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Determinants of stunting in children aged 24-59 months: a case-control study

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ABSTRACT

Stunting is a sign of persistent malnutrition during a critical period of child development, especially in the second trimester of pregnancy. This study aimed to determine the causes of stunting in infants between 24 and 59 months. The Kamaipura Health Center in Sigi Regency, Indonesia is the location for the research. Data was collected from January to December 2020 from medical record data. The population consisted of 156 children under the age of five, of which 134 samples were selected using a purposive sampling technique and were divided into two groups: stunting and non-stunting. Analytic test using Chi-square, OR, and logistic regression (p=0.05). Infants who are not exclusively breastfed have a 9.44 times higher risk of stunting (OR=9.44; 95% CI=4.28 to 20.7), according to an analysis with a CI of -95%. Chronic energy deficiency and low birth weight during pregnancy are associated with an increased risk of growth disorders by 5.98 (OR=5.98; 95% CI=2.47 to 14.43) and 4.6 times (OR=4.6) respectively; 95% CI=1.73 to 12.42). In addition, the R-square logistic regression analysis of 0.374 indicates that the overall influence of the variables is 37.4%. A history of exclusive breastfeeding, low birth weight (LBW) babies, and chronic energy deficiency (CED) during pregnancy is strongly associated with the prevalence of stunting. To reduce the prevalence of poor growth, better health promotion is needed from the beginning of pregnancy.

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1. INTRODUCTION

Inadequate or excessive consumption hinders the body's ability to utilize nutrients, leading to malnutrition in children and reduced disease-fighting abilities. An unbalanced diet causes a lack of all the nutrients needed, resulting in malnutrition [1]. In addition, stunting is a sign of ongoing malnutrition during a critical period for a baby's growth and development. This occurs throughout the second trimester of pregnancy and eventually results in the death of the children [2]. This impacted 30.8% of the population under five years of age in Indonesia in 2018 [3].

The second sustainable development goal (SDG) aims to ensure food security and eradicate hunger and all types of malnutrition by 2030, including stunting. For the purpose of developing and improving nutrition intervention strategies, it is essential to understand the risk factors for poor growth, which is one of the main causes of neonatal morbidity. This condition is strongly influenced by nutritional factors, including nutrition

during pregnancy and in early childhood. By identifying and addressing these risk factors, stunting rates can be reduced by 40% by 2025. In order for children to acquire healthy eating habits, it is important to pay attention to how their parents interact with them as well as their food intake [4].

Stunting, based on a concept by Waterlow, provides a classification of the severity of protein-energy deficiency and growth problems in children by community [5]. Growth retardation can be caused by a variety of factors, but the first 1,000 days of life are especially important because they mark the start of the developmental process [6]. Premature birth, low birth weight (LBW) babies, low education of the mother, low socioeconomic position of the family, unhealthy lifestyle, and limited access to health services are some additional risk factors [7].

Stunting has direct and long-term effects, including increasing health costs, increasing morbidity, and decreasing children's cognitive and motor development [8]. Six global nutrition targets have been set by the World Health Organization (WHO) for 2025 as part of a comprehensive maternal and child nutrition implementation plan that has been carried out since 2012. This initiative aims to assist member countries and partners in reducing child stunting under the age of five [9].

To combat stunting, the SDGs call for ending hunger and all forms of malnutrition by 2030. By 2025, the stunted growth rate is expected to fall to 40%. In addition, the government has identified stunting as one of its main priorities. Regulation of the Minister of Health Number 39 of 2016 concerning Guidelines for Implementing the Healthy Indonesia Program with a Family Approach reinforces this [8].

Around 150.8 million, or 22.2%, of children under five worldwide were stunted in 2017, according to WHO. Eighty-three million of them, or 83.6 million, live in Asia, with 58.7%, 14.9%, 4.8%, 4.2% and 0.9% of them respectively living in south, southeast, east, west, and central regions. In terms of prevalence, Indonesia is ranked third in the Southeast/South-East Asia Regional (SEAR) region. The incidence of stunting under five was 30.8% in 2018, with very short under five reaching 11.5%, according to state registration data. Due to the large decline in this condition, Indonesia has also risen to the fifth highest ranking of countries for the prevalence of stunting in children under the age of five [3].

