APPLICATION OF CART METHOD IN ANALYZING FACTORS AFFECTING NUTRITIONAL STATUS OF CHILDREN AGED 6-23 MONTHS

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ABSTRACT

This study aims to analyze factors that affect the nutritional status of children aged 6-23 months. The data used were acquired from a survey conducted at mother and child health services ('*posyandu*'), daycares, and households in four districts in Padang City, West Sumatera. In this study, variables that are hypothesized to contribute to nutritional status are sex, birth weight, family income, number of family dependents, exclusive breastfeeding status, mother's employment status, education level, knowledge and nutritional behavior. Data analysis was done by using tree structure analysis namely CART method. It is showed that variables which significantly affect the nutritional status of children aged 6-23 months are mother's education level, knowledge and nutritional behavior. Children with low mother's education level have higher prevalence of severely underweight and underweight when mother's knowledge is poor or enough. in the group of children whose mothers have higher level of education, the variable that has a significant influence on child's nutritional status is mother's nutritional behavior. In the group of children whose mothers have higher level of education, the variable that has a significant influence on child's nutritional status is mother's nutritional behavior, the prevalence of overweight is likely to be high in children whose mothers nutritional behaviour is not good. Therefore, intervention from related parties is needed to implement programs for improving mother's knowledge about nutrition that will lead to better child's nutritional status.

Keywords: Nutritional status, Children aged 6-23 months, Padang city, CART

INTRODUCTION

Nutritional status is one of the important aspects that greatly affects the degree of national public health. The quality of human resource in the future will mostly be influenced by the status. Malnutrition can cause health problems (morbidity, mortality and disability) and degrade the quality of human resource. Furthermore, malnutrition can be a threat to the resilience and survival of a nation, especially Indonesia. A group of children under two years old is vulnerable to health and nutrition problems. Consequently, it requires special attention and monitoring. On the other hand, the fact

shows that brain growth gives an impact on children health. The better children brain grows, the better children health. Brain growth can develop to reach the maximum processing capacity at the beginning of life (under two years) because 85% of brain cells have been formed during that period. Besides, the brain will anatomically develop well if the child gets a good nutrient intake. Lack of nutrient intake causes the brain not to develop. This is called an empty brain (Siswono, 2003). In next phases, malnutrition will affect human health, performance and survival including physical growth, morbidity, mortality, cognitive development, reproduction, physical work capacity and risk of some early adult chronic diseases (Pelletier and Frongillo, 2003). Moreover, age 0-24 months will be a golden period of rapid growth and optimal development if the child gets the appropriate nutrient intake. Otherwise, if the child does not get food according to nutritional needs during that period, his growth and development will disrupt the at the moment and the future.

In order to prevent malnutrition, it is necessary that adequate nutrition should be given during infancy and early childhood so that child's potential can completely develop. As is known, the period from birth to age of two years is "a critical window" for optimal growth, health and behavioral development. Poor nutrition leads to poor health which will contribute to the decline of nutritional status. This effect is widely observed in infants and toddlers (Martorell et al., 1994). Furthermore, poor nutritional status in children can cause death (Gabriele and Schettino, 2007).

Chandran (2009) argues that malnutrition is caused by socio-economic factors and low maternal education. In addition, according to Amosu et al. (2011) most nutritional problems are influenced by interacting factors such as poverty, education, and food availability at the household level, which will affect the low income of the family. On the other hand, Labada et al. (2016) states that the number of family members also impact on child's nutritional status. Besides, the results of Setiani study (2013) shows that there is a significant relationship between nutritional status of children aged 6-12 months and their mother's knowledge level, job, and exclusive breastfeeding. Giri et al. (2013) also proves that there is a relationship between nutritional status and exclusive breastfeeding. Gender is also a determinant factor in determining the nutritional status of children as the result of Aries et al. (2012) study, namely there is a difference in the prevalence of malnutrition between girls and boys.

Based on above descriptions, this study aims to analyze the causality between nutritional status of children aged 6-23 months and characteristics of infants and socio-economic characteristics of mother and family. In this research, causality analysis is comprehensively conducted by using a tree-structured analysis named CART method. This method is nonparametric analysis as it does not require binding assumptions such as the normal distribution assumption for response variables. By using this method, the structure of the data can be visually viewed to facilitate the exploration and decision making depended on the obtained model. Moreover, the tree-structure method can identify interactions among predictor variables that are locally caused by gradually decision making in the set of complex data (Breiman et al., 1984)

In the health field, CART method can guide researchers to specify which variables can be chosen as potential intervention sites. This method is often used in public health since the research on behavioral factors has some intuitions of the most important predictor. (Jake, 2014).

