Inflammatory Disease		
		Headaches		
		Breast Cancer		
		Venous Thromboembolism		
		Diabetes		
		Drug Interactions		
		Cardiovascular Issues		
		Hypertension > 160		
		Obesity		
C4	Miscarriage History	None	Cost	15%
		First Trimester		
		Second Trimester		
		Post-Septic Abortion		
C9	Number of Children	0	Cost	20%
		1 - 2		
		> 3		

Table 2 lists the criteria and sub-criteria used in the evaluation of contraceptive methods. Each criterion is associated with specific sub-criteria, categorized as either "Cost" or "Benefit," which determine the influence of each factor on the decision-making process. These criteria and sub-criteria form the basis for evaluating the suitability of each contraceptive alternative using the SAW and TOPSIS methods. The assigned weights indicate the relative importance of each criterion in the overall decision-making process, guiding the assessment towards the most appropriate contraceptive methods for individual patients based on their specific characteristics and needs.

3.1.3 Manual Calculation

The manual calculation process uses both the Simple Additive Weighting (SAW) and TOPSIS methods. Before starting the calculations, a case study is needed to demonstrate the application of these methods within the research framework. The case study used is presented in Table 3 below.

Table 3. Case Study Data

Patient Name	Age	Lactation	Number of Children	Miscarriage History	Medical Eligibility
Sutari	22	None	0	None	Headaches

Table 3 provides the data for a case study involving a patient named Sutari. This case study serves as the basis for conducting manual calculations using the SAW and TOPSIS methods. Using this case study, the SAW and TOPSIS methods will be applied to calculate the suitability scores for various contraceptive alternatives based on the criteria and sub-criteria defined earlier. The manual calculation will involve normalizing the data, applying the respective weights to each criterion, and then computing the final scores to determine the most appropriate contraceptive method for Sutari. This practical example will help illustrate how the decision support system can aid healthcare providers in making informed recommendations tailored to individual patient profiles

3.1.4 Calculation Using the SAW Method

The calculation using the Simple Additive Weighting (SAW) method involves determining the suitability scores of each contraceptive alternative based on the case study data. The suitability ratings for each alternative are presented in Table 4 below.

Table 4. Suitability Rating Data Using SAW Method

Alternative	Age	Lactation	Number of Children	Miscarriage History	Medical Eligibility
LNG Intrauterine Contraceptive Device	2	1	2	1	2
Copper Intrauterine Contraceptive Device	1	1	2	1	1
Combination Pills	1	1	1	1	4
Progestin Pills	1	1	1	1	2
Combination Injection	1	1	1	1	4
Progestin Injection	1	1	1	1	2
Implant	2	1	2	1	2
Patch/ Koyo	1	1	1	1	4
Condom	1	1	1	1	1

Table 4 shows the suitability ratings for each contraceptive alternative using the SAW method, based on the criteria defined in the study. The SAW method involves normalizing these ratings and applying the weights assigned to each criterion (as defined in previous sections). The final suitability scores for each alternative will be calculated by summing the weighted normalized ratings, allowing for the identification of the most appropriate contraceptive method for the patient, Sutari. This calculation provides a practical application of the SAW method in a real-world scenario, demonstrating its effectiveness in aiding healthcare providers in making informed decisions tailored to individual patient needs.

3.1.5 Data Normalization

In the data normalization step, the values are transformed into a matrix x as follows:

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

After transforming the values into matrix x, the next step involves calculating the normalized values based on the "Benefit" or "Cost" categories of the criteria. For each alternative (A1 to A9), the normalized value R is calculated for each criterion. The normalization formula varies depending on whether the criterion is a benefit (higher values are better) or a cost (lower values are better). Here are the calculations for each alternative:

A1 :

$$R_{11} = \frac{2}{Max(2;1;1;1;1;1;2;1;1)} = 1$$
$$R_{12} = \frac{Min(1;1;1;1;1;1;1;1;1)}{1} = 1$$
$$R_{13} = \frac{Min(2;2;1;1;1;1;2;1;1)}{2} = 0.5$$
$$R_{14} = \frac{Min(1;1;1;1;1;1;1;1;1)}{1} = 1$$
$$R_{15} = \frac{Min(2;1;4;2;4;2;2;4;1)}{2} = 0.5$$

