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# Implementation of simple additive weighting (SAW) in determining nutrition in toddlers

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ABSTRACT

The stunting or malnutrition in toddlers are the main problems facing society today [1]. Also, the fact that these young children experience lack of adequate nourishment in Indonesia is quite indisputable. Handling nutritional problems is closely related to the strategy of a nation to create healthy, intelligent and productive human resources. Efforts to improve quality human resources begin with how to manage children's growth as part of a family with good nutrition and care For this reason, this study takes part in supporting the alleviation of cases of malnutrition by using the Simple Additive Weighting (SAW) Method which is used to find the optimal alternative from a number of alternative criteria. The basic concept of SAW is to find the weighted sum of the performance ratings for each alternative across all attributes [2]. The SAW method requires a decision matrix normalization process (X) to a scale that can be compared with all alternative ratings [3]. The SAW method recognizes 2 attributes, namely the benefit criteria and the cost criteria. The method used was Simple Additive Weighting (SAW) which consists of 2 criteria, namely Height (TB) and Weight (BW) according to age for toddlers. The calculation accuracy of this application is 90% of the tested data.



## 1. Introduction

Health is an important foundation for building good human resources so that good human resources can build a country. One of the factors that affect a person's health is nutrition. For children who are still growing, especially toddlers, special attention is needed related to nutrition problems, especially from the government. Based on the 2017 Nutrition Status Monitoring (PSG) conducted by the Ministry of Health, infants under five years of age (toddlers) who experienced nutritional problems in 2017 reached 17.8%, the same as the previous year. This number consists of toddlers who experience 3.8% malnutrition and 14% malnutrition. From this data, it can be seen the importance of monitoring the nutritional status of children and toddlers to prevent potential disease or stunting as adults.

Determination of nutritional status itself is carried out by nutritionists based on reference standards for determining the classification of nutritional status by anthropometry based on the Decree of the Minister of Health Number: 1995 / MENKES / SK / XII / 2010 [4]. Which makes the WHO-NCHS (World Health Organization - National Center For Health Statistics) standard as the main reference. Anthropometry is the most frequently used method of assessing nutritional status. In general, the anthropometric indexes used are body weight for age (BW / U), height for age (TB / U) and body weight for height (BW / TB). The problem that currently happens in the decision process of the nutritional status for toddlers is often based on manual calculation. However, the manual calculation is prone to data duplication, insufficient data, and a lack of availability of the data itself, to ease the determination and calculation process of the nutritional status of toddlers, the researchers conduct a

study using the Simple Additive Weighting (SAW) method. The SAW method is selected because it defines the best alternative and some other alternatives based on specified or preferred criteria, Those are age, height, and weight of the toddlers [5].

The nutritional status of children under five is measured by age, weight and height. The weight and height variables are presented in the form of three anthropometric indicators namely weight by age, height by age, and weight by height. By using these indicators the Cipadu-Kreo health center sometimes determines the nutritional status of children under five years of age. Therefore the simple additive weighting (SAW) method is able to decide the nutritional status of toddlers by adding a toddler's body mass index variable, so as to produce the right and valid decision [6].

Fuzzy Simple Additive Weighting method (SAW) used to examine healthy food for toddlers. This method was chosen because it is able to select the best alternative from a number of alternatives. The function of this method is to determine the weight values for each alternative and assessment criteria have been determined. There are six criteria used in this study are: (1) Food Staple, (2) Vegetables, (3) Fruits, (4) Nuts, (5) Side dishes, (6) Milk and, (7) Food interlude [7].

The background of this research concerns the background by the number of severely malnourished children are increasing each year. Currently the data processing system and the calculation of the nutritional status of children under five are still using manual systems. Reporting nutritional status of children still using paper media which resulted in the frequent occurrence of data redundancy toddlers and infants often data loss occurs. This method is the most famous and most widely used in dealing with situations of Multiple Attribute Decision Making (MADM). MADM itself is a method used to find the optimal alternative of a number of alternatives to certain criteria. That is Weight, Tall, Age, Wrist Circumference, abdominal circumference [8].

