



Ecological analysis of infectious diseases, healthcare access, and socioeconomic factors on stunting prevalence in West Sumatra Indonesia

Analisis ekologi penyakit menular, akses pelayanan kesehatan dan faktor sosial ekonomi terhadap prevalensi stunting di Sumatera Barat Indonesia

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Abstract

Stunting is a condition of growth failure characterized by height below the expected standard for their age. The prevalence of stunting in West Sumatra has fluctuated above 20% between 2021 and 2023, highlighting its status as a public health issue. Unaddressed stunting in early childhood can adversely affect learning capacity and elevate the risk of non-communicable diseases later in life. This ecological study analyzes factors associated with stunting prevalence in West Sumatra using secondary data from 2021 sourced from the Health Office, Social Office, Central Bureau of Statistics, and the National Population and Family Planning Board across 19 districts/cities. The dependent variable was stunting prevalence, while the independent variables included acute respiratory infections (ARI), vitamin A supplementation, antenatal care (ANC), family planning, poverty, families at risk of stunting, and Conditional Cash Transfer (CCT) beneficiaries. Statistical analyses using Pearson and Spearman tests identified significant positive associations between stunting prevalence and ARI percentage ($p=0,020$), poverty level ($p=0,023$), and CCT beneficiaries ($p=0,028$). Conversely, ANC coverage showed a significant negative association with the prevalence of stunting ($p=0,021$). In conclusion, the prevalence of stunting in West Sumatra in 2021 is influenced by various factors, including ARI, poverty levels, PKH beneficiaries, and ANC coverage.

Keywords: Ecological analysis, risk factors, interventions, stunting prevalence

Abstrak

Stunting merupakan kondisi gagal tumbuh yang ditandai dengan tinggi badan yang tidak sesuai dengan usianya. Prevalensi stunting di Sumatera Barat berfluktuasi lebih dari 20% pada tahun 2021 hingga 2023, hal tersebut menunjukkan bahwa stunting merupakan masalah kesehatan masyarakat. Stunting yang tidak tertangani pada balita dapat berdampak buruk pada kapasitas belajar dan meningkatkan risiko penyakit tidak menular di kemudian hari. Studi ekologi ini menganalisis faktor-faktor yang terkait dengan prevalensi stunting di Sumatera Barat dengan menggunakan data sekunder dari tahun 2021 yang bersumber dari Dinas Kesehatan, Dinas Sosial, Badan Pusat Statistik, dan Badan Kependudukan dan Keluarga Berencana Nasional di 19 kabupaten/kota. Variabel dependen pada penelitian ini adalah prevalensi stunting, sedangkan variabel independen adalah infeksi saluran pernapasan akut (ISPA), suplementasi vitamin A, *Antenatal Care* (ANC), Keluarga Berencana, kemiskinan, keluarga berisiko stunting, dan penerima Program Keluarga Harapan (PKH). Analisis statistik menggunakan uji Pearson dan Spearman mengidentifikasi terdapat hubungan positif yang signifikan antara prevalensi stunting dengan persentase ISPA ($p=0,020$), tingkat kemiskinan ($p=0,023$), dan penerima bantuan PKH ($p=0,028$). Sebaliknya, cakupan ANC menunjukkan hubungan negatif yang signifikan dengan prevalensi stunting ($p=0,021$). Kesimpulan,

Prevalensi stunting di Sumatera Barat pada tahun 2021 dipengaruhi berbagai faktor, termasuk ISPA, tingkat kemiskinan, dan penerima bantuan PKH, serta cakupan ANC.

Kata Kunci: Analisis ekologi, faktor risiko, intervensi, prevalensi stunting

Introduction

One of the major global health goals is to lower the prevalence of stunting, because it might negatively affect children's development until a later age (Dewey, 2020). Inappropriate handling of stunting can have a negative impact on the growth and development of children. The impact is both short- and long-term. In the short term, stunting increases morbidity and mortality, reduces child development and learning capacity, and increases the risk of infections and noncommunicable diseases. In the long term, stunting increases susceptibility to fat accumulation, mostly in the midsection, lower fat oxidation, lower energy expenditure, increased insulin resistance, and the risk of non-communicable diseases. It can also reduce the work capacity and reproductive outcomes in adulthood (Soliman et al. 2021). The impact of stunting can downgrade the quality of human resources needed to improve national development.