A2 :

$$R_{21} = \frac{1}{Max(2;1;1;1;1;1;2;1;1)} = 0.5$$
$$R_{22} = \frac{Min(1;1;1;1;1;1;1;1;1)}{1} = 1$$
$$R_{23} = \frac{Min(2;2;1;1;1;1;2;1;1)}{2} = 0.5$$

$$R_{24} = \frac{Min(1;1;1;1;1;1;1;1;1)}{1} = 1$$
$$R_{25} = \frac{Min(2;1;4;2;4;2;2;4;1)}{1} = 1$$

A3 :
$$R_{31} = \frac{1}{Max(2;1;1;1;1;1;2;1;1)} = 0.5$$
$$R_{32} = \frac{Min(1;1;1;1;1;1;1;1;1)}{1} = 1$$
$$R_{33} = \frac{Min(2;2;1;1;1;1;2;1;1)}{1} = 1$$
$$R_{34} = \frac{Min(1;1;1;1;1;1;1;1;1)}{1} = 1$$
$$R_{35} = \frac{Min(2;1;4;2;4;2;2;4;1)}{4} = 0.25$$

A4 :
$$R_{41} = \frac{1}{Max(2;1;1;1;1;1;2;1;1)} = 0.5$$
$$R_{42} = \frac{Min(1;1;1;1;1;1;1;1;1)}{1} = 1$$
$$R_{43} = \frac{Min(2;2;1;1;1;1;2;1;1)}{1} = 1$$
$$R_{44} = \frac{Min(1;1;1;1;1;1;1;1;1)}{1} = 1$$
$$R_{45} = \frac{Min(2;1;4;2;4;2;2;4;1)}{2} = 0.5$$

A5 :
$$R_{51} = \frac{1}{Max(2;1;1;1;1;1;2;1;1)} = 0.5$$
$$R_{52} = \frac{Min(1;1;1;1;1;1;1;1;1)}{1} = 1$$
$$R_{53} = \frac{Min(2;2;1;1;1;1;2;1;1)}{1} = 1$$
$$R_{54} = \frac{Min(1;1;1;1;1;1;1;1;1)}{1} = 1$$
$$R_{55} = \frac{Min(2;1;4;2;4;2;2;4;1)}{4} = 0.25$$

A6 :
$$R_{61} = \frac{1}{Max(2;1;1;1;1;1;2;1;1)} = 0.5$$
$$R_{62} = \frac{Min(1;1;1;1;1;1;1;1;1)}{1} = 1$$
$$R_{63} = \frac{Min(2;2;1;1;1;1;2;1;1)}{1} = 1$$
$$R_{64} = \frac{Min(1;1;1;1;1;1;1;1;1)}{1} = 1$$
$$R_{65} = \frac{Min(2;1;4;2;4;2;2;4;1)}{2} = 0.5$$

A7 :
$$R_{71} = \frac{2}{Max(2;1;1;1;1;1;2;1;1)} = 1$$
$$R_{72} = \frac{Min(1;1;1;1;1;1;1;1;1)}{1} = 1$$
$$R_{73} = \frac{Min(2;2;1;1;1;1;2;1;1)}{2} = 0.5$$
$$R_{74} = \frac{Min(1;1;1;1;1;1;1;1;1)}{1} = 1$$
$$R_{75} = \frac{Min(2;1;4;2;4;2;2;4;1)}{2} = 0.5$$

A8 :
$$R_{81} = \frac{1}{Max(2;1;1;1;1;1;2;1;1)} = 0.5$$
$$R_{82} = \frac{Min(1;1;1;1;1;1;1;1;1)}{1} = 1$$
$$R_{83} = \frac{Min(2;2;1;1;1;1;2;1;1)}{1} = 1$$
$$R_{84} = \frac{Min(1;1;1;1;1;1;1;1;1)}{1} = 1$$

$$R_{85} = \frac{Min(2;1;4;2;4;2;2;4;1)}{4} = 0.25$$

A9 :

$$R_{91} = \frac{1}{Max(2;1;1;1;1;1;2;1;1)} = 0.5$$
$$R_{92} = \frac{Min(1;1;1;1;1;1;1;1;1)}{1} = 1$$
$$R_{93} = \frac{Min(2;2;1;1;1;1;2;1;1)}{1} = 1$$
$$R_{94} = \frac{Min(1;1;1;1;1;1;1;1;1)}{1} = 1$$
$$R_{95} = \frac{Min(2;1;4;2;4;2;2;4;1)}{1} = 1$$

The normalized values are then used to compute the final scores for each alternative by applying the respective weights and summing the results. These calculations help determine the most suitable contraceptive method for the case study, utilizing the SAW method to provide a clear and data-driven recommendation.

