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Nutritional Status of Child Under Five Years Model Based of Consumption, Behavior, Biology and Environment Factors

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Abstract---Malnutrition problem is one of the major public health problem in Indonesia. In Pengotan village, as one of the traditional villages of Bali, malnutrition problems among child under five still exist. The local community has a unique traditional way of life. However, the majority of the households are poor which lack of education, low income, and own limited land. The objective of this cross-sectional survey was to investigate the nutrition status model of Pengotan village based on consumption, behavior, biology and environmental factors. Confirmatory Factor Analysis (CFA) showed that behavior and consumption can be continued to analyze Structural Equation Model (SEM). However, biology and environment factors were not appropriate to be used. The final model that fit to nutrition status was behavior (r=0,389) and consumption factors (r=-0,254). Factors affected nutrition status among others were food, infection, food intake and utilize, environment, lifestyles, medical care and heredity, biology, environment, and behavior. However, this study found that dominant factors related to nutrition status of children under five in Pengotan village were behavior and consumption factors.
Keywords---behavior, consumption, nutritional status, SEM.

Introduction

Under-nutrition in child under five years is still one of public health problem in Indonesia. Infant growth monitoring by PHC Bangli, in December 2009 in the village of Pengotan reported there is still a child under five years underweight 9 people (3.8%) and severely underweight one person (0.4%) [1]. In December 2010 there was an increase in the number of children under five underweight is becoming 12 people (7.06%) and severely underweight remain one person (0.59%) [2]. In November 2011 the number of children under five underweight is rising again to 13 people (5.75%) and severely underweight still remains one person (0.44%) [3].

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Factors associated with nutritional problems described by some experts such 1) Call and Levinson (1973) stated nutritional status is influenced by food intake and food use [4], 2) Blum (1983) stated that health status is affected by environmental, behavioral, health services and heredity [5]. 3) UNICEF (1998) stated that the immediate cause of malnutrition in infants is low consumption of food and infectious diseases [6]. and 4) Cheah et al. stated nutritional problems are influenced by three main factors that is biological, environmental and behavioral factors [7]. Pengotan village belonging Bali Age Village has a unique associated with the implementation of religious ceremonies [8].

Implementation of nutrition programs always to consider the availability the budget, while funding has been allocated to support the implementation of a program is not easily modified in accordance with the development of the situation in the field. Level of education the community in the village Pengotan which low status of poor households also characterized by low purchasing power of the family so the family consumption insufficient nutrients the body needs, especially child under five years. This situation has the potential to increase the incidence of nutritional problems in child under five years. Based the above description should be analyzed risk factors associated with the occurrence of nutritional problems, especially the problem of malnutrition in children under five in the village Pengotan.

These factors are then analyzed statistically using a structural equation model (SEM) to assess the strength of the relationship with the other factors. The results of SEM analysis is used to create a model of a problem of nutrition in infants with a nutritional problem that connects the behavioral, consumption, environment and biology factors.

In general, this study aimed to develop a model of nutritional status of child under five years in the Pengotan village of Bangli based on consumption, behavioral, biological and environmental factors. This study is expected to find a model-specific nutritional status of child under five years and can increase the development of knowledge, especially about the risk factors associated with the occurrence of nutritional problems in child under five years.

Research Methods

This type of research is an analytic survey with cross-sectional design. The study was conducted in Pengotan Village as one of the traditional village Bali. The target population is all child under five years numbering 260 people. To fulfill the requirements of data analysis using the Structural Equation Model (SEM) around 200-400 [9].

Results

Analysis of Structural Equation Model (SEM)

- *Measurement Model*

Confirmatory factor analysis (CFA) of factor of nutritional status with weight for age (SG1), height for age (SG2), weight for age (SG3) and BMI for age (SG4) is said to be able to explain the nutritional status variables when loading estimate value> 0.5 or p-value <0.05. The SG1 indicator value estimate loading> 0.5, while the SG3 and SG4 has a p-value <0.05, but SG2 has p-value >0,05. That is an indicator SG1, SG3 and SG4 valid variables used to describe the nutritional status, so it can be used for the model analysis.

