

Identifying risk factors and recommending interventions to reduce stunting in Sigi Regency

Nasrul NASRUL¹, Fahmi HAFID², T. Iskandar FAISAL¹, Taufiqurrahman TAUFIQURRAHMAN², Kadar RAMADHAN³

1 Department of Nursing, Poltekkes Kemenkes Palu, City of Palu, Indonesia.

2 Department of Nutrition, Poltekkes Kemenkes Surabaya, City of Surabaya, Indonesia.

3 Department of Midwifery, Poltekkes Kemenkes Palu, City of Palu, Indonesia.

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ABSTRACT

Background: Stunting is a significant health issue in children and Sigi Regency has been recognized as a hotspot for stunting in Central Sulawesi since 2021. The objective of this study is to analyze the determinants of stunting among children aged 0-24 months in Sigi Regency.

Methods: This analytical research utilizes a cross-sectional design. The sample comprises 436 children aged 0-24 months, with their mothers as respondents. Data collection is scheduled for September-October 2022. The primary outcome variable in this study is stunting status, while the potential risk factors, or independent variables. Data analysis was carried out using SPSS and multivariate analysis was carried out using backward logistic regression and was significant with $p < 0.05$.

Results: The study found that the significant determinants contributing to stunting in children under two in the stunting area of Sigi District are maternal education < 9 years (AOR=2.3, 95% CI: 1.4-3.9), male gender of the child (AOR=1.8, 95% CI: 1.1-2.8), birth length < 48 cm (AOR=1.7, 95% CI: 1.0-2.8), low birth weight (AOR=2.2, 95% CI: 1.1-4.5).

Conclusion: Implementing educational programs targeting mothers with less than 9 years of education enhances their understanding of nutrition and childcare practices. Emphasize the importance of a balanced diet, with a focus on increasing the intake of animal protein sources.

KEYWORDS

Growth, Community, Prevention, Intervention, Strategies, Malnutrition.

INTRODUCTION

Stunting is a significant health issue in children and is characterized by a child's anthropometric measurement showing a height-for-age indicator Z-score < -2 SD based on the WHO standard¹. Stunting typically appears early in life, inhibiting long-term linear growth and posing challenges for subsequent growth recovery². There has been a decreasing trend in the prevalence of stunting among children under five in Indonesia, from 37.2% in 2013 to 30.8% in 2018³. Likewise, in the province of Central Sulawesi, the occurrence of stunting in children aged 6-23 months decreased from 32.3% in 2007 to 31.5% in 2011 and further to 26.0% in 2016⁴. The causes of child stunting are multifactorial⁵.

At the national level, research in Indonesia by Beal et al. (2018) identified various factors contributing to stunting, including non-exclusive breastfeeding during the first six months of life, low socioeconomic status of households, premature birth, low birth length, short maternal stature, low maternal education level, inadequate sanitation facilities, untreated drinking water, limited access to healthcare, and residing in rural areas⁶. Provincial-level research by Nasrul et al. (2018) revealed that risk factors for stunting in Central Sulawesi are low birth weight, lack of handwashing practices, and lack of access to sanitation facilities⁷. In a district-level study by Nasrul et al. (2017), the prevalence of stunting in Sigi Regency was found to be 43.8%⁸.

The study conducted in Kinovaro, Sigi Regency, identified factors contributing to stunting, including low birth weight, exclusive breastfeeding, immunization history, and infec-

Correspondencia:
Fahmi Hafid
hafid.fahmi79@gmail.com

tious diseases⁹. Meanwhile, in Biromaru, Sigi Regency, factors contributing to stunting were birth length and parity¹⁰ and the City of Palu in Central Sulawesi shows that risk factors for the incidence of stunting macro nutritional intake (protein and fat), mother's education, maternal work, family income and household food security^{11,12}. Latest studies in Indonesia^{13,14}, show that the factors influencing child stunting are diverse and multifaceted. Searching for the "Publish or Perish" software reveals that there has been no research conducted on the factors influencing stunting among children aged 0-24 months in Sigi Regency. Nevertheless, Sigi Regency has been recognized as a hotspot for stunting in Central Sulawesi since 2021¹⁵.