3.1.6 Calculating Preference Values

After normalizing the data, the normalized matrix RRR is obtained as follows:

$$R = \begin{bmatrix} 1 & 1 & 0.5 & 1 & 0.5 \\ 0.5 & 1 & 0.5 & 1 & 1 \\ 0.5 & 1 & 1 & 1 & 0.25 \\ 0.5 & 1 & 1 & 1 & 0.5 \\ 0.5 & 1 & 1 & 1 & 0.25 \\ 0.5 & 1 & 1 & 1 & 0.5 \\ 1 & 1 & 0.5 & 1 & 0.5 \\ 0.5 & 1 & 1 & 1 & 0.25 \\ 0.5 & 1 & 1 & 1 & 1 \end{bmatrix}$$

The next step is to calculate the preference values by multiplying the normalized matrix values by the criterion weights for each alternative and then summing the results.

V_1 = (15 x 1) + (15 x 1) + (20 x 0.5) + (15 x 1) + (35 x 0.5) =72.5
V_2 = (15 x 0.5) + (15 x 1) + (20 x 0.5) + (15 x 1) + (35 x 1) =82.5
V_3 = (15 x 0.5) + (15 x 1) + (20 x 1)+ (15 x 1) + (35 x 0.25) =66.25
V_4 = (15 x 0.5) + (15 x 1) + (20 x 1) + (15 x 1) + (35 x 0.5) =75
V_5 = (15 x 0.5) + (15 x 1) + (20 x 1) + (15 x 1) + (35 x 0.25) =66.25
V_6 = (15 x 0.5) + (15 x 1) + (20 x 1) + (15 x 1) + (35 x 0.5) =75
V_7 = (15 x 1) + (15 x 1) + (20 x 0.5) + (15 x 1) + (35 x 0.5) =72.5
V_8 = (15 x 0.5) + (15 x 1) + (20 x 1) + (15 x 1) + (35 x 0.25) =66.25
V_9 = (15 x 0.5) + (15 x 1) + (20 x 1) + (15 x 1) + (35 x 1) =92.5

Based on the calculated preference values, the ranking of the alternatives is presented in Table 5 below.

Table 5. Preference Values Using SAW Method

Alternative	Preference Value
Condom	92.5
Copper Intrauterine Contraceptive Device	82.5
Progestin Pills	75
Progestin Injection	75
Implant	72.5
LNG Intrauterine Contraceptive Device	72.5
Combination Pills	66.25
Combination Injection	66.25
Patch/ Koyo	66.25

Table 5 lists the preference values calculated using the SAW method for each contraceptive alternative. Kondom has the highest preference value of 92.5, making it the top-ranked option based on the criteria and weights used in this analysis. Other alternatives follow in descending order of preference, with Koyo, Pil Kombinasi, and Suntik Kombinasi having the lowest preference values at 66.25. This ranking provides a clear guide for selecting the most suitable contraceptive method for the patient in the case study, based on the decision support framework established in this research.

3.1.7 Calculation Using the TOPSIS Method

The calculation using the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method is performed using the same case study data as previously. The initial step involves normalizing the data to create a normalized decision matrix.Normalization of data is conducted using the initial values, converting each value into a normalized form. The normalized value for each criterion is calculated by dividing each element by the square root of the sum of the squares of all elements in that column. The results for each alternative are as follows:

A1 :

$$R_{11} = \frac{2}{\sqrt{2^2+1^2+1^2+1^2+1^2+1^2+2^2+1^2+1^2}} = 0.5164$$
$$R_{12} = \frac{1}{\sqrt{1^2+1^2+1^2+1^2+1^2+1^2+1^2+1^2+1^2}} = 0.333$$
$$R_{13} = \frac{2}{\sqrt{2^2+2^2+1^2+1^2+1^2+1^2+2^2+1^2+1^2}} = 0.2462$$
$$R_{14} = \frac{1}{\sqrt{1^2+1^2+1^2+1^2+1^2+1^2+1^2+1^2+1^2}} = 0.333$$
$$R_{15} = \frac{2}{\sqrt{2^2+1^2+4^2+2^2+4^2+2^2+2^2+4^2+1^2}} = 0.4714$$