METHODOLOGY

Study Design

This study intends to describe the variables that influence nutritional status of children aged 6-23 months. Assessment of nutritional status uses weight-for-age ratio index converted by WHO-NCHS standard. Child's nutritional status is obtained by first calculating the value of z-score using the formula:

$$z-score = \frac{(actual\ weight - reference\ median)}{reference\ standard\ deviation}.$$

Based on WHO standard reference there are four levels of nutritional status namely, severely underweight, underweight, normal, and overweight. Cut-off points are given: for severely underweight is z-score <- 3 SD, underweight -3SD <z-score <-2SD, normal -2SD <z-score <2SD and overweight z-score > 2 SD.

The hypothesized variables which effect child nutritional status are the characteristics of the children (age, sex, birth weight), family's socio economic characteristics (family income, total family dependent, exclusive breastfeeding status), and maternal characteristics (mother's education level, employment status, knowledge and nutritional behavior).

Sampling Design

This research is a survey study using descriptive and causality analysis. The survey was conducted in four districts in Padang City i.e. Lubuk Kilangan, Kuranji, West Padang and Nanggalo. The selection of districts is done in order to represent the socio-economic conditions of the people of Padang City. In addition, several previous studies have shown that in those districts the prevalence of malnutrition is still high. Octavianis (2016) indicates that from a survey of 88 children under five years old in Lubuk Kilangan District, 51.1% of them are suffering from malnutrition. Furthermore, Nilakeusema's et.al. research (2015) yields that from a survey of 107 children under five years old in West Padang District, only 82.8% have normal nutritional status. Based on the results of Lonika's research (2011), Out of 96 respondents in Kuranji District, 80.21% of children under five years old have normal nutritional status, 13.54% have underweight status and 6.25% have severely underweight status. Moreover, Putri et al. (2015) obtains that 36,6% out of 227 children under five years old in Nanggalo District have underweight status.

Respondents in this survey are mothers with their children aged 6-23 months. The selection of respondents was done by purposive sampling technique. The survey was conducted at several Mother

and Child Health Services ('posyandu'), daycare, and households in district of Lubuk Kilangan, Kuranji, West Padang and Nanggalo. The survey was conducted from August - September 2017.

Data analysis

In this study, the analysis of variables affecting nutritional status of children aged 6-23 months is done by using CART Method. CART aims to derive an accurate data group as a characteristic of a classifier. In addition, CART is used to describe the relationship between response variable (in this case the nutritional status of children) and one or more variables that are suspected to effect the response. The model is yielded by repartitioning the data set on the parent nodes into two subsets of data (called as child nodes) recursively based on the involved predictors in the analysis. This splitting procedure will continue until the termination rule is fulfilled. A terminal node is any node that can be splitted further and has no child nodes. Estimation is obtained at each terminal node. As a result, the partition procedure can be graphically depicted as a decision tree diagram which is easy to be intrepreted. Data analysis was done by using SPSS .

RESULTS AND DISCUSSION

Descriptive Analysis

This study was conducted on 218 mothers who have children aged 6-23 months, domiciled in four districts in Padang city i.e. Lubuk Kilangan, West Padang, Nanggalo and Kuranji. Table 1 and Table 2 refer to children's distribution based on their characteristics.

Table 1. Distribution of observations based on nutritional status of children

Nutritional Status	N	%
Severely underweight	5	2.3
Underweight	27	12.4
Normal	177	81.2
Overweight	9	4.1

Table 1 illustrates that the prevalence of 6-23 months children suffering from malnutrition (severely underweight, underweight, overweight) is still high, about 19% of the 218 children surveyed. This indicates that the nutritional problem still occures and needs special attention since children aged 6-23 months are very susceptible to malnutrition.

Table 2. Distribution of observations based on chlidren characteristics

Infant characteristics	N	%
Sex :		
Boy	93	42.7
Girl	125	57.3
Exclusive Breastfeeding status :		
Yes	189	86.7
No	29	13.3

Based on survey results, the percentage of boys and girls observed is quite similar. It is expected to reveal the characteristics of the child's nutritional status in proportion. Exclusive breastfeeding status in Table 2 shows that mothers have awareness of the importance of exclusive breastfeeding. Table 3 illustrates the distribution of observations depending on the characteristics of the family and mother.

Table 3 shows that most of the respondents come from middle dan low income families. In terms of education, about 25% of respondents have college degree. Furthermore, only 12.8 % of mothers have good nutritional knowledge while about 73% have good nutritional behavior.

