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E-MONITORING THE VULNERABILITY OF MALNUTRITION OF CHILDREN USING THE TOPSIS METHOD.

SRI NURHAYATI[1,*], RIANI LUBIS[2]

[1]Department of Computer System, Universitas Komputer Indonesia, Bandung, Indonesia
[2]Department of Informatics Engineering, Universitas Komputer Indonesia, Bandung, Indonesia
*Corresponding Author: sri.nurhayati@email.unikom.ac.id

Abstract

A health problem that needs to be addressed by national and international authorities is the issue of children's nutritional status. In Indonesia, this problem needs serious attention from the government and the wider community. This study aims to design a monitoring model for the vulnerability of malnutrition to be used by stakeholders in overcoming malnutrition by reducing the causes. The impact that occurs due to malnutrition in children resulted in stunted growth. Therefore, information is needed to find out what are the causes of malnutrition so that it is easier to solve this problem by suppressing the factors that cause malnutrition. In this study, the method used to determine the causes of malnutrition[vulnerability was the Topsis method by analysing the factors of malnutrition which include nutritional intake, infectious diseases, childcare patterns, household food availability, sanitation, and poverty. The results of this study were in the form of a monitoring model to determine malnutrition in children so that it can assist stakeholders in overcoming malnutrition by suppressing the factors that cause malnutrition.

Keywords: Child's nutritional status, Fuzzy topsis, Malnutrition factors.

1. Introduction

The rapid development of information technology has a big impact on all aspects of life, including the health aspect. The application of information technology can help in providing information on health fulfilment services, one of which is the nutritional status of children [1, 2]. Integrated Healthcare Center is a form of Community-Based Health Efforts, assisted by health workers to provide basic public health services with a focus on mothers and children, one of the services is to record the nutritional status of each child. Children's nutrition is an important thing that must be considered by parents and the government. Fulfilment of nutrition in children under five years old is a factor that needs attention in maintaining health, development, and growth in children. Malnutrition can be prevented if the root of the problem in the community concerned can be identified. The handling of the problem can be done fundamentally through handling the root of the problem [3-5]. Each region has a very important role in considering what factors are the causes of malnutrition.

Research on malnutrition in Indonesia has been carried out by looking at the factors that cause it. Research on malnutrition has been carried out by controlling for a comprehensive range of socio-economic factors, suggesting that maternal education, water and sanitation conditions, household poverty and access to health services strongly influence chronic malnutrition among children in Indonesia [6]. In addition, there are studies which showed that early malnutrition diagnosis should enhance nutritional support, delay disease progression, and improve child survival [3, 7]. It is highly recommended to monitor the nutritional status and see the factors that cause it so that the child's growth and development can be controlled.

This study aims to design a model of e-monitoring system for malnutrition vulnerability that is used by interested parties to solve malnutrition by reducing the causes. The method used to determine the factors causing malnutrition in each Integrated Healthcare Center is the Topsis method. Some factors cause the vulnerability of malnutrition in children, these factors must always be monitored so that prevention efforts can be done well and accurate. Based on previous research, the factors that were determined by the United Nations are nutritional intake, infectious diseases, childcare patterns, household food availability, sanitation, and poverty [8, 9].

Based on these problems, a model for monitoring the vulnerability of malnutrition in children was made that can help stakeholders (health workers) in overcoming malnutrition by suppressing the factors that cause malnutrition.

2. Research Method

The first stage in this research is to identify the object of research used namely alternative data (Integrated Health Center) and the criteria data which are the factors that cause malnutrition. The alternative data used are data from six Integrated Health Centers in Bandung Regency, while the evaluation criteria for each Integrated Health Center are nutrition intake, infectious diseases, childcare patterns, household food availability, sanitation, and poverty [10, 11]. Table 1 shows each value of the criteria for the malnutrition causes, while Table 2 shows the value of the criteria in each alternative.

In this study, Topsis method was used to determine the malnutrition vulnerability in children. This method used a principle that the chosen alternative must have the shortest distance to the positive ideal solution and the furthest from the negative ideal solution from a geometric perspective using Euclidean. The Euclidean distance used to determine the relative proximity of an alternative to the optimal solution [12, 13]. The flow chart of the calculation process using the Topsis method is shown in Fig. 1.