According to the profile of the Central Sulawesi Provincial Health Office in 2019, there were 21.4% of toddlers experiencing stunting, with prevalence rates of 34.9%, 26.0%, 24.6% and 9.4% respectively in Donggala District, Tojo Una Una, Sigi, and Buol. At the Kamaipura Health Center, the third highest incidence was 47.3%, with 114 and 136 short and very short toddlers. In general, there are 250 children with developmental delays out of 528 toddlers in 2019. To find out the causes of stunting in children aged 24 to 59 months, is the aim of this study.

2. METHOD

The Kamaipura Health Center in Sibalaya Village, Tambulava District, Sigi Regency, Indonesia became the research location. This outpatient health center has 5 villages, each of which has a posyandu and an auxiliary health center. Information was obtained from January to December 2020 from medical record data. The stages consist of planning, recording medical data, entering data for iterative analysis, and preparing research reports. This research was completed from February 11 to March 28, 2021, March 30 to May 20, 2021, and May to August 2021.

The study population, using a retrospective analytic observation strategy, consisted of 156 children between the ages of 24 and 59 months. Sampling is purposive sampling. Examples are taken from health records. In addition, there was a 1:1 sex match between case and control group data. The findings revealed a total sample of 134 toddlers, divided equally between stunted and control. Chi-square statistical tests, odds ratio (OR), and multivariate logistic regression were used to analyze the data at the 95% confidence level (=0.05).

The sample selection process the case group (stunting) and the control group were selected first (not stunting). The following step involved 1:1 sex matching between the two groups. Data analysis is the final step, as illustrated in Figure 1.

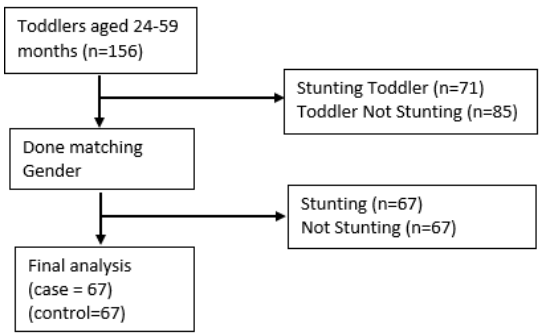

Figure 1. Sample selection process

Based on secondary data from the Kamaipura Health Center, Figure 1 showed that 156 samples were aged 24-59 months, of which 71 were short. A total of 67 children under the age of five were included and divided into case and control groups for analysis. The sample was selected based on sex matching with a ratio of 1:1 between the stunting (cases) and non-stunted (control) groups. According to the sex of the child, stunting, the dependent variable, is defined as WHO has <-2 SD. This study's independent variables were a history of exclusive breastfeeding, LBW, and chronic energy deficiency (CED).

3. RESULTS AND DISCUSSION

3.1. RESULTS

3.1.1. Univariate Analysis

The univariate analysis can explain the frequency distribution of the characteristics of the respondents between the case and control groups. Table 1 showed that the presentation of stunting cases in toddlers aged 24-59 months with exclusive breastfeeding (22.4%) was lower than the control group (73.1%). Meanwhile, the incidence in those with a history of low birth weight at 44.8% and mothers who experienced CED during pregnancy at 31.3% was much higher than the control group at 11.9% and 9.0%, respectively.

Table 1. Distribution of the sampling frequency of the stunting and non-stunted groups in children aged 24-59 months

Characteristics of respondents	Stunting			
	Case		Control	
	n=67*	%	n=67*	%
Children of educated mothers				
Low education	58	86.6	40	59.7
Higher education	9	13.4	27	40.3
Children of mothers' employment status				
Does not work	59	88.1	57	85.1
Working	8	11.9	10	14.9
Child gender				
Male	33	49.3	33	49.3
Female	34	50.7	34	50.7
Child's age				
Age 24-35 months	34	50.7	23	34.4
Age 36-47 months	13	19.4	22	32.8
Age 48-59 months	20	29.9	22	32.8
History of exclusive breastfeeding				
Not exclusive breastfeeding	52	77.6	18	26.9
Exclusive breastfeeding	15	22.4	49	73.1
LBW history				
LBW	30	44.8	8	11.9
Not LBW	37	55.2	59	88.1
History of chronic energy deficiency				
CED	21	31.3	6	9.0
Not CED	46	68.7	61	91.0

Note: *n, Number of samples from the previous survey in January-December 2020
LBW: Low birth weight; CED: Chronic energy deficiency

