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Stunting on Children Aged 6 – 23 Months in East Nusa Tenggara Province

Weny Wulandary[1✉] and Trini Sudiarti[1]
[1]University of Indonesia, Depok, Indonesia

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Abstract

Stunting is the impaired growth and development that children experience from chronic malnutrition, repeated infection, poor maternal health, and inadequate psychosocial stimulation. The focus of this study is determinants of stunting of 6 – 23 months children in East Nusa Tenggara Province using data from the Study of Indonesian Nutritional Status in 2021. This research is a quantitative study that uses a cross-sectional design. The results showed that the proportion of stunting in 6-23 months in NTT province was 32.8%. The results of the bivariate analysis showed that variables significantly associated with stunting included child age (OR: 1.723 CI 95% 1.215-2.445), gender (OR: 1.777 CI 95% 1.305-2.419), LBW (OR: 2.106 CI 95% 1.206-3.423), SBL (OR: 1.768 CI 95% 1.133-2.759), history of infectious disease (OR: 1.548 CI 95% 1.141-2.099), maternal education (OR: 1.555 CI 95% 1.136-2.127), and toilet sanitation (OR: 1.881 CI 95% 1.384-2.555). The results of multivariate analysis showed that the most dominant factor of stunting was a history of infectious diseases (p-value 0.003; OR: 2.244). Children who have a history of infectious diseases are at risk of stunting by 2.2 times higher than children who do not have a history of infectious diseases after being controlled by child age, gender, LBW, SBL, and toilet sanitation.

Introduction

Stunting remains a significant health issue in Indonesia, which still exceeds the WHO standard of <20% (WHO, 2019). Indonesia ranked second in the prevalence of stunting in Southeast Asia in 2020 at 26.92% (UNICEF, 2020). The impact of stunting on children includes short-term and long-term impacts, including increased morbidity and mortality, stunted child development, impaired learning, and working capacity, increased risk of infectious and non-communicable diseases, increased fat accumulation, especially in the abdomen, low-fat oxidation, low energy expenditure, insulin resistance, and increased risk of diabetes, hypertension, and dyslipidemia (Akseer *et al.*, 2022; Soliman *et al.*, 2021).

Stunting can be caused by various factors, which are classified as caused during pregnancy and after birth. Mothers who have a chronic energy deficiency, anemic mothers, insufficient weight increase during pregnancy, stunted mothers, mothers exposed to nicotine and cigarette smoke, and risky pregnancy age are all factors that contribute during pregnancy (Santosa *et al.*,2022; Syahril *et al.*, 2020). Stunting after birth can result from direct and indirect factors. The direct causes of stunting are insufficient nutritional intake and infectious diseases, meanwhile, indirect factors include non-exclusive breastfeeding, low maternal knowledge, insufficient complementary foods, taboos or unhealthy traditions, an unhealthy environment, sanitation and water supply, food insecurity, an inability to receive complete immunization according to age, health services, and parenting as household (Vonaesch *et al.*, 2017; Yani *et al.*, 2023).

The region in Indonesia that has the highest prevalence of stunting is East Nusa Tenggara (NTT) Province, which reached 37.8% based on SSGI 2021 (Kemenkes RI,

✉ Correspondence Address:
Pondok Cina, Depok, West Java, Indonesia 12345
Email: trini.fkmui@gmail.com

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2021). Although it shows a decrease compared to data based on Basic Health Research (Riskesdas), which reached 42.6% in 2019 NTT Province remains the largest contributor to stunting every year (Kemenkes RI, 2018). According to this number, one in three children in NTT Province is stunted (BPS Nusa Tenggara Timur, 2022). The purpose of this study was to determine the probable factors of stunting and the dominant factors associated with the incidence of stunting in children aged 6–23 months in East Nusa Tenggara Province based on data from the Indonesian Nutrition Status Study in 2021.