This research aims to examine the factors influencing stunting in children aged 0-24 months in Sigi Regency. The research is important because it will provide insights into the determinants of stunting among children aged 0-24 months in Sigi Regency, which can be used to develop interventions to reduce the problem of stunting in this region. The findings of the research could have implications for policy and programming aimed at reducing stunting in Sigi Regency and other regions with high rates of stunting.

METHOD

This research utilizes an analytical research design a cross-sectional approach. The study will be conducted in Sigi Regency, involving a sample size of 436 children aged 0-24 months. Sigi Regency is one of the districts in Central Sulawesi Province, Indonesia (Figure 1). Sigi District Health Service, the 25 villages designated as the locus for handling stunting are in nine sub-districts, including Sigi Biromaru, Nokilalaki, Palolo, South Dolo, West Marawola, Kulawi, Gumbasa, South Dolo and Dolo sub-districts. Determining the number of research samples used the Slovin formula and obtained a total of 436 research respondents. The participants will consist of mothers with children aged 0-24 months, and the inclusion criteria encompass the child's age falling within 0-24 months, residence in Sigi Regency, the child being in good health, and the parent's willingness to participate as a respondent. Exclusion criteria involve the child having a chronic illness or disability.

Data collection is scheduled for September-October 2022. Research data collection was assisted by research enumerators who had passed the selection and participated in full enu-

