

Determinants of Stunting and Innovations for Stunting Reduction among Children Under Two Years of Age in Central Sulawesi

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ABSTRACT

Central Sulawesi is one of the Indonesian provinces with the highest stunting prevalence. Based on the 2024 Indonesian Nutritional Status Survey (SSGI), the stunting prevalence in Central Sulawesi reached 26.1%, substantially higher than the national average of 19.8%. This study aimed to analyze the determinants of stunting and identify innovations that have been effective in reducing stunting prevalence among children under two years of age (baduta) across 13 districts/cities in Central Sulawesi. An ecological study design was applied using secondary data analysis of the 2021 and 2024 SSGI datasets, complemented by documentary review of regional innovation programs. The results revealed substantial variation in stunting prevalence between districts/cities, ranging from 16.5% in Tojo Una-Una to 36.9% in Buol in 2024. The main determinants of stunting included young maternal age at pregnancy, low coverage of the sixth antenatal care visit (K6), suboptimal iron-folic acid supplement consumption, high rates of early marriage, and poor dietary diversity among children under two. Districts with the sharpest declines in stunting, such as Tojo Una-Una (-12.8 points), Parigi Moutong (-9.4 points), and Sigi (-7.7 points), implemented innovations based on cross-sectoral collaboration, utilization of local food resources, and digital reporting. It is concluded that convergent, participatory, and data-driven interventions are more effective in reducing stunting than fragmented sectoral approaches.

INTRODUCTION

Stunting is a condition of impaired growth in children resulting from chronic malnutrition, particularly during the first 1,000 days of life, characterized by low height-for-age relative to the standard. Globally, stunting remains one of the most serious public health problems, affecting approximately 148.1 million children under five, or 22.3%, in 2022.¹ In Indonesia, although the stunting prevalence has shown a declining trend from 37.6% in 2013 to 19.8% in 2024, disparities between provinces remain very wide.² Central Sulawesi is one of the seven provinces with the highest stunting prevalence in Indonesia, reaching 26.1% based on the 2024 SSGI data.³

Stunting among children under two years of age (baduta) has serious long-term consequences, including impaired cognitive development, reduced learning capacity, increased risk of metabolic diseases in adulthood, and diminished economic productivity.^{4,5} Studies have shown that linear growth in early life is strongly associated with subsequent child development outcomes in low-

and middle-income countries.⁶ The economic loss attributable to stunting has been estimated at 2-3% of a country's Gross Domestic Product.⁷

The determinants of stunting are multifactorial and complex, encompassing both direct and indirect factors. Direct factors include inadequate nutrient intake and recurrent infectious diseases, while indirect factors comprise household food security, caregiving practices, access to health services, and environmental and sanitation conditions.^{8,9} At the upstream level, socioeconomic factors such as poverty, low education, and early marriage contribute significantly to the occurrence of stunting.¹⁰ In Central Sulawesi, early marriage rates remain high, with an age-specific fertility rate for women aged 15-19 years reaching 38.77 per 1,000 births according to Statistics Indonesia data.¹¹

The Government of Indonesia has issued Presidential Regulation Number 72 of 2021 on the Acceleration of Stunting Reduction, which sets a target stunting prevalence of 14% by 2024.¹² To achieve this target, various convergent intervention programs have been implemented at the district/city level, encompassing eight convergence actions for stunting reduction acceleration. However, the achievements across districts/cities show highly significant variation, indicating differences in the effectiveness of program implementation.⁹

In Central Sulawesi, SSGI data reveal an interesting dynamic: several districts have dramatically reduced their stunting prevalence, while others have experienced increases. Tojo Una-Una, for instance, reduced its prevalence from 29.3% ²⁰²¹ to 16.5% ²⁰²⁴, whereas Buol increased from 28.9% to 36.9% over the same period.³ This phenomenon highlights the importance of identifying specific determinants and effective local innovations for stunting reduction. Several districts in Central Sulawesi have developed unique local innovations, such as the Keranjang DASHAT (Healthy Kitchen to Overcome Stunting) program in Parigi Moutong, the Mosintuwu Mamporewu Balita Stunting program in Poso, and the SIARAN Stunting Village program in Tojo Una-Una.³ However, no comprehensive study has yet analyzed the determinants of stunting and comparatively examined the effectiveness of these various innovations at the district/city level across Central Sulawesi. Therefore, this study aims to analyze the determinants of stunting and identify effective innovations for reducing stunting prevalence among children under two years of age in 13 districts/cities of Central Sulawesi.