3.1.2. Bivariate analysis

Bivariate analysis describes several variables that are determinants of stunting in children aged 24-59 months including a history of exclusive breastfeeding, a history of low birth weight births, and a history of CED between the case group and the control group as shown in Table 2. The results in Table 2 also showed that toddlers without exclusive breastfeeding had a 9 times risk of stunting greater than those breastfed, OR=9.44 (CI: 95% CI; 4.289 to 20.763), p-value 0.000<0.05. Similarly, those with LBW had a 5.98 times risk of experiencing stunting compared to those without LBW, OR value=5.98 (CI: 95%; 2.476 to 14.439), p-value 0.000 <0.05. Mothers with CED during pregnancy have 4.64 times the potential of delivering stunted children, OR=4.64 (CI: 95%; 1.734 to 12.425), p-value 0.003<0.05. Furthermore, the Chi-square (X^2) statistical test showed that the three factors are $X^2_{count}>X^2_{tab}$ (3.34). It can be concluded that these three variables affect the incidence of stunting in toddlers.

3.1.3. Multivariate analysis with logistic regression

Logistic Regression Analysis of this study indicates that 3 factors or variables directly affected the incidence of stunting. The R-Square value of 0.374 showed that the overall influence strength was weak at 37.4%. Among the three factors, the incidence of stunting is directly influenced by a history of exclusive

breastfeeding (p-value 0.000 <0.05), which gives the largest contribution, and LBW at birth (p-value 0.008), showing that the hypothesis was accepted. Contrary to the case with the pregnancy history of CED, the hypothesis was rejected with a p-value of 0.539>0.05. After further analysis, the Exp.β value of Exclusive Breastfeeding was 0.136, indicating an increase in the risk of stunting by 13.6%. Meanwhile, it was 0.269 in the history of LBW, showing an elevation in the risk of stunting by 26.9%, as presented in Table 3.

Table 2. Determinants of stunting in children aged 24-59 months

Variable	Stunting Case n=67*	%	Control n=67*	%	X^2_{count}	CI (95%)	OR	p-Value
History of exclusive breastfeeding								
Not exclusive breastfeeding	52	77.6	18	26.9	34.57	4.289-20.763	9.44	0.000**
Exclusive breastfeeding	15	22.4	49	73.1				
LBW history								
LBW	30	44.8	8	11.9	17.78	2.476-14.439	5.98	0.000**
Not LBW	37	55.2	59	88.1				
History of chronic energy deficiency								
CED	21	31.3	6	9.0	10.44	1.734-12.425	4.64	0.003**
Not CED	46	68.7	61	91.0				

Note:
*n, Number of samples from the previous survey in January-December 2020
**Significant p < 0.05 (95% CI)
$X^2_{count,}$ Chi-Quadrat count
OR, Odds Ratio; CI, Confidence Interval
LBW: Low birth weight; CED: Chronic energy deficiency

Table 3. Factors influencing the incidence of stunting in children aged 24-59 months

Variable	n*	p-value	OR	Exp.β	R-square
History of exclusive breastfeeding	134	0.000**	9.44	0.136	0.374
History of low birth weight		0.008**	5.98	0.269	
History of chronic energy deficiency		0.539	4.64		

Note:
*n, Number of samples from the previous survey in January-December 2020
**Significant p<0.05 (95% CI),
Exp.β, Exponential Beta
*OR, Odds ratio; CI, Confidence interval

3.2. DISCUSSION

3.2.1. History of exclusive breastfeeding

When exclusive breastfeeding is not given for the first six months, stunting, a nutritional problem, can affect the growth and development of children in the future. This also applies to children over five years. Breastfeeding ensures a healthy and productive future generation by providing babies with the best food for the first six months of life [10]. According to WHO, full breastfeeding can improve the health and nutritional status of infants by providing half of the nutrition for infants between the ages of 7 to 12 months.

One of the key factors affecting gene expression is exclusive breastfeeding, which also contains a lot of protein (OR: 737,362). This allows the genes and antibodies from the mother's milk to work together to create immunity in the newborn's body. Healthy babies get adequate nutrition, which promotes growth and prevents stunting [11]. Along these lines, immunoglobulin A (sIgA) and lactoferrin secreted from breast milk boost the child's immune system, enabling age-appropriate physical growth and development [12].