A2 :

$$R_{21} = \frac{1}{\sqrt{2^2+1^2+1^2+1^2+1^2+1^2+2^2+1^2+1^2}} = 0.2582$$
$$R_{22} = \frac{1}{\sqrt{1^2+1^2+1^2+1^2+1^2+1^2+1^2+1^2+1^2}} = 0.333$$
$$R_{23} = \frac{2}{\sqrt{2^2+2^2+1^2+1^2+1^2+1^2+2^2+1^2+1^2}} = 0.4714$$
$$R_{24} = \frac{1}{\sqrt{1^2+1^2+1^2+1^2+1^2+1^2+1^2+1^2+1^2}} = 0.333$$
$$R_{25} = \frac{1}{\sqrt{2^2+1^2+4^2+2^2+4^2+2^2+2^2+4^2+1^2}} = 0.1231$$

A3 :

$$R_{31} = \frac{1}{\sqrt{2^2+1^2+1^2+1^2+1^2+1^2+2^2+1^2+1^2}} = 0.2582$$
$$R_{32} = \frac{1}{\sqrt{1^2+1^2+1^2+1^2+1^2+1^2+1^2+1^2+1^2}} = 0.333$$
$$R_{33} = \frac{1}{\sqrt{2^2+2^2+1^2+1^2+1^2+1^2+2^2+1^2+1^2}} = 0.2357$$
$$R_{34} = \frac{1}{\sqrt{1^2+1^2+1^2+1^2+1^2+1^2+1^2+1^2+1^2}} = 0.333$$
$$R_{35} = \frac{4}{\sqrt{2^2+1^2+4^2+2^2+4^2+2^2+2^2+4^2+1^2}} = 0.4924$$

A4 :

$$R_{41} = \frac{1}{\sqrt{2^2+1^2+1^2+1^2+1^2+1^2+2^2+1^2+1^2}} = 0.2582$$
$$R_{42} = \frac{1}{\sqrt{1^2+1^2+1^2+1^2+1^2+1^2+1^2+1^2+1^2}} = 0.333$$
$$R_{43} = \frac{1}{\sqrt{2^2+2^2+1^2+1^2+1^2+1^2+2^2+1^2+1^2}} = 0.2357$$
$$R_{44} = \frac{1}{\sqrt{1^2+1^2+1^2+1^2+1^2+1^2+1^2+1^2+1^2}} = 0.333$$
$$R_{45} = \frac{2}{\sqrt{2^2+1^2+4^2+2^2+4^2+2^2+2^2+4^2+1^2}} = 0.2462$$

A5 :

$$R_{51} = \frac{1}{\sqrt{2^2+1^2+1^2+1^2+1^2+1^2+2^2+1^2+1^2}} = 0.2582$$

$R_{52} = \frac{1}{\sqrt{1^2+1^2+1^2+1^2+1^2+1^2+1^2+1^2+1^2}} = 0.333$

$R_{53} = \frac{1}{\sqrt{2^2+2^2+1^2+1^2+1^2+1^2+2^2+1^2+1^2}} = 0.2357$

$R_{54} = \frac{1}{\sqrt{1^2+1^2+1^2+1^2+1^2+1^2+1^2+1^2+1^2}} = 0.333$

$R_{55} = \frac{4}{\sqrt{2^2+1^2+4^2+2^2+4^2+2^2+2^2+4^2+1^2}} = 0.4924$

A6 :

$R_{61} = \frac{1}{\sqrt{2^2+1^2+1^2+1^2+1^2+1^2+2^2+1^2+1^2}} = 0.2582$

$R_{62} = \frac{1}{\sqrt{1^2+1^2+1^2+1^2+1^2+1^2+1^2+1^2+1^2}} = 0.333$

$R_{63} = \frac{1}{\sqrt{2^2+2^2+1^2+1^2+1^2+1^2+2^2+1^2+1^2}} = 0.2462$

$R_{64} = \frac{1}{\sqrt{1^2+1^2+1^2+1^2+1^2+1^2+1^2+1^2+1^2}} = 0.333$

$R_{65} = \frac{2}{\sqrt{2^2+1^2+4^2+2^2+4^2+2^2+2^2+4^2+1^2}} = 0.2467$

A7 :

$R_{71} = \frac{2}{\sqrt{2^2+1^2+1^2+1^2+1^2+1^2+2^2+1^2+1^2}} = 0.5164$

$R_{72} = \frac{1}{\sqrt{1^2+1^2+1^2+1^2+1^2+1^2+1^2+1^2+1^2}} = 0.333$

$R_{73} = \frac{2}{\sqrt{2^2+2^2+1^2+1^2+1^2+1^2+2^2+1^2+1^2}} = 0.4714$

$R_{74} = \frac{1}{\sqrt{1^2+1^2+1^2+1^2+1^2+1^2+1^2+1^2+1^2}} = 0.333$

$R_{75} = \frac{2}{\sqrt{2^2+1^2+4^2+2^2+4^2+2^2+2^2+4^2+1^2}} = 0.2462$

A8 :

