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Toddler Nutritional Status Monitoring Using Intelligent System

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ABSTRACT: Nutritional status is a state of physical health of a person or group of people as a result of food consumption and utilization of nutrients. Nutritional Status distinguish between poor nutritional status, less, better, and more. The current method used Indonesia to determine the nutritional status of children by manually using a Health Card. How to detect it is by weighing each month toddler, weighing results are recorded on the health card, and the weight point of weighing results last month and this month weighing results are connected with a line. These lines describe the child's growth chart. Anthropometry used is the standard of the World Health Organisation (WHO).This procedure is not effective. In addition, midwife may differ in determining nutritional status of children. The research aims to develop software to detect nutritional status automatically. This study includes two phases. The first is management of toddlers medical records. The second is detection of nutritional status using Support Vector Machine (SVM). The results of detection process is children status good nutrition, stunting, malnutrition and infant nutrition. From four testing, average accuracy value is 86%.
Keywords: KMS, Nutritional Status, SVM, WHO.

I. INTRODUCTION

Nutritional Status of Children is state of child health, which is determined by degree of physical needs energy and other nutrients, from food, which influences physical, measured antroppometri, and categorized by WHO-NCHS standards. Nutritional status include: poor nutritional status, less, better, and more. One method to determine nutritional status of children is anthropometric measures.Anthropometric measurements is relatively simple and a lot to do and is preferable because of practical, reasonably accurate, and easily done by anyone after equipped with a simple exercise. Determination of nutritional status of toddler required a specific reference standard. In accordance with that addressed in this activity that reference standard for toddler is standard reference of WHO-NHCS. Determination of nutritional status is done by connecting dots into a line on graph in WHO-NCHS reference standard. According to this reference standard, normal nutritional status when growth graph range is between -2 up to +2. When the growth charts were below this range, the growth is said to be in poor nutrition status and when it is more under more or less than -3 said poor nutritional status.In Indonesia, monitoring the nutritional status of children is done by using a tool named Card Towards Healthy. How to detect it is by weighing toddlers every month, weighing results are recorded on a health card. Weight between point of weighing results last month, and the results of weighing this month is connected with a line. The series of these lines will be a toddlers growth chart [1]. The problems arising from use of manual Health Card is difficulty in determining nutritional status of toddlers every month. In addition, determining of manually nutritional status is less accurate. This is because manually Health Card based only on age and weight. Another problem is difficulty in documenting toddlersmedical records.

Studies on detection of toddlers nutritional status have been made. The first, is study of Vijayasree [2]. This study is an attempt to assess nutritional status of pre-school from two villages, Andhra Pradesh, India. Anthropometric measurements were carried out are 200 rural preschool children ages 3-5 years. Includes anthropometric measurements of height and weight in accordance with procedure. To determine nutritional status based on height and weight, weight and height 'and' height and age 'low water use classification index (low water classification). Study also compared the MUAC measurement results compared with WHO standards. The analysis showed that the weight of boys and girls belonging to all regions in age group 3-5 years. Height and weight of children is lower than standard NCHS. Further research is study of Samiran Bisai [3]. The purpose of this study was to detect prevalence of malnutrition and related factors. This study using cross-sectional method, using data from 141 children ages 1-5 years, from Lodha Tribe in India. Data were collected using a structured questionnaire, which included household sociodemographic data, status of child morbidity and anthropometric measurements such as height, weight. Statistical analysis was performed using statistical Medcalc Software. Results of study was overall prevalence of malnutrition in form of underweight, stunting, wasting and overweight are respectively 40.4%, 29.8%, 34.0%, 5.0%. According to WHO classification of malnutrition severity, less weight overall prevalence is very high, indicating a critical situation. The results showed that the morbidity status, number of siblings, maternal literacy status has a significant relationship to more important weight (P <0.05 (; badanterlalurendah weight levels were significantly higher among children who had been reported morbidity. Kesimpulandariadaah study of children of pre-school in Lodha who suffer nutritional stress, associated with morbidity, lack of maternal education and the high number of siblings.