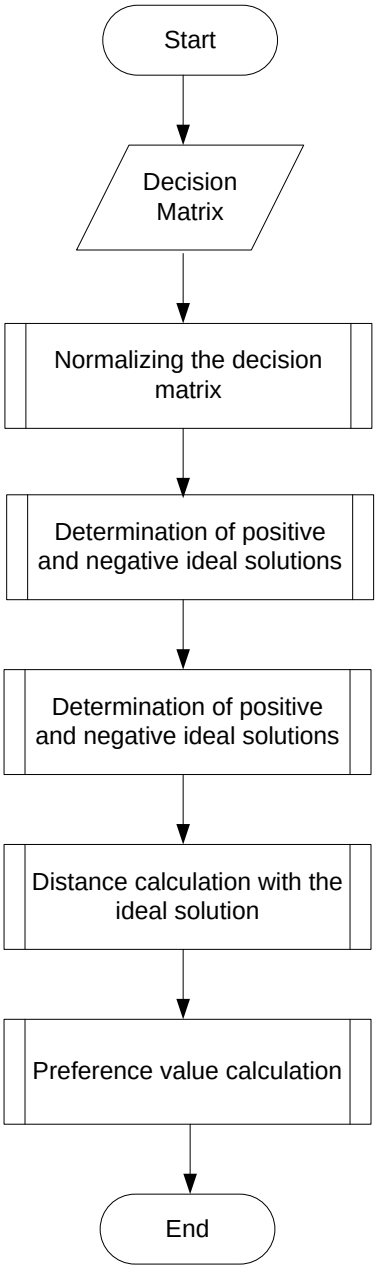

Fig. 1. Stages of calculation using Topsis.

Table 1. Criteria data.

Criteria	Criteria Name	Weight
K1	Nutrition Intake	5
K2	Infectious diseases	2
K3	Sanitation	2
K4	Childcare	3
K5	Food availability	4
K6	Poverty	4
K7	Education	5

Table 2 Alternative values of all criteria.

Alternative	Criteria						
	K1	**K2**	**K3**	**K4**	**K5**	**K6**	**K7**
A1	3	3	3	3	5	5	5
A2	4	5	5	2	3	4	5
A3	4	4	5	3	3	4	4
A4	5	3	4	2	4	2	4
A5	4	4	3	5	4	2	4
A6	3	4	3	4	4	2	4

The explanation of the steps in Fig. 1 is as follows:

- Matrix of Decisions

  This matrix refers to the number of alternatives (*m*) that will be evaluated based on criteria (*n*).
- Normalization of the decision matrix

After making a decision matrix following the problem to be solved, the next step is to normalize the matrix obtained using equation 1.

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

where r_{ij} is the normalized matrix of the basic matrix of the problem, with $i = 1, 2, 3, ... m$, and $j = 1, 2, 3 ... n$. Whereas x_{ij} is the basic matrix that will be normalized. For each, i denotes the row of the matrix, and for each j denotes the column of each matrix.

- Normalized weighting matrix

Normalization of the r_{ij} matrix uses a weight rating so that a normal weight rating matrix is obtained. Equation 2 is used to obtain the weight rating matrix.

$$y_{ij} = w_i.r_{ij} \quad (2)$$

where y_{ij} is the weighted rating matrix, w_i is the weight of the i rating, and r_{ij} is the normalized matrix in step two. For $i = 1, 2, ..., m$, and $j = 1, 2, ..., n$. In this case, the rating weight must be determined based on the number of decision variables being resolved.

- Determination of a positive ideal solution (A+) and a negative ideal solution (A-)

The determination was based on the weighted rank matrix value in step 3. Equations 3 and 4 are used to find the value of a positive ideal solution and the value of a negative ideal solution

$$A^+ = (y_1^+, y_2^+, \ldots, y_n^+) \quad (3)$$

$$A^- = (y_1^-, y_2^-, \ldots, y_n^-) \quad (4)$$

where :

$$y_i^+ = \begin{cases} \max\ y_{ij} : if\ j\ is\ the\ profit\ attribute \\ \max\ y_{ij} : if\ j\ is\ the\ cost\ attribute \end{cases}$$

$$y_i^- = \begin{cases} \max\ y_{ij} : if\ j\ is\ the\ cost\ attribute \\ \max\ y_{ij} : if\ j\ is\ the\ profit\ attribute \end{cases}$$

- Determination of the distance between the weighted values

The weighted values of each alternative to the positive and the negative ideal solution were calculated. Equation 5 is used to determine the distance between the weighted values of each alternative to the positive ideal solution.

$$D_i^+ = \sqrt{\sum_{i=1}^{n}\left(y_i^+ - y_{ij}\right)^2} \quad (5)$$

Equation (6) is used to calculate the distance between the weighted values of each alternative to the negative ideal solution.

$$D_i^- = \sqrt{\sum_{i=1}^{n}\left(y_{ij} - y_i^-\right)^2} \quad (6)$$

- Preference value calculation

The final step is to calculate the preference value for each alternative using Eq. (7).

$$V_i = \frac{D_i^-}{D_i^- - D_i^+} \quad (7)$$

3. Results and Discussion

We discuss the results of research**,** namely the results of the calculation of malnutrition vulnerability (part A), and the model of monitoring vulnerability to malnutrition (part B).