CFA of factor consumption with the indicator value estimate energy consumption (FK1a) loading > 0.5, while protein consumption (FK1b), composition of the dish (FK3) and different types of consumption (FK4) has a p-value <0.05, but frequency of eating (FK2) and availability of materials food (FK5) has p-value >0,05. That is an indicator FK1a, FK1b, FK3 and FK4 valid explaining consumption factors that can be used for the model analysis.

CFA of factor behavior with the indicator value estimate loading Breastfeeding (FP1) > 0.5, while weaning age (FP3), utensil Eating (FP6), hygiene child under five years (FP8) and history of prenatal care (FP10) has a p-value <0.05, but complementary feeding (FP2), way of food preparation (FP4), feeding (FP5), abstinence food (FP7), maternal nutrition knowledge (FP9), history of childbirth (FP11) and frequency of visits of health services (FP12). That is an indicator

FP1, FP3, FP6, FP8 and FP10 valid explain behavioral factors that can be used for the model analysis.

CFA factor biology with the indicator value estimate loading child under five years age (FB1)>0.5, while birth weight (FB2) and infectious disease (FB3) has a p-value> 0.5. That is only valid indicator of FB1 explains biological factors. To explain the biological variables have to use more than one indicator variable. Because only one valid indicator of biological factors explains (FB1), the biological factors are not used for the model analysis.

Confirmatory Factor Analysis factor environment with the income level (FL1) indicator value estimate loading> 0.5 while expenditures level (FL2), cost ceremony (FL3), access to health care (FL4) and environmental sanitation (FL5) has a p-value> 0.05. That is only a valid indicator FL1 explain environmental factors. To explain the environmental variables have to use more than one indicator variable. Because only one indicator (FL1) valid environmental factors explain the environmental factors are not used in the model analysis.

- *Structural Models*

A structural model is to determine the relationship between the dependent and independent variables. To determine the most appropriate models can be seen in the output analysis of SEM that is 1) an assessment of normality to see the normality of the data, 2) observations farthest from the centroid to see the data outliers, 3) the standardized regression weights to see the strength of the relationship between variables dependent and independent, 4) modification indices for re-specification models and 5) the model fit summary to see the feasibility of the model.

Distribution of data is considered normal if the value of cr skewness, kurtosis and cr cr multivariate average under 2.58. Given a sample size >200, then the data is considered to be normally distributed. Outlier data is data that has extreme value compared to other data points. Mahalanobis Distance Based on the put out there are 71 data including outliers with values p2 <0.5.

- *Feasibility of Test Model*

Measurement models are part of the SEM models consisting of a dependent variable or multiple variables and multiple independent variables indicators of each of these variables. After measurement models proved to be valid, the process continued with the structural model of the analysis of the relationship between the independent and dependent variables and between indicators.

Figure 1 illustrates the relationship between the dependent variable, and the independent indicator. Based on the goodness of fit index consisting of six feasibility test method is Chi-Square, GFI (Goodness of Fit Index) ≥ 0.90, AGFI (Adjusted Goodness of Fit Index) ≥ 0.80, TLI (Tucker-Lewis Index) ≥ 0.90, CFI (Comparative Fit Index) ≥ 0.90 and RMSEA (Root Mean Square Error of Approximation) ≤ 0.08, it turns out none of which meet the required cut-off value so that the model is not yet feasible.

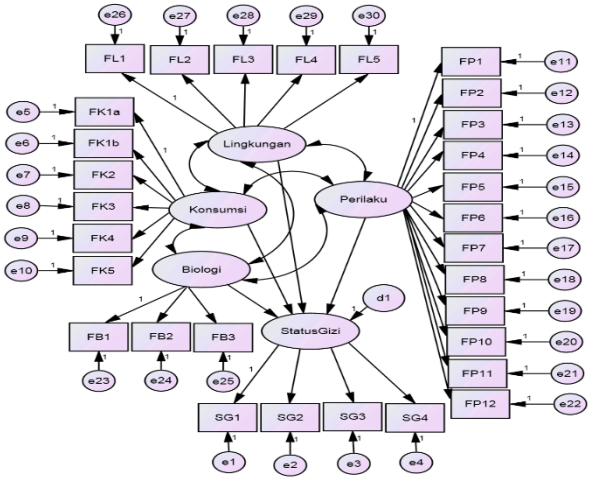

Figure 1. Relationship Model Dependent Variable Nutritional Status, independent variables Consumption, Behavior, Biology and Environment and indicators