The amount of time a mother breastfeeds her baby and the child's rapid growth in the second and third years of life are closely related. This is because breastfeeding can meet a third of a baby's nutritional needs during the first two years, which also includes an immune component to protect babies from infectious diseases [13]. In Southern Ethiopia, babies who were not exclusively breastfed for the first six months had a higher risk of stunting than babies who were breastfed [14].

Other studies have shown that maternal malnutrition results in limited fetal development, which increases neonatal mortality. Until the age of two, a child who survives only grows slowly. Deficiencies of zinc and vitamin A are potentially fatal, and the danger is higher in the first two years of life because of inadequate treatment. Iodine and iron deficiency can also hinder the full development of babies apart from stunting [13].

The crucial period in the first 1,000 days of life has an impact on the life cycle of stunted children in the long term. If you are not exclusively breastfed, the risk of experiencing poor growth is four times greater. Child malnutrition is the direct source of this condition, with short-term implications for increased morbidity [6].

High calcium content and easier absorption, make breast milk an ideal food and can promote healthy growth and reduce the risk of stunting. By providing nutrition that is tailored to the needs of the baby, it also helps to avoid malnutrition. Therefore, breastfeeding counseling should be available to prevent growth retardation. Although interventions are needed at all stages of the life cycle, what is especially important is the promotion of exclusive breastfeeding during the first six months of a child's life and the provision of complementary foods with adequate nutritional density up to five years of age [15], [16].

Insufficient exclusive breastfeeding (OR=6.90; 95% CI 2.81 to 16.97) and supplementary feeding less than four times per day (OR=3.60; 95% CI 1.32 to 9.95) are two factors that have been shown to influence stunting in children. Diarrhea also increases the likelihood of this condition (OR=7.46; 95% CI 2.98 to 18.65) [17]. Growth retardation is a symptom of a complex condition involving developmental delay, impaired immunological function, reduced cognitive function, metabolic abnormalities, and stunting is a type of micronutrient deficiency. Children may be stunted and have iron and iodine deficiencies, which prevent them from developing optimally. The risk of infant death in the first two years of life also increases due to inadequate breastfeeding [18].

3.2.2. History of low birth weight infants

Based on statistical tests, the value (p=0.001) indicates that there is a significant effect that LBW can experience growth and development disorders in children aged 0-60 months, with a risk of stunting of 3.64 times, which has a significant impact on children's growth and development compared to non-LBW babies[19]. LBW births are associated with inadequate cognitive development, future growth, fetal and newborn mortality, and morbidity. Stunting and intrauterine growth retardation, which persists into adulthood, is determined by the history of LBW [15]. Those with a history of birth length of 48 cm have a 4.5 times higher risk of experiencing stunting in children, while those who have this complication have a 1.75 times higher risk (CI=1.731-11.696). P value is equal to 0.003[21], [22].

WHO established the 2006 criteria for child growth (weight for height z-score), LBW (weight for Z-score -2 SD), stunting (height for Z-score -2 SD) and wasting as the three main contributors to anthropometric failure. A review of 299,353 children aged between 12 and 59 months from 35 low- and middle-income countries revealed that, respectively, 38.8%, 27.5%, and 12.9% were stunted, low birth weight, and wasting. in childhood (95% CI: 12.8% to 13.0%) [23]. LBW births and a history of CED, or low birth weight due to prenatal malnutrition, are two risk factors for stunting [24], [25].

3.2.3. History of chronic energy deficiency (CED)

According to the results of the analysis, stunting in children aged 24-59 months and a history of CED correlated 4.64 times. Pregnant women with previous CED, there were 31.3% and 9.0% of children with a history of stunting and not stunting, respectively. Studies show that to prevent CED in pregnancy, health promotion and prevention activities must be stepped up immediately. In addition, it is important to carry out regular antenatal care (ANC) checks to find early signs of malnutrition during pregnancy, which are associated with low birth weight and risk factors for stunting in children.

During pregnancy and the first few weeks after delivery, there is a risk of malnutrition. Low birth weight and mothers with a history of CED during pregnancy had a significant correlation (p=0.0017), which would affect stunting and child development [22]. The possibility of stunting in pregnant women with CED is 4.11 times higher [21]. Since the time of conception, the nutritional status of pregnant women is a factor that influences the growth and development of the fetus in the womb and can have an effect in the long term. In addition, inadequate nutrition, short or underweight gestation periods, and low birth weight babies all contribute to growth problems [16], [26].

