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Original Research Paper

THE RISK FACTORS OF STUNTING CHILDREN AGED 0-5 YEARS IN INDONESIA: A MULTILEVEL ANALYSIS

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ABSTRACT

This study aims to examine the risk factors for stunting in children aged 0–5 years in Indonesia using data from the 2019 Indonesian Toddler Nutritional Status Survey in Central Sulawesi Province, Indonesia. Twelve potential predictors of stunting are categorized into household and housing characteristics; characteristics of mother and father; antenatal care services and child characteristics were analyzed. Multilevel analysis was carried out to examine the role of cluster/district differences, as well as individual and household level characteristics on stunting status. Of the 1113 children analyzed, there were 30, 8% (95% CI: 28.5–33.3%) were stunted. The risk of stunting increased significantly among children living in households with three or more children under five years of age (aOR = 1.53, 95% CI: 1.03–1.92, p=0.029). The risk also increased in children from households with five to seven members (aOR = 1.28; 95% CI: 1.13-1.40, p=0.007). Children of mothers who attended fewer than four ANC visits were at risk of developing stunting than those whose mothers attended four or more ANC visits (aOR = 1.44, 95% CI: 1.18–1.59, p=0.002). Boys have a higher chance of experiencing stunting than girls (aOR = 1.53, 95% CI: 1.12–1.65, p<0.001). The risk of stunting in children weighing <2500 g at birth is 2.55 times greater than their normal body weight ≥2500 g (aOR = 2.75; 95% CI: 2.15–3.35, p<0.001). The importance of implementing integrated interventions to address environmental problems, especially at the individual level related to stunting in Central Sulawesi, starting from environmental factors to the individual level.

INTRODUCTION

One of Indonesia's missions stated in the 2020-2024 National Medium-Term Development Plan (RPJMN) is to improve the quality of Indonesian people. Efforts made through one of the indicators and targets to reduce the prevalence of stunting (short and very short) in toddlers, namely 14 percent in 2024[1]. The Sustainable Development Goals (SDGs) also make reducing the prevalence of stunting an indicator, especially in the second goal, namely eliminating hunger, achieving food security and good nutrition and increasing sustainable agriculture[2].

Stunting is one of the challenges and global nutritional problems that are being faced by people in the world. The Ambitious World Health Assembly targets a 40% reduction in stunting rates worldwide by 2025. The 2018

Global Nutritional Report reports that there are around 150.8 million (22.2 percent) stunted children under five, which is one of the factors hindering human development in the world[3]. The World Health Organization (WHO) has determined five subregions of stunting prevalence, including Indonesia which is in the Southeast Asia region (36.4 percent)[2]. The World Health Organization (WHO) in 2019 stated that the South-East Asia region is still the region with the highest prevalence of stunting in the world, namely 31.9 percent after Africa (33.1 percent). Indonesia is the sixth country in the South-East Asia region after Bhutan, Timor Leste, Maldives, Bangladesh and India, which is 36.4 percent[4].

The Sustainable Development Goals (SDGs) make stunting one of the problems that will be controlled. Indonesia supports the achievement of the 2nd SDGs or sustainable development goals, namely ending hunger, achieving food security and better nutrition, and supporting sustainable agriculture. The target includes tackling the problem of stunting, which is expected to continue to decrease in prevalence in 2025. The 2nd goal is closely related to the 3rd goal, namely ensuring a healthy life and supporting well-being for all at all ages.[5]. Basic Health Research (Riskesdas) data shows that the prevalence of stunting under five in Indonesia in 2018 reached 30.8 percent. Based on data from the 2019 Indonesian Toddler Nutrition Status Survey (SSGBI), the national prevalence of stunting based on height/age is 27.3 percent and is currently still at 24.4 percent or 5.33 million children under five. This means that one in four toddlers in Indonesia is stunted. Currently, Indonesia is a country with the 2nd highest child stunting burden in the Southeast Asia Region and 5th in the world[1].