Research from D. Otgonjargal [4] describe nutritional status of children under five years in Mongolia.The study used cross-sectional methods are carried out in 21 provinces, from four economic regions of Ulaanbaatar capital city. Research using cluster-sample survey conducted in two stages in 2010. A total of 706 children aged 0-59 months have been selected as a sample. Data were collected through questionnaires, and anthropometric measurements. The prevalence of delayed growth, malnutrition and weight loss under each standard is 15.6%, 1.7% and 4.7%. Children under five suffering from malnutrition is highest among the 24-35 month age group (20.8%). The difference was statistically significant ($p < 0.005$) was found between rural and urban areas related to malnutrition. Geographically, the region-specific prevalence rates of malnutrition ranged from 9.0% in Ulaanbaatar to 33.1% in the Western Conference.

MomciloPelemiš [5] analyzed nutritional status of pre-school children.Samples registered is 325 children, including 196 boys and 129 girls. Child's height and weight were measured during May 2013. Data was analyzed by descriptive statistics and multivariate (MANOVA) analysis of variance for $p \leq 0.05$. That boys and girls from pre-school age are significantly different in terms of nutritional status. Percentage of malnourished children is very high (31.76%), at the same time there are 13.54% of children are overweight. 54.70% of the children were found normal nutritional status.

From research that has been done by some previous researchers, almost all research on analysis. Research on development of software to detect nutritional status of children is still very rare. Our Objective research is to develop detection software nutrient status automatically. This study includes two subject matter. The first is management of toddlers medical records. The second is detection of nutritional status using Support Vector Machine (SVM) [6] - [7]. SVM concepts can be explained simply as an attempt to find the best hyperplane serves as a divider of two classes in the input space. Hyperplane in a d-dimensional vector space is the affine subspace d-1 dimension which divides the vector space into two parts, each of which corresponds to different classes. The outcome of this process is index value of biggest decisions function, stating class of test data. If class of classification process is same as class on test data, then classification process is correct.

II. MATERIALS

Data used in this study can be divided into two. The first is data that is used as training data. The data is data that will be used in classification process. The data is taken from the infant anthropometric of men and women toddleraccording to the World Health Organisation (WHO), which includes age data, weight, body length and head circumference [1]. The second is data used in the testing process. The data is data results of examination each month from Posyandu. Data is collected in Posyandu Sejahtera Badran, Ponowaren, Tawangsari, Sukoharjo, Middle of Java, Indonesia. Data taken include medical records toddler and men and women toddler anthropometric include: age, body weight, body length and head circumference.

III. METHOD

1.1. Medical Record Data Processing

Database development for management of toddler medical records, so toddler medical records from born to five years old may well documented, including status of nutrition development. Examples of forms for management of toddlersmedical records can be seen in figure1.

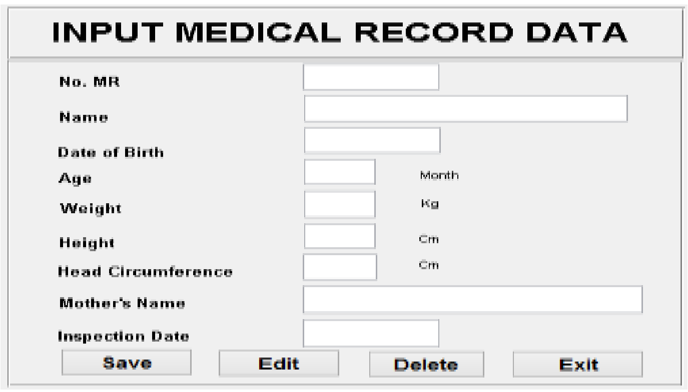

Figure 1. Form Design For Toddler Medical Record Data Input

1.2. Detection of Nutritional Status Toddler

Development of detection methods nutritional status by using intelligent systems. The method used is detection of nutritional status based on age, body weight, body length and head circumference using Support Vector Machine [6].

