

An Analysis of SAW Modelling Results and TOPSIS As a Recommendation for Toddlers' Health Recovery at Mother and Children Health Care Center

Rina Fiati¹
{rina.fiati@umk.ac.id¹}

Informatics Engineering, Faculty of Engineering, Universitas Muria Kudus, Gondangmanis, PO Box 53, Bae, Kudus 59352¹

Abstract. The purpose of research is to provide information to health workers of Mother and Children Health Care Center about the types and characteristics of the appropriate infants' food supplementary products and giving that supplementary food. Data testing is done by comparing two methods of SAW and TOPSIS with fuzzy multi attribute decision making approach. The criteria include toddler age, nutrient status, parents' income, number of children, electricity bill, breastfeeding, dental examination, physical examination and mother assessment. The test results of both modeling are used as a recommendation in giving supplementary food for toddlers' health recovery. Giving supplementary food (Supplementary feeding) is given to nutrient-prone groups that include underweight children of 6-59 months old who are based on the results of body weight measurement according to Length/Body Height, smaller than minus two Standard Deviation ($<-2Sd$). The testing by using SAW method, the obtained value was 0.84; meanwhile the one which used TOPSIS method, the obtained value was 0.67; therefore the difference of test results of both methods showed a significant difference.

Keywords: toddler, nutrition, SAW, TOPSIS, standard deviation, decision.

1 Introduction

In order to provide healthy food and accelerate nutrient improvement in relation to the implementation of Healthy Living Society Activity (Gernas), giving supplementary food (MT) is an effort that can be done in line with other gernas activities. A good nutrient status is one of the determinants of the health development success which is basically as an integral part of National development as a whole. Toddlers, school-aged children, and pregnant women are vulnerable groups who really need special attention because of the negative impacts if they are suffered from malnutrition. The growth and development disorders in infants and children under 2 years (*baduta*) is a problem that needs to be addressed seriously. Under the age of two year children is a very important period as well as a critical period in the growth and development process either physically or intelligently. Being thin and stunting at school age will have an impact on the learning performance at school, which will also influence on Human Resource quality. According to the Decree of Indonesian Health Minister No. 899 / Menkes / SK / X / 2009 concerning with Technical Specification of Supplementary Food for Toddlers 2-5 Years, Primary School Children and Pregnant Women. and Regulation of Indonesian Health Minister No. 41 of 2014 about Balanced Nutrient Guideline (PGS) it is

ICCSET 2018, October 25-26, Kudus, Indonesia

Copyright © 2018 EAI

DOI 10.4108/eai.24-10-2018.2280619

stated that Pregnant women who have chronic energy deficiency status (KEK) can have an impact on the growth and health of their babies. In this case, giving supplementary food is given to nutrient-prone groups that include underweight children of 6-59 months old and primary school children who have underweight category, they are toddler and school aged children who are based on the results of body weight measurement according to Length / Body Height, they are smaller than minus two Standard Deviation (<-2 Sd), and pregnant women with chronic energy deficiency (KEK) are pregnant women with measurements of upper arm circumference (LiLA) is smaller than 23.5 cm. Therefore, giving supplementary food is focused on both macronutrients and micronutrients for infants [1]. The role of "POSYANDU" cadres in giving recommendation of supplementary food to nutrient-prone groups basically is to increase nutrient intake which ultimately can improve the nutrient status of the target. Participation of all parties is expected to support the success of MT activities to the target so that an appropriate decision making is required. One of the roles that is a *decision support system*, an interactive computer-based system which helps decision makers to make use of data and modelling [2]. The decision making matter, is basically a form of selection from various alternative actions that might be chosen in which its process done through a particular mechanism so that it can produce the best decision. The word "decision" means a choice, that is the choice of two or more possibilities. In relation to the process, "decision" means the final state of a more dynamic process that is known as *decision-making*. The decision is seen as a process because it consists of a series of related activities and is not only considered as a wise act [3]. In this research, the model of SAW (Simple Additive Weighting Method) and Topsis (Technique for Others Reference by Similarity to Ideal Solution) were selected as a problem solving in supplementary feeding for infants' health recovery. The purpose of this research is to provide information to health workers at POSYANDU and related parties about the types and characteristics of the appropriate infants' food supplementary products and giving that supplementary food (MT) to the target. Based on the above background the researcher intends to conduct research testing for the provision of nutritional supplements which can be used as a recommendation by POSYANDU in providing infants' health recovery.

