

Analysis of Stunting Risk Factors Using Binary Logistic Regression in the Working Area of Napan Community Health Center, North Bikomi District, North Central Timor Regency

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ABSTRACT

Stunting is a chronic nutritional problem that affects children's physical growth and cognitive development. This study aimed to identify the risk factors associated with stunting among toddlers in the working area of the Napan Community Health Center, North Bikomi District, North Central Timor Regency. This research employed a quantitative approach using binary logistic regression, since the response variable was dichotomous, namely stunted and non-stunted. The study used primary data obtained through structured interviews and direct measurements, supported by secondary data from the Napan Community Health Center. The population consisted of 433 toddlers aged 0–60 months, and 108 toddlers were selected as the sample, comprising 54 stunted and 54 non-stunted toddlers. The simultaneous test showed that the predictor variables jointly affected stunting incidence. The partial test indicated that dietary habit and child-rearing culture were significant factors influencing stunting. The model explained 47.4% of the variation in stunting status and had a classification accuracy of 75.9%. These findings suggest that improving children's dietary practices and strengthening appropriate child-rearing patterns are important in reducing the risk of stunting in the study area.

KEYWORDS

Stunting, Binary Logistic Regression, Toddlers, Risk Factors, Napan Community Health Center..

1. INTRODUCTION

Stunting remains one of the most serious nutritional problems affecting children under five years of age. It reflects chronic malnutrition caused by prolonged inadequate nutritional intake, recurrent infections, poor environmental sanitation, and inappropriate childcare practices. Stunting not only inhibits physical growth but also affects cognitive development, learning ability, and productivity in later life. Therefore, stunting is not merely a health problem, but also a major challenge for human resource development [1, 2].

In Indonesia, stunting continues to be a public health concern, particularly in rural and socioeconomically vulnerable areas. Although the national prevalence has gradually declined, disparities across regions remain substantial. Border and remote areas often face more complex conditions, such as limited health services, inadequate sanitation, unsafe water access, and persistent cultural practices related to child feeding and childcare. These conditions make the study of stunting determinants at the local level especially important [3], [4], [5].

Previous studies in Indonesia have identified several determinants of stunting, including nutritional intake, birth weight, maternal education, family income, sanitation, and parenting practices [3], [5]. However, evidence from rural border areas

such as the working area of the Napan Community Health Center remains limited. This area has distinct geographical, social, and cultural characteristics that may shape the pattern of stunting risk factors differently from other regions. Therefore, an area-specific analysis is needed to provide more contextual evidence for local intervention.

Binary logistic regression was used in this study because the dependent variable was dichotomous, namely stunted and non-stunted. This method is suitable for examining the simultaneous effect of multiple predictor variables and for identifying the most influential risk factors [3]. Based on this background, this study aimed to analyze the risk factors associated with stunting among toddlers in the working area of the Napan Community Health Center, North Bikomi District, North Central Timor Regency.

2. LITERATURE REVIEW

2.1 Stunting

Stunting is a condition of chronic growth failure in children caused by long-term inadequate nutritional intake, recurrent infections, and insufficient care. According to the World Health Organization growth standard, a child is categorized as stunted when the height-for-age index is below minus two standard deviations from the median. Stunting is associated with impaired physical growth, poor cognitive development, reduced educational performance, and lower productivity in adult life [1, 2].

2.2 Factors Associated with Stunting

Stunting is a multifactorial problem. Several factors may contribute to its occurrence, including demographic characteristics, nutritional intake, disease history, socioeconomic status, access to health services, environmental sanitation, and cultural parenting patterns [4, 5]. Low birth weight is often considered a biological risk factor because it may reflect inadequate fetal growth. Recurrent infection can reduce nutrient absorption and increase metabolic demand. Exclusive breastfeeding and complete immunization may protect children from illness and nutritional deficiencies. Dietary habit plays a key role because insufficient dietary diversity and low food intake can result in chronic undernutrition [6, 7]. In addition, parental income, access to clean water, and child-rearing culture may influence the daily health and nutrition of children [4, 8].