Based on the results of the CFA measurement models, biological and the environment independent variables can not be used in the SEM analysis. Analysis SEM model shown in Figure 2 involving the dependent variable nutritional status (SG1, SG3 and SG4) and the independent variable consumption (FK1a, FK1b, FK3, and FK4) and behavior (FP1, FP3, FP6, FP8 and FP10).

Table 6 shows that the four methods of the six methods used to assess the feasibility of models already meet the cut-off value, so that the model can be said to be feasible. Although the model is feasible, but there are 71 of data outliers, that is based on the Mahalanobis method by looking at the column p2 <0.05. After the removal of data outliers 40 of data, followed by SEM analysis.

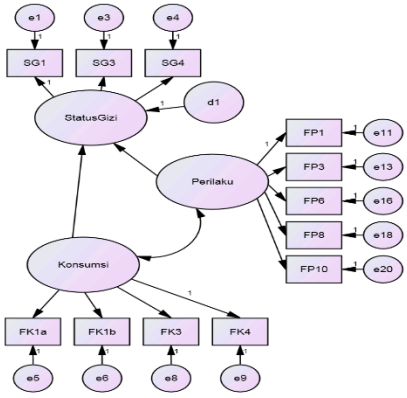

Figure 2. Relationships Model Dependent Variable Nutritional Status, Independent Variables and Consumption Behavior and Indicators

Table 1. Goodness of Fit Index Confirmatory Model Nutritional Status, Consumption, and Behavior

Goodness of Fit Index	*Cut-off value*	Models Result	Information
Chi-Square	Expected small	132.598	Feasible
df		51	-
Probability	Positive ≥ 0.05	0.000	-
GFI	≥ 0.90	0.917	Feasible
AGFI	≥ 0.80	0.873	Feasible
TLI	≥ 0.90	0.815	Not Feasible
CFI	≥ 0.90	0.857	Not Feasible
RMSEA	≤ 0.08	0.079	Feasible

Relationship model variable nutritional status, consumption and behavior using the data 220 still looks like Figure 2. To get a decent model of Table 1 shows the results of the feasibility analysis of the model. Of the six methods used to assess the feasibility of the model have been four methods meet the cut-off value, so we can conclude the model is feasible. Values in the column model results show Table 2 better than Table 1.

Table 2. Goodness of Fit Index Confirmatori, Model Nutritional Status, Consumption, and Behavior by Eliminating Data Outliers

Goodness of Fit Index	*Cut-off value*	Model Results	Information
Chi Square	Expected small	96.100	Feasible
df	Positive	51	
Probability	≥ 0.05	0.000	
GFI	≥ 0.90	0.929	Feasible
AGFI	≥ 0.80	0.892	Feasible
TLI	≥ 0.90	0.815	Not Feasible
CFI	≥ 0.90	0.857	Not Feasible
RMSEA	≤ 0.08	0.064	Feasible

- *Respsifikasi Model*

Although the model is said to be feasible according to the results in Table 2, however, it needs to be modified (re-specification models) by following the results of loading "modification indices", as shown in Table 3.

Table 3. Results Loading Model Modification Indices

Independent Variables and *Error*			*M.I.*	*Par Change*
e5	<-->	Behavior	5.700	.042
e6	<-->	Behavior	6.149	-.052
e8	<-->	e4	6.868	.154
e9	<-->	e4	16.551	.272
e9	<-->	e8	19.712	.224
e13	<-->	Consumption	4.383	-.017
e11	<-->	e13	10.676	.037
e11	<-->	e16	5.539	-.024

By following the modification indices in Table 3, the e5 is connected with the behavior; e6 associated with the behavior; e8 associated with e4 and so on, in order to obtain results as shown in Figure 3.