3.1 Malnutrition vulnerability calculation (part A)

This section discusses the results of Topsis method calculation of the malnutrition vulnerability. Following the method, each stage of the analysis was carried out according to the Topsis stage. The final result which is the determination of malnutrition vulnerability in each Alternative (Integrated Healthcare Center) in an area, it is shown in Table 3.

Table 3 shows that each Integrated Healthcare Center has a preference value that becomes a reference for stakeholders to monitor which Integrated Healthcare Center are considered vulnerable to malnutrition. From Table 3**,** it is proven that the A1 Integrated Healthcare Center has the highest-ranking (the vulnerability to malnutrition is high compared to other Integrated Healthcare Center). It indicates that the A1 Integrated Healthcare Center needs more attention from stakeholders regarding its malnutrition status.

In addition, the calculation results of the Topsis method also showed the value of malnutrition vulnerability causes in each Integrated Healthcare Center. Table 4 shows the results of information analysis on the malnutrition causes in each Integrated Healthcare Center.

Table 3. Result of malnutrition vulnerability in every alternative.

Alternative	Preference Value
A1	0,556
A2	0,462
A3	0,454
A4	0,367
A5	0,430
A6	0,304

Based on Table 3, it is concluded that A1 and A5 alternatives have the highest preference value, meaning that the alternative (Integrated Healthcare Center) has a high susceptibility to malnutrition compared to other alternatives. From these results, the stakeholders (health workers) prioritize counselling that is firstly conducted at Integrated Healthcare Center A1 and A5. Based on Table 4, stakeholders can see the factors that cause malnutrition in A1 and A2. The factor that causes malnutrition in A1 is K6 (poverty), this factor is used as material for counselling by health officer.

Table 4 Factors that potentially cause malnutrition in each alternative.

Alternative	Factors affecting bad nutrition	Total
A1	Poverty	60%
A2	Infectious diseases	52%
A3	Sanitation	52%
A4	Nutrition Intake	52%
A5	Childcare	61%
A6	Childcare	49%

In Indonesia, the cost required to prevent child malnutrition based on Baltusen calculations is Rp 52.66 billion per year. Poor nutritional status in children will cause the loss of very high economic potential [14]. By monitoring the vulnerability to malnutrition, factors that cause malnutrition will be identified. Therefore, preventive measures can focus on the cause to minimize the cost of handling malnutrition.

3.2 Malnutrition vulnerability monitoring model (part B)

Nutrition vulnerability e-monitoring is used by Integrated Healthcare Center officers and stakeholders (health workers) in each region. It is used to monitor the malnutrition vulnerability in every Integrated Healthcare Center in an area and the causes of malnutrition. The e-monitoring model is shown in Fig. 2.

Topsis method is used to calculate the vulnerability of malnutrition and determine the cause. The data used is the criterion value of each factors causing malnutrition including nutritional supplies, infectious diseases, childcare, household availability, sanitation, education, and poverty. Those involved in the system consist of Integrated Healthcare Center officer and health officer. Integrated Healthcare Center officers are assigned to process the criteria for factors causing malnutrition and will get information from the data processing. Health workers get information about the order of malnutrition vulnerability in each Integrated Healthcare Center and provide the factors causing it. This information is used to prioritize Integrated Healthcare Center to be given counselling, where the type of extension is adjusted to the cause.

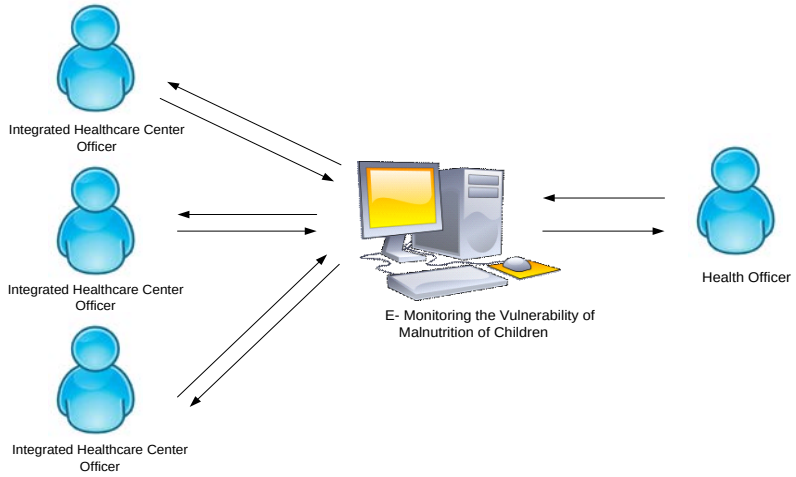

Fig. 2. E-monitoring model of malnutrition vulnerability.