2.3 Binary Logistic Regression

Binary logistic regression is a data analysis method used to determine the relationship of a binary (dichotomous) variable (Y) with predictor variables (X), whether they are categorical or continuous.

Suppose the probability of the variable y given the value x is denoted as $\pi(x)$. The model $\pi(x)$ is denoted as follows:

$$\pi(x) = \frac{e^{\beta_0 + \beta_1 x_1 + \dots + \beta_p x_p}}{1 + e^{\beta_0 + \beta_1 x_1 + \dots + \beta_p x_p}} \quad (1)$$

This equation is called the logistic regression function which shows a non-linear relationship between the independent variables and the probability. To obtain a linear relationship, a transformation is performed, often called the logit transformation. The logit form of $\pi(x)$ is expressed as $g(x)$, namely:

$$\text{logit}[\pi(x)] = g(x) = \ln \left[\frac{\pi(x)}{1 - \pi(x)} \right] = \beta_0 + \beta_1 x_1 + \dots + \beta_p x_p \quad (2)$$

This model is a linear function of its parameters. In logistic regression, the dependent variable y is expressed as $y = \pi(x) + \varepsilon$, where ε can have one of two possible values: $\varepsilon = 1 - \pi(x)$ with probability $y = 1$ and $\varepsilon = -\pi(x)$ with probability $1 - \pi(x)$ if the value $y = 0$, and it follows a binomial distribution $(1, \pi(x))$ with mean 0 and variance $\pi(x)(1 - \pi(x))$.

2.4 Multicollinearity Test

The multicollinearity test is conducted to identify whether there is correlation among the independent variables in the regression model. The presence or absence of multicollinearity can be known through the correlation coefficient of each independent variable. A good regression model should show no correlation between independent variables.

In the multicollinearity test, if the VIF value is less than 10 or the Tolerance value is greater than 0.01, then there is no multicollinearity. Meanwhile, if the VIF value is greater than 10 or the Tolerance is less than 0.01, then multicollinearity occurs.

2.5 Significance Tests for Parameters

Parameter significance testing in regression usually includes simultaneous and partial tests, as both are used to evaluate the regression model as a whole and individually.

The simultaneous test aims to determine whether the independent variables collectively (simultaneously) have a significant influence on the dependent variable. The hypotheses used in the simultaneous test are: $H_0: \beta_1 = \beta_2 = \dots = \beta_p = 0$ (There is not X variables that has an effect on Y variable)

$H_1: \beta_j \neq 0, j = 1, 2, \dots, p$ (at least one X variable that has an effect on Y variable).

The test statistic used in the simultaneous test is the G Test.

$$G = -2 \ln \left[\frac{\left(\frac{n_1}{n}\right)^{n_1} \left(\frac{n_0}{n}\right)^{n_0}}{\prod_{i=1}^n \pi_i^{y_i} (1 - \pi_i)^{1-y_i}} \right] \quad (3)$$

Where:

$n_0 = \sum_{i=1}^n (1 - y_i)$: number of observations with category $y = 0$

$n_1 = \sum_{i=1}^n y_i$: number of observations with category $y = 1$

n = total number of observations

p = number of parameters Reject H_0 if $G > \chi^2_{(v, \alpha)}$ or $p\text{-value} < \alpha$, where v is the degrees of freedom (the number of predictor variables in the model without β_0).