Method

This research is a quantitative study with a cross-sectional study design using secondary data from the Indonesian Nutrition Status Study in 2021. A cross-sectional study is a type of observational study design that looks at data from the population at one point in time (Wang & Cheng, 2020). A total of 759 data samples were collected from all children aged 6–23 months recorded in the Census Block in NTT Province. After applying the inclusion and exclusion criteria, there were 490 samples in the multivariate analysis. The dependent variable studied was the incidence of stunting in children aged 6–23 months in NTT Province. The independent variables studied included child characteristics (age, sex, birth weight, birth length, early breastfeeding initiation, exclusive breastfeeding status, minimum dietary diversity (MDD), history of infectious diseases); family characteristics (maternal age at childbirth, father's education, mother's education, father's occupation, mother's occupation, number of family members, and family food insecurity; health facility utilization characteristics (basic immunization, vitamin A supplementation); and environmental characteristics (residence, drinking water source, and toilet sanitation). The analysis included univariate, bivariate, and multivariate analyses using multiple logistic regressions of determinant models.

Result and Discussion

This study examines the factors associated with stunting in children aged 6–23 months in NTT Province, which has the highest incidence of stunting at 37.8% according to SSGI 2021 (Kemenkes RI, 2021). Despite this proportion being lower than the 42.6% reported by Riskesdas (2018), NTT Province continues to be a significant contributor to stunting in Indonesia. A public health issue is considered chronic if the prevalence of stunting exceeds 20% (WHO, 2019). Figure 1 presents the percentage of stunted children aged 6–23 months in NTT Province in 2021.

According to the results of the study, the prevalence of stunting in children aged 6 to 23 months in NTT Province is 32.8%, indicating a very high prevalence category of public health issues (30%) (WHO, 2019). Furthermore, 190 children (25.0%) were classified as moderately stunted (-3 SD to -2 SD), while 59 children (7.8%) were classified as severely stunted (-3 SD). Table 1 shows the distribution of child features, mother and household characteristics, access to health services, and environmental factors.

The research results evinced that child age, gender, LBW, SBL, history of infectious diseases, mother's education level, vitamin A supplementation, and toilet sanitation all had a significant relationship with the prevalence of

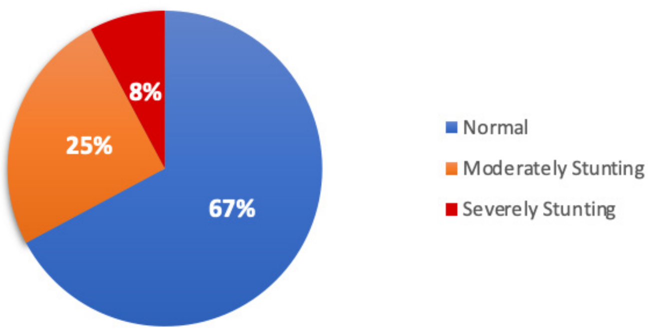

Figure 1. Proportion of Stunting among Children 6–23 Months in NTT Province in 2021

Table 1. Distribution of Children, Maternal and Family Characteristics, Access to Health Services, and Environmental Characteristics

No	Variables	Frequency (n)	Percentage (%)
	Children Characteristics		
1	Child age		
	12 – 23 months	533	70.2
	6 – 11 months	226	29.8
	Total	759	
2	Sex of Child		
	Boy	391	51.5
	Girl	368	48.5
	Total	759	100.0
3	Low Birth Weight (LBW)		
	LBW (<2500 gram)	75	11.2
	Normal (≥ 2500 gram)	594	88.8
	Total	669	100.0
4	Short Birth Length (SBL)		
	SBL (<48 cm)	104	20.1
	Normal (≥48 cm)	414	79.9
	Total	518	100.0
5	Early Initiation of Breastfeeding (EIB)		
	No	366	50.1
	Yes	365	49.9
	Total	731	100.0
6	Exclusive Breastfeeding		
	No	289	38.4
	Yes	463	61.6
	Total	752	100.0
7	Minimum Dietary Diversity (MDD)		
	Not achieved (score <5)	548	72.2
	Achieved (score ≥5)	211	27.8
	Total	759	100.0
	Breast milk	478	63.0
	Grains, roots, and tubers	717	94.5
	Legumes and nuts	107	14.1
	Dairy products	213	28.1
	Flesh foods	295	38.9
	Egg	245	32.3
	Vitamin A-rich fruits and vegetables	255	33.6
	Other fruits and vegetables	536	70.6
8	Children with a History of Infectious Diseases		
	Yes	344	45.3
	No	415	54.7
	Total	759	100.0
	1 history of disease	243	32.0
	2 history of diseases	75	9.9
	3 or more history of diseases	26	3.4
	Acute respiratory infection	304	40.1
	Diarrhea	91	12.0
	Pneumonia	37	4.9
	Tuberculosis (TBC)	5	0.7
	Measles	37	4.9
	Helminthiasis	13	1.7
	Maternal and Household Characteristic		
1	Maternal age at childbirth		
	<20 or >35 y	184	25.2
	20–35 y	547	74.8
	Total	731	100.0
2	Father's education level		
	Low (≤ Junior High School)	533	70.2
	High (> Junior High School)	226	29.8
	Total	759	100.0
	No Education	52	6.9
	Incomplete Primary School	92	12.1
	Completed Primary School	294	38.7