2 Methodology

2.1 Data collecting method

To obtain the data completely and accurately, it is required cooperation with the concerned parties; therefore the steps taken to collect data are as the followings:

- a) Literature review
This method is done by obtaining data from various literatures, related to the problems and the information needed.
- b) Observation and interview
This method is done by doing observation and conducting interview to related parties that is with *Posyandu* Cadres, *Puskesmas* (*public health center*), Nutritionist.

2.2 Testing model

2.2.1 SAW Method (Simple Additive Weighting Method)

The SAW method or weighted summing method is a method to find weighted adding/sum of each alternative performance of all attributes. This method requires the decision matrix normalization process (X) to a comparable scale to all existing alternative ratings. Simple Additive Weighting (SAW) is a method that uses weighted sum method. The Simple Additive Weighting (SAW) method is often used to overcome the problem in a Multiple Attribute Decision Making (MADM) situation in which MADM is a method used to find the optimal alternative from various number of alternatives completed with certain criteria [4].

$$\begin{cases} \frac{x_{ij}}{\max x_{ij}} & \text{if } j \text{ is a benefit attribute} \\ & \text{(benefit)} \\ \frac{\min x_{ij}}{x_{ij}} & \text{if } j \text{ is the cost attribute (cost)} \end{cases} \quad (1)$$

Where r_{ij} is the normalized performance rating of the alternative A_i on the attribute C_j ; $i = 1, 2, \dots, m$ and $j = 1, 2, \dots, n$. The preference value for each alternative (V_i) is given as follows:

$$V_i = \sum_{j=1}^n w_j r_{ij}$$

A larger value of V_i indicates that alternative A_i is more chosen (selected). Simple Additive Weighting (SAW) method requires the process of normalizing the decision matrix (X) to a scale that can be compared to all existing alternative ratings

$$R_{ij} = \dots \dots \dots \quad (2)$$

Information :

R_{ij} : The normalized performance rating of alternative (i) on the attribute criterion (j); Where $i = 1, 2, 3, \dots$ etc. and $j = 1, 2, 3, \dots$ etc.

R: Average normalized performance.

i: Alternative, that is data of toddlers/infants.

j: Criteria used.

X_{ij} : Weight value on criteria.

Max X_{ij} : The largest weight of the criteria at each alternative used in the calculation of normalization.

The next step is looking for the preference value (V) to determine the final process in a calculation of Simple Additive Weighting (SAW) method.

Here's the formula for finding the preference value:

$$V_i = \sum W_j R_{ij} \dots \dots \dots \quad (3)$$

Information :

V_i : The preference value for each alternative (i).

V : Preference value.

W_j : The percentage weight assigned to each criterion (j).

W : Percentage weight.

R_{ij} : The normalized performance rating of the alternative (i) on the attribute.

Where $i = 1,2,3, \dots$ etc. and $j = 1,2,3, \dots$ etc.

R : The performance rating is normalized

2.2.2 TOPSIS Method

TOPSIS is a multicriteria method for identifying a limited alternatives collection which is based on minimizing the distance of the farthest ideal point and maximizing the distance of the lowest ideal point. The TOPSIS method is chosen because of the absence of the quantitative method used to evaluate credit quality, from the experimental analysis verifying that the proposed credit indicator system quality is reliable and TOPSIS is suitable for credit quality evaluation [5]. The steps of the Topsis method are as follows :

- a. Creating a normalized decision matrix
- b. Creating a normalized weighted decision matrix
- c. Determining the positive ideal solution matrix and negative ideal solution matrix
- d. Determining the distance between the value of each alternative with the positive ideal solution matrix and the negative ideal solution matrix
- e. Specifying the preference value for each alternative

TOPSIS requires a work rating of each alternative A_i on each of the normalized C_j criteria.

