

Scoring System in Prediction of Stunting Risk Among Children in West Sumatera Province, Indonesia

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ABSTRACT

This research explained scoring system in prediction of stunting risk among children in West Sumatera Province, Indonesia. This research was conducted in 2020 with case-control study among children under-five years. The number of respondents in this research were 40 cases group (stunting) and 40 control group (non-stunting) matching by age and sex. The sampling technique in this research was cluster random sampling. Data were gathered from primary data used a questionnaire. Data analysis was performed using chi-square test for bivariate analysis and multiple logistic regression for modeling, and Receiver Operation Characteristic (ROC) Curve as a diagnostic test in SPSS version 23.0. Sensitivity, specificity and accuracy ≥ 0.8 (80.0%) was assessed good. The scoring system for analyzing stunting risk in West Sumatera Province, Indonesia is based on predictors of mother's level of education, birth weight, exclusive breastfeeding, the child's appetite and parenting style. The accumulated total score obtained from the predictors is between 0 (if there is no risk) to 6 (if it has all risks). The cut-off point in grouping high risk of stunting and low risk of stunting is based on a total score of ≥ 4 (high risk of stunting) and < 4 (low risk of stunting). The accuracy of scoring system in prediction of stunting risk among children in West Sumatera Province, Indonesia was 87.2% with a sensitivity of 70.0% and specificity of 90.0%. This scoring system of stunting risk can be categorized quite well in predicting stunting risk in West Sumatera Province, Indonesia.

Keywords: Prediction; Stunting; Scoring System; Risk Factors; Indonesia

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INTRODUCTION

Stunting among children under-five years describes a situation of failure to grow as an effect of chronic nutrition insufficiency [1]. The outcome of this condition for children become shorter for his age [1], [2]. Stunting is one of the type of child health problem in whole world. In world, there are 22.9% children with stunting. More than half of children under-five years who are stunted live in Asia region and more than a third live in Africa region [3-5]. The prevalence of stunting in Indonesia ranks fifth in the worldwide. The morbidity rate for children under-five years was 32 per 1,000 live births [6]. Although various efforts have been made to solve the problem of malnutrition in children, the percentage of stunting is still quite high. It is calculated that 37.0% children with stunting. The program to reduce the stunting rate will remain a government program, especially the ministry of health [7]. This aims to improve children's health in the future. The long-range impacts of stunting in children and community are decrease cognitive, physical growth, productivity capacity and growing the degenerative disease risk. Moreover, onset of stunting of < 2 years will cause low cognitive attainment in school-year age and adolescent [8], [9].

The cause of stunting is multifactorial risk factors. Many risk factors for stunting have been known. The determinant factors include age of mother, mother's level of education, mother's working status, socioeconomic, parity, childbirth, birth weight, exclusive breastfeeding, immunization status, infectious diseases of children, the child's appetite, parenting style, mother's chronic energy

deficiency [10-12]. The occurrence of stunting among children in Indonesia has its own determinant factors that could be different from stunting in developed countries. Determinant factors such as mother's level of education, mother's working status, socioeconomic, exclusive breastfeeding and parenting style are different in children with stunting in Indonesia [13], [14]. Therefore, it is necessary to calculate the appropriate stunting risk factors for Indonesians to help increase public awareness in recognizing the risk of stunting among children under-five years in Indonesia [15].

The scoring system of stunting risk factors can be determined through algorithms or early detection models through useful variables so that parents can detect stunting risk among children [16]. This is a preventive estimate, using scoring system by classifying stunting risk from the determinant variables, making it easier to classify. Scoring system can classify groups at high risk and low risk of stunting, built based on existing determinant data so that the risk of stunting can be estimated early.

MATERIALS AND METHODS

We used a case-control study design. Research location in West Sumatera Province, Indonesia from June-September 2020. The number of respondents in this research were 40 children in the case group (stunting) and 40 children in the control group (non-stunting). The control group was matched by age and sex. The inclusion criteria in this research were child who lived with his/her biological parents and children under five years. The sampling

technique in this research was cluster random sampling. This study passed the ethical review by the ethics committee of the Faculty of Medicine, Universitas Andalas, Padang, Indonesia. Data was gathered through primary data using research questionnaire. Data collection was carried out through interviews by researchers and written informed consent.

