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Application of Simple Additive Weighting Method for Determination of Toddler Nutrition Status

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***Abstract*—** 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. Then from 20 samples of toddlers categorizing by age group. Obtained the nutritional status results there are 1 toddlers get a SAW value of 0.44 with poor nutritional status, 3 toddlers with undernourished status, 8 toddlers with excess nutrition status and 8 toddlers with a balanced nutrition status with the highest SAW value with a value

Keywords— *toddler nutritional status, antropometri, simple additive weighting*

I. INTRODUCTION

Balita is a time when children start walking and is the greatest period in growth and development, namely at the age of 1 to 5 years (Mitayani, 2010). Toddler is a group of people who are vulnerable to nutrition. Age of toddlers experiencing a cycle of growth and development that requires substances greater than other age groups. Poor nutrition is a condition of a person's condition that is malnourished, or his nutrition is below average (Alamsyah et al, 2015). Children's nutritional status is an important thing that must be considered by parents and the government (Wulandari, 2018). If a toddler's nutrition is insufficient, a toddler will experience malnutrition resulting in damage that cannot be repaired when the child is growing up. Therefore nutritional status is an important thing that must be known by everyone especially parents (Putri et al, 2017). Nutrition problems are still a threat in some countries, such as Indonesia facing multiple nutrition problems, namely the problem of undernutrition and the problem of over nutrition. Problems of malnutrition are generally caused by poverty, lack of food availability, poor environmental quality (Arisman, 2010), lack of parents' knowledge about nutrition, balanced diet and health. Causes toddlers more vulnerable to problems of unbalanced nutritional intake.

While nutrition is more a term for toddlers who have a body weight where the toddler's body weight exceeds the normal toddler's weight (Romadhon and Purnomo. 2016). More nutrition is a condition of the body of a person who is overweight because of the excess amount of energy intake stored in the form of fat reserves (Supriyatini, et al, 2017). It was driven by the lack of attention of parents about the pattern of toddler food that causes toddlers to excess nutrition that they need.

Nutrition problems in Indonesia, especially in some regions in the East such as NTT and West Papua, are still considered high. However, nationally, nutritional status in Indonesia has experienced significant improvements. For example, the province of NTT decreased the proportion of chronic nutrition

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(prevalence of stunting) by 9.1%, nearly 2% per year has decreased, this shows a multisectoral effort that is converged at the central and regional levels. Sufferers of malnutrition certainly will not be separated from the monitoring of health workers, where in any case health workers are formed to always be alert to help improve patient nutrition. Improvements in national nutritional status can be seen based on the 2018 Basic Health Research (Riskesdas). In the prevalence of Underweight Nutrition (Underweigth) the improvements occurred successively from 2013 by 19.6% up to 17.7% in 2018. Stunting prevalence from 37, 2% dropped to 30.8%, and the prevalence of thinness (wasting) from 12.1% dropped to 10.2%. In calculating the case of malnutrition cases must be taken from the body weight index according to height (BBTB) or so-called very thin according to WHO standards accompanied by clinical symptoms. interventions on nutrition, especially in Eastern Indonesia, have been handled or intervened by nutrition workers at the Puskesmas. The results of the Health Workforce Research (Risnakes) in 2017, Nutrition Workers throughout Indonesia have fulfilled 73.1% Puskesmas. for 26.1% of Puskesmas that do not yet have Nutrition Workers, mainly in remote and very remote areas, the Ministry of Health has the Nusantara Sehat program. Nusantara Sehat consists of health workers such as doctors, dentists, nutritionists, nurses, midwives, pharmacy staff, sanitarians, health analysts and community health workers who are trained to be placed in Puskesmas for 2 years.

Literature Review

2.1. Decision Support System

In general, decision support systems are defined as part of computer-based information systems including knowledge-based systems or knowledge management that are used to support decision making in an organization or company. Decision support systems (SPK) are usually built to support solutions to a problem or to an opportunity (Nofriansyah, 2014). In general, a decision support system is a system that is able to provide the ability, both the ability to solve problems and the ability to communicate for semi-structured problems (Basuki and Cahyani, 2017). While specifically, a decision support system is a system that supports the work of a manager or group of managers in solving semi-structured problems by providing information or proposals leading to certain decisions (Nofriansyah and Defit, 2017). From the above understanding it can be understood that a decision support system is a process or steps used to take a decision in solving a problem. The characteristics of the decision support system are:

a. Support the decision making process of an organization or company
b. There is a human / machine interface where the human (user) still holds the control of the decision making process
c. Supports decision making to discuss structured problems and supports multiple interacting decisions
d. Have a dialogue capacity to obtain information according to needs
e. Having an integrated subsystem in such a way that it can function as a system unity
f. Has two main components, namely data and mode

Broadly speaking, the decision support system is built by three main components, namely:

1. Data subsystem (Database)

Data subsystem is a decision support system component that is useful as a data provider for the system. The data is stored to be organized in a database that is organized by a system called a database management system.