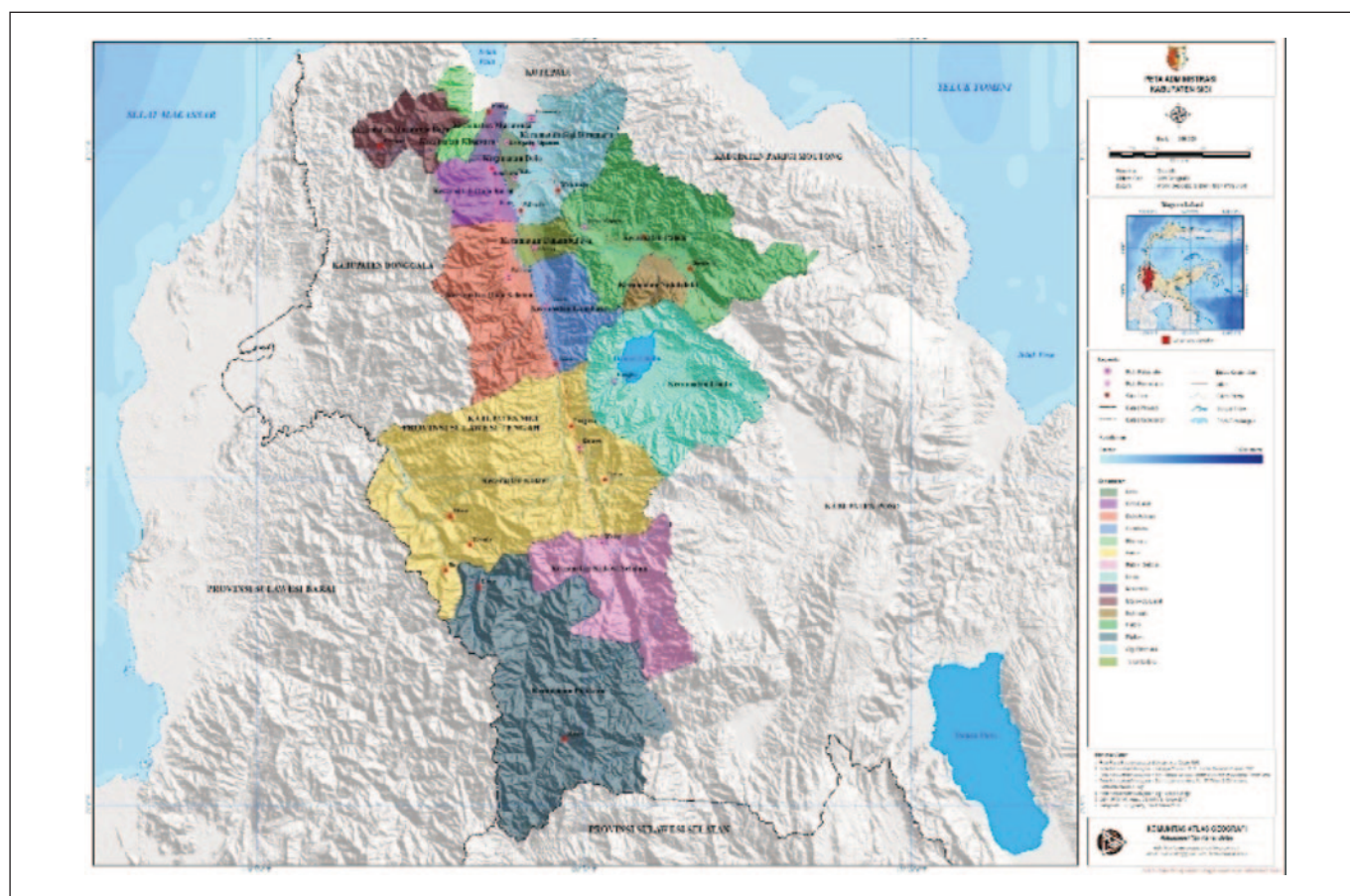


Figure 1. Administrative Map of Sigi Regency, Central Sulawesi Province, Indonesia (<https://sulteng.bpk.go.id/peta-administrasi-kabupaten-sigi/>)

erator training with enumerator criteria, namely having a D3 education in nutrition, serving for more than 2 years, not being pregnant for women, being over 20 years old, domiciled in Sigi district, having health insurance, and There is no ethnic, religious or racial conflict. The primary outcome variable in this study is stunting status, while the potential risk factors, or independent variables, include maternal characteristics such as age and education level, delivery mode, child's gender and age, household factors such as drinking water source and toilet ownership, infant feeding practices such as early breastfeeding initiation, birth length, birth weight, exclusive breastfeeding history, and current breastfeeding status during the study period, socioeconomic factors such as food insecurity, number of children, and birth spacing, healthcare utilization, complementary feeding practices, and smoking exposure within the household. Additionally, a comprehensive medical history will be collected, including information on past illnesses, acute respiratory infections, diarrhea, pneumonia, pulmonary tuberculosis, measles, and intestinal parasitic infections. Stunting status will be assessed directly by measuring

the child's length using a Length Board Measuring tool, while the child's age will be obtained from their birth certificate or Child Health Card. Other relevant data will be gathered.

Data analysis used the SPSS program and statistical tests, namely bivariate tests using Chi-Square and multivariate tests using logistic regression with the backward method, and was significant with $p < 0.05$.

This study has obtained ethical approval from the Ethics Committee of Poltekkes Kemenkes Palu (number 0011/KEPK-KPK/IV/2022 dated April 7, 2022) and research permission from the Central Sulawesi provincial government's Regional Unity and Community Affairs Agency (number 071/0204/Bid.III-BKBPD/2022 dated March 13, 2022).

RESULTS

In 2023, the Sigi Regency Government designated 38 village areas as stunting focus locations, spread across 13 districts. In this study, it was found that 28.2% of children in Sigi Regency experienced stunting in 2023. Table 1 indicates that variables

Table 1. Cross-tabulation of stunting in children under 2 years in the stunting locus of Sigi Regency