Table 3. Distribution of observations based on family and mother characteristics

Characteristic of family and mother	N	%
Family income (IRD)		
< 2 million	111	50.9
2 -5 million	90	41.3
> 5 million	17	7.9
Mother's employment status		
Work	170	78.0
Unemployed	48	22.0
Mother's educations level		
Elementary school	11	5.0

Junior high school	26	11.9
Senior high school	126	57.8
College	55	25.2
Mother's nutritional knowledge		
Poor	73	33.5
Moderate	117	53.7
Good	28	12.8
Mother's nutritional behavior		
Bad	5	2.3
Good enough	54	24.8
Good	159	72.9

Nutritional Status Analysis by using CART Method

In the CART Method, the resulted model is graphically presented as a decision tree diagram. The split appearing variables are significantly influenced by the response variables, and the first to appear is the most significant.

Tree diagram of the nutritional status model is shown in Figure 1. It can be seen that the most significant variable affecting nutritional status is mother's education level. Other variables that significantly affect the nutritional status of children are mother's knowledge and nutritional behavior. The tree diagram describes the distribution of child's nutritional status whose first stage includes 218 observations divided into two groups namely groups of children with low mother's education level (elementary / junior / high school) and groups of children with higher mother's education level (college). Out of 218 observations, there are 164 children with low mother's education and 55 children with high mother's education.
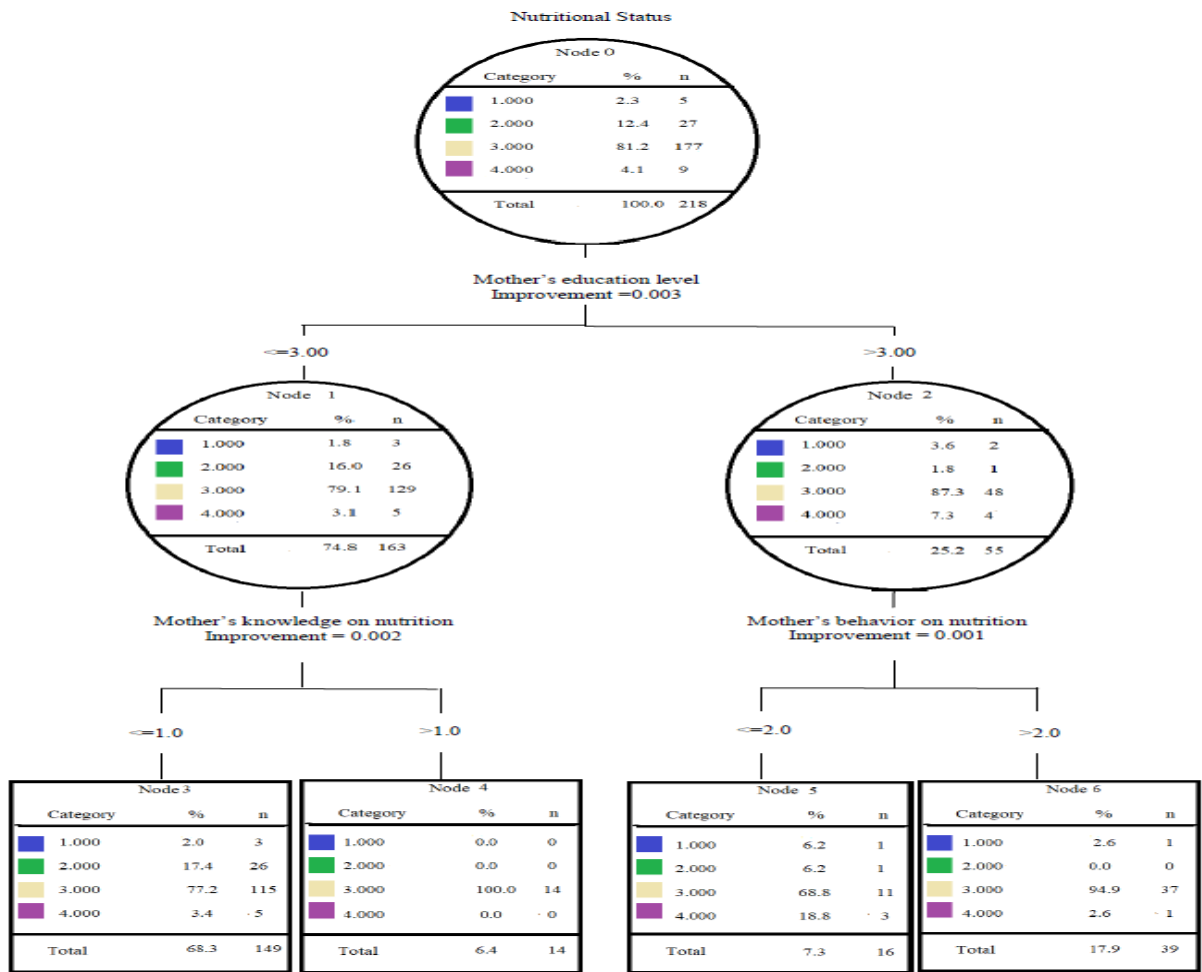
Fig.1. Tree Diagram of Nutritional Status Using CART Method