2. Model subsystem (modelbase)

The model is an imitation of the real nature. The obstacle that is often faced in designing a model is that the designed model is not able to reflect all real natural variables. so the decision taken is not according to need, therefore, in storing various models must be considered and flexibility must be maintained. Another thing that must be considered is that for each model that is stored, it should add detailed information and a comprehensive explanation of the model made.

3. Dialogue Subsystem (User System Interface)

Dialog subsystem is a facility that is able to integrate a system installed with the user interactively, known as a dialogue subsystem through which the system dialogue subsystem is implemented so that users can communicate with the system created.

The objectives of the decision support system are as follows:

1. Assist in making decisions on structured problems
2. Providing support for the manager's consideration and not intended to replace the manager's function
3. Increasing the effectiveness of decisions taken more than improving efficiency.
4. The speed of computer computing enables decision makers to do a lot of computing quickly at a low cost
5. Increased productivity building a decision-making group, especially experts, can be very expensive.

2.2. *Simple additive weighting*

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Simple Additive Weighting method is a method used to find optimal alternatives from a number of alternatives with certain criteria (Latif et al, 2018). Simple Additive Weighting Method is often also known as the weighted sum method (Nofriansyah, 2014). The basic concept of Simple Additive Weighting is to find the weighted sum of the performance ratings for each alternative on all attributes. The Simple Additive Weighting method requires the process of normalizing the decision matrix (X) to a scale that can be compared with all existing alternative ratings.

The steps for solving a problem using the Simple Additive Weighting method (Nofriansyah and Defit, 2017):

1. Determine the criteria that will be used as a reference in making decisions, namely Ci.
2. Give weight values for each criterion as W.
3. Give a value of the suitability rating of each alternative to each alternative.
4. Make a decision matrix based on criteria (Ci), then normalize the matrix based on an equation that is adjusted to the type of attribute (profit attribute or cost attribute) to obtain an normalized matrix R.

$$ij = \begin{cases} \frac{xij}{Max\ xi} & \text{if j is the benefit attribute} \\ \frac{Min\ xij}{xij} & \text{if j is the cost attribute} \end{cases}$$

Information:
Rij = the value of the performance rating is nominalized
Xij = attribute value owned by each criterion
Max Xij = the greatest value of each criterion
Min Xij = the smallest value of each criterion
Benefit = if the biggest value is the best

The final result is obtained from the ranking process, namely the addition and multiplication of R-nannized matrices with weight vactors so that the greatest value is chosen as a bail alternative (Ai) as the solution.

$$Vi = \sum_{j=1}^{n} \text{Wj rij}$$

Information :
vi = ranking for each alternative.
Wj = the weight value of each criterion
Rij = value of nominalized performance ranking

2.3. Nutritional status

Nutritional status assessment can be used for individual nutritional status assessment which is useful for the needs of referrals from community groups or health centers, in addition it can also be used for monitoring children's growth that is needed by parents for child development (Azmi, 2015). There are various ways to assess nutritional status, one of which is by measuring the human body known as "Anthropometry". Toddler Nutrition Status Toddler nutritional status is measured by age, body weight (BW), and Height (TB) (Purwati, 2016). The BB and TB variables are presented in the form of three anthropometric indicators, namely body weight according to age (BW / U), height by age (TB / U), and weight by height (BW / TB). The weight and height figures of every toddler are converted into Bet-Z-Score using the anthropometry book (Almatsier, 2009).