Variable	Nutritional Status				p-value
	Normal		Stunting		
	n (313)	% (71.8)	n (123)	% (28.2)	
Mother's Age in years					
<20	18	64.3	10	35.7	0.362
≥20	295	72.3	113	27.7	
Mother's Education in Years					
<9	53	54.6	44	45.4	<0.001
≥9	260	76.7	79	23.3	
Child's Gender					
Boys	157	68.6	72	31.4	0.115
Girls	156	75.4	51	24.6	
Type of Delivery					
Normal	226	68.3	105	31.7	0.004
Caesarean Section	87	82.9	18	17.1	
Child's Age In Month					
0-6	12	85.7	2	14.3	0.239
7-24	301	71.3	121	28.7	

Table 1 continuation. Cross-tabulation of stunting in children under 2 years in the stunting locus of Sigi Regency

Variable	Nutritional Status				p-value
	Normal		Stunting		
	n (313)	% (71.8)	n (123)	% (28.2)	
Source of Drinking Water					
Not Improved	27	65.9	14	34.1	0.375
Improved	286	72.4	109	27.6	
Family Toilet Ownership					
No	37	52.9	33	47.1	<0.001
Yes	276	75.4	90	24.6	
Early Initiation of Breastfeeding					
No	115	66.9	57	33.1	0.065
Yes	198	75.0	66	25.0	
Birth Length					
<48 cm	97	64.7	53	35.3	0.019
≥48 cm	211	75.4	69	24.6	
Birth Weight					
Low	28	54.9	23	45.1	0.004
Normal	285	74.0	100	26.0	
Exclusive Breastfeeding					
No	190	70.6	79	29.4	0.468
Exclusive	123	69.9	53	30.1	
Current Breastfeeding					
No	111	76.6	34	23.4	0.119
Yes	202	69.4	89	30.6	
Food Security					
Yes	7	77.8	2	22.2	0.687
No	306	71.7	121	28.3	
Number of Children					
>3	27	69.2	12	30.8	0.710
≤3	286	72.0	111	28.0	
Birth Interval In Years					
First Children	134	77.9	38	22.1	0.062
≤3	80	66.1	41	33.9	
>3	99	69.2	44	30.8	
Health Facility Utilization					
No	28	77.8	8	22.2	0.404
Yes	285	71.3	115	28.8	

Table 1 continuation. Cross-tabulation of stunting in children under 2 years in the stunting locus of Sigi Regency

Variable	Nutritional Status				p-value
	Normal		Stunting		
	n (313)	% (71.8)	n (123)	% (28.2)	
PMT Provision					
No	237	72.3	91	27.7	0.706
Yes	76	70.4	32	29.6	
Stimulation Provision					
No	84	64.1	47	35.9	0.020
Yes	229	75.1	76	24.9	
Family Members Smoking					
No	77	76.2	24	23.8	0.257
Yes	236	70.4	99	29.6	
History of Acute Respiratory Infections					
No	54	81.8	12	18.2	0.049
Yes	259	70.0	111	30.0	
History of Diarrhea					
No	232	71.8	91	28.2	0.976
Yes	81	71.7	32	28.3	
History of Pneumonia					
No	261	73.3	95	26.7	0.135
Yes	52	65.0	28	35.0	
History of Pulmonary Tuberculosis (TB)					
No	309	71.9	121	28.1	0.779
Yes	4	66.7	2	33.3	
History of Measles					
No	311	71.7	123	28.3	0.374
Yes	2	0.0	0	0.0	
History of Intestinal Parasitic Infections					
No	299	71.4	120	28.6	0.323
Yes	14	82.4	3	17.6	
Child's Condition during the Study					
Mild Illness	313	72.0	122	28.0	0.110
Healthy	0	0.0	1	100.0	

significantly associated with stunting status in Sigi Regency include the mother's education in years ($p < 0.001$, where mothers with < 9 years of education had more stunted children, 45.4%). The type of delivery also showed a significant relationship with stunting incidence, with a p -value of 0.004. Family toilet ownership demonstrated a significant association with stunting status ($p < 0.001$, with families without toilets having more stunted children, 47.1%). Birth length exhibited a significant relationship with stunting status ($p = 0.019$, where children born with a length < 48 cm had more stunted children, 35.3%). Stimulation provision had a significant association with stunting status ($p = 0.020$, with children who did not receive stimulation provision having more stunted children, 35.9%). The history of acute respiratory infections had a significant relationship with stunting incidence ($p = 0.049$, with children having a history of acute respiratory infections having more stunted children, 30.0%).