In 2020, the Government of Indonesia set 41 strategic priority projects (Major Project), one of which in the health sector was to accelerate the decrease in stunting prevalence to 14% by 2024 (Presidential Regulation No. 18 of 2020). The Indonesian Nutritional Status Survey (SSGI) and Basic Health Research (SKI) were conducted to monitor and evaluate the nutritional status of the Indonesian population. This survey found that in recent years, the prevalence of stunting has decreased in Indonesia. In 2023, 21,5% of children under five in Indonesia were stunted. This figure has decreased from 24,4% in 2021 (MoH, 2022). Despite this decrease, the average decrease from 2021 to 2023 is only 1,45%. This indicates that to achieve a target of 14% by 2024, more effective and efficient interventions are needed.

While Indonesia has seen a gradual decline in the prevalence of stunting, the situation in West Sumatra underscores the urgency for targeted interventions. In West Sumatra, stunting is still classified as a public health issue according to the WHO standards. This is because it has a prevalence > 20%. The

prevalence of stunting in West Sumatra has fluctuated from 2021 to 2023. In 2021, the prevalence of stunting was 23,3%, which will increase to 25,2% by 2022 (MoH, 2022). In 2023, the prevalence decreased to 23,7% (MoH, 2023). Despite this decrease, this figure is still far from the target set for 2024 (14 %).

The factors that can influence the occurrence of stunting originate in multiple sectors. These factors are not only at the individual level but also at the household, population, and environmental levels (Mulyaningsih et al., 2021). In addition to nutritional intake and infectious diseases, which are micro factors at the individual scale, macro-scale factors in a wider population and at larger scales, such as at the regional level, can also affect stunting. These macro-scale factors include socioeconomic factors, nutrition-sensitive and-specific programs, accessibility to health services, and household environment, including access to improved water sources and sanitation (Vaivada et al., 2020). These macroscale factors have wide-ranging impacts on the prevalence of stunting in the population. A systematic review found that strategies to reduce stunting often involve macro-level interventions at macro level (Hariani et al., 2021; Rahmadiyah et al., 2022).

The Indonesian Government has made various efforts to reduce the prevalence of stunting by 14% in accordance with the National Medium-term Development Plan target, which must be achieved in 2024, with types of efforts including specific and sensitive nutritional interventions (MoH, 2022). Antenatal care, routine immunization, iron supplementation for adolescent girls and pregnant women, treatment of sick children, deworming, and supplemental feeding for children under five years and pregnant women are examples of specific nutritional interventions. Access to improved sanitation, health insurance, early childhood education, family planning, social assistance, healthy houses, family food security, and a variety of foods for toddlers are among the most sensitive nutritional interventions (MoH, 2022).

However, based on the Indonesian Nutrition Status Study in 2021, the stunting incidence in Indonesia and most of its provinces remains higher than 20% (MoH, 2021). The unachieved target may have been caused by the stunting intervention that was not carried out in accordance with the socio-demographic conditions and dominant risk factors in the area. For instance, remote areas or regions far from governmental centers often face limited access to healthcare services, sanitation, and clean water. These conditions can increase the vulnerability of the population to diseases, such as acute respiratory infections (ARI), malnutrition, and intestinal parasitic infections (Gizaw et al., 2022).

This ecological study also involved the spatial mapping of the prevalence of stunting and associated factors across regions. This mapping can assist in determining geographical patterns and associations between environmental conditions and stunting prevalence. This ecological study design allows for the understanding that stunting is a complex phenomenon that is not limited to nutrition but also broader social, economic, and environmental aspects. Previous research on the risk factors for stunting has predominantly focused on the individual level, whereas population-level studies remain limited. This study aimed to analyze the risk factors associated with stunting in toddlers using a broader approach. We hypothesized that macro-level factors may also influence the prevalence of stunting.

Previous ecological studies on stunting have been conducted at the national level. Eryando et al. (2022) applied the Spatial Autoregressive (SAR) method to identify significant risk factors for stunting across various regions, considering spatial autocorrelation between areas. The analysis revealed significant spatial relationships in regions such as Sumatra, Java, Sulawesi, and Bali-NTB-NTT, indicating that the prevalence of stunting in one area is linked to that in neighboring areas. Additionally, Laksono & Kusri (2020) conducted an ecological study on stunting using data from the Indonesian Health Profile 2017, focusing on the relationship between stunting prevalence, poverty, and healthcare services. A cross-tabulation analysis found that poverty significantly contributed to the high prevalence of stunting.