The partial test is used to analyze the influence of each independent variable on the dependent variable [9]. In the partial test, the following hypotheses are used:

$H_0: \beta_j = 0$ (There is not an independent variable that influence the dependent variable) $H_1: \beta_j \neq 0, j = 1, 2, \dots, p$ (at least one independent variable influence the dependent variable)

In this study, the partial test is performed using the Wald test statistic.

$$W = \frac{\hat{\beta}_j}{SE \hat{\beta}_j} \quad (4)$$

Description:

W = Wald test

$\hat{\beta}_j$ = parameter estimate (estimated value)

$SE \hat{\beta}_j$ = standard error for the coefficient $\hat{\beta}_j$

Reject H_0 if $W > Z_{\alpha \frac{1}{2}}$ or $p_{value} < \alpha$

2.6 Goodness of Fit

The model goodness-of-fit test is conducted to assess whether the obtained regression model is appropriate, so that there is no significant difference between the observational data and the model's prediction results.

Hypotheses:

H_0 : The model fits (there is no difference between the observational results and the prediction results)

H_1 : The model does not fit (there is a difference between the observational results and the prediction results)

Test Statistic:

$$\hat{C} = \sum_{k=1}^g \frac{(o_k - n_k \pi_k)^2}{(n_k \pi_k) (1 - \pi_k)} \quad (5)$$

Description:

o_k = Sum of the response variable values in the k -th group

π_k = Estimated probability average in the k -th group

g = Number of groups

n_k = Number of observations in the k -th group

Accept H_0 if $\hat{C} \leq \chi^2_{(\alpha, g-2)}$ and accept H_1 if $\hat{C} > \chi^2_{(\alpha, g-2)}$ or $p_{value} < \alpha$

2.7 Classification Accuracy

To assess whether the classification results are accurate, the accuracy rate is evaluated. One method that can be used to measure it is by using APER (Apparent Error Rate). The APER value is obtained by calculation given in the following table.

Table 1. Logistic Regression Classification

Observation	Prediction Result	
	y_1	y_2
y_1	n_{11}	n_{12}
y_2	n_{21}	n_{22}

Description:

n_{11} = number of subjects y_1 correctly classified as y_1

n_{12} = number of subjects y_1 correctly classified as y_2

n_{21} = number of subjects y_2 correctly classified as y_1

n_{22} = number of subjects y_2 correctly classified as y_2

$$\begin{aligned}
 APER(\%) &= \frac{\text{number of incorrect predictions}}{\text{total number of predictions}} \\
 &= \frac{n_{12} + n_{21}}{n_{11} + n_{12} + n_{21} + n_{22}} \times 100\%
 \end{aligned}$$

With accuracy value: $ACCURACY = 1 - APER$

2.8 Odds Ratio

Odds Ratio (OR) describes the tendency of a certain part of the population in a specific category compared to another part of the population in another category in an independent variable that has a significant influence on the dependent variable. The first equation describing the odds ratio of event Y is

$$O(Y = 1) = \frac{P(Y = 1)}{1 - P(Y = 1)} \quad (6)$$

Then the second equation for the odds of event X is

$$O(X = 1) = \frac{\frac{P(Y=1)}{1-P(Y=1)}}{\frac{P(X=1)}{1-P(X=1)}} \quad (7)$$

Description:

OR : Odds Ratio

$O(Y = 1)$: Odds of event Y

$O(X = 1)$: Odds of event X

3. METHODOLOGY

This study employed a quantitative approach using binary logistic regression analysis. The study was conducted in the working area of the Napan Community Health Center, North Bikomi District, North Central Timor Regency. The data consisted of primary data collected through structured interviews and direct field measurements, as well as secondary data obtained from the Napan Community Health Center.

The population in this study comprised all toddlers aged 0–60 months recorded in the working area of the Napan Community Health Center, totaling 433 toddlers. The sample consisted of 108 toddlers, including 54 stunted toddlers and 54 non-stunted toddlers. These data were used to compare the characteristics of toddlers with and without stunting and to identify the significant factors associated with stunting incidence.