No	Variables	Frequency (n)	Percentage (%)
	Completed Junior High School	95	12.5
	Completed High School	162	21.3
	Completed DI/D2/D3	18	2.4
	Completed D4/College	46	6.1
3	Mother's education level		
	Low (≤ Junior High School)	382	51.9
	High (> Junior High School)	354	48.1
	Total	736	100.0
	No Education	26	3.5
	Some Primary	58	7.9
	Completed Primary	188	25.5
	Completed Junior High School	110	14.9
	Completed High School	230	31.3
	Completed DI/D2/D3	51	6.9
	Completed D4/College	73	9.9
4	Father's Employment Status		
	Not working	41	5.4
	Working	718	94.6
	Total	759	100.0
	Government Employee	37	4.9
	Corporate Employee	51	6.7
	Entrepreneur	92	12.1
	Farmer/farm laborer	431	56.8
	Fisherman	34	4.5
	Labourer	50	6.6
	Other	23	3.0
5	Mother's Employment Status		
	Not working	345	46.9
	Working	391	53.1
	Total	736	100.0
	Student	5	0.7
	Government Employee	36	4.9
	Corporate Employee	71	9.6
	Entrepreneur	26	3.5
	Farmer/farm laborer	172	23.4
	Other	81	11.0
6	Family size		
	>4 individuals	482	63.5
	≤4 individuals	277	36.5
	Total	759	
7	Food Insecurity		
	Insecurity	544	71.9
	Security	213	28.1
	Total	757	
	Food insecurity that is classified as low (score 1–4)	351	46.4
	Food insecurity that is classified as moderate (score 5–6)	130	17.2
	Food insecurity that is classified as severe (score 7–8)	63	8.3
	Access to Health Service Characteristics		
1	Basic Immunization Status		
	Incomplete	225	29.6
	Complete	534	70.4
	Total	759	100.0
	Incomplete (6–8 months)	53	46.9
	Complete (6–8 months)	60	53.1
	Incomplete (9–23 months)	172	26.6
	Complete (9–23 months)	474	73.4
2	Vitamin A Supplementation		
	Incomplete	319	42.0
	Complete	440	58.0
	Total	759	
	Environmental Characteristics		
1	Residence		
	Rural	606	79.8
	Urban	153	20.2

No	Variables	Frequency (n)	Percentage (%)
	Total	759	
2	Drinking water sources		
	Insufficient	111	14.6
	Sufficient	648	85.4
	Total	759	100.0
3	Toilet Sanitation		
	Insufficient	335	44.1
	Sufficient	424	55.9
	Total	759	100.0

stunting. In this study, there was no statistically significant relationship between early initiation of breastfeeding, exclusive breastfeeding status, MDD, maternal age at childbirth, father's education level, father's employment status, mother's employment status, number of family members, food insecurity, basic immunization status, place of residence, and drinking water source. Table 2 presents the results of the bivariate analysis of the association between the independent variables and the incidence of stunting.

Children aged 12 - 23 months have a 1.72 times greater chance of stunting than children aged 6 - 11 months. This finding is similar to a study on children in Indonesia, which found that children aged 12 to 23 months are 1.89 times more likely to be stunted than children aged 6 to 11 months (Titaley *et al*., 2019). Children's body length rises by 50% during the first year of life, or around 25 cm, compared to birth, whereas development slows significantly in the second year, increasing by just 10-12 cm (Caballero *et al*., 2003). In addition, children should receive complementary feeding after 6 months of age, but the incidence of early and delayed complementary feeding still occurs, leading to malnutrition and other health problems. Stunting is significantly associated with Infant and Young Child Feeding (IYCF) practices as late and early introduction of complementary foods (Tessema *et al*., 2013).