Anthropometry is derived from the words anthropos and metros. Anthropos means body and metros means size. So anthropometry is a measure of the body. Anthropometry is a method of assessing nutritional status that is most often used, including in infants. "The advantages of anthropometric methods are that the procedure is simple, relatively does not require experts, the tools are cheap and easy to obtain, the method is precise and accurate, can detect past nutritional conditions, can evaluate the nutritional status of certain periods and can be used for screening (Supariasa et al, 2012). Anthropometry is a human measurement that tends to measure the human dimension (Kuswana, 2015). Anthropometry is a science created from a new scientific sub-discipline called physical anthropology which is the implication of the development of Anthropology studies. Anthropology is the development of human studies concerning philosophy and aesthetics. Then anthropometry began to be recognized and used in measurements of the body, bones and the proportion of human body size.

Anthropometric characteristics when viewed from an approach, divided into two namely (Kuswana, 2015):

1. Static anthropometry, where measurements are taken when the body is at rest / at a stationary / stationary position.
2. Dynamic anthropology, where body dimensions are measured in various moving body positions.

III. PROPOSED METHOD

3.1. Research Stages

In applying a necessary step method of research. Following are the steps taken in carrying out research methods (Prsetyo and Jannah, 2012):

1. Determine the data needs that will be needed, namely the data requirements in the form of toddler data and variables that influence in determining toddler nutrition.
2. Determine the simple additive weighting method procedure, with the following steps:

a. Determine the criteria - criteria that will be used as a variable in decision making.

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b. Determine the suitability rating of each alternative on each of the existing criteria.
c. Make a decision matrix based on criteria, then normalize the matrix based on an equation that is adjusted to the type of attribute (profit attribute or cost attribute) to obtain an normalized matrix R.
d. The final result is obtained from the ranking process that is the sum of the multiplication matrix normalized R with weight vectors so that the greatest value is chosen as the best alternative as a solution.

3.2. Research instrument

The research instrument serves as a tool in collecting data needed in a research. The preparation of research instruments as well as evaluating, because by evaluating researchers can obtain data from the object under study, and the results obtained can be measured using methods previously determined by researchers. In writing and this research the researcher needs several aspects of the criteria needed to be a reference criteria in making a decision, which are as follows: Height or Body Length by Age, Weight by Age, Height or Length by Body Weight and Body Mass Index According to age.

3.3. Data Analysis Method

In this simple additive weighting process requires the decision maker to determine several criteria related to be a reference in making decisions. These predetermined criteria are given a value or weight for each criterion. The total rating for an alternative is obtained by adding up all the multiplication results between the rating (which can be compared across attributes) and the weight of each attribute. Rating of each attribute must be dimension free which means it has passed the previous normalization process. Then from each toddler anthropometric data given processed to toddler nutrition calculations based on anthropometric data that has been determined and given the value of each anthropometric measurement. Then from each of the anthropometric assessment status data mentioned above is reprocessed by giving criteria weights to the anthropometric assessment status that has been determined based on the conditions of each existing status. After that normalization with the following formula:

$$R_{ij} = \begin{cases} \dfrac{x_{ij}}{\underset{i}{Max}\, x_{ij}} & \text{Jika j adalah atribut keuntungan (benetif)} \\ \dfrac{\underset{i}{Min}\, x_{ij}}{x_{ij}} & \text{Jika j adalah atribut biaya (cost)} \end{cases}$$

After conducting the normalization process, then proceed with the ranking process that is the sum of each normalized result multiplied by the weight that has been determined. Calculation of weight data with formulas:

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

Furthermore, after the value of the simple additive weighting method is known to be given the nutritional status of each range of values.

Tabel . Nutritional status with the SAW Method

SAW Value	Nutritional Status
0 - 0.45	*Malnutrition*
0.46 - 0.70	*Underweight Nutrition*
0.71 - 0.85	*Excess Nutrition*
0.86 - 1	*Balanced Nutrition*

From the above data it can be seen that a baby named sheni gets a value of 0.63, so the nutritional status is lacking because it is in the range of values 0.46-0.70 while a baby named Fahri gets a value of 0.81 then the status of excess nutrition is because it is in the range of values 0.71-0.85.

IV. RESULT AND DISCUSSION

The results of research conducted at the Cipadu Kreo Health Center in Tangerang City, through the research process by interviewing and requesting anthropometric data for infants aged three months to five years. The anthropometric data which is a process of analyzing the needs of this study aims to find out the significant nutritional status between poor nutrition, poor nutrition, adequate nutrition, excess nutrition and balanced nutrition at the Cipadu Kreo Health Center in Tangerang City. The sample in this study were infants aged three months to five years totaling twenty infant data as research samples.