The results of multivariate analysis showed that the main determinant of stunting incidence was maternal education below 9 years with an adjusted odds ratio (AOR) of 2.3. The second determinant was low birth weight with an AOR of 2.2. The third determinant was male sex with an AOR of 1.8. The fourth determinant was birth length < 48 cm with an AOR of 1.7 (Table 2).

DISCUSSION

The determinants of stunting in the Stunting Focus Areas of Sigi, Indonesia. The significant factors contributing to stunting are identified as follows: maternal education below 9 years, low birth weight, male sex, and birth length < 48 cm. Maternal education exhibits the most robust correlation with the occurrence of stunting. Mothers with limited educational backgrounds have a higher likelihood of delivering children who experience stunting. Findings from additional research studies suggest that mothers with lower levels of education elevate the risk of stunting in children under the age of five by 3.01 times compared to mothers with higher educational levels (OR = 3.01; 95% CI = 1.92 to 4.73), demonstrating statistical significance ($p = 0.000$)¹⁶. This is due to the fact that mothers with a lower level of education are more prone to having insufficient knowledge and awareness regarding the significance of nutrition for both pregnant women and children. Furthermore, mothers with limited education are also more inclined to face constraints in accessing high-quality healthcare and food¹⁷.

Low birth weight (LBW) is a condition in which a baby is born weighing less than 2.5 kg. LBW is a major risk factor for stunting. Babies with LBW are more likely to experience growth and developmental problems later in life. Babies with LBW have experienced stunted growth and development during the prenatal period¹⁸. Infants with low birth weight (LBW) have a 20-fold higher likelihood of experiencing complications and mortality compared to babies with normal weight¹⁹. LBW infants face potential risks of cognitive deficits, delays in mo-

Table 2. Multivariate analysis of determinants of stunting in children under 2 years of age in the stunting locus of Sigi Regency

Variables	p	AOR	95%CI	
			Lower	Upper
Mother's Education in years				
<9	0.002	2.3	1.4	3.9
≥9		1.0		
Sex				
Boys	0.014	1.8	1.1	2.8
Girls		1.0		
Birth Length				
<48 cm	0.040	1.7	1.0	2.8
≥48 cm		1.0		
Low Birth Weight (LBW)				
Yes	0.024	2.2	1.1	4.5
No		1.0		
Stimulation Provision				
No	0.095	1.5	0.9	2.4
Yes		1.0		

tor development, cerebral palsy, and other behavioral and psychological issues²⁰.

Boys are more at risk of experiencing stunting than girls. Several studies exploring concurrent wasting and stunting have also shown that, overall, boys are more likely to be affected than girls²¹. A recent analysis of DHS data from Africa explored sex differences in undernutrition and found that though differences were small, overall, boys were more susceptible to undernutrition than girls²². This is likely due to a combination of biological and environmental factors. Boys tend to have higher muscle mass and metabolism than girls, which requires more energy and nutrients to support growth and development. Additionally, boys are more likely to engage in physically demanding activities, which can increase the risk of injury and infection.

Birth length is the measurement of the length of a child at birth. Birth length less than 48 cm is one of the indicators of low birth weight (LBW). Children with birth length less than 48 cm are at increased risk of stunting. Infants born with a length less than 48 centimeters (short) are 15.0 times more

likely to suffer from stunting ($p < 0.05$; 95% CI: 2.58– 87.9) compared to newborns with a length of 48 centimeters or more (normal)²³. The length of a child's body is inseparable from the growth and development of the fetus during the neonatal period.