MATERIALS AND METHODS

This study used an ecological study design combining secondary data analysis and documentary review. The units of analysis were the 13 districts/cities in Central Sulawesi Province, namely Banggai Kepulauan, Banggai, Morowali, Poso, Donggala, Toli-Toli, Buol, Parigi Moutong, Tojo Una-Una, Sigi, Banggai Laut, Morowali Utara, and Palu City.

Data on stunting prevalence and determinant indicators were obtained from the Indonesian Nutritional Status Survey (SSGI) for 2021 and 2024, published by the Ministry of Health of the Republic of Indonesia. SSGI is a national household-based survey using a stratified multistage probability sampling design. The Central Sulawesi sample in the 2024 SSGI involved 7,521 children under five whose nutritional status was measured.³ The determinant indicators analyzed included: prevalence of stunting, underweight, wasting, severe wasting, and overweight per district/city; the proportion of maternal age at pregnancy; antenatal care coverage (K1, K4, K6); the proportion of iron-folic acid supplement (TTD) consumption; the proportion of early initiation of breastfeeding (EIBF); the proportion of exclusive breastfeeding; and the fulfillment of Minimum Dietary Diversity (MDD) and Minimum Acceptable Diet (MAD) among children under two.¹⁶

Data on regional innovations were obtained through documentary review, including: reports of the Central Sulawesi Provincial Stunting Deliberation (Rembuk Stunting) for 2023 and 2024, evaluation documents of the Eight Convergence Actions for Stunting Reduction Acceleration, innovation program reports from five selected districts/cities (Poso, Parigi Moutong, Sigi, Tojo Una-Una, and Palu City), and media publications related to stunting reduction programs in Central Sulawesi during the 2022-2025 period.¹³

Data analysis was conducted descriptively and comparatively by comparing changes in stunting prevalence between districts/cities from 2021 to 2024, identifying determinants correlated with these changes, and categorizing and evaluating the types of innovations implemented by districts/cities with the largest reductions in stunting. Trend analysis was performed using calculations of absolute change (delta) and relative percentage change. Ethical clearance was not required because this study used aggregate data that were officially published and did not involve individual-level data.

RESULTS

Stunting Prevalence across Districts/Cities in Central Sulawesi

Based on the 2024 SSGI data, the stunting prevalence in Central Sulawesi was 26.1% (95% CI: 24.7-27.6%), higher than the national average of 19.8%. There was very wide variation between districts/cities, ranging from 16.5% in Tojo Una-Una to 36.9% in Buol. A comparison of the 2021 and 2024 SSGI data reveals diverse patterns of change across the 13 districts/cities (Table 1).³

Table 1. Comparison of Stunting Prevalence across Districts/Cities in Central Sulawesi, SSGI 2021 and 2024

District/City	SSGI 2021 (%)	SSGI 2024 (%)	Delta (%)	Category
Tojo Una-Una	29.3	16.5	-12.8	Decline
Parigi Moutong	31.7	22.3	-9.4	Decline

Sigi	40.7	33.0	-7.7	Decline
Morowali	28.6	22.6	-6.0	Decline
Poso	26.7	21.1	-5.6	Decline
Morowali Utara	24.6	20.4	-4.2	Decline
Toli-Toli	29.4	26.9	-2.5	Decline
Banggai Kepulauan	30.6	28.4	-2.2	Decline
Donggala	29.5	29.6	+0.1	Stable
Banggai Laut	26.1	26.6	+0.5	Stable
Palu City	23.9	25.6	+1.7	Increase
Banggai	26.0	28.7	+2.7	Increase
Buol	28.9	36.9	+8.0	Increase
Central Sulawesi	29.7	26.1	-3.6	Decline

Determinants of Stunting in Central Sulawesi

Analysis of the 2024 SSGI data revealed several key determinants associated with stunting prevalence in Central Sulawesi. At the provincial level, the prevalence of underweight reached 24.2% (95% CI: 22.9-25.5%), wasting 8.7% (95% CI: 8.0-9.5%), and severe wasting 2.5% (95% CI: 2.1-3.1%). At the district/city level, there was a correlation between stunting prevalence and other nutritional status indicators, in which districts with high stunting also tended to have high prevalence of underweight and wasting (Table 2).³