$R_{81} = \frac{1}{\sqrt{2^2+1^2+1^2+1^2+1^2+1^2+2^2+1^2+1^2}} = 0.2582$

$R_{82} = \frac{1}{\sqrt{1^2+1^2+1^2+1^2+1^2+1^2+1^2+1^2+1^2}} = 0.333$

$R_{83} = \frac{1}{\sqrt{2^2+2^2+1^2+1^2+1^2+1^2+2^2+1^2+1^2}} = 0.2357$

$R_{84} = \frac{1}{\sqrt{1^2+1^2+1^2+1^2+1^2+1^2+1^2+1^2+1^2}} = 0.333$

$R_{85} = \frac{4}{\sqrt{2^2+1^2+4^2+2^2+4^2+2^2+2^2+4^2+1^2}} = 0.4924$

A9 :

$R_{91} = \frac{1}{\sqrt{2^2+1^2+1^2+1^2+1^2+1^2+2^2+1^2+1^2}} = 0.2582$

$R_{92} = \frac{1}{\sqrt{1^2+1^2+1^2+1^2+1^2+1^2+1^2+1^2+1^2}} = 0.333$

$R_{93} = \frac{1}{\sqrt{2^2+2^2+1^2+1^2+1^2+1^2+2^2+1^2+1^2}} = 0.2357$

$R_{94} = \frac{1}{\sqrt{1^2+1^2+1^2+1^2+1^2+1^2+1^2+1^2+1^2}} = 0.333$

$R_{95} = \frac{1}{\sqrt{2^2+1^2+4^2+2^2+4^2+2^2+2^2+4^2+1^2}} = 0.1231$

After performing normalization, the next step is to calculate the weighted normalized matrix. This is done by multiplying each element of the normalized matrix by the corresponding weight of each criterion.

Table 6. Weighted Normalized Matrix Data

Alternative	Age	Lactation	Number of Children	Miscarriage History	Medical Eligibility
LNG Intrauterine Contraceptive Device	7.7460	5	9.4281	5	8.6164
Copper Intrauterine Contraceptive Device	3.8730	5	9.4281	5	4.3082
Combination Pills	3.8730	5	4.7140	5	17.2328

Progestin Pills	3.8730	5	4.7140	5	8.6164
Combination Injection	3.8730	5	4.7140	5	17.2328
Progestin Injection	3.8730	5	4.7140	5	8.6164
Implant	7.7460	5	9.4281	5	8.6164
Patch/ Koyo	3.8730	5	4.7140	5	17.2328
Condom	3.8730	5	4.7140	5	4.3082

Table 6 presents the weighted normalized matrix values for each contraceptive alternative. Each of these values reflects how each alternative performs with respect to the weighted criteria, making it easier to identify the most suitable contraceptive method based on the calculated scores. This step is crucial in TOPSIS as it provides a balanced evaluation considering the relative importance of each criterion, leading towards the final ranking of alternatives. The next step is to determine the values for the positive ideal solution and the negative ideal solution.

Table 7. Positive and Negative Ideal Solution Value Data

A^+	7.7460	5	4.7140	5	4.3082
A^-	3.8730	5	9.4281	5	17.2328

The next process is to find the distance between the weighted normalized values and the negative and positive ideal solutions..

For Alternatives A1:

$$\sqrt{(7.7460-7.7460)^2+(5-5)^2+(4.7140-9.4281)^2+(5-5)^2+(4.3082-8.6164)^2}$$
D^+ = 6.3861

$$\sqrt{(7.760-3.8730)^2+(5-5)^2+(9.4281-9.4281)^2+(5-5)^2+(8.6164-17.2328)^2}$$
D^- = 9.4468

For Alternatives A2:

$$\sqrt{(7.7460-3.8730)^2+(5-5)^2+(4.7140-9.4281)^2+(5-5)^2+(4.3082-4.3082)^2}$$
D^+ = 6.1010

$$\sqrt{(3.8730-3.8730)^2+(5-5)^2+(9.4281-9.4281)^2+(5-5)^2+(4.3082-17.2328)^2}$$
D^- =12.9246