In this study, the research area was specific to a single province. This ecological study analyzed the factors on a macro scale. The findings of this study are expected to provide valuable insights for policymakers to evaluate and refine existing stunting intervention programs by considering the conditions and factors that are dominant in society.

Methods

The analytical approach used in this study was an ecological approach that focused on group comparisons over individual analyses. Aggregate data for districts/cities were used in this study. According to Laksono & Kusri (2020), variables in ecological studies can be aggregate, environmental, or global measurements.

Ecological studies provide insights at the population level, offering a valuable perspective for assessing complex public health issues such as stunting. Stunting is influenced by various population-level factors including socioeconomic factors, access to healthcare, and sanitation. Environmental and social determinants are more appropriately analyzed at the population level. Ecological studies facilitate the examination of the associations between population-level risk factors and stunting prevalence within the same geographic region. The findings of these studies can be applied to public policy, as population-level analyses align with the scale of policy intervention. Nonetheless, this ecological study design has potential limitations, such as the risk of ecological fallacy, inability to control confounders at the individual level, and limitations of aggregated data that may limit the interpretation of results.

The ecological analysis applied in this study aimed to determine the influence of infectious diseases, health access, and socioeconomic factors on the prevalence of stunting at the district/city level in West Sumatra Province. This research utilized secondary data collected from the Health Office, Social Office, Central Bureau of Statistics, and National Population and Family Planning Board of West Sumatra Province. The unit analysis applied for this research was the district or city in West Sumatra Province, which consisted of seven cities and 12 regencies.

Spatial mapping is used to identify areas where stunting occurs, and the specific types of intervention priorities that can be implemented in these areas (Eryando et al., 2022; Haile et al., 2016). This mapping can provide a visualization of programs that have successfully achieved the targets in each region. Mapping was conducted using the QGIS 3.32.1 software.

The prevalence of stunting was assessed by the percentage of children under five years of age with a height-for-age z-score (HAZ) of less than -2 standard deviations (SD). In this study, stunting was categorized as stunting prevalence based on the National Medium-Term Development Plan target of 14%. Areas that reached the target of $\leq 14\%$ were categorized as low and those that were still $>14\%$ were categorized as high. The independent variables were categorized based on the Ministry of Health's Strategic Plan target, Regional Medium-Term Development Plan, or average provincial percentage. The cut-offs based on the National Medium-Term Development Plan target, the Ministry of Health's Strategic Plan target, and Regional Medium-Term Development Plan targets in this study were used to evaluate areas that still need more attention in each program because they have not yet reached the target. Variables that do not have national or regional targets use the average provincial percentage as the cut-off.

The ARI prevalence was assessed by the percentage of children under five years of age who had pneumonia and non-pneumonia cough in each region. It was categorized based on the average provincial prevalence. Coverage of Vitamin A supplementation was assessed by the percentage of children under five years of age who received vitamin A supplementation twice a year. It was categorized based on the Ministry of Health's Strategic Plan target for 2024, which is 90% (MoH, 2020). ANC coverage was assessed based on the percentage of pregnant women who made at least four ANC visits during pregnancy. The percentage of family planning was assessed by the percentage of reproductive-age couples who used contraception to regulate the number of births. ANC coverage and percentage of family planning are categorized based on the Medium-term Development Plan target of West Sumatra for 2024, which are 78% and 55,89%, respectively (Regional Regulation No. 6 of 2021).

The poverty percentage was assessed as the percentage of the population that had an average monthly per capita expenditure below the poverty line. It was categorized based on the Medium-Term Development Plan target of West Sumatra for 2024 (6,03 %). The percentage of families at risk of stunting was assessed by the percentage of families with one or more risk factors for stunting. Meanwhile, the percentage of Conditional Cash Transfer (CCT) or "Program Keluarga Harapan (PKH)" beneficiaries is assessed by the percentage of families who receive CCT in each region. The percentage of families at risk of stunting and CCT beneficiaries were categorized based on the provincial percentage average. Areas with a percentage of $\leq 66,55\%$ for families at risk of stunting and $\leq 13,20\%$ for CCT beneficiaries are categorized as low. Areas with higher percentages were categorized as high.