Boys have a 1.78 times greater chance of stunting than girls. This result follows other studies that boys have a 1.31 times higher chance of being stunted compared to girls (Thurstans

Table 2. The Association Among Independent Variables and Stunting

Independent Variables	Stunting Status				Total		OR (95% CI)	P-value
	Stunting		Normal					
	n	%	n	%	N	%		
Child age								
12 – 23 months	193	36.2	340	63.8	533	100	1.723	0.003*
6 – 11 months	56	24.8	170	75.2	226	100	(1.215 – 2.445)	
Sex of baby								
Boy	152	38.9	239	61.1	391	100	1.777	<0.001*
Girl	97	26.4	271	73.6	368	100	(1.305 – 2.419)	
Low Birth Weight (LBW)								
LBW (<2500 gram)	36	48.0	39	52.0	75	100	2.106	0.003*
Normal (≥ 2500 gram)	181	30.5	413	69.5	594	100	(1.296 – 3.423)	
Short Birth Length (SBL)								
SBL (<48 cm)	43	41.3	61	58.7	104	100	1.768	0.016*
Normal (≥48 cm)	118	28.5	296	71.5	414	100	(1.133 – 2.759)	
Early Initiation of Breastfeeding (EIB)								
No	116	31.7	250	68.3	366	100	-	0.618
Yes	123	33.7	242	66.3	365	100	(0.670 – 1.244)	
Exclusive Breastfeeding								
No	100	34.6	189	65.4	289	100	-	0.393
Yes	145	31.3	318	68.7	463	100	(0.849 – 1.585)	
Minimum Dietary Diversity (MDD)								
Not achieved (score <5)	189	34.5	359	65.5	548	100	-	0.132
							(0.936 – 1.875)	
Achieved (score ≥5)	60	28.4	151	71.6	211	100		
Children with a History of Infectious Diseases								
Yes	131	38.1	213	61.9	344	100	1.548	0.006*
No	118	28.4	297	71.6	415	100	(1.141 – 2.099)	

Independent Variables	Stunting Status				Total		OR (95% CI)	P-value
	Stunting		Normal					
	n	%	n	%	N	%		
Maternal age at childbirth								
<20 or >35 y.o	68	37.0	116	63.0	184	100	-	0.116
20–35 y.o	166	30.3	381	69.7	547	100	(0.849 – 1.910)	
Father's education level								
Low	186	34.9	347	65.1	533	100	-	0.072
High	63	27.9	163	72.1	226	100	(0.986 – 1.950)	
Mother's education level								
Low	140	36.6	242	63.4	382	100	1.555	0.007*
High	96	27.1	258	72.9	354	100	(1.136 – 2.127)	
Father's Employment Status								
Not working	11	26.8	30	73.2	41	100	-	0.505
Working	238	33.1	480	66.9	718	100	(0.364 – 1.501)	
Mother's Employment Status								
Not working	114	33.0	231	67.0	345	100	-	0.649
Working	122	31.2	269	68.8	391	100	(0,798 – 1.484)	
Family size								
>4 individuals	163	33.8	319	66.2	482	100	-	0.482
≤4 individuals	86	31.0	191	69.0	277	100	(0.827 – 1.558)	
Food Insecurity								
Insecurity	184	33.8	360	66.2	544	100	-	0.363
Security	64	30.0	149	70.0	213	100	(0.845 – 1.676)	
Basic Immunization Status								
Incomplete	68	30.2	157	69.8	225	100	-	0.368
Complete	181	33.9	353	66.1	534	100	(0.603 – 1.182)	
Vitamin A Supplementation								
Incomplete	120	37.6	199	62.4	319	100	1.454	0.020*
Complete	129	29.3	311	70.7	400	100	(1.071 – 1.974)	
Residence								
Rural	205	33.8	401	66.2	606	100	-	0.273
Urban	44	28.8	109	71.2	153	100	(0.859 – 1.868)	
Drinking water sources								
Insufficient	38	34.2	73	65.8	111	100	-	0.812
Sufficient	211	32.6	437	67.4	648	100	(0.705 – 1.649)	
Toilet Sanitation								
Insufficient	136	40.6	199	59.4	335	100	1.881	<0.001*
Sufficient	113	26.7	311	73.3	424	100	(1.384 – 2.555)	