For Alternatives A3:

$$\sqrt{(7.7460-3.8730)^2+(5-5)^2+(4.7140-4.7140)^2+(5-5)^2+(4.3082-17.2328)^2}$$
D^+ = 13.4924

$$\sqrt{(3.8730-3.8730)^2+(5-5)^2+(4.7140-9.4281)^2+(5-5)^2+(17.2328-17.2328)^2}$$
D^- = 4.7140

For Alternatives A4:

$$\sqrt{(7.7460-3.8730)^2+(5-5)^2+(4.7140-4.7140)^2+(5-5)^2+(4.3082-4.3082)^2}$$
D^+ = 5.7932

$$\sqrt{(3.8730-3.8730)^2+(5-5)^2+(4.7140-9.4281)^2+(5-5)^2+(4.3082-17.2328)^2}$$
D^- =9.8216

For Alternatives A5:

$$\sqrt{(7.7460-3.8730)^2+(5-5)^2+(4.7140-4.7140)^2+(5-5)^2+(4.3082-17.2328)^2}$$
D^+ = 13.4924

$$\sqrt{(3.8730-3.8730)^2+(5-5)^2+(4.7140-9.4281)^2+(5-5)^2+(17.2328-17.2328)^2}$$
D^- =4.7140

For Alternatives A6:

$$\sqrt{(7.7460-3.8730)^2+(5-5)^2+(4.7140-4.7140)^2+(5-5)^2+(4.3082-4.3082)^2}$$
$$D^+ = 5.7932$$

$$\sqrt{(3.8730-3.8730)^2+(5-5)^2+(4.7140-9.4281)^2+(5-5)^2+(4.3082-17.2328)^2}$$
$$D^- = 9.8216$$

For Alternatives A7:

$$\sqrt{(7.7460-7.7460)^2+(5-5)^2+(4.7140-9.4281)^2+(5-5)^2+(4.3082-8.6164)^2}$$
$$D^+ = 6.3861$$

$$\sqrt{(7.760-3.8730)^2+(5-5)^2+(9.4281-9.4281)^2+(5-5)^2+(8.6164-17.2328)^2}$$
$$D^- = 9.4468$$

For Alternatives A8:

$$\sqrt{(7.7460-3.8730)^2+(5-5)^2+(4.7140-4.7140)^2+(5-5)^2+(4.3082-17.2328)^2}$$
$$D^+ = 13.4924$$

$$\sqrt{(3.8730-3.8730)^2+(5-5)^2+(4.7140-9.4281)^2+(5-5)^2+(17.2328-17.2328)^2}$$
$$D^- = 4.7140$$

For Alternatives A9:

$$\sqrt{(7.7460-3.8730)^2+(5-5)^2+(4.7140-4.7140)^2+(5-5)^2+(4.3082-4.3082)^2}$$
$$D^+ = 3.8730$$

$$\sqrt{(3.8730-3.8730)^2+(5-5)^2+(4.7140-9.4281)^2+(5-5)^2+(4.3082-17.2328)^2}$$
$$D^- = 13.7575$$

This step is done by calculating the closeness of each alternative to the ideal solution value.

$$V_1 = \frac{9.4468}{9.4468+6.3861} = 0.5967$$

$$V_2 = \frac{12.9246}{12.9246+6.1010} = 0.6793$$

$$V_3 = \frac{4.7140}{4.7140+13.4924} = 0.2589$$

$$V_4 = \frac{4.7140}{4.7140+5.7932} = 0.6290$$

$$V_5 = \frac{4.7140}{4.7140+13.4924} = 0.2589$$

$$V_6 = \frac{9.8216}{9.8216+5.7932} = 0.6290$$

$$V_7 = \frac{9.4468}{9.4468+6.3861} = 0.5967$$

$$V_8 = \frac{4.7140}{4.7140+13.4924} = 0.2589$$

$$V_9 = \frac{13.7575}{13.7575+3.8730} = 0.7803$$

Based on the calculations, the ranking of the contraceptive alternatives using the TOPSIS method is presented in Table 8 below.

