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Spatial Characteristics of Areas Determining the Occurrence of Stunting in South Sumatera

Karakteristik Spasial Daerah Penentu Terjadinya Stunting di Sumatera Selatan

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ABSTRACT

Background: The prevalence of stunting in Indonesia is 24.4%. The determinants of stunting are family, household, inadequate nutritional intake, exclusive breastfeeding, infectious diseases and social factors. Stunting has an impact on cognitive development, chronic disease, mental retardation and obesity.
Objectives: To identify the determinants of stunting at the district/city level in South Sumatra.
Methods: Cross-sectional study design. The number of samples is 2,272 respondents. Data on stunting under-fives in 17 regencies/cities comes from Riskesdas 2018. Regency/city characteristic variables include swamp areas, malaria endemic, gross domestic product (LPDB), population growth rate (LPP) and the Public Health Development Index (IPKM). Data analysis was carried out using univariate, bivariate with chi-square, and identifying the most influential factors with multivariate analysis.
Results: The number of respondents is 2,272 toddlers; the prevalence of stunting is 31.2%. 52.5% of Regencies/cities in South Sumatra are swamp areas. The significant characteristic variable with stunting is the type of swamp area p=0.001 PR=1.230 (1.088-1.390 95% CI). The multivariate result of the variable that has the greatest influence on the incidence of stunting is the swamp area variable p = 0.000. Results; PR 1.469 (95% CI 1.208-1.788). Regencies with non-swamp type areas had a 1.469 times higher risk of having stunting toddlers compared to swampy area type.
Conclusions: The prevalence of stunting is 31.2%. A significant variable with the occurrence of stunting wass the condition of the swamp area, p=0.001, OR = 1.230 (1.088-1.390). The multivariate results of the most dominant factor were swamp areas PR value: 1.469, Regencies with non-swamp type areas had a 1.469 times higher risk of having stunting toddlers compared to swampy area type regencies after control with API, IPKM and LPP variables (95% CI: 1.208 - 1.788).

INTRODUCTION

The public health problem in Indonesia namely stunting with a prevalence of 30.8[1] exceeds the World Health Organization (WHO) threshold of 20% and the stunting reduction target that must be achieved is 14% by 2024[2]. Globally, the results of stunting prevalence studies in several countries show that the prevalence is also high. A study on toddlers under 5 years old in Sabah, Malaysia, found a stunting prevalence of 33.3%[3]. A study related to the incidence of stunting of 6965 toddlers aged 0 to 59 months in Bangladesh obtained results of a stunting prevalence of 37%[4]. A study in Indonesia, namely the 2020 Southeast Asia Nutrition Survey (SEANUT) on 2236 children in Indonesia aged 6 to 12 years, found a stunting prevalence of 31.4%[5].

Beal Study, et, al 2018 conducted a study using the WHO conceptual framework to obtain the results of the determinants of factors that influence the occurrence of toddler stunting in Indonesia, including child factors, maternal factors, the environment, and access to health services. These four factors are babies not receiving exclusive breast milk, low economic status, babies born prematurely, short birth length, mother's height, and low education level. Environmental factors in the form of sanitation, namely latrines and drinking water that are not good and healthy, as well as poor access to health services in terms of monitoring growth and immunization[6].

Stunted toddlers under two years old (*Baduta*) have suboptimal intelligence, low immune function, and

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in the future will be more susceptible to disease, putting them at risk of low levels of productivity. In general, stunting can slow down economic growth, reduce poverty rates and ultimately widen various inequalities[7]. Risk factors that are related to stunting are the baby's birth weight, mother's education level, child's gender, parent's occupation, mother's employment level, mother's nutritional status, infection, mother's height, sanitation, family economic status, environmental influences, and exclusive breastfeeding[8].

The biological implications of stunting have an impact on brain and neurological development, which can lead to lower cognitive scores of 7% with math scores 2.11 lower compared to non-stunted children. A comparison of children with stunting and non-stunting in the quantitative assessment test and the Peabody picture vocabulary test showed a score of 16.1% for children with stunting, this score was 48.8% lower than children who were not stunted. In the first 1000 days of life, stunted children are likely to have a non-verbal IQ <89 and are at risk of having an IQ 4.57 times lower when compared to the IQ of children who are not stunted[9].

