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The Impact of Mining Activities on the Prevalence of Stunting in Children (A Comparative Study in the Mining Area of Langgikima Pesisir and the Non-Mining Area of Wawolesea)

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ABSTRACT

Introduction: Stunting remains a major public health issue worldwide, with 149 million children (21.9%) affected in 2020. In Indonesia, despite the 2024 target of 14%, prevalence was still 21.6% in 2022. Beyond nutrition, stunting is influenced by environmental, socioeconomic, and maternal factors. In North Konawe, Southeast Sulawesi, mining activities further threaten water, sanitation, and food security. The aim of this study is to see Impact of Mining Activities on the Prevalence of Stunting in Children (A Comparative Study in the Mining Area of Langgikima Pesisir and the Non-Mining Area of Wawolesea).

Method: A cross-sectional study was conducted on 58 children aged 24–59 months from mining (Coastal Langgikima) and non-mining (Wawolesea) areas. Data on water access, sanitation, breastfeeding, maternal nutrition, diet, and socioeconomic status were collected through questionnaires and anthropometry. Chi-Square and logistic regression were used to analyze associations and key predictors.

Result: Stunting prevalence was higher in mining areas (48.3%) compared to non-mining (27.6%). Bivariate analysis revealed significant associations with access to clean water (p=0.008), sanitation (p=0.001), exclusive breastfeeding (p=0.001), maternal nutritional status (p=0.001), and socioeconomic status (p=0.035). Multivariate analysis showed that exclusive breastfeeding remained the most influential factor, while other variables lost significance after adjustment.

Conclusion: Children in mining areas face greater risk of stunting due to combined environmental, maternal, and socioeconomic vulnerabilities. Exclusive breastfeeding emerged as the strongest protective factor. Policies should integrate nutrition programs with improvements in water, sanitation, and maternal health, alongside multisectoral collaboration between health, environment, and mining sectors.

Introduction

Stunting is a form of chronic malnutrition that remains a serious issue in public health development, both globally and nationally. According to the 2020 Joint Child Malnutrition Estimates (JCME) report, approximately 149 million children worldwide are stunted, equivalent to 21.9% of the total population of children under five years of age.[1] Stunting not only reflects chronic malnutrition due to long-term inadequate nutritional intake, but also impacts physical growth, cognitive development, intelligence, future work productivity, and even increases the risk of chronic non-communicable diseases in adulthood.[2] This condition makes stunting a sensitive indicator in assessing the quality of human development in a country.

The Indonesian government has made reducing stunting a national development priority in line with the global commitment to the 2030 Sustainable Development Goals (SDGs), particularly target 2.2, which emphasizes the elimination of all forms of malnutrition.[3] The national target in the National Medium-Term Development Plan is to reduce the prevalence of stunting to 14% by 2024. However, the results of the 2022 Indonesian Nutrition Status Survey (SSGI) still show a prevalence of 21.6%, which means that nearly one in five toddlers in Indonesia still experience growth retardation. [4]. This situation indicates that achieving the 14% target will not be easy without a more integrated multisectoral strategy.

A number of studies in Indonesia show that stunting is influenced by various determining factors, both directly and indirectly. These factors include limited access to clean water and sanitation, low coverage of exclusive breastfeeding, toddler diets that do not meet balanced nutritional standards, the nutritional status of mothers before and during pregnancy, and the socioeconomic conditions of families.[5] In addition, the 2018 Basic Health Research (Riskesdas) report also confirms that household environmental factors, parental education levels, and maternal health behaviors contribute significantly to stunting.[6] Thus, stunting is not merely a nutritional problem, but a complex issue related to environmental, social, economic, and cultural aspects.