Table 8. Preference Values Using TOPSIS Method

Alternative	Preference Value
Condom	0.7803
Copper Intrauterine Contraceptive Device	0.6793
Progestin Pills	0.6290
Progestin Injection	0.6290
Implant	0.5967
LNG Intrauterine Contraceptive Device	0.5967

Combination Pills	0.2589
Combination Injection	0.2589
Patch/ Koyo	0.2589

Table 8 shows the preference values calculated using the TOPSIS method for each contraceptive alternative. Kondom ranks the highest with a preference value of 0.7803, indicating it is the most suitable option among the evaluated alternatives based on the criteria considered. Alat Kontrasepsi Dalam Rahim Copper follows with a preference value of 0.6793. Pil Progestin and Suntik Progestin share the same preference value of 0.6290, making them equally ranked. Implant and Alat Kontrasepsi Dalam Rahim LNG also share the same preference value of 0.5967, placing them in the middle of the ranking. Pil Kombinasi, Suntik Kombinasi, and Koyo have the lowest preference values at 0.2589, indicating they are the least preferred options based on the analysis. These results provide a comprehensive evaluation of the contraceptive alternatives, helping healthcare providers make data-driven decisions that align with individual patient needs and the relative importance of each criterion considered in the study.

3.1.7 Validity Testing of Decision Results

Validity testing of the decision results was conducted to determine which method is the most ideal. The validity comparison was made using the recommendations directly from an expert, based on the same case study, allowing for a comparison of the results. Below are the expert's recommendations compared with the results obtained using the SAW and TOPSIS methods.

Table 9. Decision Validation

Rank	Expert Recommendation	SAW Recommendation	SAW Value (%)	Remarks	TOPSIS Recommendation	TOPSIS Value (%)	Remarks
1	Condom	Condom	92.5%	Match	Condom	78.03%	Match
2	Copper Intrauterine Contraceptive Device	Copper Intrauterine Contraceptive Device	82.5%	Match	Copper Intrauterine Contraceptive Device	67.93%	Match
3	Progestin Pills	Progestin Pills	75%	Match	Progestin Pills	62.9%	Match
4	Progestin Injection	Progestin Injection	75%	Match	Progestin Injection	62.9%	Match
5	Implant	Implant	72.5%	Match	Implant	59.67%	Match
6	LNG Intrauterine Contraceptive Device	LNG Intrauterine Contraceptive Device	72.5%	Match	LNG Intrauterine Contraceptive Device	59.67%	Match
7	Combination Pills	Combination Pills	66.25%	Match	Combination Pills	25.89%	Match
8	Combination Injection	Combination Injection	66.25%	Match	Combination Injection	25.89%	Match
9	Patch/ Koyo	Patch/ Koyo	66.25%	Match	Patch/ Koyo	25.89%	Match

Table 9 presents a comparison of the rankings from expert recommendations with those derived from the SAW and TOPSIS methods. The results show that both methods align closely with the expert's recommendations, demonstrating their validity in ranking contraceptive alternatives. The SAW method consistently provided values close to the expert's rankings, with preference values ranging from 92.5% for Kondom to 66.25% for the lower-ranked alternatives. All rankings matched the expert's recommendations, indicating that SAW is reliable for this decision-making. The TOPSIS method also matched the expert's rankings across all alternatives, though the preference values varied more significantly, with the highest being 78.03% for Kondom and the lowest at 25.89% for the alternatives at the bottom of the list. Despite the variance in percentage values, the order remained consistent with the expert's recommendations. This validation exercise confirms that both SAW and TOPSIS are effective in making decisions aligned with expert judgment, although SAW demonstrates slightly closer value ranges to expert recommendations. Both methods can be considered reliable tools for aiding decision-making in contraceptive selection, providing a structured approach to evaluating alternatives based on multiple criteria.

3.2 Discussion

The table above outlines the validity testing results by comparing expert recommendations with outcomes derived from two decision-making methods: Simple Additive Weighting (SAW) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS). This comparison aims to identify which method is more effective in selecting the optimal contraceptive method. According to expert recommendations, the nine contraceptive methods are ranked with condoms at the top, followed by copper intrauterine devices (IUD Copper), progestin pills, progestin injections, implants, LNG IUDs, combination pills, combination injections, and patches. The SAW method produced recommendations that were fully aligned with those of the experts, achieving high consistency with percentage values ranging from 66.25% to 92.5%. This alignment indicates that the SAW method accurately mirrors expert recommendations, providing results that are closer to the ideal expert judgment. On the other hand, the TOPSIS method also yielded rankings consistent with the experts, but with lower percentage values ranging from 25.89% to 78.03%. Although these values were lower, the rankings still matched the expert recommendations, suggesting that while TOPSIS is valid, it may not be as precise as SAW for this application. The analysis suggests that the SAW method is preferable for decision-making in contraceptive method selection due to its ability to produce results that are more closely aligned with expert evaluations. The consistency and higher percentage values in the SAW results suggest it is better suited to reflect the expert's preferred choices, thereby supporting more accurate and effective decision-making. The findings have significant implications. Firstly, employing the SAW method in the selection of contraceptive methods can improve the accuracy and reliability of decisions made by healthcare providers, such as midwives. Secondly, integrating a web-based system that uses SAW can facilitate the selection process, ensuring decisions are more aligned with the specific needs and conditions of patients.