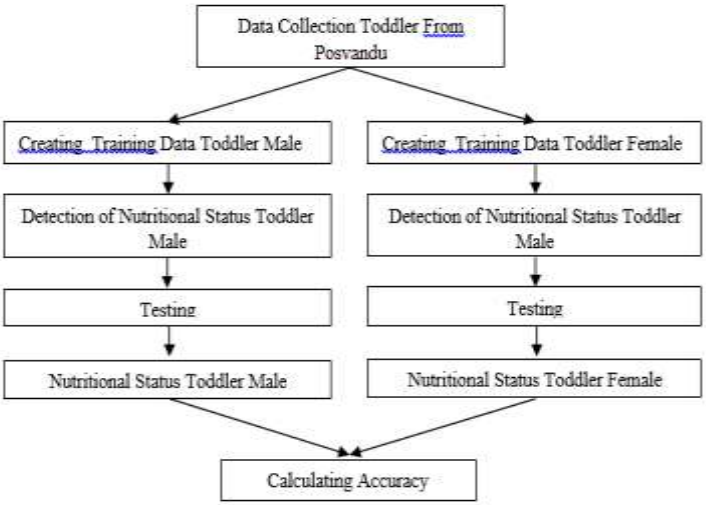

Figure 2. Steps of Research

Steps of nutritional statusdetection can be described as shown below:

a. Capturing Data From Posyandu (Integrated Health Care Center)

Data from Posyandu (Integrated Health Care Center) include medical records toddlers and anthropometric data includes: age, body weight, body length and head circumference.

b. Feature extraction

Feature extraction is a process to obtain accurate information in order to do identification process [8] - [9] (Duda, 2000). Features used for detection of nutritional status include: age, weight features, body length and head circumference according World Health Organisation (WHO) of children under five male and female. Features that are selected will be used for classification of nutritional status include: Toddler Nutrition Good, Toddler Nutrition Less, Toddler Toddler Nutrition Malnutrition and More.

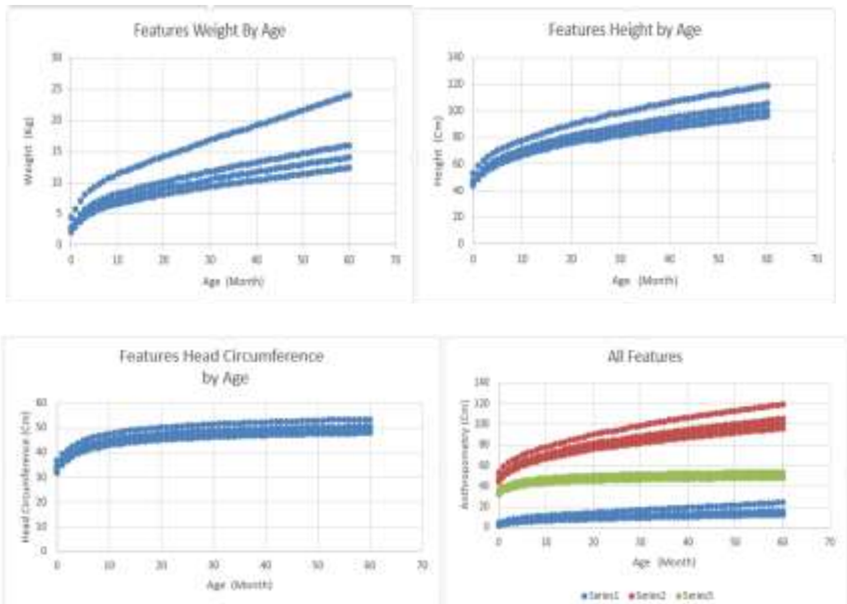

Figure 3 Graph of Features Used

c. Nutritional Status Monitoring Using Support Vector Machine (SVM)

Process of monitoring nutritional status do with classification process. Classification process consists of two parts, namely classification for toddler boys and girls. One method of classification is Support Vector Machine (SVM) [7]. Monitoring of nutritional status based on age and weight, age and body length, age and head circumference and by all. Outcome of this process is index value of biggest decisions function that states class of test data. If class resulting from classification process same with class of test data, then clasification is correct. The results of classification process is status of good nutrition, stunting, children malnutrition and infant nutrition. Development of nutritional status detection applications using programming language Matlab [9]. Applications developed aims to facilitate midwives to record medical records toddler, watching the nutritional status of children automatically, and display charts the development of nutritional include weight, body length and head circumference. Graph of development of nutritional status of children is shown in Figure 5.