Based on the results of the 2019 Indonesian Toddler Nutrition Status Survey, the prevalence of stunting in Central Sulawesi Province was 30.8 percent with the lowest stunting prevalence in Toli-toli Regency, which was 13.9 percent[1]. There are 7 districts with a higher prevalence of stunting than the provincial prevalence, namely Parigi Moutong (32.2%), Banggai Laut (33.7%), Donggala (33.9%), Tojo Una-una (34%), Morowali Utara (34.2%), Poso (39%) and Sigi (47.1%). While the results of the 2019 Indonesian Nutrition Status Survey (SSGI), the prevalence of stunting in Central Sulawesi Province was 31.26 percent, which was above the national average of 27.67 percent.[1]. Based on SSGI data in 2021 the prevalence of stunting in Central Sulawesi Province has decreased by 29.7 percent and is still above the national average of 24.5 percent. Central Sulawesi is still included in the top 10 regions with the highest prevalence, which is 8th in terms of national prevalence, while the 2024 Regional Medium Term Development Plan (RPJMD) target is 13.0 percent and the RPJMD target up to 2026 is 8 percent.

Stunting is of more concern because it can have an impact on a child's life until they grow up, especially the risk of impaired physical and cognitive development if it is not handled properly[6]. The impact of stunting in the short term can be a decrease in learning ability due to a lack of cognitive development. Meanwhile, in the long run, it can reduce the quality of life of children as adults due to decreased opportunities for education, employment opportunities, and better income. In addition, it increases the risk of becoming obese later in life, thereby increasing the risk of various non-communicable diseases, such as diabetes, hypertension and cancer[7].

The results of a literature search show that various risk factors as determinants of stunting have been grouped based on epidemiological criteria. The host factor can be identified based on the mother's and child's aspects. In the maternal aspect, the determinant of stunting consists of the mother's BMI[8,9,10], mother's age[11], socio-economic factors[7,12], antenatal

visits[9], mother's education[13,14,15,16], physical violence on the mother[14], mother's stature[15], unplanned pregnancy[14], birth spacing[14], the position of the mother as the head of the household[10], hand washing behavior[9]and water consumption behavior[9]. While the child aspect consists of the age of the child[16], anemia in children[12], PMT consumption[10,14], consumption of light food[15], food diversity[9], MP ASI[9], early initiation of breastfeeding[9,17], gender[7,15], birth order[11], micronutrient supplementation[9], and neonatal size,[13,15,17]. The environmental factors consist of toilet and sanitation facilities[9], temperature[9], pet[17], ownership of agricultural land[17]and area of residence[16,17]. The last aspect is the agent factor which consists of infectious diseases (diarrhea)[9,15]and food insecurity[9].

According to the WHO conceptual framework for stunting (2013) that factors affecting stunting consist of several levels, namely at the individual level the prevalence of stunting is more common in males than females, at the family level such as food security, child care, household environment such as clean water and sanitation, lack of basic health services and maternal education, while at the community level such as beliefs, norms, health services and livelihoods[18]. Considering that stunting is influenced by factors that exist at several levels, not only at the individual level, but at the family and community levels, this study aims to analyze the risk factors for stunting at the individual, family and community levels.

MATERIALS AND METHODS

This analysis uses data derived from the results of the 2019 Indonesian Toddler Nutrition Status Survey (SSGBI) in the Central Sulawesi Province of Indonesia. The Indonesian Toddler Nutrition Status Survey is a new activity carried out in 2019 and is integrated with the National Socio-Economic Survey (SUSENAS) conducted by the Central Bureau of Statistics (BPS). This activity aims to get an overview of the prevalence of nutritional status based on anthropometric measurements at the district/city level and is expected to become input for policy making to accelerate stunting reduction in Indonesia[19]. The household sample used in this activity was obtained from the SUSENAS sample conducted by BPS. Observations were then made on toddlers in the household sample. The data obtained was sent to the Libangkes Agency, Ministry of Health of the Republic of Indonesia for further processing and analysis. Data from the 2019 Indonesian Toddler Nutrition Status Survey covers 13 regencies/cities in Central Sulawesi Province. There were 705 census blocks visited; 20,091 households visited under five, and 2,221 children were measured with a response rate of 90.1%. In this analysis, we used stunting data aged 0-59 months from 1,113 children under five years (toddlers).