From the maternal determinant perspective, the proportion of pregnant women under 20 years of age in Central Sulawesi remained relatively high. Data showed that 10.8% of mothers of children under five began their pregnancy before the age of 20, which increases the risk of stunting up to twofold.^{6,18} The sixth antenatal care visit (K6) coverage in Central Sulawesi only reached 66.8%, lower than the national average. The proportion of mothers who received and consumed at least 90 iron-folic acid tablets during pregnancy also remained suboptimal.³

Regarding infant and young child feeding practices, the proportion of early initiation of breastfeeding (EIBF) in Central Sulawesi was 61.8%, while the proportion of exclusive breastfeeding for infants aged 0-5 months only reached 47.6%. The fulfillment of Minimum Dietary Diversity (MDD) among children aged 6-23 months was only 36.9%, and Minimum Acceptable Diet (MAD) was 22.2%. These data indicate that feeding practices for children under two in Central Sulawesi remain far from optimal.^{3,19}

Table 2. Nutritional Status of Children Under Five per District/City in Central Sulawesi, SSGI 2024

District/City	Stunting (%)	Underweight (%)	Wasting (%)	Sv. Wasting (%)	Overweight (%)
Tojo Una-Una	16.5	27.3	10.7	2.9	2.3
Morowali Utara	20.4	21.1	6.4	2.2	2.5
Poso	21.1	17.1	4.0	0.8	2.8

Parigi Moutong	22.3	22.0	8.7	5.7	4.3
Morowali	22.6	18.5	7.8	0.7	2.5
Palu City	25.6	23.6	7.8	2.4	2.7
Banggai Laut	26.6	28.7	11.2	2.0	1.6
Toli-Toli	26.9	24.0	9.0	2.1	2.6
Banggai Kepulauan	28.4	27.2	12.7	3.4	0.9
Banggai	28.7	21.7	8.3	1.5	2.0
Donggala	29.6	28.4	10.5	1.9	2.9
Sigi	33.0	30.8	8.5	2.5	1.4
Buol	36.9	30.1	11.6	2.5	2.7
Central Sulawesi	26.1	24.2	8.7	2.5	2.6

Effective Innovations for Stunting Reduction

Analysis of five districts/cities with documented innovation programs showed that districts implementing innovations based on cross-sectoral collaboration and local food utilization tended to have larger reductions in stunting. Tojo Una-Una District, which reduced its prevalence by 12.8 points, implemented the SIARAN Stunting Village program and integrated digital reporting. Parigi Moutong District, with a 9.4-point reduction, ran the Keranjang DASHAT program based on local food. Poso District, which declined by 5.6 points, relied on the M2BS and GERTAK PENTING programs.³

In the 2024 Stunting Deliberation (Rembuk Stunting) evaluation, the ranking of convergence action performance showed: Parigi Moutong in first place (124 points), Palu City in second (122 points), Tojo Una-Una in third (115 points), and Sigi in sixth (104 points). In a separate evaluation of the Eight Convergence Actions in 2024, Poso District achieved the best rank first in Central Sulawesi. Several convergence service indicators in Poso exceeded national targets, including iron-folic acid supplement consumption among pregnant women (87.68% against a target of 85%) and the sixth antenatal care visit (93.95% against a target of 80%).³

DISCUSSION

The results of this study show that the stunting prevalence in Central Sulawesi remains above the national average and the WHO threshold of 20%, although it has declined from 29.7% ²⁰²¹ to 26.1% ²⁰²⁴. This finding is consistent with previous studies reporting that provinces in eastern Indonesia tend to have higher stunting prevalence than western regions.^{20,10} Geographic factors, accessibility of health services, and disparities in economic development are the main explanations for these differences.⁹

The wide variation in stunting prevalence between districts/cities (16.5%-36.9%) indicates that local determinant factors play a significant role. Buol District, which experienced the highest increase

in prevalence (+8.0 points), requires special attention. Studies in other areas with similar characteristics show that increases in stunting prevalence are often associated with weakened cross-sectoral coordination, changes in regional budget policies, and insufficient village-level assistance.²⁴