*Significant (p<0.05)

et al., 2020). In addition, research conducted on children in Indonesia shows that boys are 1.33 times more at risk of stunting than girls (Titaley *et al*., 2019). Boys are more at risk of stunting, this according to research conducted in Bangladesh can be caused by the factor that boys more often skip meals, so that food intake becomes inadequate due to boys playing more than girls (Islam *et al*., 2018). Boys are known to be more vulnerable than girls from the beginning of conception. Male fetuses during pregnancy grow faster, have smaller placentas for their size, and have relatively lower levels of adipose tissue, making them more likely to face greater nutritional disruption during periods of rapid cell division compared to slower-growing female fetuses (Eriksson *et al*., 2010; Guihard-Costa *et al*., 2002; Thurstans *et al*., 2020). This results in boys having less nutrient reserve capacity and thus being more vulnerable to malnutrition (Aiken & Ozanne, 2013; Sandman *et al*., 2013).

LBW children have a 2.1 times greater chance of stunting than children who are not LBW. These results are in line with research conducted in Rwanda that children who have a history of LBW are at risk of stunting 2.12 times more than children who do not have a history of LBW (Nshimyiryo *et al*., 2019). In addition, research conducted in Ethiopia shows that the probability of stunting is 3.2 times higher in children who have a history of LBW than children who do not have a history of LBW (Gonete *et al*., 2021). Children under two years old in Indonesia who have a history of birth weight <2500 grams are at a 2.55 times higher risk of stunting compared to children whose birth weight is ≥2500 grams (Titaley *et al*., 2019). This may be due to children with a history of LBW being at higher risk of remaining malnourished during the early childhood years, even after controlling for child biological factors, child health, maternal factors, household environment, health service utilization, and community characteristics (Aryastami *et al*., 2017; Ntenda, 2019).

SBL children have a 1.77 times greater chance of stunting than children who are not SBL. This is in line with research conducted in Bogor showing that children aged 0 - 23 months who have a history of SBL are 1.6 times more at risk of stunting than children who are not SBL (Utami et al., 2018). Children who have a history of SBL <48 cm, have a 2.02 times risk of stunting compared to children whose birth length is ≥48 cm (Hastuti et al., 2020). SBL indicates poor nutritional status during pregnancy (Utami et al., 2018). Chronic nutritional deficiencies including maternal macronutrients and micronutrients during pregnancy can cause the mother after childbirth to have less protein and energy reserves and cannot provide adequate breast milk for the baby, thus impacting child growth (Kusharisupeni, 2006).

Children with a low level of maternal education are 1.55 times more likely to have stunted children than children with a high level of maternal education. This is following research conducted on children under two years of age in Indonesia that mothers whose highest level of education is junior high school have a 1.430 times chance of having stunted children compared to mothers with tertiary education (Laksono et al., 2022). In addition, mothers with low educational status are 3 times more likely to have stunted children compared to mothers with secondary and higher education (Yefri et al., 2022). Low education level is a risk factor for having stunted children because parental education affects better employment opportunities with higher income which is associated with the risk of stunting in parents with low income (Torlesse et al., 2016). Higher family income reflects the increased ability of households to buy good quality food, be able to access adequate health facilities, have proper sanitation facilities, and have a source of safe drinking water (Titaley et al., 2019).

Children who received incomplete vitamin A supplementation had a 1.45 times greater chance of being stunted than children who received incomplete vitamin A supplementation. This result is consistent with research conducted on toddlers in Bengkulu province that children who do not get vitamin A supplements have a 2.4 times greater risk of stunting compared to children who get vitamin A supplements (Simanjuntak et al., 2018). Vitamin A plays a role in the maintenance of mucous membranes and immune function (Hodge & Taylor, 2023). Vitamin A deficiency can cause diseases such as diarrhea, respiratory problems, and a decreased immune system (Ssentongo et al., 2020).