Data on the nutritional status of children under five years old (toddlers) were obtained from measurements based on age, weight (BB) and height (TB). The weight of children under five was weighed using a digital scale with a precision of 0.1 kg, while their height/length was measured using a height/length measuring device with a precision of 0.1 cm. Variables of weight and height of children under five are presented in the form of three anthropometric indices, namely weight/age, height/age, and weight/height. To assess the nutritional status of children under five, the weight and height of each child under five are converted into a standardized value (Z-score) using the WHO 2005 anthropometric standard. Furthermore, based on the Z-score value of each of these indicators, the nutritional status of the child is determined. toddlers with stunting limitations if the Z-score < -3.0 to Z-score < -2, ≥-2.0.

In total, we analyzed 12 potential predictors of stunting, which were categorized into four main groups, namely household and housing characteristics; characteristics of mother and father; antenatal

care services and child characteristics (Figure 1). There are two variables according to household and housing characteristics, namely the total number of household

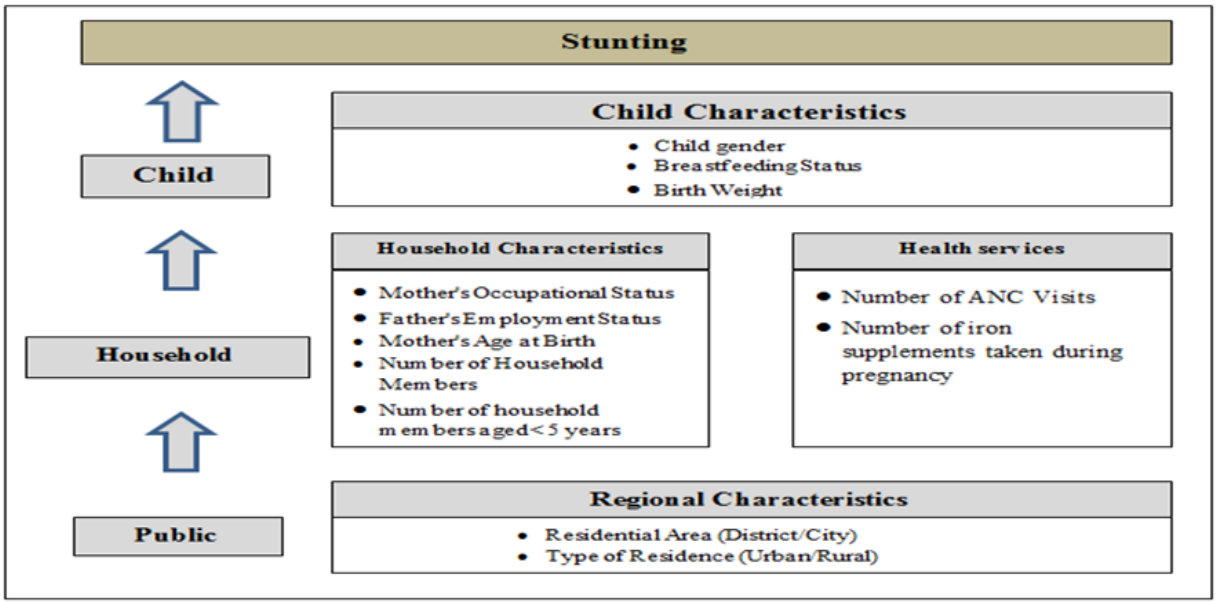

Figure 1. A framework for analyzing risk factors for stunting in children aged 0-5 years in Central Sulawesi

namely the employment status of the mother and father, as well as the age of the mother at delivery. For the antenatal care group, we used the number of antenatal care visits and the number of iron/folic acid supplements used during pregnancy. In the group of children's characteristics there are three potential predictors included, namely the sex of the child, the child's weight at birth.

Data analysis was carried out in several stages. At the initial stage descriptive statistics were used to test all the variables used, followed by bivariate analysis to see the distribution according to stunting status. Logistic regression analysis was then performed for each potential predictor to determine the unadjusted odds ratio (OR) as an approximate measure of the relationship between the outcome variable and the potential predictor. In the next stage, we carry out a multilevel analysis and two sequential models.

First, we created a Null model (blank model) aimed at assessing the role of clusters, districts and provinces without adjusting for region and all potential predictors at the individual/household level. The median odds ratio (MOR) was calculated for each level to measure the association with stunting status.