The malnutrition vulnerability e-monitoring system has provided information to stakeholders (health officer) about the vulnerability of malnutrition in each Integrated Healthcare Center and its causes. The functional design of the malnutrition vulnerability e-monitoring system is shown in Fig. 3. It shows that system users are Integrated Healthcare Center officers and stakeholders (health workers). The activity for users in the e-monitoring system is shown in Table 5. It shows a description of each activity carried out by system users, starting from the system entry stage (login), the process of calculating the vulnerability of malnutrition at each Integrated Healthcare Center, and get information.

Table 5. Use case description.

Use case	Description
Login	The process carried out by the user to enter the system
Processing of child nutrition data	The process carried out by Integrated Healthcare Center officers to process data on causes of child malnutrition (criteria data) in each Integrated Healthcare Center
Monitoring of counselling materials	The process is carried out by Integrated Healthcare Center staff to see counselling material that will be obtained from health workers related to the causes of malnutrition in children.
Calculate vulnerability of child malnutrition	The process carried out by the system to calculate the vulnerability of Malnutrition in each Integrated Healthcare Center and to determine the cause of malnutrition using the Topsis method
Monitoring about malnutrition vulnerability and its causes	The process carried out by health workers to monitor the vulnerability of malnutrition of children in each Integrated Healthcare Center and the factors causing this malnutrition

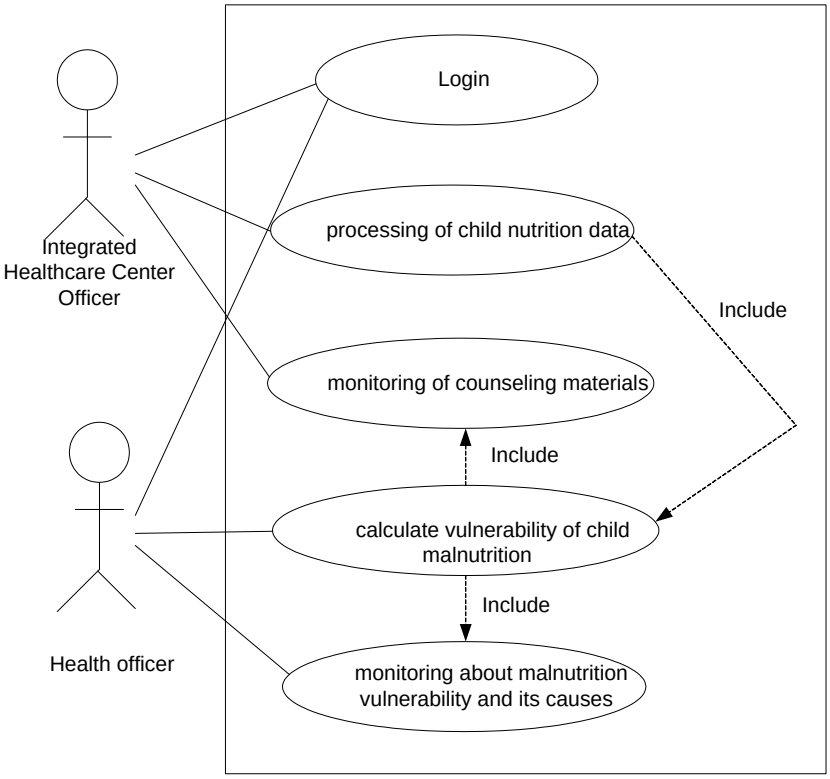

Fig. 3. Use case e-monitoring.

This e-monitoring system model can be developed in Indonesia to monitor the vulnerability of malnutrition in each Integrated Healthcare Center. Compared to the system from previous studies which only looked at the causes of malnutrition [6], the model in this study not only informs the causes of malnutrition but can also be used to monitor which Integrated Healthcare Center need to consider nutritional vulnerability. Therefore, it can overcome the problem of malnutrition by reducing factors cause.

4. Conclusion

The vulnerability of malnutrition in children is a problem that must be considered by the government. Manual malnutrition vulnerability monitoring can be carried out more effectively through e-monitoring so that malnutrition problems that arise in an area can be immediately addressed. This e-monitoring model can help stakeholders (health workers) in dealing with malnutrition by looking at the causative factors of malnutrition.

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