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^m x_{ij}^2}} \quad (4)$$

with $i = 1,2, \dots, m$; and $j = 1,2, \dots, n$

Where :

r_{ij} = normalized matrix [i] [j]

x_{ij} = decision matrix [i] [j]

The ideal positif solution A^+ and the ideal negative solution A^- can be determined based on the normalized weighted rating (y_{ij}) as:

$$y_{ij} = w_i \cdot r_{ij}; \text{ with } i=1,2,\dots,m; \text{ with } j=1,2,\dots,n$$

$$A^+ = (y_1^+, y_2^+, \dots, y_n^+);$$

$$A^- = (y_1^-, y_2^-, \dots, y_n^-);$$

In which:

y_{ij} = normalized weighted matrix [i] [j]

w_i = the weight vector [i] of the AHP process

y_j^+ = max y_{ij} , if j is a benefit attribute , while min y_{ij} , if j is a cost attribute

y_j^- = min y_{ij} , if j is a benefit attribute, while max y_{ij} , if j is a cost attribute

$j = 1,2, \dots, n$

The distance between A_i alternative with an ideal positive solution:

$$D_i^+ = \sqrt{\sum_{j=1}^n (y_i^+ - y_{ij})^2} ; \quad i=1,2,\dots,m \quad (5)$$

In which :

At + = Alternative distance Ai with ideal positive solution

yi + = ideal positive solution [i]

yij = weighted normalized matrix [i] [j]

The distance between Ai alternative with an ideal negative solution:

$$D_i^- = \sqrt{\sum_{j=1}^n (y_{ij} - y_i^-)^2} ; \quad i=1,2,\dots,m \quad (6)$$

In which :

Di- = alternative distance Ai with ideal negative solution

yi- = ideal positive solution [i]

yij = weighted normalized matrix [i] [j]

The preference value for each alternative (Vi) can be seen in the formula (2.11).

$$V_i = \frac{D_i^-}{D_i^- + D_i^+} ; \quad i=1,2,\dots,m \quad (7)$$

In which :

Vi = proximity of each alternative to the ideal solution

At + = Alternative distance Ai with ideal positive solution

Di- = alternative distance Ai with ideal negative solution

Greater Vi values show

$$A^+ = (y_1^+, y_2^+, \dots \dots \dots y_n^+)$$

$$A^- = (y_1^-, y_2^-, \dots \dots \dots y_n^-)$$

+ that alternative Ai is preferred (more chosen)

3 Results and Discussion

Nutrient supplementation is adding food or nutrient which is given in the form of ; a) supplementary food, b) blood added tablets c) vitamin A capsules, and d) nutrient powder which aims to meet toddlers' nutritional adequacy . Toddlers are the most vulnerable age to malnutrition. Malnutrition can occur from mild to severe levels and it occur slowly over long periods of time. Nutritional status which exists in society/community describes the level of health which is caused by the balance between the needs and nutrient intake consumed by someone[6]. Recovery Supplementary Food is nutrient supplementation in the form of supplementary food with special formulations and it is fortified with vitamins and minerals given to the target groups as an additional food for nutrient status recovery. Giving

supplementary food to the target needs to be done correctly according to the recommended consumption rules. Inadequate food supplementation, inappropriate to consumption rules, will be ineffective dealing with nutrient status recovery and may cause nutritional problems.

Additional foods are given as:

- a. Additional Foods Counseling is an additional food given to prevent the occurrence of nutritional problems.
- b. Supplemental Food Recovery is an additional food given to overcome the nutritional problems given during the 90 days of eating.
- c. The process analysis model of SAW and TOPSIS testing is done so that maternal and child health services in providing supplementary food for health recovery of toddler from according to requirement or benefit of user. Activities of finding or identifying problems, evaluating, modeling and determining the type of supplementary food for toddlers are more appropriate.

3.1 Decision variables/criteria

Variables / criteria used as model of counting / testing in giving recommendation of toddler health education at maternal and child health services, among others:

- a. Toddler data include: age 6 - 59 months, weight by age (BB/U), height by age (TB/U) and Weight by Body height (BB/TB)
- b. Nutrition Status of Toddlers
- c. Parent Income
- d. Number of Children
- e. Electricity Bill
- f. Breastfeeding
- g. Dental examination
- h. Physical examination
- i. Mother's assessment

3.2. Analysis of data testing in toddlers

In this study the sample used was five infants, with the assessment: (1) very less [value less than 60]; (2) less [value between 61-70]; (3) sufficient [value between 71-80]; (4) Good [value is more than 80].

Table 1. Toddler Data.

TODDLER DATA		
NO	INITIALIZATION Toddler	NAME
1	A1	Toddler 1
2	A2	Toddler 2
3	A3	Toddler 3
4	A4	Toddler 4
5	A5	Toddler 5

Table 2. Criteria.

CRITERIA	INITIALIZATION
	Criteria
Toddler data	C1
Nutrition Status	C2
Parent Income	C3
Number of Children	C4
Electricity Bill	C5
Breastfeeding	C6
Dental examination	C7
Physical examination	C8
Mother's assessment	C9

Table 3. Data weight value for Toddlers.