Households with inadequate sanitation are 1.89 times more likely to have stunted children than households with proper sanitation. This is following research conducted in Aceh province that households with improper sanitation have a 2.98 times higher risk of having stunted children compared to households with proper sanitation (Wicaksono et al., 2021). Poor sanitation and an unhealthy environment can lead to infectious and inflammatory diseases that have an impact on the incidence of stunting (Millward, 2017). Children with a history of illness have a 1.55 times greater chance of stunting than children without a history of illness. These results are in line with research conducted in Bangka Belitung that children suffering from infectious diseases have a 2.27 times chance of stunting compared to those who did not (Julianti & Elni, 2020). Research in Zimbabwe states that infectious diseases that occur repeatedly are associated with the incidence of stunting in children (Beal et al., 2018; Mutasa et al., 2022).

Table 3 shows the results of the multivariate analysis. Determinants of stunting incidence in this study based on multivariate analysis were child age, gender, history of infectious disease, and toilet sanitation, while birth weight and birth length were control variables. The most dominant variable associated with stunting was a history of infectious disease. Children who have a history of infectious disease have a risk of stunting 2.2 times higher than children who do not have a history of infectious disease after controlling for the variables of child age, gender, birth weight, birth length, and toilet sanitation. Infectious diseases cause a decrease in appetite, and inadequate fulfillment of nutritional needs, in addition to diseases that occur chronically and repeatedly cause gastrointestinal disorders such as environmental enteric dysfunction (EED) which has an impact on changes in intestinal morphology, decreased absorption of nutrients, and impaired barrier function against pathogens (Crane et al., 2015). EED causes inflammation that inhibits bone growth and directly affects height (Budge et al., 2019; Millward, 2017).

Table 3. Final Multivariate Modeling

Variables	P-value	OR	95% CI
Child age	0.004	2.025	1.251-3.277
Sex of baby	0.005	1.982	1.223-3.211
Birth weight	0.096	1.947	0.882-4.296
Birth length	0.058	1.925	0.972-3.813
History of infectious diseases	0.003	2.244	1.299-3.875
Toilet sanitation	0.016	1.748	1.104-2.768

In addition, air pollution can impair linear growth through repeated infections with respiratory illnesses and fevers and is associated with an increased risk of stunting in children (Dewey & Mayers, 2011). This can be caused by immune activity, namely increased metabolic demand, anorexia and decreased food intake, increased catabolism, and altered metabolism of essential nutrients, such as retinol and iron that are diverted as part of the body's defense mechanisms (Dewey & Mayers, 2011; Sederquist et al., 2014). This combination can lead to nutritional imbalances, resulting in impaired growth. In addition, an indirect cause of impaired growth is household income allocated not to food and nutrition, but to health care costs related to infections, leading to inadequate diets for children and impaired linear growth (Sinharoy et al., 2020).

Infectious diseases in children, especially those that are recurrent and/or severe, can interfere with the absorption and digestion of macronutrients and micronutrients which can further increase the catabolism of nutrient reserves, alter the activity of intestinal enzymes, and damage the intestinal lining (Gabain *et al*., 2023). Infectious diseases were causally linked to stunting by directly reducing insulin-like growth factor (IGF-1) levels in a study of children in Zimbabwe (Jones *et al*., 2015). The Global Enteric Multicenter Study (GEMS) showed significantly lower length-for-age (HAZ) z-scores in children after infection (Kotloff *et al*., 2013). Cohort studies have shown that infection during the first 2 years of life has an impact on linear height (Korpe & Petri, 2012).

Conclusion

The incidence of stunting in children aged 6 - 23 months in NTT Province, namely 247 children (32.8%) were stunted, while 506 children (67.2%) had normal nutritional status. Moderately stunted children were 25.0%, while severely stunted were 7.8%. Determinants of stunting in children aged 6 - 23 months in East Nusa Tenggara Province include child age, sex, birth weight, birth length, history of infectious disease, mother's education level, vitamin A supplementation, and toilet sanitation. The most dominant variable associated with stunting was a history of infectious disease. Children who have a history of infectious disease have a risk of stunting 2.2 times higher than children who do not have a history of infectious disease after controlling for the variables of child age, gender, birth weight, birth length, and toilet sanitation. The most dominant variable associated with stunting was a history of infectious disease.

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