Data analysis by the univariate method was carried out on each variable to provide an overview of the distribution and proportion of each variable studied, while bivariate analysis was also employed to determine the correlation between each independent variable and stunting prevalence. Prior to conducting the correlation analysis, the Shapiro-Wilk normality test was performed to evaluate the assumption of data normality. If the data were normally distributed, the Pearson correlation test was employed for correlation analysis. Conversely, if the data did not follow a normal distribution, Spearman's correlation test was used for the analysis.

The independent variable was significantly associated with the prevalence of stunting if the p-value was less than 0,05. Furthermore, the positive direction of the association indicates that an increase in the value of the independent variable increases the prevalence of stunting. Conversely, the negative direction of the association indicates that an increase in the value of the independent variable decreases the prevalence of stunting. Data processing and analyses were performed using Microsoft Excel and SPSS software version 21. Microsoft Excel was utilized to organize research data sourced from various origins into a structured format, facilitating easier access and analysis. In this study, the data collected from each region were complete, accurate, and relevant, as they were derived from credible governmental agencies. Additionally, SPSS was used to conduct both descriptive and inferential statistical analyses.

Result and Discussion

The results of the descriptive analysis presented in Table 1 show that the stunting prevalence in West Sumatra Province, based on the Health Office data, is 11,97%. The region with the lowest stunting prevalence was Payakumbuh City (5,9%), whereas the region with the highest prevalence was the

Mentawai Islands regency (19,6%). Based on data from the Health Office in 2021, 36,8% of the regions were categorized as having a high prevalence of stunting (Figure 1). These areas include the Mentawai Islands Regency, Solok Regency, Sijunjung Regency, Tanah Datar Regency, Pasaman Regency, West Pasaman Regency, and Padang Panjang City.

Table 1. The results of descriptive analysis of the stunting prevalence, infectious diseases, healthcare access, and socioeconomic factors in West Sumatra Province

Variables	n	Mean ± SD	Median	Min	Max
Stunting prevalence	19	11,97 ± 4,62	12,30	5,9	19,6
ARI prevalence	19	17,79 ± 8,99	16,03	7,02	40,05
Health services					
Coverage of vitamin A supplementation	19	92,53 ± 10,16	93,74	58,29	99,96
Coverage of ANC	19	74,63 ± 13,98	75,16	36,58	93,53
Percentage of family planning	19	51,86 ± 8,82	51,82	30,71	63,20
Socioeconomic					
Percentage of poverty	19	6,63 ± 2,83	7,02	2,31	16,19
Percentage of families at risk of stunting	19	66,55 ± 7,35	68,26	56,25	80,13
Percentage of CCT beneficiaries	19	13,20 ± 5,13	12,71	4,93	25,36

Based on the mapping of stunting prevalence, the high prevalence of stunting was not spread randomly, but clustered geographically. Areas with high stunting prevalence tended to be in the northern and eastern regions. In addition, the Mentawai Islands Regency in the southwestern region has a high prevalence of stunting. On average, the northern region of West Sumatra has a high prevalence of ARI, percentage of poverty, CCT beneficiaries, and families at risk of stunting. In addition, the coverage of ANC visits, percentage of family planning, ODF, and access to proper latrines were low in this region. On average, the eastern region has a high prevalence of ARI, percentage of poverty, CCT beneficiaries, and families at a risk of stunting. In addition, the average coverage of ANC visits in this region was low.

The Mentawai Islands Regency is an archipelago separated from the mainland West Sumatra. This causes access to food and health services in this region to be lower than that in other regions. This region had low scores for the food security index, vitamin A supplementation coverage, ANC visits, family planning, ODF, and access to proper latrines. Meanwhile, the poverty rate, CCT beneficiaries, and stunting risk families in this region are high. This makes the prevalence of stunting in the Mentawai Islands Regency

highest in West Sumatra. This finding is in line with that of Johnson (2022), who found that the incidence of stunting in children in Ghana decreased with the growth of an increasingly developing region. A greater distance from the main settlement indicated a lack of access to health services and other essential facilities.