	Parameter	weight
Toddler data	6-59 bl	1
	<=BB/U normal	2
	<=TB/U normal	3
	Normal	4

Table 4. Weight value of Nutritional status.

	Parameter	weight
Nutrition Status	Less	1
	normal	3
	over	4

Table 5. Weight value of Parent Income.

Criteria	Parameter	weight
Income	<=5k	1
	<=1m	2
	1-2m	3

Table 6. Weight value of Number of child dependents.

Criteria	Parameter	weight
Number of Children	1	1
	2	2
	3	3
	>=4	4

Table 7. Weight value of Electricity Bill.

Criteria	Parameter	weight
Electricity bill	<50000	1
	50k s/d <100k	2
	100k s/d <250k	3
	>250k	4

Table 8. Weight rating for breastfeeding.

Criteria	Parameter	weight
Breastfeeding	Not drinking ASI	2
	s/d age 4 months	3
	s/d age 6 months	4

Table 9. Weight value of Dental Examination.

Criteria	Parameter	weight
Dental Examination	Number of teeth available	4
	Number of teeth missing	1
	Karios teeth exist	4
	No dental carios	1

Table 10. Weight value of Physical Examination.

Criteria	Parameter	Information	weight
Physical examination	Skin, fingers, sight	bad	2
		sufficient	3
		healthy	4

Table 11. Weight Value of Mother's assessment.

Criteria	Parameter	Information	weight
Mother's assessment	KIA Book	none	2
		sketchy	3
		complete	4

The following results of data calculation by SAW and Topsis method obtained the following values:

Table 12. Topsis counting results with ideal solution alternative distance (+) and (-).

A+	0.1060	0.1511	0.0344	0.0256	0.0288	0.0986	0.1014	0.09	0.0273
A-	0.0530	0.0377	0.01147	0.0128	0.0096	0.0986	0.1014	0.09	0.0273
	D+	D-							
	0.117277	0.054557							
	0.127787	0.011558							
	0.125548	0.027979							
	0.066126	0.079876							
	0.05575	0.115582							
	V	Result							
	0.317497642	Toddler 1							
	0.082941988	Toddler 2							
	0.182243615	Toddler 3							
	0.54708821	Toddler 4							
	0.674609222	Toddler 5							

4 Conclusion

Supplementary feeding to nutrient-prone groups is basically aimed at increasing nutrient intake that can ultimately improve target nutritional status. The participation of all parties is highly expected in supporting the success of the MT giving activities to the target. In additional feeding activities accompanied by community nutrition counseling and education activities to provide an understanding of the importance of nutrition for health and efforts that can be done in order to prevent and overcome nutrition problems that occur in the community as part of human resource development.

1. Some conclusions can be drawn based on the results and discussion as follows:
The main target of MT's toddler is underweight children aged 6-59 months with an indicator of body weight (BB) according to body length (PB) / height (TB) less than minus 2 standard deviations (<- 2 SD) who are not hospitalized and not outpatient.
2. Supplemental Food Recovery is an additional food given to overcome the nutritional problems given during 90 days of eating.
3. Government efforts to improve the welfare and health of underprivileged families.

References

- [1] Kementerian Kesehatan RI, Buku Petunjuk Teknik PMT. 2017.
- [2] F. Rina and dkk, "Cloud Computing Security," Semin. Nas. ilmu Komput., vol. 1, pp. 137–141, 2013.
- [3] E. Turban, J. E. Aronson, and T. P. Liang, Decision Support System and Intelligence System Ed. 7. Prentice-Hall, 2005.
- [4] S. Kusumadewi, S. Hartati, A. Harjoko, and R. Wardoyo, Fuzzy Multi- Attribute Decision Making (FUZZY MADM). Yogyakarta: Graha Ilmu, 2006.

- [5] F. Rina and dkk, "Penentuan Prioritas Produk Kerajinan yang Berpotensi Menjadi Produk Unggulan Menggunakan Pemodelan Technique For Others Reference by Similarity to Ideal Solution (TOPSIS)," 2017.
- [6] Wildani A.H and dkk, Pemetaan daerah tertinggal untuk mengidentifikasi status gizi pada anak berdasarkan psikologi keluarga. Program studi Teknik Informatika Fakultas Teknik Universitas Muria Kudus, 2017.