Southeast Sulawesi Province is one of the regions facing significant challenges in tackling stunting. Data from the Southeast Sulawesi Provincial Health Office in 2021 shows that several districts/cities in this province have stunting prevalence rates above the national average.[7] This shows the disparity in health development between regions in Indonesia, especially in the eastern region, which is relatively underdeveloped compared to the western region. One district of particular concern is North Konawe District. This district is known as a mining area with massive mineral resource exploitation activities over the past decade. These mining activities have the potential to cause various environmental problems, such as water pollution, land degradation, declining sanitation quality, and loss of community access to clean natural resources.[8]

Such environmental conditions can affect children's health, including increasing the risk of stunting. Children living in mining areas tend to be more vulnerable to malnutrition due to limited access to clean water and nutritious food. In addition, economic pressure on families due to dependence on the fluctuating mining sector can also have an impact on meeting the nutritional needs of toddlers.[9] Research by Wahyuni and Fithriyana shows that children in mining areas have a greater risk of stunting than children in non-mining areas.[10] This is in line with previous studies that found that environmental factors, especially water quality and sanitation, are important determinants of stunting.[9]

However, research specifically comparing stunting risk factors between mining and non-mining areas is still very limited, especially in Southeast Sulawesi Province. In fact, a more comprehensive understanding of the differences in risk factors in these two areas is very important for formulating targeted interventions. By understanding the dominant factors causing stunting in each area, local governments and related sectors can design more effective policies and programs to reduce the prevalence of stunting.

Based on this background, this study was conducted to analyze the risk factors that influence the incidence of stunting in children under five years of age in mining and non-mining areas of North Konawe Regency. The results of this study are expected to make a real contribution to efforts to accelerate the reduction of stunting through evidence-based interventions.

Method

This study used a quantitative comparative cross-sectional design to analyze risk factors of stunting among children under five in North Konawe Regency. The research was conducted from June to August 2023 in mining (Langgikima Pesisir) and non-mining (Wawolesea) areas. The population consisted of all children aged 24–59 months in the study areas. A total of 58 samples were selected using proportional cluster random sampling. Inclusion criteria were children who had lived in the study area for at least six months and were accompanied by a mother or caregiver willing to participate. Children with congenital abnormalities or chronic diseases were excluded.

Data were collected using structured questionnaires and anthropometric measurements based on WHO growth standards. The variables included access to clean water, sanitation, dietary patterns, exclusive breastfeeding, maternal nutritional status, and family socioeconomic status.

Data analysis was performed using Chi-Square tests for bivariate analysis and logistic regression for multivariate analysis to determine dominant factors.

Results were presented as odds ratios (OR) with 95% confidence intervals, and $p<0.05$ was considered statistically significant.

Result

This study involved 58 children aged 24–59 months, consisting of 29 from mining areas (Langgikima Pesisir) and 29 from non-mining areas (Wawolesea). Based on anthropometric measurements using WHO growth standards, the prevalence of stunting was higher in the mining area (48.3%) compared to the non-mining area (27.6%). This difference indicates a greater risk for children living in environments with mining activities.

Table 1 shows the results of the above analysis, a picture of the relationship between each independent variable and the incidence of stunting was obtained. For access to clean water, it was found that toddlers living in households with poor access to clean water had a stunting prevalence of 66.7% (14 toddlers), while in households with good access to clean water, only 27.0% (10 toddlers) experienced stunting. This difference is statistically significant with a p-value of 0.008, indicating a significant relationship between clean water quality and stunting. In terms of environmental sanitation, toddlers from families with poor sanitation showed a higher prevalence of stunting, namely 71.4% (15 toddlers), compared to families with good sanitation, which was 21.6% (8 toddlers). The test results showed a p-value of 0.001, so it can be concluded that sanitation is closely related to stunting in toddlers.

Furthermore, in terms of exclusive breastfeeding, the prevalence of stunting in toddlers who were not exclusively breastfed reached 80.9% (17 toddlers), which was much higher than toddlers who were exclusively breastfed, which was only 27.0% (10 toddlers). This difference is significant prevalence was only 29.7% (11 toddlers). The analysis results showed a p-value of 0.035, which means that there is a significant relationship between socioeconomic status and the incidence of stunting.

Table 2 shows results of multiple logistic regression analysis, only the variable of exclusive breastfeeding history was included in the final model as a significant factor affecting stunting in toddlers. The exclusive breastfeeding variable showed a regression coefficient (B) value of 2.440 with a in terms of stunting. The variable of maternal nutritional status also shows a similar pattern. Children of mothers with poor nutritional status had a stunting prevalence of 80.9% (17 toddlers), while children of mothers with good nutritional status only had a stunting prevalence of 27.0% (10 toddlers). The Chi-Square test resulted in a p-value of 0.001, confirming that maternal nutritional status is significantly associated with stunting.