Figure 4. Main MenuFor Girls

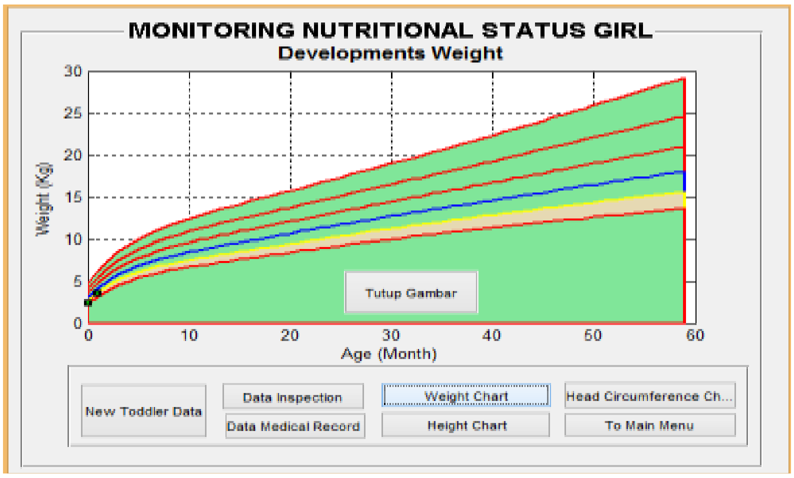

Figure 5. Graph Monitoring Developments Weight Loss Girls Toddler

d. Calculating Accuracy Monitoring Nutritional Status

Results of classification will be made comparison with Groundtruth (midwife) using *Receiver Operating Characteristic* (ROC), so that will be obtained four values, each of which is a true positive, false negative, false positive, and true negative. Truepositive (TP) indicates the nutritional status of identified appropriately in accordance with the class. False positive (FP) is a nutritional status that should be identified correctly in its class in classification process turned out to be wrong in identifying. Truenegatif (TN) is a nutritional status that are not members of class identified right is not a member of that class. Falsenegatif (FN) shows nutritional status should not be a member of class identified as members of class. Based on all four grades were obtained true positive rate (TPR), which is known as sensitivity. Sensitivity formula is as follows:

$$TPR = \frac{TP}{TP+FN} \quad (1)$$

The false positive rate (FPR) or specificity is a value that indicates the level of error in identification that obtained using following equation: $FPR = \frac{FP}{FP+TN}$ (2)

While the value that indicates the accuracy of identification (accuracy) is obtained from the following equation:

$$Accuracy = \frac{TP+TN}{TP+FP+TN+FN} x100\% \quad (3)$$

IV. EXPERIMENT AND RESULTS

The training data used in system developed is 240 data. The training data 0 to 59 is normal infants, 60 to 119 data is stunting, 120 to 179 is malnutrition children data and 180 to 240 is toddler overnutrition. While features used to detect nutritional status were age, body weight, body length and head circumference. Experiments carried out through four times the test by using 50 data testing. The first testing is testing for detection method of nutrition based on age and weight. Second is based on age and body length. The third trials are testing based on age and head circumference. While the fourth trial is testing the nutritional status based on age, body weight, body length and head circumference at once. This scenario is used to observe effect of feature selection in this case age, body weight, body length and head circumference on performance of infant nutritional detection methods are developed. Results of the first test showed an accuracy rate of 85.1%. Results of second testing showed an accuracy rate of 86 %%. Results of thirthtesting showed an accuracy rate of 90.6%. Results of fourthtesting showed an accuracy rate of 82.3%. This indicates that the method used by using the training data can be detected very accurately. Results of tests that have been done can be shown in Table 1.

Table 1. Results of Testing

Amount of Data	**Accuracy**			
	Testing 1 (Weight/Age)	**Testing 2 (Height/Age)**	**Testing 3 (Head Circumference/Age)**	**Testing 4(W,H,HC/Age)**
60	85.1%	86%	90.6%	82.3%

V. CONCLUSION

Based on test results, it can be concluded that the software to detect the nutritional status of children with methods Support Vector Machine (SVM) can be used as a model for detecting nutritional status of children. This is demonstrated by average value of 98% accuracy.

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