Second, Model 1 was developed to examine the role of cluster/district differences as well as individual/household level characteristics and stunting status, after adjusting for one another. The association size used in this model is aOR (adjusted odds ratio). The backward elimination method was used to remove all individual/household level characteristics that were not significantly related to the study results, using a significance level of 0.05 while the cluster variable, district remained in the model. We obtained all aORs and 95% confidence intervals (95% CI) for all predictors retained in the final model. All estimates presented in this analysis take into account the complex sample design. Statistical analysis of the data was performed using Stata/MP software (version 14.2; StataCorp).

RESULT

The results of the analysis showed that of the 1,113 children under the age of five

included in this study, 30.8% (95% CI: 28.5–33.3%) were stunted. The lowest prevalence of stunting in Central Sulawesi Province was in Toli-toli Regency, which was 13.9 percent. There are 7 districts with a higher prevalence of stunting than the provincial prevalence, namely Parigi Moutong (32.2%), Banggai Islands (33.7%), Donggala (33.9%), Tojo Una-una (34%), North Morowali (34.2%), Poso (39%) and Sigi (47.1%). As shown in Table 1, the stunting incidence rate differed significantly (p=0.01) across regions or districts.

The distribution of all respondents according to household and housing, mothers and fathers, antenatal care services and children's characteristics is presented in Table 1. Without adjusting for other covariates, there is a significant relationship between stunting and region, number of household members; number of household members under five years old; mother's age at delivery; number of ANC visits, sex of child; and the child's weight at birth.

The results of the multilevel modeling are presented in Table 2. The Null model shows that the district's MOR is 1.32. A stronger cluster effect is reflected in a high MOR (3.27). When individual-level factors (household, mother/father, antenatal care and child variables) were added to the null model (Model 1), all MOR changed, but only slightly. District MOR fell 14%, district MOR edged up 1.5% and cluster MOR only rose 1.2%. These findings reflect the consistent roles of districts and clusters even after the inclusion of individual-level variables in the model. In addition, this analysis found that residual heterogeneity between clusters (MOR = 3.27) had greater relevance than other individual-level variables to stunting.

Based on Model 1 analysis, a much higher risk of stunting was found for children under five from Parigi Moutong, Banggai Kepulauan, Donggala, Tojo Una-una, North Morowali, Poso and Sigi Regencies. At the household level, the likelihood of stunting increased significantly among children living in households with three or more children under five years of age (aOR = 1.53, 95% CI: 1.03–1.92, p = 0.029). Also, the odds are increased in children from households where five to seven family members live (aOR = 1.28; 95% CI: 1.13 to 1.40, p=0.007) (Table 2). Children of mothers who attended fewer than four ANC visits were at risk of developing stunting than those whose mothers attended four or more ANC visits (aOR = 1.44, 95% CI: 1.18–1.59, p=0.002). ≥ 2500g (aOR = 2.75; 95% CI: 2.15–3.35, p<0.001).

DISCUSSION

This study shows that the likelihood of stunting increases significantly among children living in households with three or more children under five years of age, households with five to seven household members, children whose mothers during pregnancy attended less than four antenatal care services, male children, and children weighing <2500 g at birth. This study uses nationally representative data so it should be a concern for policy makers and stakeholders at the Central Sulawesi Province level to help design effective evidence-based interventions to reduce the prevalence of stunting in children under the age of five in Central Sulawesi and nationally.

Our study found that the region and cluster where the mother lived was a significant predictor of stunting in Central Sulawesi. In our analysis, children who live in Parigi Moutong, Banggai Kepulauan, Donggala, Tojo Una-una, Morowali Utara, Poso and Sigi districts are predicted to have a higher tendency to be stunted compared to those living in other districts in Central Sulawesi. This condition may reflect the lower socio-economic conditions of the people in the region, especially in the districts with island territories. Studies show that resources and facilities, including personnel and health services in island areas are more limited

Table 1 .Distribution of Respondents According to the Characteristics of Stunting Risk Factors in Central Sulawesi in 2019