However, this study has certain limitations. The data used was restricted to interviews with experts from Klinik Zahra Harapan Bunda, which may limit the applicability of the results to other settings. Additionally, the study only compared the SAW and TOPSIS methods, without exploring other MCDM methods that could also be relevant. For future research, expanding data collection to include more experts from a variety of clinics and hospitals would be beneficial. Furthermore, exploring other MCDM methods, such as the Analytic Hierarchy Process (AHP) or ELECTRE, could provide additional insights and determine if there are more effective methods for this context. Including sensitivity analysis in future studies could also help to assess how variations in criterion weights might influence the outcomes of the recommendations.

4. Related Work

Research on the selection of contraceptive methods using multi-criteria decision-making (MCDM) techniques has advanced significantly in recent years. Among the prominent methods, Simple Additive Weighting (SAW) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) are frequently employed in this context. Ginting *et al*. (2020) demonstrated that the SAW method effectively provides optimal decisions by considering various criteria, such as effectiveness, cost, and convenience [16]. This finding is consistent with an earlier study by Nurcahyo *et al*. (2019), which concluded that the SAW method can accurately reflect user preferences in the selection of contraceptive methods [17]. These studies highlight the SAW method's capability in providing clear and user-aligned recommendations for contraceptive choices. Similarly, TOPSIS has been widely applied in studies focusing on contraceptive method selection. Kurniawan *et al*. (2021) found that TOPSIS effectively identifies the best solution by evaluating the relative proximity of each alternative to the ideal solution [18]. They reported that TOPSIS produces robust and consistent results in medical decision-making contexts, including the selection of contraceptive methods. This robustness is further supported by Prasetyo *et al*. (2022), who indicated that TOPSIS aids in optimizing choices based on multifaceted criteria commonly encountered in contraceptive selection [19]. These findings underscore the utility of TOPSIS in providing structured and reliable decision support in healthcare settings.

Furthermore, studies have explored the potential benefits of combining SAW and TOPSIS to enhance decision accuracy and robustness. Wibowo *et al*. (2021) revealed that the integration of SAW and TOPSIS yields more comprehensive and informative outcomes in complex decision-making scenarios, including contraceptive method selection [20]. This combined approach addresses the limitations of using a single method and allows for a more nuanced evaluation of alternatives. The present study aligns with these previous findings by applying both SAW and TOPSIS to assess their effectiveness in contraceptive method selection. By comparing these two methods, this research adds value to the existing literature by providing a detailed comparative analysis, highlighting each method's strengths and weaknesses in a clinical contraceptive selection context. This study confirms that both SAW and TOPSIS are effective tools, consistent with prior research;

however, it extends the knowledge base by offering a direct application and comparison within a clinical setting, thus providing practical insights into their relative performance and suitability for decision-making in family planning clinics.

5. Conclusion and Recommendations

This study concludes that the Simple Additive Weighting (SAW) method is more effective for decision-making in selecting contraceptive methods compared to the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS). The validation results indicate that SAW provides outcomes that are more consistent and closely aligned with expert recommendations, showing higher percentages of agreement. Therefore, to achieve accurate and expert-guided decisions, the SAW method is preferred. Based on these findings, clinics and decision-makers involved in contraceptive method selection are advised to use the SAW method in their decision-making processes. This method not only delivers more reliable results but also aligns more closely with expert recommendations, thereby enhancing satisfaction and success in contraceptive programs. By using SAW, healthcare providers can make decisions that are better aligned with individual needs and are more likely to yield successful outcomes.

For future research, it is recommended that the application and testing of the SAW method be extended to a wider scope, incorporating additional variables that may influence decisions on contraceptive method selection. Variables that could be included are users' health conditions, individual preferences, and economic and social factors. Further research could also investigate the integration of SAW with digital technologies to enhance and simplify decision-making processes in practical settings. This approach could improve the efficiency of decision-making and equip healthcare providers with tools that support evidence-based recommendations, ultimately contributing to more effective family planning initiatives.

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