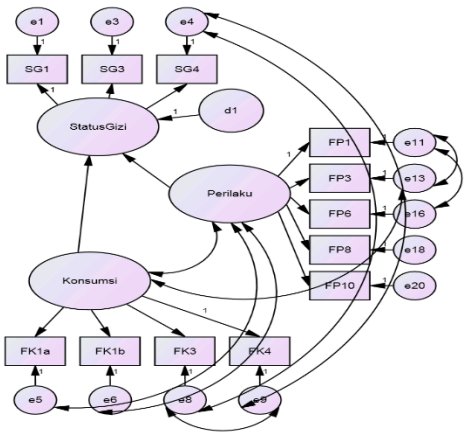

Figure 3. Model Respesifikasi Relations between Dependent Variable Nutritional Status, Independent Variables and Consumption Behavior and indicators

Based on the six models, namely the feasibility test method Chi-Square 24.953 value is less than Chi-Square 96.100 (Table 4), GFI (Goodness of Fit Index) ≥ 0.90, AGFI (Adjusted Goodness of Fit Index) ≥ 0.80, TLI (Tucker-Lewis Index) ≥ 0.90, CFI (Comparative Fit Index) ≥ 0.90 and RMSEA (Root Mean Square Error of Approximation) ≤ 0.08. Table 4 shows that the goodness of fit index results re-specification models already fulfill required cut-off value so that the model is feasible.

Table 4. Goodness of Fit Index Confirmatori, Respesifikasi Model Nutriton Status, Consumption and Behavior

Goodness of Fit Index	Cut-off value	Respesifikasi Model Result	Information
Chi-Square	Expexted small	24.953	Feasible
df		43	
Probability	Positive ≥ 0.05	0.987	
GFI	≥ 0.90	0.982	Feasible
AGFI	≥ 0.80	0.967	Feasible
TLI	≥ 0.90	1.088	Feasible
CFI	≥ 0.90	1.000	Feasible
RMSEA	≤ 0.08	0.000	Feasible

Table 5 p-value column with values <0.05 or columns estimate the value of > 0.5 indicates an indicator FP1, FP3, FP6, and FP8 can explain the behavior of the independent variables. Indicators SG1, SG3, and SG4 can explain the dependent variable nutritional status. Indicators FK1a, FK1b, FK3 and FK4 independent variables can explain consumption. It can be concluded all indicators explain the dependent variable or independent.

Table 5. Loading Regression Weight Results Relations Dependent Variable, Independent and indicators

Relations Dependent, Independent Variable dan Indicators			*Estimate*	*p-value*
FP1 (Breastfeeding)	<---	Behavior	1.000	
FP8 (Hygiene under five)	<---	Behavior	0.921	0.020
FP10 (history of Prenatal Care)	<---	Behavior	0.521	0.090
FP6 (Eating Utensil)	<---	Behavior	0.690	0.014
FP3 (Weaning Age)	<---	Nutrition Status	0.445	0.043
SG1 (Weight for Age)	<---	Nutrition Status	1.000	
SG3 (Weight for Height)	<---	Nutrition Status	3.903	0.005
SG4 (BMI for age)	<---	Consumption	4.330	0.002
FK4 (Different Types of Consumption)	<---	Consumption	1.000	
FK1a (Energy Consumption)	<---	Consumption	2.904	0.000
FK1b (Protein Consumption)	<---	Consumption	3.599	0.000
FK3 (Composition of The Dish)	<---	Consumption	0.852	0.000

The independent variables behavior are strong enough to explain of the dependent variable nutritional status (r = 0.389), as well as the independent variables consumption explain is strong enough the dependent variable nutritional status (r = -0.254), or in other words, the behavior of the independent variables explain 15.13% of the nutritional status of the dependent variable and the independent variable consumption rate of 6.45%, while the remaining 84.87% to the behavior of the independent variable and 93.55% for the independent variable is explained by the unique consumption factor, in this case, the error (d1). The relationship between the independent variable is the independent variable consumption relationship with the behavior strong enough (r = 0.505). That is meaning 25.5% of the independent variable behavior explains the independent variable consumption.