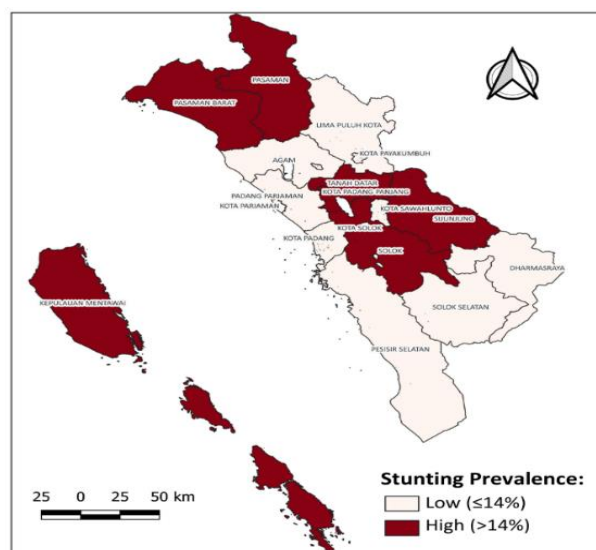


Figure 1. Distribution of the stunting prevalence in West Sumatra 2021

The average prevalence of ARI was found to be 17,79%. This figure is lower than the

is Mentawai Islands Regency (25,36%). Based on Figure 4, 10 of the 19 regions in West Sumatra still have a high percentage of CCT beneficiaries. A high percentage of CCT beneficiaries represents the poverty rate in the region. The

higher the poverty rate in a region, the higher is the percentage of CCT beneficiaries. Based on this research, eight of the nine regions with a high percentage of CCT beneficiaries have a high percentage of poverty.

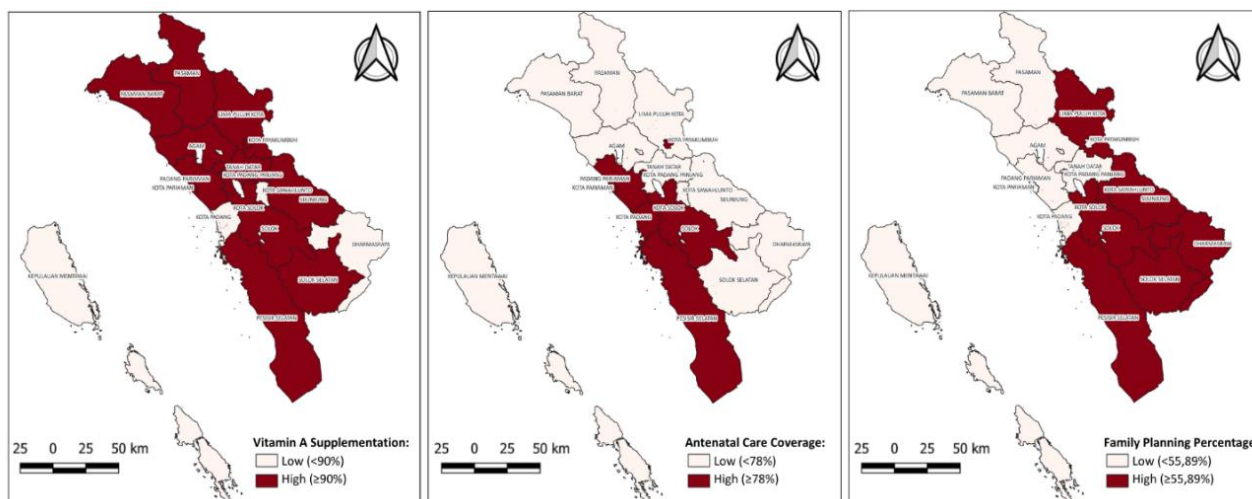


Figure 3. Distribution of healthcare services in West Sumatra 2021

Table 2 shows the results of the analysis of the association between independent variables and stunting prevalence. ARI are infectious diseases that are associated with stunting. This study found that most areas with a lower prevalence of ARI than the provincial average had a low prevalence of stunting. Table 2 shows that eight out of 11 areas with a lower prevalence of ARI had a low prevalence of stunting. In addition, if we look deeper at the high stunting prevalence areas, the average prevalence of high ARI (57%) is higher than that of low ARI (43%). This means that there is a positive association between ARI and stunting prevalence. Pearson's correlation test analysis revealed that the prevalence of ARI was significantly associated with the prevalence of stunting ($p=0,020$). The prevalence of respiratory infections (ARI) and stunting was strongly correlated ($r=0,528$). Infectious diseases, including ARI, can reduce a child's appetite, leading to decreased nutritional intake and worsening nutritional status. Malnourished children have weakened immune systems, which makes them more susceptible to recurrent infections. This cycle exacerbates health conditions, thereby increasing the risk of stunting (Himawati and Fitria 2020). This is supported by Anastasia et al. (2023), who reported that toddlers in West Sulawesi who

experienced ARI in the past month had a 1.6 times higher risk of stunting than toddlers who did not experience ARI. Picauly et al. (2023) stated that ARI that occur in toddlers have a direct effect on increasing the risk of stunting.