Characteristics	Total		stunt		Bivariate Analysis		
	n	(%)	n	(%)	OR	(95%CI)	ρ
Regional Characteristics							
Regency/City							
Toli-Toli	97	8.7	13	13.9	1.00		
Proud Islands	48	4.3	16	33.7	2.32	(1.82-4.50)	0.001
proud	133	11.9	39	29.5	2.41	(1.10-8.53)	0.004
Morowali	52	4.7	13	24.5	2.37	(1.13-5.45)	0.013
Poso	90	8.1	35	39.0	2.79	(1.59-6.92)	0.002
Donggala	124	11.1	42	33.9	2.34	(1.13-8.59)	0.001
Boul	76	6.8	22	29.4	1.93	(1.17-4.83)	0.004
Parigi Moutong	162	14.6	52	32.2	2.27	(1.05-5.43)	0.003
Tojo Una-Una	60	5.4	20	34.0	2.16	(1.36-6.80)	0.002
Sigi	77	6.9	36	47.1	2.52	(1.62-9.57)	0.001
Proud Sea	24	2.2	7	27.7	2.51	(1.07-7.56)	0.001
North Morowali	56	5.0	19	34.2	2.05	(1.16-9.53)	0.001
Hammer	114	10.2	27	24.1	2.39	(1.08-7.36)	0.001
Type of Residence							
Urban	587	52.7	180	30.6	1.00		
Rural	526	47.3	196	37.1	1.42	(1.28-1.57)	<0.001
Household Characteristics							
Mother's Occupational Status							
Housewife	774	69.5	256	33.1	1.00		
Work	328	29.5	115	35.2	1.14	(0.98-1.22)	0.343
Father's Employment Status							
Doesn't work	32	2.9	10	30.4	1.00		
Work	1021	91.7	345	33.8	1.50	(0.93-1.87)	0.165
Mother's Age at Birth							
20-29 years	605	54.4	198	32.7	1.00		
<20 years	106	9.5	39	36.6	1.41	(1.21-1.64)	0.044
30-39 years	356	32.0	123	34.6	1.32	(0.98-1.46)	0.076
>40 years	35	3.1	12	33.6	1.24	(0.85-1.32)	0.819
Number of Household Members							
2-4	567	50.9	184	32.5	1.00		
5-7	480	43.2	168	35.1	1.23	(1.25-1.41)	0.002
8+	66	5.9	23	35.0	1.22	(0.97-1.62)	0.480
Number of Household Members <5 Years							
1	864	77.6	288	33.3	1.00		
2	226	20.3	78	34.6	1.24	(0.95-1.38)	0.490
3+	23	2.1	10	42.0	1.57	(1.09-1.95)	0.012
Number of ANC Visits							
4 or more ANC visits	930	83.6	304	32.7	1.00		
1-3 ANC Visits	130	11.7	52	39.6	1.53	(1.38-1.70)	<0.001
No ANC visits	43	3.9	16	36.2	1.21	(0.89-1.50)	0.396
Number of Fe (Iron) Tablets Consumed During Pregnancy							
No Fe tablets were consumed	111	10.0	39	34.8	1.00		
<90 tablets	390	35.0	138	35.4	1.15	(0.89-1.28)	0.616
90 or so	391	35.1	124	31.6	0.98	(0.81-1-20)	0.287
Consumed (can't remember the amount)	221	19.9	75	34.1	0.94	(0.75-1.19)	0.627
Child Characteristics							
Gender of Child							
Man	562	50.5	178	31.6	1.00		
Woman	551	49.5	197	35.8	1.41	(1.31-1.51)	<0.001
Breastfeeding Status							
Never breastfed	1045	93.9	352	33.7	1.00		
Never breastfed	68	6.1	24	34.7	1.24	(0.96-1.45)	0.328
Birth Weight							
≥2500	688	61.8	216	31.4	1.00		
<2500	46	4.1	22	48.8	2.58	(2.03-3.45)	<0.001
Don't know	379	34.1	137	36.2	1.42	(1.31-1.71)	0.001

Table 2. Risk factors for stunting in childrenaged 0-5 years in Central Sulawesi in 2019