To combat the issue of stunting in Sigi Regency, early prevention strategies should be targeted towards breastfeeding mothers, pregnant women, and preconception women. Additionally, efforts to prevent low birth weight and being born short are crucial in reducing stunting prevalence. These findings align with the goals of the health transformation program in the Ministry of Health in Indonesia, which aims to combat stunting and improve the overall health and well-being of children in the country. By focusing on preventive measures during early stages of life, interventions can be tailored to address the specific determinants identified in this study, ultimately contributing to a reduction in stunting prevalence in the region. The most prevalent public health strategies employed to diminish stunting in toddlers are health education, counseling, collaboration, and community organizing²⁴. This finding underscores the importance of focusing on interventions to improve nutrition and growth during the critical window of the first two years of life. Investing in adolescent nutrition is essential for creating a healthy generation²⁵. However, nutrition-specific interventions alone are not enough to address the challenges of the nutrition transition. Integrated nutrition programs that address the social and economic factors that influence adolescent nutrition, coupled with behavior change interventions, are urgently needed²⁵.

Short birth length and low birth weight are also recognized as notable factors contributing to stunting. This underscores the significance of sufficient prenatal care and nutrition for expectant mothers to promote the healthy development of the fetus. Additionally, targeted interventions for infants with low birth weight are essential in preventing stunting during early childhood. Conversely, the examination did not reveal a substantial correlation between stunting and issues such as food insecurity, diarrhea, and intestinal parasitic infections. However, it is essential to interpret these results with caution, as the sample size or other confounding factors may influence the findings. In the context of efforts to reduce stunting in Sigi Regency and Indonesia as a whole, these findings can guide policymakers and public health authorities in designing targeted interventions. Focusing on nutrition and healthcare interventions during the critical stages of early childhood, particularly for children aged 7-24 months, can have a significant impact on reducing the prevalence of stunting. In order to address child stunting, governmental intervention is necessary for mothers with low educational levels and those residing in rural areas²⁶. Intervention involves thorough education on enhancing nutritional well-being during pregnancy, as well as promoting practices related to complementary feeding and breastfeeding until the child reaches 24 months of age²⁶.

Furthermore, addressing the determinants of low birth weight and birth length, such as improving maternal health and nutrition, can contribute to reducing the risk of stunting from early life. Integrating nutrition-sensitive interventions into existing health and social programs can help combat food insecurity and improve overall nutrition outcomes for vulnerable populations. Moreover, programs that promote exclusive breastfeeding and appropriate complementary feeding practices are crucial in preventing stunting. Existing knowledge regarding the role of protein in managing stunting, and emphasizes the importance of appropriate protein intake in promoting optimal growth while mitigating associated risks²⁷. Providing access to clean water, sanitation facilities, and proper hygiene practices can help reduce the risk of infections, including diarrhea and intestinal parasitic infections, which can contribute to stunting.

To achieve a comprehensive approach to reducing stunting, collaboration between various stakeholders, including the Ministry of Health, local governments, non-governmental organizations, and community members, is essential. Implementing evidence-based strategies, monitoring progress, and continuously evaluating interventions will be crucial in achieving the goal of reducing stunting in Sigi Regency and Indonesia as a whole.

CONCLUSION AND RECOMMENDATIONS

The significant determinants contributing to stunting in children under 2 years in the stunting area of Sigi District are maternal education <9 years, boys gender of the child, birth length <48 cm, and low birth weight.

We suggest implementing educational programs targeting mothers with less than 9 years of education to enhance their understanding of nutrition and childcare practices. Emphasize the importance of a balanced diet, with a focus on increasing the intake of animal protein sources. Enhance prenatal care services to reduce the number of low birth weight infants and promote the health of both mothers and newborns. Promote gender equality to ensure that both boys and girls children receive equal care and nutrition. Establish a monitoring and evaluation system to track the progress of interventions and assess their impact in reducing stunting rates in the Sigi District stunting locus area. Conduct research to understand the specific challenges and barriers faced by the community in addressing the issue of stunting and adapt interventions accordingly.

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