3.2.4. Logistics regression

Other studies have found a number of factors that affect stunting in children, including exclusive breastfeeding that is not sufficient (OR=6.90; 95% CI 2.81 to 16.97) and complementary feeding less than four times per day (OR=3.60; 95% CI 1.32 to 9.95) [17]. Promotive efforts regarding Early Breastfeeding Initiation aim to reduce the incidence of stunted growth. To avoid the 80% (p=0.02) lower risk of wasting, women should be encouraged to exclusively breastfeed their child for the first six months of life [25].

With a p-value of 0.05, exclusive breastfeeding also reduces the incidence of stunting in infants aged 12 to 35 months. Therefore, it is very important to encourage mothers to continue breastfeeding for an additional six months for the healthy development of the baby [27]. Non-exclusive breastfeeding and inappropriate complementary feeding can increase the risk of a child experiencing stunting at the age of 24 months [3].

Various initiatives have been attempted to increase nutritional intake through exclusive breastfeeding, especially for low birth weight babies, to support the nutritional adequacy of infants. As a non-pharmacological treatment to maintain body temperature stability and prevent hypothermia, it is carried out using the KMC method. This strategy encourages mothers to give exclusive breastfeeding to their children so

they grow healthy. Improving mother's education before and during pregnancy is another effort to stop stunting in children (p-value=0.000). One way is to provide nutritional advice and family support through videos based on local culture. This makes it easier for people to absorb knowledge by using more sophisticated technology to enhance knowledge [28], [29].

In addition, LBW is responsible for 26.9% of cases of stunting in children between 24 to 59 months. To prevent anemia during pregnancy, regular and routine checks of pregnant women are necessary [25], [28]. Mothers who received prenatal care during pregnancy (aOR=1.22; 95% CI: 1.08 to 1.39) and children born weighing more than 2,500 g (aOR=2.55; 95% CI: 2.05 to 3.15) are more likely to experience stunting [8]. According to the results of the stunting survey in 2010 and 2014, stunting was the most common type of malnutrition (39% increased to 51%), followed by underweight (13% in 2010 and 2014), and children who received exclusive breastfeeding for less than six months had a lower chance of being thin, by 80% (p=0.02) in 2010 and 57% (p=0.05) in 2014 [30].

Anthropometric measurements of physical growth are the standard for determining whether a child is stunted. Most developmental disorders can manifest between 3 and 24 months of age; prevalence increases markedly between 12 and 24 months of age (40% to 54%); then continued to increase until the age of 36 months (58%); and lastly, most remain stable until age five years (55%) [31]. When compared with iron-folic acid (IFA) supplementation, prenatal multi-micronutrient supplementation can result in superior developmental scores at three years of age as well as better newborn growth in the first few months of life. It has been proven that consumption of multi-micronutrients powder dramatically reduces short-term stunting and increases head circumference in children under the age of five [32].

In 27.0% and 13.2% of the population, they were stunted and had severe stages, respectively. When children are aged 0 to 36 months, low birth weight births and exclusive breastfeeding for six months are risk factors for severe stunting. Malnutrition is a serious public health problem that is exacerbated in children under three years of age [13]. The likelihood of a mother having a stunted child increased by 31% if she had at least three ANC visits during her previous pregnancy (OR 1.31; 95% CI 1.01 to 1.69). In contrast, the probability of having a baby with stunted growth was 51% greater for women who did not receive antenatal care from medical personnel (OR 1.51; 95% CI 1.18 to 1.92) [33].

The lower incidence of stunting is associated with the recommended complementary feeding, especially during the first year of life. The risk of severe stunting in children who were not given complementary foods between the ages of 6 and 8 months increased threefold (OR 2.73; 95% CI 1.06 to 7.02) [33]. Growth retardation is a fairly common problem; Chronic malnutrition in children is associated with low birth weight, older mother's age, initiation of complementary foods at inappropriate times, and lack of maternal ANC visits. Therefore, this problem requires an effective intervention [1].

4. CONCLUSION

There is a significant relationship between the incidence of stunting with histories of exclusive breastfeeding, LBW, and CED in children aged 24-59 months. The results of the logistic regression of the three variables showed that the history of exclusive breastfeeding and LBW contributed the most to the incidence of impaired growth in children. Therefore, it is necessary to improve health promotion programs since pregnancy to reduce the prevalence.

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