Wiwid, A's (2020) study shows the determinants of stunting in toddlers. Stunting aged 24 to 59 months is influenced by the mother's height and significant as a predictor of stunting (adjusted OR= 2.720; 95%CI: 1.050-7.049). Other factors, namely the father's height, the level of education and employment of the father and mother, the gender of the toddler are not factors in the risk of stunting[10]. 27.5% of stunting in toddlers is related to low parental education levels[11]. Stunting is related to LBW (low birth weight), from the results of the study of socio-economic factors it is stated that there is no significant relationship with the incidence of stunting which includes the variables of maternal education, income and number of family members with the incidence of stunting[12]. This study aims to identify regional characteristic variables that are related to stunting and determine the factors that have the most influence on the incidence of stunting among toddlers in 17 districts/cities.

METHODS

The research design is cross-sectional, the main data comes from a national scale survey, namely the 2018 Basic Health Research (RISKESDAS). The population is all households in 17 districts/cities in South Sumatra using the 2018 National Socio-Economic Survey (SUSENAS) framework. Characteristic data regional spatial data obtained from the Central Statistics Agency (BPS), Regional Planning Agency (BAPPEDA) and South Sumatra Health Profile. Data collection was carried out from March to July 2022.

The target population for this research is all toddlers aged 0 – 59 months, living in 17 districts/cities in South Sumatra. The samples were toddlers in selected households sourced from RISKESDAS in 2018. The total sample was 2,272 toddlers spread across 17 districts/cities in South Sumatra. Data on stunting toddlers comes from 2018 RISKESDAS data. Regional characteristic spatial data variables in the form of swamp area type variables, gross domestic product rate (LPDB), and population growth rate (LPP) are sourced from the Central Statistics Agency. The Community Health Development Index (IPKM) variable and the malaria endemic variable (API: Annual Paracite Incident) in 17 districts/cities in South Sumatra are sourced from the Indonesian Ministry of Health and the Health Service. The district/city characteristic variable for the type of swamp area is divided into 2 categories, namely non-swamp and swamp areas by comparing it with the average percentage of districts/cities in South Sumatra (swamps > 1.79%). Malaria endemic areas are designated into 2 categories of high and low, namely the high category (>5/1000 population and low <1/1000 population), this figure is based on the achievements of the 2021 South Sumatra Provincial Health Service report. The regional population growth rate category is categorized as high if population increase of > 1.25%. The regional gross domestic product rate based on the provincial average is divided into 2 regional categories, low (<3.29%) and high (> 3.29%). The regional IPKM variable is determined by comparing the achievement score of the Provincial Public Health Development Index of 0.5939 and then divided into 2 categories, namely low < 0.5939 and high > 0.5939. Data analysis was carried out univariately to obtain the frequency distribution of the variables studied, namely the prevalence of stunting and district/city characteristic variables. Bivariate analysis with Chi-Square to see the relationship between stunting toddlers and district/city characteristic variables. Multivariate analysis was used to obtain the variables that have the most influence on the incidence of stunting at the district/city level in South Sumatra Province.

RESULTS AND DISCUSSION

Table 1 showed that the total number of respondents who had anthropometric measurements of height and body length was 2,274. The respondents were spread across 17 regencies/cities in South Sumatra. The results of data analysis on the prevalence of stunting in toddlers showed that the prevalence of stunting in toddlers was 708 respondents (31.2%). This research shows that the majority of respondents fall into the normal category (68.8%) based on HAZ (height for age).