The simultaneous consumption and behavior independent variables associated is strong enough with the dependent variable nutritional status. Nutritional status column value estimate of 0.116

means 11.6% simultaneously the nutritional status influenced by the independent variables consumption and behavior.

Discussion

Consumption independent variables explain the dependent variable nutritional status is strong enough (r = -0.254). In other words, the independent variable consumption rate of 6.45%, explaining the dependent variable nutritional status, while the remaining 93.55% is the independent variables consumption explained by the unique factor, in this case, the error (d1).

Indicators that can explain the consumption factor is the total protein consumption, total energy consumption, different types of consumption and composition of dishes a day. Unique factors distributed on consumption is likely invalid consumption indicator is the frequency of meals a day and the availability of food in the household. In addition to the indicators that have been used to measure the consumption of other possible factors are indicators of the absorption of food in the body. The use of food in the body is highly dependent on the digestibility of food and quality of food (bioavailability). Call and Levinson (1973) also stated nutritional status is influenced by food intake and food use [4].

The process of digestion and absorption in the body also contributes to the fulfillment of nutritional needs for the infant's growth process. Circumstances that enable the digestion and absorption process works well is the environmental conditions (sleep, rest, physical activity and emotional state) and the type of food eaten (balance, diversity and adequacy) [10].

The composition of the dish a day that is not observing the principles of a balanced diet and low of different types of consumption caused to the low of food consumption that results in low levels of energy and protein consumption. Furthermore, the consumption of nutrients that do not fulfill the body's needs will result in not optimal nutritional status.

The impact of energy consumption and protein deficiency in a long period without effective prevention efforts can lead to problems of malnutrition or poor, or the appearance of a short or skinny child under five years [6]. Child under five years of food consumption, especially in the Pengotan village so needs to be improved by utilizing a source of nutritious food from the local environment and the application balanced diets by attention to the nutritional needs of the child under five years. Chid under five years consumed a balanced diet every day contains a wide range of food so that the quantity and quality of complementary nutrients needed. Nutrient consumption child under five years appropriates the recommended dietary allowance will affect the achievement of optimal nutritional status [10].

Several studies support the relationship with the consumption of nutritional status of children is 1) UNICEF stated a direct cause of malnutrition among children under five are dietary factors [6], 2) The prevalence of short infants associated with consumption of food [11], 3) Parenting feeding of the children can meet the needs of nutrients impact on the achievement of optimal nutritional status [12, 31], 4) Nutritional problems influenced the behavior described by the indicator percent of calories and protein percent the recommended dietary allowance [7], 5) nutritional status related to the level of energy consumption [13], and 6) Increase weight infants malnutrition associated with energy consumption [14]. The incidence of stunting influenced consumption, especially consumption of proteins and different types of consumption [15].

Independent variables behavior are strong enough to explain of the dependent variable nutritional status (r = 0.389). In other words, the behavior of the independent variables explain 15.13% of the nutritional status of the dependent variable, while the remaining 84.87% is explained by the independent variables unique behavioral factors, namely error (d1). Indicators that can explain the behavior factor is breastfeeding, hygiene child under five years, weaning age and history of prenatal care, eating utensils. These indicators affect the level of nutrient consumption and further toddler affect the achievement of optimal nutritional status.

Program early initiation of breastfeeding which encourages child under five years mothers in Pengotan village to breastfeed immediately after childbirth as much as 56.9%. Riskesdas 2010 stated there is a tendency of a higher level of education or economic status, the higher the percentage of mothers give colostrum to the baby, but the lower exclusive breastfeeding [16, 32].

The research find exclusive breastfeeding associated with the incidence of diarrhea [17]. To succeed in this early initiation of breastfeeding programs every across sectors and programs should be mutually supportive. Private birth attendant (midwife/nurse/doctor), health workers (Department of Health, health center, health center/hospital), Tim Mover Increased Family Welfare District/Sub-District/Village, Integrated Service Post (Agency for Community Empowerment Village Government/Village Head /Cadre Integrated Service Post) and so on, must continue to improve the performance and doing their jobs.