The finding regarding the correlation between stunting and underweight and wasting is consistent with the UNICEF conceptual framework, which states that malnutrition problems are intergenerational and interrelated.⁸ Sigi District, which had the highest stunting prevalence (33.0%), also recorded the highest underweight (30.8%), confirming that both indicators share overlapping determinants, particularly poverty and inadequate nutrient intake.²⁵

Maternal determinants such as maternal age at pregnancy are risk factors consistent with the global literature. Studies in various developing countries show that pregnancy under the age of 20 increases the risk of stunting by 1.5 to 2 times because of nutritional competition between the still-growing mother and the fetus.^{18,26} In Central Sulawesi, the persistently high rate of early marriage constitutes a structural challenge requiring cross-sectoral intervention rather than the health sector alone.¹¹

The low coverage of the sixth antenatal care visit (66.8%) and suboptimal iron-folic acid supplement consumption in Central Sulawesi indicate a persistent gap in antenatal services. A systematic review shows that iron-folic acid supplementation during pregnancy can reduce the risk of low birth weight and, subsequently, stunting.²⁷ Low birth weight itself has been identified as the most dominant predictor of stunting among Indonesian children aged 12-23 months.¹⁵ Improving the coverage of high-quality antenatal services should therefore be an intervention priority at the district/city level.

The low fulfillment of MDD (36.9%) and MAD (22.2%) indicates that the quality of feeding for children under two remains a serious problem. This finding aligns with research in several Indonesian provinces showing a significant relationship between dietary diversity and child nutritional status.^{19,28} Local food utilization interventions such as the Keranjang DASHAT program in Parigi Moutong and moringa leaf processing in Palu City represent relevant approaches for improving dietary diversity at an affordable cost.³

The analysis of regional innovations shows that districts with the largest reductions in stunting implemented convergent approaches involving multiple stakeholders and grounded in data. The SIARAN Stunting Village program in Tojo Una-Una combined hygiene campaigns, early-marriage prevention, and synchronized nutrition actions within a single integrated platform. The M2BS program in Poso adopted a foster-parent concept in which each regional agency was responsible for assisting specific villages in stunting management.³ This approach is consistent with WHO recommendations on the importance of a multisectoral approach to addressing malnutrition.²⁹

An interesting finding of this study is that Palu City, despite having the best health infrastructure as the provincial capital and achieving second place in stunting convergence, actually experienced an increase in prevalence (+1.7 points). This paradoxical phenomenon may be related to urbanization, changing consumption patterns, and increased case detection due to improved surveillance systems.³⁰ This indicates that the availability of infrastructure alone is insufficient without strengthening community-based interventions.

The digitalization of reporting implemented in Tojo Una-Una and the strengthening of the Bangda Action Web system in Poso demonstrate the importance of integrated health information systems in supporting evidence-based decision-making. Research in other areas shows that districts with strong data systems tend to be more responsive in addressing stunting problems.⁹ The limitations of this study include the use of aggregate data, which does not allow analysis of individual risk factors, and the difficulty of isolating the specific effect of each innovation on stunting reduction.

CONCLUSION

The stunting prevalence in Central Sulawesi remains above the national average, with very wide variation between districts/cities (16.5%-36.9%). The main determinants of stunting in the region include young maternal age at pregnancy, low coverage of the sixth antenatal care visit and iron-folic acid supplement consumption, high rates of early marriage, and poor fulfillment of dietary diversity and minimum acceptable diet among children under two. There is a correlation between stunting prevalence and the underweight and wasting indicators, confirming the multidimensional nature of the malnutrition problem in Central Sulawesi.

Districts with the largest reductions in stunting implemented convergent, participatory, and data-driven innovations. Programs such as the SIARAN Stunting Village, Keranjang DASHAT, and M2BS proved effective because they integrated nutrition-specific and nutrition-sensitive interventions, involved all stakeholders from the district to the village level, and were supported by digital reporting systems that enabled continuous monitoring and evaluation.

It is recommended that regional governments strengthen cross-sectoral coordination through the designation of stunting focal points at the sub-district level, improve the coverage of high-quality antenatal services, intensify early-marriage prevention programs, and replicate proven effective innovations to other districts/cities that still have high prevalence. Further research using analytical designs and individual-level data is needed to confirm the causal relationships between determinants and stunting and to evaluate the specific impact of each innovation.

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