This study uses the SAW method, in contrast to the method developed above which uses several criteria, this study used 2, namely, Height (TB) and Weight (BW) according to age. This is conducted to determine that the two selected standards can represent the nutritional status of measured toddlers. and these two indices are very commonly used by health workers to determine the nutritional status of children under five. For grouping the nutritional status itself also uses the WHO weight standard which can be seen in Table 1 [9].

**Table 1.** status itself also uses the WHO weight standard

| Categori | Value (Cut Of Point) |
|---|---|
| More Nutrition | > 120% Median Weight/Age book WHO-NHCS |
| Good Nutrition | 80 % - 120% Median Weight/Age book WHO-NHCS |
| Moderate Nutrition | 70 % - 79.9% Median Weight/Age book WHO-NHCS |
| Malnutrition | 60% - 69.9% Median Weight/Age book WHO-NHCS |
| Malnutrition | <60% Median Weight/Age book WHO-NHCS |

## 2. Method

This study used a two-stage methodology including data collection and implementation. The process is as follows:

### 2.1. Data collection

The process of obtaining information used interview method based on guides containing the main questions related to stunting phenomenon, which will be transformed into the system. The main informant interviewed was the head of Tinggede Health Community Center. The interview topic of this event revolved around the criteria and weight determination for malnutrition in toddlers. Meanwhile, interviews were also conducted with a number of communities to determine the limitations of accessibility in obtaining information regarding the nutritional quality of their children

### 2.2. Implementation of the SAW Method

The data that has been obtained in this course are then input into the system and analyzed using the SAW method (Figure 1).

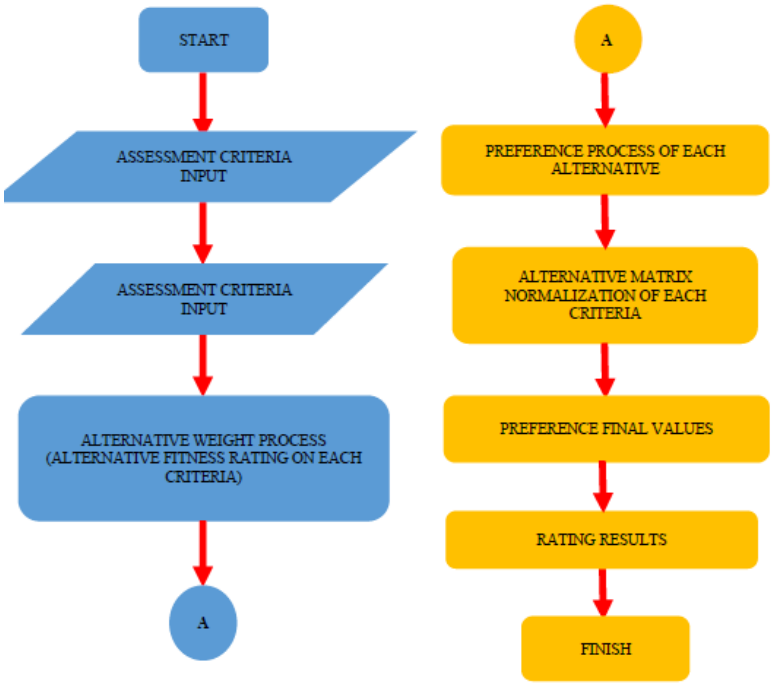


**Fig. 1.** SAW Methode

**Table 2.** Nutritional status

| Category | Score (Cut of Point) |
|---|---|
| High Nutrition | > 120% Median BW/U WHO-NHCS book |
| Good Nutrition | 80% - 120% Median BW/U WHO-NHCS book |
| Moderate Nutrition | 70% - 79.9% Median BW/U WHO-NHCS book |
| Less Nutrition | 60% - 69.9% Median BW/U WHO-NHCS book |
| Malnutrition | <60% Median BW/U WHO-NHCS book |