Table 1. Distribution Frequency of Stunting in South Sumatra in 2018

Nutritional Status (HAZ)	Frequency	
	n	%
Stunting	708	31.2
Normal	1,564	68.8
Total	2,274	100

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Table 2. Distribution of Respondents According to Regency/City Spatial and Social Characteristics in South Sumatra

Characteristics	Frequency	
	n	%
Regional Type		
Not Swampy (<1.79%)	1,186	47.8
Swamp (> 1.79)	1,086	52.2
Endemic malaria		
High (>5/1000 population)	304	13.4
Low (<1/1000 population)	1,968	86.6
Gross Domestic Product Rate		
Low (<3.29%)	1,084	47.7
High (≥3.29%)	1,188	52.3
Population Growth Rate		
High (>1.25%)	933	41.1
Low (<1.25%)	1,339	58.9
IPKM		
Low (Score <0.5939)	1,296	57.0
High (Score >0.5939)	976	43.0
Total	2,272	100

IPKM: Community Health Development Index

Based on table 2, the majority of 52.2% of toddlers in districts/cities live in areas with swamp demographics, while those living in non-swamp areas are 1,086 respondents (47.8%). For districts/cities with endemic malaria conditions, it was found that most of the areas in South Sumatra with low malaria endemic conditions were <1/1000 population. Data showed that 86.6% of respondents live in low malaria endemic areas. Based on the rate of gross domestic product, the majority of respondents live in districts/cities in South Sumatra in the high category, namely 52.2% of respondents. Based on the population growth rate variable, 58.9% of respondents were more likely to be in areas with low population growth rates. The Community Health Development Index (IPKM) variable as a tool for monitoring health developments in an area shows that the majority of respondents (57%) live in districts/cities with low IPKM area categories. Meanwhile, respondents who live in districts/cities with high IPKM are lower, namely 976 (435) respondents.

Table 3. Relationship between regional characteristics and incidence of stunting among children under five in South Sumatra

Characteristics	Nutritional Status (Stunting)				p-value	PR (95% CI)
	Yes		No			
	n	%	n	%		
Type of area						
Not Swamp (<1.79%)	375	34.5	711	65.5	0.001*	1,230 (1,088-1,390)
Swamp (< >1.79%)	333	28.1	853	71.9		
Endemic malaria						
High (>5/1000 population)	96	31.6	208	68.4	0.919	1.015 (0.850-1.213)
Low (<1/1000 population)	612	31.3	1,356	68.9		
Gross Domestic Product (LPDB) Rate						
Low (<3.29%)	347	32.0	737	68.0	0.430	1,053 (0.932-1,190)
High (≥3.29%)	361	30.4	827	69.6		
Population Growth Rate (LPP)						
High (>1.25%)	303	32.5	630	67.5	0.279	1.074 (0.949-1.214)
Low (<1.25%)	405	30.2	934	69.8		
Community Health Development Index (IPKM)						
Low (Score <0.5939)	425	32.8	871	67.2	0.059	1,131 (0.998-1,282)
High (Score > 0.5939)	283	29.0	693	71.0		

*significant <0.05 (chi-square test), PR: Prevalence Rate

Bivariate analysis in table 3 showed that the majority of stunted children totalling 475 respondents (34.5%) live in non-swampy areas. The statistical test results obtained a value of p=0.001, PR=1,230 (1,088-

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1,390). This means that there is a significant relationship between children living in swamp areas and the incidence of stunting. The results of the bivariate analysis obtained a PR value=1.230, it can be concluded that districts/cities that have swamp geography have a 1.230 times chance of not experiencing stunting compared to districts/regions that do not have swamps.

Based on the results of the analysis of the relationship between district/city malaria endemic variables and the incidence of stunting, it appears that there is almost no difference in the proportion of stunted children who live in high and low malaria endemic areas, namely 31.6% and 31.3%. Statistically, the p value=0.919 means it can be concluded that there is no relationship between malaria endemic areas and the incidence of stunting. The results of the analysis also show that there is almost no difference in the proportion of stunted children whether they live in areas with low or high gross domestic product (LPDB) rates. The p-value = 0.430 OR = 1.053 (0.932-1.190) meaning that there is no relationship between district/city LPDB and the incidence of stunting.

The proportion of stunting is higher in areas with high population growth (LPP), namely 32.55% compared to low LPP of 30.2%. The same thing was obtained from the results of the analysis of the relationship between population growth rate and the incidence of stunting which resulted in the conclusion that there was no relationship between LPP in districts/cities and the incidence of stunting with a value of p=0.279. The IPKM variable for each district/city is categorized as higher or lower than the IPKM of South Sumatra Province. The highest proportion of stunted toddlers was found in areas with low IPKM (32.8%) compared to high IPKM areas (29%). The results of the bivariate analysis have a value of p=0.059, there is no significant relationship between the district/city IPKM and the incidence of stunting.