3.1 Operational Definitions of Variables

The dependent variable was stunting status, categorized as 0 = non-stunted and 1 = stunted. The independent variables included gender, birth weight, history of infection, exclusive breastfeeding, immunization history, dietary habit, parental income, clean water condition, cultural food taboos, and child-rearing culture. The operational definitions and measurement scales of these variables are presented in **Table 2**.

Table 2. Operational Definition of Variables

Variable	Variable Name	Operational Definition	Data Category Scale	Data Scale
Y	Stunting	Results of TB and age measurement of the child by <i>posyandu</i> officers.	0 = Not stunting 1 = Stunting	Nominal
X_1	Gender	Classifying the child's gender based on information provided by the mother.	0 = Male 1 = Female	Nominal
X_2	Birth Weight	Measurement of the baby's body weight performed after birth.	0 = < 2500 grams 1 = $\geq$ 2500 grams	Nominal
X_3	History of Infection	History of infectious diseases experienced by the toddler in the last three months.	0 = Never had an infection 1 = Had an infection	Nominal
X_4	Exclusive Breastfeeding	Breastfeeding pattern that does not involve any additional food or drink other than breast milk for six months.	0 = No 1 = Yes	Nominal
X_5	Immunization History	Infant immunization history.	0 = Never 1 = Complete 2 = Incomplete	Ordinal
X_6	Dietary Habit	Menu planning and food processing adjusted to toddlers' nutritional needs.	0 = Never 1 = Sometimes 2 = Often 3 = Always	Ordinal
X_7	Parental Income	Total routine monthly income of both parents.	0 = < Rp. 1,500,000 1 = $\geq$ Rp. 1,500,000	Nominal
X_8	Clean Water Condition	Water suitable for consumption and free from physical, chemical, or biological contamination.	0 = Not Suitable 1 = Fairly Suitable 2 = Suitable	Ordinal
X_9	Cultural Food Taboos	Traditions prohibiting the consumption of certain foods because they are believed to endanger health or violate local customs.	0 = No food restrictions 1 = There are food restrictions	Nominal
X_{10}	Child-Rearing Culture	Traditional ways used by families or communities in raising, feeding, and maintaining child health according to local customs.	0 = Traditional 1 = Modern 2 = Mixed	Nominal

4. RESULT & DISCUSSION

4.1 Study Site Overview

This study was conducted in the working area of the Napan Community Health Center, located in North Bikomi District, North Central Timor Regency. The area represents a rural setting with specific geographical and socio-cultural characteristics that may influence child nutrition, sanitation, and caregiving practices.

4.2 Multicollinearity Test

The multicollinearity test showed that all predictor variables had tolerance values above the acceptable threshold and VIF values below 10. This indicates that multicollinearity was not present in the model, so all independent variables were retained for further analysis.