Data collection of risk factors through interviews with respondents includes risk factors consisting of: age of mother (< 20 years; 20-29 years; ≥ 30 years) [1], mother's level of education (low; high) [2], mother's working status (work; not work) [2], socioeconomic (< regional minimum wage; ≥ regional minimum wage) [4], parity (multiparous; primiparous) [2], childbirth (sectio caesarea; normal) [4], birth weight (low birth weight; normal) [7], exclusive breastfeeding (exclusive; non exclusive) [7], immunization status (incomplete;

complete) [7], infectious diseases of children (yes; no) [7], the child's appetite (not good; good) [7], parenting style (not good; good) [4] and mother's chronic energy deficiency (not good; good) [7].

Data analysis was performed using chi-square test for bivariate analysis and multiple logistic regression for modeling, and Receiver Operation Characteristic (ROC) Curve as a diagnostic test. P value <0.05 was assessed as statistically significant and the variable that passed as predictor variable with p value < 0.25. Sensitivity, specificity and accuracy ≥ 0.8 (80.0%) was assessed good. Data analysis used the SPSS version 23.0.

RESULTS

Risk factors for stunting among children in West Sumatera Province, Indonesia.

Table 1: Risk factors for stunting among children in West Sumatera Province, Indonesia

Variables	Group		p-value	OR (95% CI)
	Cases (f/%)(n=40)	Control (f/%)(n=40)		
Age of mother			0.876	
< 20 tahun	8 (20.0)	9 (22.5)		1.35 (0.38-4.80)
20-29 tahun	20 (50.0)	21 (52.5)		Ref
≥ 30 tahun	12 (30.0)	10 (25.0)		1.26 (0.45-3.56)
Mother's education			0.009 ^a	
Low	36 (90.0)	25 (62.5)		5.40 (1.60-18.20)
High	4 (10.0)	15 (37.5)		Ref
Mother's working status			0.018 ^a	
Work	32 (80.0)	21 (52.5)		3.62 (1.34-9.77)
Not work	8 (20.0)	19 (47.5)		Ref
Socioeconomic			0.028 ^a	
< Regional minimum wage	33 (82.5)	23 (57.5)		3.48 (1.25-9.75)
≥ Regional minimum wage	7 (17.5)	17 (42.5)		Ref
Childbirth			0.422	
Sectio caesarea	7 (17.5)	11 (27.5)		1.79 (0.61-5.22)
Normal	33 (82.5)	29 (72.5)		Ref
Parity			0.402	
Multiparous	6 (15.0)	10 (25.0)		0.53 (0.17-1.63)
Primiparous	34 (85.0)	30 (75.0)		Ref
Birth weight			0.001 ^a	
Low birth weight	21 (52.5)	6 (15.0)		6.26 (2.16-18.20)
Normal	19 (47.5)	34 (85.0)		Ref
Exclusive breastfeeding			0.048 ^a	
Non exclusive	33 (82.5)	24 (60.0)		3.14 (1.12-8.82)
Exclusive	7 (17.5)	16 (40.0)		Ref
Immunization status			0.585	
Incomplete	33 (82.5)	30 (75.0)		1.57 (0.53-4.65)
Complete	7 (17.5)	10 (25.0)		Ref
Child's infectious diseases			0.048 ^a	
Yes	33 (82.5)	24 (60.0)		3.14 (1.12-8.82)
No	7 (17.5)	16 (40.0)		Ref
Child's appetite			0.007 ^a	
Not good	24 (60.0)	11 (27.5)		3.96 (1.55-10.11)
Good	16 (40.0)	29 (72.5)		Ref
Parenting style			0.035 ^a	
Not good	31 (77.5)	21 (52.5)		3.12 (1.18-8.20)
Good	9 (22.5)	19 (47.5)		Ref
Chronic energy deficiency			1.000	
Yes	15 (37.5)	15 (37.5)		1.00 (0.40-2.47)
No	25 (62.5)	25 (62.5)		Ref

^a, significant at p<0.05

^a, p<0.25 entered the candidate variable and multivariate analysis
ref, reference

Table 1 known the association of mother's level of education, mother's working status, socioeconomic status, birth weight, exclusive breastfeeding, child's infectious diseases, child's appetite and parenting style with stunting (p<0.05). But no significant association was found between age of mother, childbirth, parity, immunization status and chronic energy deficiency with child stunting (p>0.05). Based on the bivariate analysis, it

is known that the variables included in the selection of candidate variables for multivariate analysis are variables with p value <0.25. These variables are mother's education, mother's working status, socioeconomic status, birth weight, exclusive breastfeeding, child's infectious diseases, child's appetite and parenting style. Selection of candidate variables was carried out using logistic binary regression test (Table 2).