Table 4. Multivariate Logistic Regression Analysis of District Characteristics

Variable	B	S.E	Wald	df	sig	Exp(B)	95% CI for Exp (B)	
							Lower	Upper
Type of area Swamp	0.385	0.100	14,783	1	0,000	1,479	1,208	1,788
API (Malaria)	0.337	0.153	4,854	1	0.028	1,401	1,038	1,892
LPP (Population Growth Rate)	0.170	0.101	2,836	1	0.092	1,185	0.973	1,444
Community Health Development Index (IPKM)	0.260	0.096	7,438	1	0.006	1,298	1,076	1,565

B: Coefficient, SE: Standard Error, Wald: Wald Statistics, df: degree of freedom, Sig: Significant, Exp(B): Odds Ratio
CI: Confidence Interval

Based on the final analysis of multivariate modeling, it was found that the variables that were significantly related to the incidence of stunting were the variables of swamp area type, malaria endemic, and IPKM. Meanwhile, the population growth rate variable is a confounding variable. The results of the analysis showed that the variable that has the greatest influence on the incidence of stunting is variabletype of area. This is based on the PR value in the final multivariate modeling of the variable type of area amounted to 1.469 (95% CI 1.208– 1.788). Districts/cities with non-swamp areas have a 1.469 times higher risk of having stunted toddlers compared to swamp-type districts after controlling for API, IPKM and LPP variables (95% CI: 1.208 - 1.788). In the general population, researchers 95% believe that districts with non-swamp areas will experience stunting between 1.208 and 1.788 times compared to districts with swamp areas. Districts with high malaria endemic status have a 1.401 times higher risk of having stunted toddlers compared to districts/cities with low malaria endemic status after controlling for swamp, IPKM and LPP variables (95% CI: 1.038 - 1.892). Districts with low IPKM status have a 1.298 times higher risk of having stunted toddlers compared to districts with high IPKM status after controlling for swamp, API and LPP variables (95% CI: 1.298 - 1.565).

Current nutritional problems in Indonesia have a very serious impact on the quality of human resources. In Indonesia, the incidence of stunting is one of the problems of malnutrition which occupies a fairly high position. The prevalence of stunting in South Sumatra Province as a result of Basic Health Research (Riskesdas) 2018 is 31.2%, still high above the national figure of 30.8%[1] and the WHO threshold is 20%. The target set by the government is 14% in 2024. Based on the results of data processing on stunting among children under five, it was found that the prevalence was 31.2% spread across 17 regencies/cities in South Sumatra.

Several indirect determinant variables for the occurrence of stunting include the type of geographic area where the respondent lives. Most respondents live in swampy areas, namely 52.2%. There is a significant relationship in swamp areas with the incidence of stunting in toddlers, p=0.001, PR=1.230 (1.088-1.390). This research is in line with the results of the 2018 Riskesdas data analysis on children 24 - 59 months, which showed that there was a significant relationship between the area where the child lived, namely urban and rural areas, with the incidence of stunting p=0.000, with 95% (OR: 1.33 - 1.22- 1.46). However, there is no relationship between disease and regional geography, such as several infectious diseases (diarrhea, tuberculosis, hepatitis, ARI)

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with the occurrence of stunting in children both in urban and rural areas with a p-value of >0.005[13].

The results of research at 13 stunting locus and non-locus in Indonesia showed that in the focus location villages (locus) and non-focus location villages, the proportion results were the same, with a value of 50% each for diseases experienced by stunted toddlers, namely the incidence of diarrhea, the level of worms, while acute respiratory tract infections actually occurred in non-focus villages at 52.1%. The chance of stunting occurring is 20% lower in focus location villages when compared to non-focus location villages[14].