Association analysis of vitamin A supplementation coverage with stunting prevalence showed that vitamin A supplementation coverage was not significantly associated with stunting prevalence ($P = 0,490$). However, most areas with high vitamin A supplementation coverage had low prevalence of stunting. Table 2 shows that 57% of the areas with high vitamin A supplementation coverage had low prevalence of stunting. This result is supported by Elvandari et al. (2017), who showed that children who did not receive vitamin A supplementation and had a low intake of vitamin A, vitamin C, zinc, and serum retinol had a higher morbidity. Vitamin A deficiency in children increases the risk of growth failure and decreases their immune response, making them vulnerable to infection (Huang et al., 2018).

The results of this study are supported by an ecological study by Eryando et al. (2022), which showed that the proportion of vitamin A supplementation was not significantly associated with the prevalence of stunting in Java, Sulawesi, Bali, NTT, and NTB. Pooled analyses conducted by Li et al. (2020) also found

that 35 low-income and middle-income countries had no significant correlation between vitamin A supplementation and stunting prevalence. The lack of a significant association between vitamin A supplementation coverage and stunting prevalence may be attributed to the use of aggregate data in the ecological study design, which did not capture individual-level relationships between vitamin A intake and children's nutritional status. Furthermore, the availability and utilization of vitamin A supplementation likely varies across regions, influencing the study outcomes. For instance, Kab. Pasaman may have high vitamin A supplementation coverage, yet also experience a high prevalence of ARI, which can negatively affect children's overall nutritional status, thereby obscuring the relationship between vitamin A supplementation and stunting prevalence.

Antenatal care is a health service that is provided to mothers during pregnancy. The results showed that 57,9% of the regions had coverage for at least four ANC visits that had not yet reached the target. This can be seen in Table 2, where five out of seven high-prevalence areas had a low coverage of ANC visits. This is supported by Menon et al. (2018), who found that areas with a high prevalence of stunting had a 2-3 times lower percentage of ANC visits than areas with a low

prevalence of stunting. These findings are also supported by Johnson (2022), who contended that the chance of stunting in children decreases with an increasing number of ANC visits.

The results of the statistical analysis showed that the coverage of ANC visits was significantly associated with the prevalence of stunting, characterized by a correlation test value of $p=0,021$. The coefficient correlation of $-0,525$ also indicates that ANC coverage and stunting prevalence have a strong negative correlation. The results of this study are in line with those of Menon et al. (2018), who found that ANC coverage ≥ 4 times could reduce the incidence of stunting in India by 36%. This study is also in line with that of Eryando et al. (2022), who found that at least four times can reduce the risk of stunting in the Sumatra and Java regions. To optimize maternal health and nutrition as well as fetal growth and development, increased ANC coverage is needed.

The low average coverage of ANC visits may be due to poverty. Eight of the 11 regions with low ANC visit coverage were classified as high poverty. Poverty levels hinder access to health services. Health services provide information on the importance of ANC visits for pregnant women. This minimal exposure to information is likely to result in a low ANC visit coverage.