Characteristics	Multivariate			Model Zero		
	OR	(95%CI)	ρ	OR	(95%CI)	ρ
Regional Characteristics						
Regency/City						
Toli-Toli	1.00					
Proud Islands	1.29	(1.10-1.50)	0.002			
proud	1.24	(1.00-1.53)	0.047			
Morowali	1.22	(1.13-1.45)	0.003			
Poso	1.59	(1.59-1.92)	<0.001			
Donggala	1.34	(1.13-1.59)	0.001			
Boul	1.23	(1.17-1.83)	0.002			
Parigi Moutong	1.27	(1.05-1.53)	0.013			
Tojo Una-Una	1.36	(1.36-1.70)	0.007			
Sigi	1.82	(1.82-2.57)	0.001			
Proud Sea	1.21	(1.17-1.56)	0.001			
North Morowali	1.50	(1.16-1.93)	0.002			
Hammer	1.09	(1.08-1.76)	0.001			
Type of Residence						
Urban						
Rural						
Household Characteristics						
Mother's Occupational Status						
Housewife						
Work						
Father's Employment Status						
Doesn't work						
work						
Mother's Age at Birth						
20-29 years						
<20 years						
30-39 years						
>40 years						
Number of Household Members						
2-4	1.00					
5-7	1.28	(1.13-1.40)	0.007			
8+	1.06	(0.83-1.34)	0.641			
Number of Household Members <5 Years						
1	1.00					
2	1.17	(0.94-1.41)	0.352			
3+	1.53	(1.03-1.92)	0.029			
Number of ANC Visits						
4 or more ANC visits	1.00					
1-3 ANC Visits	1.22	(1.08-1.39)	0.002			
No ANC visits	0.89	(0.72-1.12)	0.325			
Number of Fe (Iron) Tablets Consumed During Pregnancy						
No Fe tablets were consumed						
<90 tablets						
90 or so						
Consumed (can't remember the amount)						
Child Characteristics						
Gender of Child						
Woman	1.00					
Man	1.53	(1.12-1.65)	<0.001			
Breastfeeding Status						
Never breastfed						
Never breastfed						
Birth Weight						
≥2500	1.00					
<2500	2.75	(2.15-3.35)	<0.001			
Don't know	1.13	(0.98-1.30)	0.093			
Regency/City (MOR)	1.34			1.32		
Cluster (MOR)	3.31			3.27		

Compared to mainland and urban areas. The high proportion of households in island areas with limited access to proper latrines may be one of the contributing factors to the higher prevalence of stunting in those areas. Children from households that use a latrine or have no toilet facilities at all have a higher chance of being stunted. Safe access to WASH (water, sanitation, and hygiene) infrastructure is essential. Young children are more susceptible to diarrhoea, intestinal worm infections and environmental enteropathy when the household has poor WASH facilities Children from households that use a latrine or have no toilet facilities at all have a higher chance of being stunted. Safe access to WASH (water, sanitation, and hygiene) infrastructure is essential. Young children are more susceptible to diarrhoea, intestinal worm infections and environmental enteropathy when the household has poor WASH facilities Children from households that use a latrine or have no toilet facilities at all have a higher chance of being stunted. Safe access to WASH (water, sanitation, and hygiene) infrastructure is essential. Young children are more susceptible to diarrhoea, intestinal worm infections and environmental enteropathy when the household has poor WASH facilities. These infections can cause nutritional problems. For example, children may lose their appetite, so they may eat less food than they need. In addition, this type of infection can cause malabsorption of nutrients and chronic immune activation. Finally, the infection can cause a fever, which requires the body to burn more food and exert energy to fight the infection than to use it for their physical development[9].

Other significant factors at the household level found in this analysis are family size and the number of children under five living in the household. Inappropriate allocation of food and other resources in households with many children can lead to poor health and suboptimal nutritional status. In addition, large households may exhibit reduced resources, reduced food availability, accessibility and competition for scarce resources. The presence of more than one child under five years of age can also result in sub-optimal breastfeeding and complementary feeding practices[20]. These findings indicate the importance of interventions to address household level variables. Such interventions can improve a household's economic status; for example, income-generating activities, or perhaps improving household water, sanitation, and hygiene conditions. In addition, we need to consider developing nutrition-sensitive agriculture to increase household food security, especially for large-sized households or households with more than two children under five years. Promotion of family planning services is also important to ensure sufficiently long and beneficial pregnancy intervals which will help ensure mothers have time for adequate care and feeding of all children under five years in the household.