Table 2: Selection of candidate variables was carried out using logistic binary regression test

Variables	Initial OR (Step 1)	Final OR (Step 4)	Initial p-value (Step 1)	p-value elimination stage		
				Step 2	Step 3	Step 4
Mother's education	5.06	7.44	0.280	0.227	0.022	0.020
Mother's working status	0.96	-	0.968	-	-	-
Socioeconomic	1.65	-	0.654	0.654	-	-
Birth weight	11.98	11.55	0.001	0.001	0.001	0.001
Exclusive breastfeeding	5.05	6.99	0.168	0.165	0.185	0.024
Child's infectious diseases	1.67	-	0.619	0.619	0.575	-
Child's appetite	10.87	9.92	0.003	0.003	0.002	0.003
Parenting style	4.70	5.21	0.035	0.035	0.033	0.023

Table 2 shown the scoring system for analyzing stunting risk in West Sumatera Province, Indonesia is based on predictors of mother's level of education, birth weight, exclusive breastfeeding, the child's appetite and

parenting style. The scoring system of the occurrence of stunting in children was determined using the Hosmer-lemeshow test (Table 3).

Table 3: The scoring system of the occurrence of stunting in children

Variables	B	S. E	B/S. E	B/S. E/2.25	Score
Mother's education (low)	2.006	0.866	2.316	1.029	1
Birth weight (low birth weight)	2.447	0.751	3.258	1.548	2
Exclusive breastfeeding (non exclusive)	1.944	0.862	2.255	1.002	1
Chil's appetite (not good)	2.294	0.759	3.022	1.343	1
Parenting style (not good)	1.651	0.726	2.274	1.010	1
Total score					6

Table 3 shown scores of each variable, which are predictors of stunting risk are mother's level of education (low, score = 1), birth weight (low birth weight, score = 2), exclusive breastfeeding (non exclusive, score = 1), child's appetite (not good, score = 1) and parenting style

(not good, score = 1). Total maximum score based on a predictor of stunting risk is 6. In the scoring system developed, the total scoring formed is the right model to be used as a scoring system (Table 4).

Table 4: The significance of the total score in scoring system for stunting prediction among children in Indonesia

	B	S. E	p value	OR (95% CI)
Scoring system for stunting prediction among children	1.507	0.329	<0.001	4.55 (2.37-8.60)
Constant	-4.850			

Table 4 shown the stunting scoring system is a good in calculating stunting risk (p <0.05). The regression equation obtained is -4.850 + 1.507 x total score. Because the regression equation has been obtained, the

probability of a subject with a certain score is calculated to have a poor prognosis. The probability of a subject experiencing a poor prognosis can be calculated by the following equation.

$$p = \frac{1}{1 + \exp(-y)}$$

Information :

- p = probability
- \exp = natural number
- y = logistic equation = $a + b_1x_1 + b_2x_2 + \dots + b_nx_n$
- a = constant
- b = coefficient
- x = prognostic variable

The probability of the subject having a poor prognosis for each score (Table 5).

Table 5: The probability of the subject having a poor prognosis for each score

Subject score	Constant	Coefficient	$y = -4,850 + 1,507 x$ total score	$p = \frac{1}{1 + \exp(-y)}$	p (%)
0	-4.850	1.507	-4.850	0.007	0.77
1	-4.850	1.507	-3.343	0.034	3.41
2	-4.850	1.507	-1.836	0.137	13.75
3	-4.850	1.507	-0.329	0.418	41.84
4	-4.850	1.507	1.178	0.764	76.45
5	-4.850	1.507	2.685	0.936	93.61
6	-4.850	1.507	4.192	0.985	98.51

Table 5 shown The probability for the occurrence of poor prognosis of each score is known to be the lowest probability at a score of 0 at 0.77% and the highest is 6 with a poor probability of 98.51%.

Potential cut off points in categorizing stunting risk (Table 6).

Table 6: Potential cut off points in categorizing stunting risk

Number	Potential cut off points	Sensitivity	1-Specificity	Sensitivity	Specificity
1	1.00	1.000	1.000	1.000	0.000
2	0.50	1.000	0.975	1.000	0.025
3	1.50	1.000	0.775	1.000	0.225
4	2.50	0.925	0.450	0.925	0.550
5	3.50	0.700	0.100	0.700	0.900
6	4.50	0.450	0.025	0.450	0.975
7	5.50	0.075	0.000	0.075	1.000
8	7.00	0.000	0.000	0.000	1.000

Table 6 shown the cut-off point for categorizing high risk of stunting and low risk of stunting is at a cutoff score ≥ 4 with a sensitivity of 70.0% and a specificity of 90.0%. It can be shown that there is a high risk of stunting if the total score from the accumulation of predictor variables

is ≥ 4 and there is low risk of stunting if the total score from the accumulated predictor variable is ≤ 4 . The accuracy of stunting risk factor estimates can be known from the results of the analysis using ROC (Figure 1).