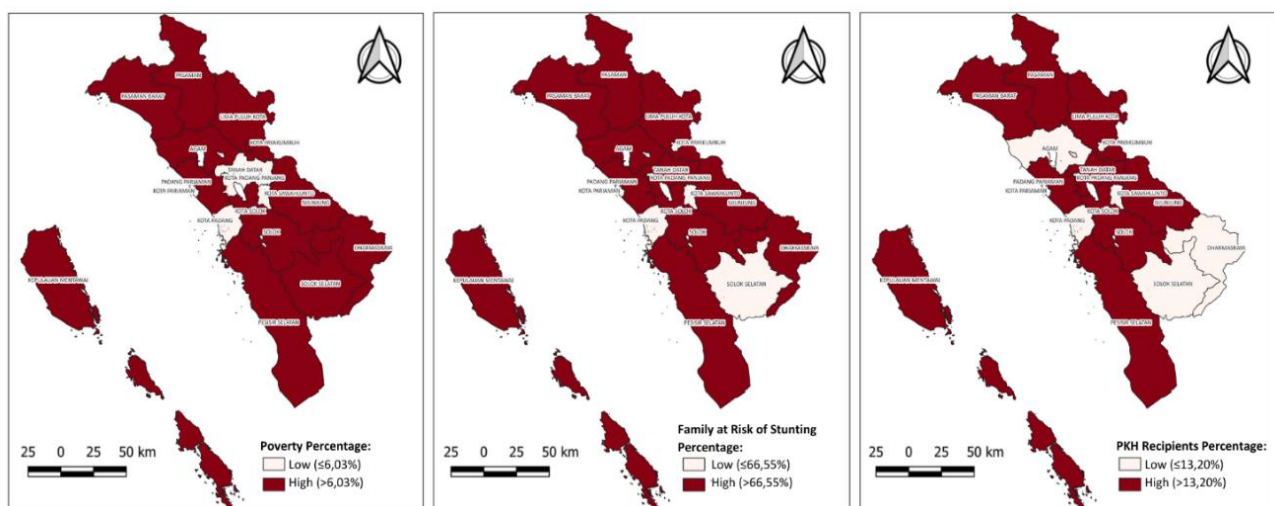


Figure 4. Distribution of socioeconomic factors in West Sumatra 2021

Family planning aims to reduce the birth rate. Statistical analysis showed that the percentage of family planning was not significantly associated with the prevalence of stunting ($P = 0,930$). However, 71,4% of the areas with high stunting prevalence had a percentage of family planning that

had not reached the target. According to Godha et al. (2016), the use of modern contraceptives at the regional level has a significantly positive impact on reducing the birth rate in Ethiopia.

A large number of family members affect food availability, income levels, and parenting

patterns. This affects inadequate food intake, which is a direct factor in stunting (Nur et al., 2021). Kinyoki et al. (2017) also mentioned that increasing family size and the number of children under five in a household increases the risk of stunting, diarrhea, and ARI.

The results of this study show that the percentage of high poverty is greater in areas with a high stunting prevalence than in those with low poverty. In 2021, five out of the seven regions with a high prevalence of stunting will have a poverty percentage that is still higher than the target. An analysis of the association between poverty percentage and stunting prevalence showed that the poverty percentage was significantly associated with stunting prevalence

($p=0,023$). The coefficient correlation of 0,519 also indicates that poverty percentage and stunting prevalence have a strong positive correlation. Previous ecological studies have found that poverty is associated with the prevalence of stunting. The higher the poverty rate, the higher the prevalence of stunting in children under five years of age in the region (Eryando et al., 2022; Laksono & Kusri, 2020). Household socioeconomic status is associated with access to nutritious food, which affects children's growth and development. This is because an increase in income increases the diversity of food families can access. Families with access to diverse foods can improve their nutrient adequacy and status (Taruvunga et al. 2013).

Table 2. The result analysis of the association between independent variables and stunting prevalence

Variables	Stunting Prevalence				r	p-value
	High		Low			
	n	%	n	%		
ARI prevalence						
Low ($\leq 17,79\%$)	3	42,9	8	66,7	0,528	0,020*
High ($> 17,79\%$)	4	57,1	4	33,3		
Coverage of vitamin A supplementation						
Low ($< 90\%$)	1	14,3	4	33,3	-0,619	0,490
High ($\geq 90\%$)	6	85,7	8	66,7		
Coverage of ANC						
Low ($< 78\%$)	5	71,4	6	50	-0,525	0,021*
High ($\geq 78\%$)	2	28,6	6	50		
Percentage of family planning						
Low ($< 55,89\%$)	5	71,4	6	50	0,022	0,930
High ($\geq 55,89\%$)	2	28,6	6	50		
Percentage of poverty						
Low ($\leq 6,03\%$)	2	28,6	5	41,7	0,519	0,023*
High ($> 6,03\%$)	5	71,4	7	58,3		
Percentage of families at risk of stunting						
Low ($\leq 66,55\%$)	1	14,3	7	58,3	0,531	0,019*
High ($> 66,55\%$)	6	85,7	5	41,7		
Percentage of CCT beneficiaries						
Low ($\leq 13,20\%$)	1	14,3	9	75	0,503	0,028*
High ($> 13,20\%$)	6	85,7	3	25		