In the group of children with low mother's education level, the significantly variable effecting child's nutritional status is mother's nutritional knowledge. This implies that children with low mother's education level have higher prevalence of severely underweight and underweight when mother's knowledge is poor or enough. It should be noticed that the prevalence of overweight in children whose mothers have low education is likely to be higher compared to those whose mothers have low knowledge. However, children with low educated mother but have good nutritional knowledge have normal nutritional status.

Furthermore, in the group of children whose mothers have higher level of education, the variable that has a significant influence on child's nutritional status is mother's nutritional behavior. The distribution of child's nutritional status in this group indicates that the prevalence of normal nutritional status is high where his mother has good nutritional behavior. The prevalence of severely underweight and underweight describes no significant difference. However, the prevalence of overweight is likely to be high in children whose mothers nutritional behaviour is not good (good enough or bad).

Discussion

This study shows that mother's education level significantly influences child's nutritional status. It is inline with as observed by Semba et. al. (2008) who argues that mother's education level is significantly related to her child's nutritional status. Mothers who have higher education will have an impact on the pattern of care and nutritional behavior given to their children. Another variable that significantly effects the status is mother's nutritional knowledge. In addition, the study of Oktavian (2016) also shows that there is a significant relationship between mother's knowledge and nutritional status of children under five years old at Lubuk Kilangan Health Center. Lastanto's research result (2015) also reveals that there is a significant relationship between mother's knowledge and lack of nutrition of children under five years old at Cebongan Public Health Center.

Human knowledge depends on the education level gained both formally and informally. The level will have an effect on the ways one's understands the knowledge of nutrition and health. The nutritional knowledge level of an individual impact his attitudes and behaviors in choosing food which ultimately influences his nutritional state. The higher the level of an individual's knowledge, the better the state of his/her nutrition (Khomsan, 2007).

The results also indicate that mother's nutritional behavior also has a significant effect on the nutritional status of her child aged 6-23 months. This is inline with the results of Setyaningsih et al (2014) who argues that there is a tendency that the better behavior in the fulfillment of child nutrition a mother has, the better nutritional status her child will have. It is also similar to the results of Ningsih et. al (2014) who concludes that the better nutritional behavior a mother has, the better nutritional status her toddler will have.

Therefore, based on analysis of nutritional status of children aged 6-23 months by using CART method, it can be concluded that the variables that significantly affect the nutritional status of children are mother's education, nutritional knowledge and behavior. The results show that mothers with low education can have children with normal nutritional status as long as they have good knowledge. Although mothers have high levels of education but they do not have good nutritional behaviour, they may have children with malnutrition (severely underweight, underweight or overweight). Therefore, hard effort from related parties is recommended to improve mother's nutritional knowledge, for example by activating more extension activities for mothers in posyandu, BKB groups (family building of children under five years old), and PKK (Empowerment and Family Welfare).

CONCLUSION

Based on data analysis result by using CART method, it is found that there is no significant influence among variables of sex, birth weight, family income, number of family dependents, mother's work status, and exclusive breastfeeding regarding the nutritional status of children aged 6-23 months. The variables that significantly influence the nutritional status of them are mother's education level, knowledge and nutritional behavior. Thus, intervention from related parties is needed to implement programs that can improve mother's nutritional knowledge. The better knowledge a mother has, the better mother's nutritional behavior will be and then the better nutritional status children will have.