Finally, in terms of family socioeconomic status, toddlers from families with low economic status had a stunting prevalence of 61.9% (13 toddlers), while in families with medium economic status, the standard error of 0.4639 and a Wald value of 13.355. The significance test results showed $p < 0.001$, so it can be concluded that this variable is significantly related to stunting. The Exp(B) value of 11.475 indicates that toddlers who did not receive exclusive breastfeeding had an 11.5 times greater risk of stunting than toddlers who did receive exclusive breastfeeding. Thus, exclusive

breastfeeding proved to be the strongest protective factor in this study.

Meanwhile, other variables such as access to clean water (p=0.110), environmental sanitation (p=0.389), feeding patterns (p=0.097), and economic status (p=0.090) were not included in the final model because they were not statistically significant in the multivariate analysis. Although these variables showed a bivariate relationship with stunting, when tested together in a multivariate model, their effects were no longer significant. This suggests that the effects of access to clean water, sanitation, feeding patterns, and economic status may be mediated or masked by the powerful effect of the exclusive breastfeeding variable. Thus, this multivariate analysis confirms that a history of exclusive breastfeeding is a dominant factor that independently contributes to the incidence of stunting in North Konawe Regency.

Table 1.
Bivariate Analysis of Risk Factors and Stunting

Variable	Category	Mining n (%)	Non n (%)	P-Value
Access to clean water	Less	14 (66.67)	10 (27.03)	0.008
	Good	7 (33.33)	27 (72.97)	
Sanitation	Less	15 (71.43)	8 (21.62)	0.001
	Good	6 (28.57)	29 (78.38)	
Exclusive breastfeeding	Less	17 (80.95)	10 (27.03)	0.001
	Good	4 (19.05)	27 (72.97)	
Maternal nutritional status	Less	17 (80.95)	10 (27.03)	0.001
	Good	4 (19.05)	27 (72.97)	
Socioeconomic status	Low	13 (61.90)	11 (29.73)	0.035
	Middle–High	8 (38.10)	26 (70.27)	

Table 2.
Multivariate Logistic Regression of Risk Factors for Stunting

Variable	B	S.E.	Wald	df	Sig.	Exp(B)	Remarks
Final Model (Step 1)							
Exclusive Breastfeeding History	2.440	0.4639	13.355	1	<0.001	11.475	Significant
Constant	-0.531	0.2771	1.773	1	0.1271	0.4083	–
Variables Not Included in the Model							
Access to Clean Water	–	–	1.985	1	0.110	–	Not Significant
Environmental Sanitation	–	–	0.2347	1	0.389	–	Not Significant
Feeding Practices	–	–	2.762	1	0.097	–	Not Significant
Socioeconomic Status	–	–	2.871	1	0.090	–	Not Significant

Discussion

Access to Clean Water

The results of this study indicate that access to clean water has a significant relationship with the incidence of stunting in North Konawe Regency (p=0.008). Children living in households with inadequate access to clean water have a stunting prevalence of 66.7%, which is much higher than that of children from households with good access to clean water, which is 27.0%. This analysis shows that limited access to clean water is not only an environmental issue, but also has direct implications for children's nutritional status and growth.

According to research conducted by Ahmat, coal mining areas experienced a 60–70% decline in water quality due to contamination.[11] While

Pratiwi et al. reported a decline in water quality in nickel mining areas in Sulawesi with high bacterial content exceeding health thresholds.[12] Suratri et al. also reported that children living in mining areas are more prone to digestive disorders, which increase the risk of stunting.[13] The odds ratio of 5.4 in this study confirms that children who live without access to clean water are more than five times more likely to experience stunting than those who have adequate access.

Sanitation

The results of the study show a striking difference in sanitation conditions between the Langgikima Pesisir mining area and the non-mining area of Wawolesea. In the mining area, the majority of respondents (71.43%) considered sanitation to be inadequate, while in the non-mining area, 78.38% stated that sanitation conditions were good.