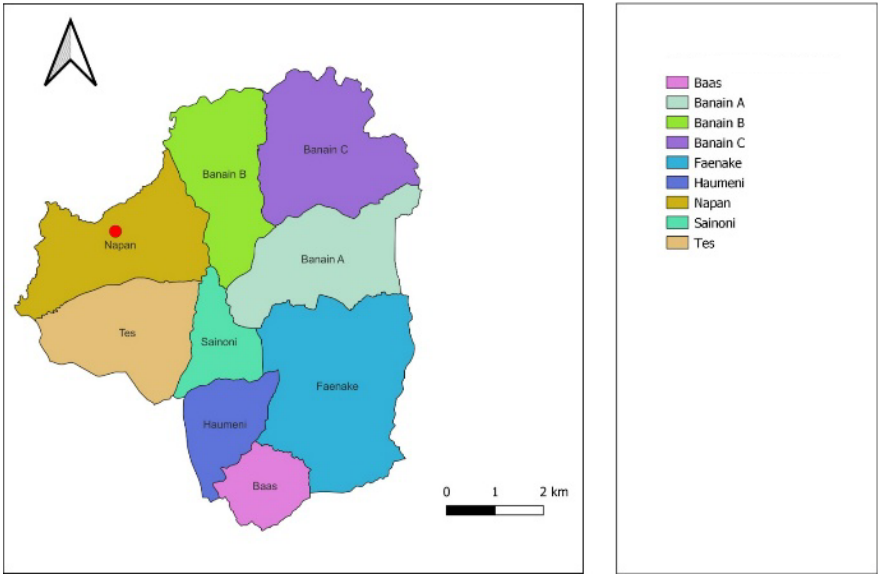


Figure 1. Research Location: Napan Community Health Center Working Area

Table 3. Multicollinearity Test

Model	Variable	Collinearity Statistics	
		Tolerance	VIF
1	Gender	0.833	1.200
	Birth Weight	0.839	1.191
	History of Infection	0.894	1.118
	Exclusive Breastfeeding	0.914	1.094
	Immunization History	0.920	1.087
	Dietary Habit	0.949	1.054
	Parental Income	0.843	1.186
	Clean Water Condition	0.922	1.084
	Cultural Food Taboos	0.862	1.160
	Child-Rearing Culture	0.821	1.218

Table 4. Simultaneous Test Results

		Chi-square	df	Sig.
Step 1	Step	47.450	10	0.000
	Block	47.450	10	0.000
	Model	47.450	10	0.000

4.3 Simultaneous Test (G Test)

The simultaneous test results showed that the binary logistic regression model was statistically significant, with a Chi-square value of 47.450 and a significance value of 0.000. This indicates that, collectively, the independent variables had a significant effect on stunting incidence among toddlers in the study area. The model summary showed a -2 Log Likelihood value of

Table 5. Model Summary

Step	-2 Log Likelihood	Cox & Snell R^2	Nagelkerke R^2
1	102.232	0.356	0.474

102.232 and a Nagelkerke R Square value of 0.474. This means that the independent variables included in the model explained 47.4% of the variation in stunting status, while the remaining 52.6% may be influenced by other factors outside the model.

4.4 Partial Tests (Wald)

Table 6. Partial Test Results

Step	Variable	B	S.E.	Wald	df	Sig.	Exp(β)
1	Gender (1)	0.355	0.552	0.413	1	0.521	1.426
	Birth Weight (1)	0.290	0.547	0.280	1	0.597	1.336
	History of Infection (1)	-0.097	0.625	0.024	1	0.877	0.908
	Exclusive Breastfeeding (1)	-0.803	0.569	1.989	1	0.158	0.448
	Immunization History (1)	1.810	1.289	1.972	1	0.160	6.113
	Dietary Habit (1)	-3.244	0.746	18.916	1	0.000	0.039
	Parental Income (1)	-0.525	0.549	0.913	1	0.339	0.592
	Clean Water Condition (1)	1.103	0.610	3.272	1	0.070	3.014
	Cultural Food Taboos (1)	-0.746	0.572	1.700	1	0.192	0.474
	Child-Rearing Culture (1)	-1.511	0.644	5.508	1	0.019	0.221
	Constant	1.322	40192.937	3.121	1	0.077	3.751

The partial test using the Wald statistic indicated that only two independent variables significantly affected stunting incidence, namely dietary habit and child-rearing culture. Dietary habit had a significance value of 0.000, while child-rearing culture had a significance value of 0.019. Other variables, such as gender, birth weight, history of infection, exclusive breastfeeding, immunization history, parental income, clean water condition, and cultural food taboos, were not statistically significant at the 5% level.

From the analysis results above, a binary logistic regression model can be constructed with the independent variables influencing the dependent variable as follows:

$$\pi(x_i) = \frac{\exp(g(x))}{1 + \exp(g(x))}$$

with $g(x) = 1.322 - 3.244X_6 - 1.511X_{10}$

Description:

X_6 = Dietary habit

X_{10} = Child-rearing culture

The negative coefficients for dietary habit and child-rearing culture indicate that better practices in these variables are associated with a lower likelihood of stunting. In contrast, poorer dietary patterns and inappropriate child-rearing practices increase the probability of stunting among toddlers.