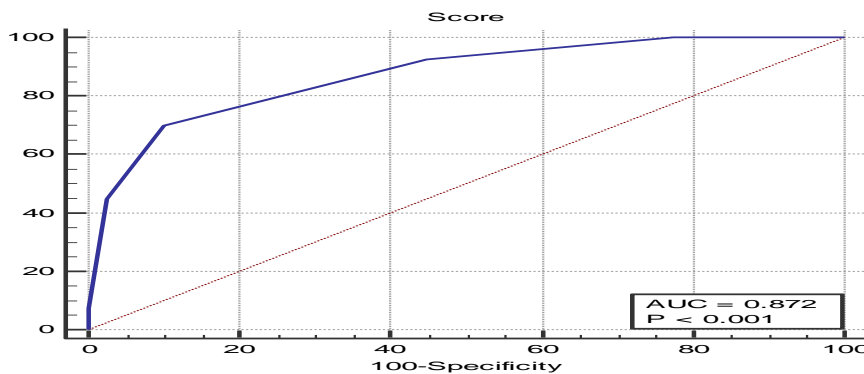


Figure 1: The accuracy of stunting prediction in children

Figure 1 shown the accuracy of scoring system in prediction of stunting risk among children in West Sumatera Province, Indonesia was 87.2%. This scoring system of stunting risk can be categorized quite well in

predicting stunting risk in West Sumatera Province, Indonesia.

DISCUSSION

The scoring system for analyzing stunting risk in West Sumatera Province, Indonesia is based on predictors of mother's level of education, birth weight, exclusive breastfeeding, the child's appetite and parenting style. The accumulated total score obtained from the predictors is between 0 (if there is no risk) to 6 (if it has all risks). The cut-off point in grouping high risk of stunting and low risk of stunting is based on a total score of ≥ 4 (high risk of stunting) and < 4 (low risk of stunting). The accuracy of scoring system in prediction of stunting risk among children in West Sumatera Province, Indonesia was 87.2% with a sensitivity of 70.0% and specificity of 90.0%. This scoring system of stunting risk can be categorized quite well in predicting stunting risk in West Sumatera Province, Indonesia.

This study confirmed the occurrence of stunting among children in Indonesia has its own determinant factors that could be different from stunting in developed countries. Determinant factors such as mother's level of education, mother's working status, exclusive breastfeeding and parenting style are different in children with stunting in Indonesia [13], [14].

Malnutrition and stunting are two related problems. Stunting in children is the impact of nutrient deficiency during the first thousand days of life. Stunting in toddlers needs special attention because it can cause inhibition of physical growth, mental development, and health status in children. Stunting emergencies can become a burden on the state [17].

Programs that have been carried out to prevent stunting are more focused on pregnant women in preventing stunting. However, it has not focused on post-pregnancy to determine child development. So it can be concluded that there is no tool for early detection of stunting risk in children by combining the two focuses, namely both pregnant and post-pregnancy women [18], [19].

The results of this study can be a solution to early stunting prevention procedures through screening. Stunting cases occur usually because this disease is not recognized by the public. So that people need to know from an early age the risk of their children experiencing stunting in order to know and also understand the signs of stunting. If the community knows the characteristics of stunting from an early age, it can be treated immediately so that it does not cause bad complications. In addition, to optimize child development, the community must also understand the importance of stimulating children's growth and development [20].

CONCLUSION

The scoring system for analyzing stunting risk in West Sumatera Province, Indonesia is based on predictors of mother's level of education, birth weight, exclusive breastfeeding, the child's appetite and parenting style. The accuracy of scoring system in prediction of stunting risk among children in West Sumatera Province, Indonesia was 87.2% with a sensitivity of 70.0% and specificity of 90.0%. This scoring system of stunting risk can be categorized quite well in predicting stunting risk in West Sumatera Province, Indonesia.

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CONFLICTS OF INTEREST

The author reports no conflicts of interest in this study.

ABBREVIATIONS

AUC: Area under curve

OR: odds ratio

ROC: Receiver operating characteristics

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