Stages of the study will be described using the simple additive weighting (SAW) method manually. The description of the research data uses measurement data for infants aged three months to five years from the Cipadu Kreo Health Center in Tangerang in February 2019. This needs analysis was carried out by processing anthropometric data received from the Cipadu Kreo Health Center in Tangerang City which aims to explore the factors used as material for the process of determining nutritional status through assessments in infants aged three months to five years. Anthropometric data will be processed using the simple additive weighting method. The data obtained is then processed to calculate the nutritional status of children under five based on the calculation of the Ideal Body Weight of each toddler with the formula for ages 0 - 12 months, namely BBI = (age (months) / 2) + 3, while for

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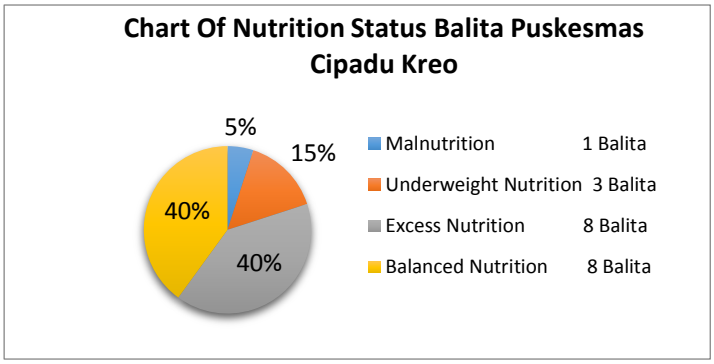
ages 1-10 years, it is calculated using the formula BBI = (age (years) x 2) + 8. Then the measurement data for children under five provided by the Cipadu Kreo Health Center in Tangerang City were processed for under five nutrition calculation using the Z score from the anthropometric data determined by the Ministry of Health Decree in 2010 and given the value of Anthropometric status of every toddler. Furthermore, from each of the anthropometric assessment status data above, it will be reprocessed by giving a weighting of sub-criteria to each anthropometric assessment status that has been determined based on the conditions of each existing status. After that the data that has been processed into predetermined criteria will be normalized by the following formula:

$$R_{ij} = \begin{cases} \dfrac{x_{ij}}{\underset{i}{Max}\, x_{ij}} & \text{Jika j adalah atribut keuntungan (benetif)} \\ \dfrac{\underset{i}{Min}\, x_{ij}}{x_{ij}} & \text{Jika j adalah atribut biaya (cost)} \end{cases}$$

Normalization of C1 (Body Weight by Age) of each baby due to benefits, so look for the max of all C1 data is 1.00. Normalization of C2 (Height or Body Length by Age) of each baby because of the benefits, then the max of all C2 data is 1.00. Normalization of C3 (Body Weight according to Height or Body Length) of each baby due to benefits, then the max of all C3 data is 1.00. Normalization of C4 (Body Mass Index by Age) of each baby due to benefits, then the max of all C4 data is 1.00. Next is the normalization process. After conducting the normalization process, then continue the ranking process by multiplying the specified weight. From the calculation results, the results obtained from the determination of the nutritional status of children under five by using the method of simple additive weighting, further from the results previously given nutritional status based on the values that have been known from previous calculations.

With the results of the assessment using the simple additive weighting method that has been described from the results of previous calculations, it can be seen the amount of nutritional status of each toddler who is a sample of research at the Cipadu Kreo Health Center in Tangerang City can be seen in the graph below:



Source: Research Results (2019)

Figure 4.1. Nutrition Status Chart

From the graph above the nutritional status of children under five in the Cipadu Kreo Health Center - Tangerang City looks 40% balanced nutritional status that is as many as 8 toddlers out of 20 toddlers and excess nutritional status has a percentage of 40% ie as many as 8 toddlers out of 20 toddlers and underweight nutritional status has a percentage of 15% namely as many as 3 toddlers out of 20 toddlers while the status of malnutrition has a percentage of 5% or as many as 1 toddler out of 20 toddlers who became the study sample.

V. Conclusion and Suggestion

By drawing conclusions with two calculations, namely calculations based on ideal weight calculations with calculations based on the simple additive weighting method, it is shown that more accurate and detailed nutritional status data for toddlers with calculations based on the simple additive weighting method is because the calculation uses the simple additive weighting method using four criteria while the calculation based on ideal body weight only one criterion and nutritional status based on the calculation of ideal body weight is said to be not accurate enough because it does not calculate the height or length of the toddler's body.

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