4.5 Goodness-of-Fit

Table 7. Model Goodness-of-Fit Test Result

Step	Chi-Square	df	Sig.
1	13.187	7	0.069

The Hosmer–Lemeshow goodness-of-fit test produced a significance value of 0.069, which is greater than 0.05. This indicates that the model fits the observed data adequately and that there is no significant difference between the observed outcomes and the model predictions.

4.6 Classification Accuracy

The classification table showed that the model correctly classified 75.9% of the observations. This means that the binary logistic regression model had a fairly good ability to distinguish between stunted and non-stunted toddlers in the study area.

Table 8. Model Classification Accuracy

Observed		Predicted		Percentage Correct
		Not Stunting	Stunting	
Step 1	Not Stunting	37	16	69.8
	Stunting	10	45	81.8
Overall Percentage				75.9

4.7 Odds Ratio and Interpretation

Table 9. Odds Ratio

Variable	β	Odds Ratio
Dietary Habit	-3.244	0.039
Child-Rearing Culture	-1.511	0.221
Constant	1.322	3.751

The odds ratio for dietary habit was 0.039, indicating that toddlers with better dietary habits had substantially lower odds of being stunted than those with poorer dietary habits. Likewise, the odds ratio for child-rearing culture was 0.221, meaning that more appropriate child-rearing practices were associated with lower odds of stunting. These results suggest that dietary management and caregiving practices play important roles in preventing stunting in the study area.

4.8 Discussions

The finding that dietary habit significantly influenced stunting is consistent with the understanding that long-term nutritional intake is one of the main determinants of child growth. Inadequate food quality, low dietary diversity, and irregular feeding practices may contribute to chronic nutritional deficiency, which eventually manifests as stunting [6, 7, 10]. This result confirms that nutritional behavior at the household level remains a central issue in stunting prevention.

Child-rearing culture was also found to be a significant factor. This suggests that caregiving practices, including feeding habits, child supervision, responsiveness to illness, and daily care patterns, are closely related to children's nutritional outcomes [8, 9]. In communities where traditional caregiving practices are strongly maintained, the quality of parenting behavior may either protect children from stunting or increase their vulnerability, depending on whether such practices support proper nutrition and health care.

Meanwhile, several variables such as gender, birth weight, history of infection, exclusive breastfeeding, immunization history, parental income, clean water condition, and cultural food taboos were not statistically significant in this model. This does not necessarily mean that these factors are unimportant, but rather that their effects were not strong enough to reach statistical significance within the sample used in this study. Their influence may also interact with other social, environmental, or behavioral variables not fully captured in the model, as reported in studies on the multifactorial nature of stunting [4, 11].

The model explained 47.4% of the variation in stunting status, indicating that nearly half of the observed variation could be accounted for by the included predictors. However, the remaining variation suggests that other determinants, such as maternal education, household sanitation behavior, access to health services, maternal nutritional status, and child morbidity patterns, may also contribute to stunting incidence and should be considered in future studies [5, 11].

From a practical perspective, these findings imply that stunting reduction programs in the Napan Community Health Center area should not focus only on medical treatment, but also on household-level nutrition education and the improvement of caregiving practices. Community-based interventions involving mothers, families, and local health workers may be especially important for strengthening proper feeding behavior and child care [7].

5. CONCLUSION

Based on the binary logistic regression analysis, the model was statistically significant and adequately fitted the observed data. Among the ten predictor variables examined, dietary habit and child-rearing culture were identified as significant factors associated with stunting among toddlers in the working area of the Napan Community Health Center. These findings indicate that nutritional behavior and caregiving practices are key determinants of stunting in the study area. Therefore, efforts to reduce stunting should prioritize improvements in children's dietary practices and parenting-related interventions at the household and community levels.

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