Our analysis shows that low birth weight babies are more likely to be stunted[8]. Because stunting often starts in the womb, it is likely that underweight tends to persist into the early stages of childhood. Low birth weight was reported in infants with normal weight growth at birth. Suboptimal child growth during the prenatal period is often the result of maternal malnutrition[9]. However, during the postnatal period, optimal feeding practices can reduce the effects of poor intrauterine growth. Thus, after giving birth, if food intake is inadequate, exacerbated by unhealthy environmental conditions, children will be more susceptible to infection, leading to poor absorption of nutrients and eventually leading to poor growth. Babies with low birth weight (less than 2.5 kg at birth) have a two times higher risk of experiencing stunting than babies with normal birth weight[12]. Neonatal weight and especially length is a good indicator of a child's future nutritional status. Low baby weight and short

length are indicative of intrauterine growth restriction, which means that the baby does not grow at a normal rate in the uterus during pregnancy[13]. Lower neonatal weight and height may also be associated with maternal malnutrition during pregnancy, which in turn affects infant development. In addition, small babies are also born prematurely, which means they are not fully developed during pregnancy. In the long term, it can lead to various developmental problems, such as growth retardation, lower development of cognitive abilities, and poor neurodevelopmental outcomes[15]. In addition, this association can be explained by the greater possibility of children with low birth weight to contract infectious diseases such as diarrhea and acute respiratory infections. These infections can make children more susceptible to later complications associated with stunting[17].

We also found that boys are more at risk of stunting than girls[7]. It is assumed that boys' susceptibility to infections and other diseases can interfere with the child's growth[15]. the lower likelihood of stunting in girls compared to boys related to child feeding preferences or other health exposures, that boys are biologically more susceptible to disease than girls. In addition, boys receive complementary foods early, as parents perceive that breastfeeding is insufficient to meet the greater energy intake they believe is necessary for male infants including sex differences in this nutritional status with biological variances in morbidity between boys and girls early in life[8,9,10].

Our findings also suggest that optimal maternal nutrition should be highly recommended even before conception, as it is essential for ensuring optimal growth in the womb. Trials have examined the benefits of using iron/folic acid supplements or multiple micronutrient supplements during pregnancy in improving fetal growth, birth length, and postnatal growth[21]. There is a strong relationship between stunting and consumption of animal foods, especially various types of animal foods. In addition, nutrition education and counseling during pregnancy supplemented with nutritional support can actually increase birth weight, which is important for adequate child growth. For this reason, an educational strategy is needed to promote consumption of macronutrients during pregnancy. Provision of balanced energy protein supplementation, especially in malnourished mothers can increase fetal growth. Evidence suggests greater dietary diversity and consumption of foods from animal sources are associated with improvements in linear growth. Recent analysis shows that households adopting a diverse diet, including a diet fortified with complementary nutrients, will increase nutrient intake and reduce the risk of stunting.

All of this evidence reflects the need to promote the utilization of antenatal care services for mothers and their infants, as our analysis found. Antenatal visits lead to regular and repeated contact with health workers and opportunities for interactive health education. By carrying out adequate antenatal care, mothers will increase knowledge about proper feeding for their babies after delivery, including breastfeeding and complementary foods for breastfeeding. Mothers can also have the opportunity to receive information about childhood diseases and infections, and how to prevent them. Adequate antenatal care is related to the mother's attitude about providing adequate care after delivery, which will result in optimal child growth and well-being.

Strengths and Limitations

The strength of this study is the use of representative data collected by the Central Sulawesi Provincial Health Office with a large sample size sufficient to analyze the relationship between various levels of variables and stunting in children under five years of age. In addition, the multilevel modeling approach

used in the analysis allows testing the importance of districts, and clusters, for stunting. One limitation that needs to be considered in this study is the use of cross-sectional data which does not allow for causal conclusions. The information obtained in this study relies on secondary data. Another limitation is that the choice of variables to be analyzed depends on their availability in the data, many of the determinants of stunting include disease and infection.

CONCLUSION AND RECOMMENDATIONS

The findings of this study indicate the need for integrated interventions to reduce stunting in Central Sulawesi. Interventions should concentrate on the prenatal and postnatal periods, using a multi-sectoral approach to address a variety of factors from the societal to the individual level. Additionally efforts to promote adequate food intake during pregnancy are complemented by educational interventions. It is important to encourage pregnant women to get adequate antenatal care, which will not only benefit the mothers but also their children. After delivery, optimal infant and young child feeding practices, from exclusive breastfeeding in the first six months to appropriate complementary feeding, are essential for optimal food intake, child growth and development. as well as to prevent infections and diseases that can ultimately affect growth. In addition, guaranteeing the availability and affordability of safe and healthy food is very important to increase household food security.

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