REFERENCES

Amosu, A.M., Degun, A.M., Atulomah, N.O.S., andOlanrewju, M. F. 2011. A study of the Nutritional Status of Under 5 Children of Low-Income Earners in a South-Western Nigerian Community. Current Research Journal of Biological Sciences, 3(6):578–585

Aries M., Hardinsyah, and Tuhiman H. 2012. The Determination of Underweight and Stunting Children Aged 0 - 36 Months Based on the Data of Conditional Family Program (CFP) 2007,Journal of Nutrition and Food, 7 (1): 19 – 26

Breiman L., Friedman J.H Olshen R.A & Stone C.J. 1984. Classification and Regression Tree. New York, NY: Chapman and Hall

Chandran, V. 2009. Nutritional Status of Preschool Children: a Socio-Economic Study of Rural Areas of Kasaragod District in Kerala. Journal of Shodhganga,X: 163

Gabrielle, A. and Schettino, F. 2007. Child Malnutrition and Mortality in Developing Countries: Evidence from a Cross-Country Analysis. Online at http://mpra.ub.uni-muenchen.de/3132/MPRA , Paper No. 3132, posted on July 11th, 2007.(Accessed on November 9th, 2017)

Giri, M.K.W, Muliarta I.W, Wahyuni D.S. 2013. The Relationship between Exclusive Breastfeeding and Nutritional Status of children aged 6-24 months in Kampung Kajanan, Buleleng. Jurnal Sains and Teknologi, 1(1) : 184 –192. https://doi.org/10.23887/jst-undiksha.VIII.1423

Khomsan A. 2007. Study of Nutrition Program Implementation: Utilization, Coverage of Effectiveness and Impact on Nutritional Status. Bogor. Department of Community Nutrition, Bogor Agricultural University.

Labada, A., Ismanto, A., & Kundre, R. 2016.The Relationship between The Characterization of Mother with Nutritional Status of Children Under Five years that Visiting in The Center of Public Health of Bahu Manado. e-Journal of Nursing. http://ejournal.unsrat.ac.id/index.php/jkp/article/view/ 11899

Lastanto. 2015. The Analysis of Factor that Influence Under Five Underweight Incidences in Working Area of Cebongan Community Health Center. Theses, unpublished. Surakarta. STIKES KusumaHusada

Lonika A. 2011. Factors that influence the Nutritional Status of Children under Five Years (Case Study: District Kuranji Padang). Theses, unpublished. Padang. Andalas University

Martorell R, Kettel K.L, and Schroeder D.G. 1994. Reversibility of Stunting: Epidemiological Findings in Children from Developing Countries. Eur. J. Clin. Nutr. : 45 – 57

Morgan Jake. 2014. Classification and Regression Tree Analysis.Boston University School of Public Health, Department of Health Policy and Management.

Nilakesuma, A., Journalist, Y. D., &Rusjdi, S. R. 2015. The Relationship between Infants Nutritional Status and Exclusive Breastfeeding, Maternal Education Level and Family Economic Status in Work Area of Padang PasirCommunity Health Center.Andalas Journal of Public Health, 4 (1):37 – 44

Ningsih S, Kristiawati, Krisnana I. 2014. The Relationship between Mother's Behavior and Underweight Status of Toddler. Pediomaternal Nursing Journal3(1): 58 – 65

Octavianis. 2016. Some Factors Related to The Nutritional Status of Toddlers at LubukKilanganPublic Health Center. Human Care Journal, 1(3): 1 – 12

Onis M., Dewey K.G., Borghi E., Onyango A.W., Blössner M., Daelmans B., Piwoz E., Branca F. 2013. The World Health Organization's global target for reducing childhood stunting by 2025: Rationale and proposed actions. Matern.Child Nutr. 9(52):6–26, doi: 10.1111/mcn.12075. https://www.ncbi.nlm.nih.gov/pubmed/24074315

Putri R.F., Sulastri D., Lestari, Y. 2015. Some Factors Related to TheNutritional Status of Children Under Five Years in the Working Area of NanggaloPublic Health Center Padang. Andalas Journal of Public Health, 4(1) :254 – 261, http://jurnal.fk.unand.ac.id

Pelletier D.L. andFrongillo E.A. 2003.Changes in child survival are strongly associated with changes in malnutrition in developing countries. Journal of Nutritions. 133(1):107–119

Semba R.D., de Pee S, Sun K, Sari M., Akhter N., and Bloem M.W. 2008. Effect of parental formal education on risk of child stunting in Indonesia and Bangladesh: a cross-sectional study. Lancet, 371 :322 – 328

Setiani D.Y. 2013.Some Factors Related to the Nutritional Status of Infants Aged 6-12 Month at Posyandu Sub District "B"Surakarta City, Theses, unpublished. Jakarta. STIK Saint Carolus.

Setyaningsih S.R., Agustini N. 2014. Knowledge, Attitude, and Behavior of Mothers related to the Nutritional for Preschool Children: An Observation. Indonesian Journal of Nursing, 17(3): 88 – 94

Siswono. 2003. Brain Growth Occurs In the First 2 Years of the Beginning of Life. http://www.gizi.net (accessed on October 3rd, 2017)