## 3. Results and Discussion

The data that has been obtained through interviews are then analyzed using the SAW method

### 3.1. Determine alternatives, that is. Ai [10]

**Table 3.** List of Toddler Alternatives

| No | Criteria Kode | Toddler's Name |
|---|---|---|
| 1 | A1 | Muhammad Al Fatih |
| 2 | A2 | Teguh Hendra Ardiyansiah |
| 3 | A3 | Pradipta |
| 4 | A4 | Fahrul |
| 5 | A5 | Fahmi Ardian Syah |

### 3.2. Determine the criteria that will be used as a reference in making decisions, namely. Cj

**Table 4.** List of Toddler Criteria

| No | Criteria Kode | Toddler's Name |
|---|---|---|
| 1 | C1 | Berat Badan (BB) |
| 2 | C2 | Tinggi Badan (TB) |

### 3.3. Create an alternative matrix and criteria. Namely by inputting the measurement results for toddlers

**Table 5.** List of Weight and Height Toddler

| No. | Toddler's Name (A) | Weight (C1) | Height (C2) |
|---|---|---|---|
| 1 | Rizal Algaesan | 7.4 | 71 |
| 2 | Haziq | 8.2 | 69 |
| 3 | M.Azka Alfarezi | 7 | 66 |
| 4 | M.Ziad Alfarezi | 13 | 90 |
| 5 | Yazid Alfarizi | 13 | 87.8 |

### 3.4. Furthermore, normalizing the criteria [11]. The following is the SAW Matrix normalization formula:

$$r_{ij} = \frac{x_{ij}}{Max_{\{x_{ij}\}}} \quad (1)$$

Information

$r_{ij}$/A : alternative

$x_{ij}$/N : alternative value

It is known that each criterion used this time is a benefit, and in this research, the value used as the maximum value is taken from the median value of the BB / U and TB / U index from the 2010 anthropometric SK book. Because all toddlers who are used as alternatives are male -male and 6 months old. Then the maximum value is 7.9 for C1 and 67.6 for C2. The normalization process is shown in the following Table 6.

**Table 6.** Calculation Result

| No | The C1 | Calculation | Result | The C2 | Calculation | Result |
|---|---|---|---|---|---|---|
| 1 | $P_{11}$ | $=\frac{6.3}{7.9}$ | 0.79747 | $P_{12}$ | $=\frac{66.4}{67.6}$ | 0.98225 |
| 2 | $P_{21}$ | $=\frac{9.2}{7.9}$ | 1.16456 | $P_{12}$ | $=\frac{71.5}{67.6}$ | 1.05769 |
| 3 | $P_{31}$ | $=\frac{8.31}{7.9}$ | 1.02532 | $P_{12}$ | $=\frac{74}{67.6}$ | 1.09467 |
| 4 | $P_{41}$ | $=\frac{7}{7.9}$ | 0.88608 | $P_{12}$ | $=\frac{65}{67.5}$ | 0.96154 |
| 5 | $P_{51}$ | $=\frac{7.5}{7.9}$ | 0.94937 | $P_{12}$ | $=\frac{67.5}{67.6}$ | 0.99852 |

Then calculate the final value of nutritional status using the weight values that have been determined in Table 4 above. By using the following formula :

$$V_i = \sum_{j=1}^{n} w_j P_{ij} \quad (2)$$

Where :

$V_i$ : alternative
$p_{ij}$ : alternative value
w : criterion weights

Then here are the results of the final calculation for each alternative using the formula above:

v1 = ( 0.797468354 x 0.5 ) + ( 0.982248521 x 0.5 ) = 0.889858438
v2 = ( 1.164556962 x 0.5 ) + ( 1.057692308 x 0.5 ) = 1.111124635
v3 = ( 1.025316456 x 0.5 ) + ( 1.094674556 x 0.5 ) = 1.059995506

for the normalization results can be seen in Table 7. as follows:

**Table 7.** Results of Criteria Normalization

| No. | Nama Balita | Weight (C1) | Height (C2) |
|---|---|---|---|
| 1 | Rizal Algaesan | 0,89157 | 1,02601 |
| 2 | Haziq | 1,03797 | 1,02071 |
| 3 | M.Azka Alfarezi | 1 | 1,03286 |
| 4 | M.Ziad Alfarezi | 1,02362 | 1,00446 |
| 5 | Yazid Alfarizi | 0,97744 | 0,95539 |

From the final result above, it is then converted into a percentage and then grouped according to nutritional status can be seen in Table 8 below.

**Table 8.** Results of toddlers' nutritional status

| No. | Toddler's Name | The calculati on results (%) | Nutritional status |
|---|---|---|---|
| 1 | Rizal Algaesan | 96% | Good Nutrition |
| 2 | Haziq | 103% | Good Nutrition |
| 3 | M.Azka Alfarezi | 102% | Good Nutrition |
| 4 | M.Ziad Alfarezi | 101% | Good Nutrition |
| 5 | Yazid Alfarizi | 97% | Good Nutrition |
| 6 | Humaira | 88% | Good Nutrition |
| 7 | Maikel | 103% | Good Nutrition |
| 8 | Kalisa | 98% | Good Nutrition |
| 9 | Navia Ramadani | 163% | High Nutrition |
| 10 | Nur Rizki | 94% | GoodNutrition |
| 11 | Aura Malika Zafa | 161% | High Nutrition |
| 12 | Nurjannah | 86% | Good Nutrition |
| 13 | Nafia | 89% | Good Nutrition |
| 14 | Muh. Rayyan | 97% | Good Nutrition |
| 15 | Napi | 96% | Good Nutrition |
| 16 | Moh. Raka Gani A. | 117% | Good Nutrition |
| 17 | Muh Ramadan | 100% | Good Nutrition |
| 18 | Abizar | 87% | Good Nutrition |
| 19 | Hafid | 92% | Good Nutrition |
| 20 | Putu Azka D. | 105% | Good Nutrition |
| 21 | Abdila Abqori | 100% | Good Nutrition |
| 22 | Muh. Fahrul | 93% | Good Nutrition |
| 23 | Moh.Rifaldi Algifari | 97% | Good Nutrition |
| 24 | Rafael | 129% | High Nutrition |
| 25 | Lupna | 94% | Good Nutrition |
| 26 | Khalik Nurfatia | 96% | Good Nutrition |
| 27 | Adifa Fauza | 100% | Good Nutrition |
| 28 | Retno Rindiani | 96% | Good Nutrition |
| 29 | Aluna | 99% | Good Nutrition |
| 30 | Arumi Azkadina Hamid | 86% | Good Nutrition |

To test the accuracy, a comparison was carried out with the data obtained from the nutritional status calculation of Tinggede Health Center based on the BB/TB Index. Based on this process, it was discovered that 3 of the 30 data set had unsuitable results. Furthermore, when presented, the calculation accuracy of the application becomes 90% of the toddlers' data tested.

There is need for further research on the type of criteria used for the recruitment of respondents, therefore, determining whether the inclusion of these standards will increase the calculation accuracy or not.

## 4. Conclusion

The implementation of the SAW method for determining the nutritional status of toddlers using 2 criteria, namely body weight according to age and height or length of body according to age, can give good results, both in terms of function and accuracy. Of the 30 anthropometric measurement data processed in this system, the results were 27 toddlers who had the same results as the calculation from

the puskesmas or around 90%. So the calculations in this application are quite relevant and can be used as a reference for the nutritional status of toddlers

## Declarations

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