Unique behavioral factors probability distributed on behavioral indicators invalid that is way of preparing food, maternal nutritional knowledge, frequency to healthcare, food taboos, childbirth history, way of feeding and giving complementary feeding. Study in Purbalingga, Central Java stated malnourished child under five years who had parents with primary school education level [18].

Mother visits to integrated service posts *(posyandu)* in Pengotan village for child under five years weighing regularly every month as much as 181 subjects (69.6%). Achieving this requires attention so it can be increased according to the desired target (80.0%). Riskesdas (2010) stated that there is a tendency the higher the level of education and economic status, the lower the percentage of children who are not weighed [16, 33].

Child under five years who can not regularly visit to *posyandu* to be given motivation through home visits *posyandu* cadre, or appeals the head of the hamlet, village heads, or improvement of family welfare (*PKK)* respected public figures like *kelian/ bendesa* indigenous stakeholders in each temple in every village in the region Pengotan village. To increase visits to posyandu need for efforts to improve the *posyandu* revitalization program. *Posyandu* management capabilities continue to be improved, so that there is a special attraction for mothers to visit the the posyandu on a regular basis every month [19, 20, 21]. Frequency to integrated service post (*posyandu)* and health card (*KMS)* ownership is not related to nutritional status by weight for height and height for age [22]. The parenting based feeding practices associated with nutritional status [23]. The giving local complementary feeding increased the weight, especially at month 2 and influential improve nutritional status at month 3 [24].

The one of the factors influencing health status is behavior such prenatal care, maternal physical health, socio-cultural (income, education, occupation) [5]. This statement supports the results of research on the relationship the nutritional status with behavior, especially the history of antenatal care. Child under five years age is one factor to determine nutritional needs. Energy and protein consumption increased accordingly age infants increased to achieve optimal growth and development. Example, male infants aged 12 months based on the recommended dietary allowance of energy requires 2050 kcal and 50 grams of protein to achieve optimal nutritional status. This menu can be supplemented with additional food made from "Kahiguru" ingredients that contain high protein [25].

These results contrast with research Cheah et al. 2010, which states there is a relationship between biological factors (age and birth weight) and nutritional status [7]. However, there are several studies that support this research that the nutritional status (weight/height) is not associated with birth weight [22] and the incidence of sick [26] and the birth weight was not associated with the incidence of respiratory infection in infants [27].

Research Cheah et al. (2010) stated one of the environmental indicators is the amount of spending and family income is the key factor causing nutritional problems and states the nutritional status associated with particular environmental sanitation. It turned to the two results of these studies do not support these results [5, 6]. However, several studies support the results of this study are found the economic condition is not related to nutritional status [28], stated that environmental sanitation is not related to the frequency of diarrhea and nutritional status [29] and environmental sanitation hygiene is not related to the incidence of diarrhea [30].

Conclusion

Based on the results and discussion and supported with relevant references can be summarized as follows: 1) Models nutritional status of children in Pengotan village determined by consumption and behavior, 2) Nutritional status of child under five years in Pengotan village related with

consumption (r = -0.254), especially the amount of protein and energy consumption, different types of consumption andm composition of the dishes a day, 3) Nutritional status of child under five years in Pengotan village related with behavior (r = 0.389), especially breastfeeding, age of weaning, child under five years hygiene, history of prenatal care and eating utensils, 4) Nutritional status of child under five years in Pengotan village not related to biology and environment.

Related results of the study suggest the following:1) Reduction programs nutritional problems in the village of Bangli Pengotan should focus on behavioral factors, especially breastfeeding, weaning age, toddlers and hygiene history of prenatal care, as well as the number of factors, especially the consumption of energy and protein intake, 2) Villages which have characteristics similar to Pengotan village can conduct pilot nutrition program to improve nutritional status of child under five years with a focus on programs related to behavioral factors and child under five years consumption, 3) Further research needs to be done related to biological and environmental factors in Pengotan village of Bangli by adding indicators such as the level of absorption of nutrients on biological factors or social interaction on environmental factors.

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