The suboptimal sanitation conditions in the mining area are in line with various previous research findings that confirm the systemic impact of extractive activities on sanitation infrastructure. Mining areas have sanitation systems that do not meet health standards due to soil and groundwater contamination by mining waste containing heavy metals and hazardous chemicals.[14] Children in mining areas with poor sanitation have 3.2 times more episodes of diarrhea than children in areas with good sanitation, which contributes significantly to stunting through the mechanisms of malabsorption of nutrients and chronic electrolyte loss.[15]

Exclusive Breastfeeding

The results of the study reveal a very significant disparity in exclusive breastfeeding practices between the mining area of Langgikima Pesisir and the non-mining area of Wawolesea, with profound consequences for the incidence of stunting in children. In the mining area, the majority of children (80.95%) had a history of inadequate exclusive breastfeeding, while in the non-mining area the situation was much better, with 72.97% of children receiving adequate exclusive breastfeeding.

The low rate of exclusive breastfeeding in mining areas is influenced by various environmental and work pressures experienced by mothers.[16] Many mothers stop exclusive breastfeeding before six months due to stress, fatigue, and concerns about the quality of breast milk due to exposure to pollutants.[17] Some mothers introduce complementary foods early because they believe that breast milk alone is not sufficient in a polluted environment. Children who do not receive exclusive breastfeeding are at higher risk of respiratory and digestive tract infections, which contribute to stunting through repeated infections and impaired nutrient absorption.[18]

Based on this analysis, researchers identified that mining areas create a complex combination of environmental, social, and economic factors that systematically hinder optimal breastfeeding practices and contribute to high rates of stunting.

Maternal Nutritional Status

The results of the study show a very significant difference between mining and non-mining areas in terms of maternal nutritional status and the incidence of stunting in children. In mining areas, the proportion of mothers with poor nutritional status reached 80.95% and was closely related to the high prevalence of stunting, while in non-mining areas the majority of mothers had adequate nutritional status (72.97%).

These findings are consistent with previous studies showing that maternal nutritional status is one of the strongest determinants of stunting in children. Previous studies have shown that maternal nutritional status has a significant impact on child growth and development.[19] A comprehensive analysis of various studies in Southeast Asia also reinforces the scientific evidence of a strong and significant relationship between maternal nutritional status during pregnancy and the risk of stunting in children under five years of age. These findings consistently show that investing in improving maternal nutritional status, both before conception, during pregnancy, and during breastfeeding, is a fundamental strategy in efforts to prevent stunting and improve the quality of future generations.[20]

Socioeconomic Status

The results of the study show that family economic status has a significant relationship with the incidence of stunting (p.value = 0.035). Children from families with low economic status recorded 61.90% in mining areas experienced stunting, much higher than 29.73% in non-mining areas. Conversely, sufficient economic status was

more dominant in non-mining areas (70.27%) than in mining areas (38.10%).

This condition is in line with the concept of basic causes in the UNICEF framework, which places poverty and limited resources as the fundamental causes of stunting.[21] Other studies show that children from low-income families have a much higher risk of stunting than children from middle- or high-income families. These economic limitations reduce families' access to nutritious food and health services, so the prevalence of stunting tends to be higher in the lowest economic groups than in more prosperous groups.[22]

The difference between mining and non-mining areas not only reflects income levels, but also relates to socio-economic structures and the availability of local resources. In the non-mining area of Wawolesea, household food security is better because the community still has access to local food sources such as seafood and agricultural products, which are relatively more affordable. Conversely, in mining areas, despite the potential for increased income, access to nutritious food is limited due to dependence on markets with higher prices.

Conclusion

This study found that stunting prevalence is higher in mining areas compared to non-mining areas. Five factors access to clean water, sanitation, exclusive breastfeeding, maternal nutritional status, and socioeconomic status, were significantly related to stunting, with clean water and sanitation as dominant determinants. These results show that stunting is not only a nutritional issue but also shaped by environmental, behavioral, and structural factors. Efforts to reduce stunting must therefore combine nutrition-specific programs with improvements in water, sanitation, maternal health, breastfeeding support, and family economic empowerment.

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