Analysis of the relationship between the percentage of families at risk of stunting and the prevalence of stunting revealed a significant association between the two variables ($p= 0,019$). Families at risk of stunting typically have lower socioeconomic status, which limits their access to sufficient and nutritious food. According to Zhang et al. (2016), family socioeconomic factors

including maternal education and per capita family income are significant predictors of stunting. Low income often prevents young children from receiving optimal nutrition for growth, as families are frequently unable to afford healthy and balanced meals given the need to allocate their limited income to other essential household needs (Utami et al., 2019; Al Rahmad et al., 2020).

Analysis of the association between the percentage of CCT beneficiaries and the prevalence of stunting showed that the percentage of CCT beneficiaries was significantly associated with the prevalence of stunting ($p = 0,028$). Among areas with a higher percentage of CCT beneficiaries, 66,7 average had a higher prevalence of stunting than the provincial average. The percentage of CCT beneficiaries provides an overview of the population below the poverty line. The CCT programme is a nutrition-sensitive intervention targeted at poor and vulnerable families to address health, education, and social welfare issues. Beneficiary families are obligated to attend family capacity-building meetings (Pertemuan Peningkatan Kemampuan Keluarga/P2K2), where CCT facilitators provide training, one of which is the Health and Nutrition module that guides stunting prevention behavior (Sabarisman & Sulubere, 2023).

The percentage of CCT beneficiaries reflects the proportion of population living below the poverty line in a given area. Ideally, the higher the percentage of poor residents in an area, the greater is the coverage of CCT beneficiaries. A study conducted in Peru found that conditional cash transfers are significantly and positively associated with the prevalence of stunting. This suggests that, as the coverage of conditional cash transfer interventions increases, the prevalence of stunting also increases. This may indicate that the program effectively reaches the poorest segments of society, although further analysis is required to draw definitive conclusions (Huicho et al., 2017). Although this study found that the percentage of CCT beneficiaries was positively correlated with the prevalence of stunting, we hope that this program can support national priority programs to prevent and reduce the incidence of stunting.

The advantage of this ecological study is that it can be used as a basis for developing and evaluating stunting-handling programs. In addition, this ecological study used regularly available data sourced from relevant agencies in West Sumatra. Therefore, this ecological study can be conducted on an ongoing basis to evaluate stunting programs. This study not only estimated the percentage of each variable but also provided the spatial distribution of the variables that could indicate priority regions with hot spots where interventions should be focused.

However, this study has several limitations. The use of secondary data means

that not all macro factors affecting the prevalence of stunting can be analyzed because of limited data availability. Future ecological studies should utilize the newest data and incorporate additional variables to develop more comprehensive policies or strategies. Further research should employ longitudinal studies to gain a deeper understanding of the relationship between each factor and prevalence of stunting. In addition, triangulation with qualitative data in future research can address the limitations of this study.

Conclusion

Increases in the percentage of ARI, poverty, and CCT beneficiaries were significantly and positively associated with the prevalence of stunting. Additionally, an increase in ANC coverage was significantly negatively associated with the prevalence of stunting. Based on the results of this study, there are still areas with a stunting prevalence above the national target. Therefore, specific resources and public health efforts must be improved, particularly in areas with a high prevalence of stunting.

The results of this study also show that each region had different problems in achieving health indicators. Therefore, it is expected that the implemented policies and interventions can adjust to the problems that exist in each region. This study enriches global literature by providing new evidence on the importance of population-based interventions in addressing stunting. The findings have the potential to serve as a foundation for policymaking at both the national and international levels, particularly in regions with similar demographic and socioeconomic characteristics. This study supports more effective and efficient efforts to reduce stunting. The results also align with the Sustainable Development Goals (SDGs), specifically Goal 2 (Zero Hunger) and Goal 3 (Good Health and Well-being). Reducing stunting contributes to the achievement of the SDGs' targets to end hunger and ensure equitable access to health care services. Identifying risk factors at the population level offers strategic recommendations that can aid in achieving global goals to reduce the prevalence of stunting and to improve maternal and child health outcomes.

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