Malaria is one of the variables of other infectious diseases which can be a risk factor for stunting, a condition of malnutrition experienced by people who are sick with no appetite so that nutritional intake is inadequate, requiring more nutritional intake to fight the disease. If someone don't pay attention to good nutritional intake, it will lead to malnutrition accompanied by infection. Case control research on children in Palu showed that there was almost no difference in the proportion of stunted toddlers living in high and low malaria endemic areas. Statistically, the result was p = 0.919, so there was no relationship between malaria endemic areas and the incidence of stunting. The statistical test for history of infectious disease resulted in an OR value of 3.400 (95% CI 1.027-11.257). These results state that infectious diseases have a 3,400 times greater risk of occurring in toddlers who are not affected by infectious diseases[15]. Research on children aged 24-59 months in Padang Timur District, Padang City, the Andalas Health Center Working Area, shows that there is a relationship between infectious diseases and stunting. On average, diarrhea and acute respiratory infections showed a significant relationship with stunting with p value = 0.001, OR 6.9 (2.1 - 22.7)[16].

This research showed that there is no difference in the proportion of stunted children living in high and low endemic areas. These results contradict with research conducted in the period from 2014-2018, for 4 years in Indonesia which showed that malaria is a responsive predictor of stunting in toddlers with Annual Parasite Incidence per 1000 population (X12). The prediction model equation with an R^2 value (44.9%) which means the Annual Parasite Incidence of malaria can be used in Indonesia to estimate the prevalence of stunting in toddlers. The recommendation given in the results of this research is to fulfill access to sanitation facilities at the household level, prioritizing areas where malaria is endemic[17].

The indirect variable which is a risk factor to describe the economic level of a region is the gross domestic product (LPDB) rate variable. In this study, LPDB is described by measuring family income and the incidence of stunting. This research showed that there is almost no difference in the proportion of stunted children whether they live in areas with low or high gross domestic product (LPDB) rates. The p-value=0.430 and OR=1.053 (0.932-1.190) which means there is no relationship between district/city LPDB and the incidence of stunting. Several studies showed different results. Monthly family income is a significant factor associated with stunting (AOR=0.05, 95% Cl 0.02, 0.15) and showed a strong relationship between academic achievement in school-age children and socio-economics. Different results were showed by the results of a systematic review of stunting risk factors which are consistently determining factors in journal reviews, namely the family welfare index in the form of income. Based on the literature study, it states that income level influences protein adequacy, which is one of the variables related to food intake. Access to good food is supported by high income, so the need for protein, especially at the age of 12-24 months, is met and the risk of LBW does not occur[18]. Other research that is in line, showed that there is a relationship between family income level and stunting, p=0.018 OR; 5.6 (1.4 - 23.2). The conclusions of research in the 10 highest regions in Indonesia in 2010-2019 showed that there was an influence of the rate of economic growth, level of education and the number of poor people on the number of stunting[19].

A collection of health indicators (IPKM) is a series of health indicators that can provide an overview of health problems that directly or indirectly function to increase life expectancy and health[20]. This research found that the proportion of stunted toddlers was greater in areas with low IPKM (32.8%) compared to high IPKM areas, 29%. The results of the bivariate analysis, p=0.059, did not show a significant relationship between district/city IPKM and stunting. This research is not in line with research by Nur Handayani et al, showing a relationship between IPKM and several health variables. Linear regression analysis shows the results, namely that the IPKM indices have a significant relationship with the prevalence of undernutrition, in which the reduction in the prevalence of undernutrition in children under five has the greatest contribution to the reproductive health index[21].

Several IPKM indicators which include 7 indicators are also used as research variables. A study on 6 month old babies in Semarang City showed that the proportion of stunting in male babies was 39.6% and female babies were 60.4%. The results of this study also prove that the determinants of stunting include several variables, namely family economic level (p<0.001, OR: 5.39, 95% CI: 2.73;10.63), weight at birth (p= 0.074, OR: 2.46, 95 % CI: 0.91;6.64), incidence of Acute Respiratory Tract Infections (ARI) (p= 0.016, OR: 2.29 .95% CI: 1.16;4.51), and diarrhea (p= 0.092, OR: 1.79, 95% CI: 0.90; 3.52). Based on the logistic regression test, several of these variables show that the most dominant determinant of stunting is the family's economic level (OR=5.39), the highest among other variables[22].

The results of the analysis of several research variables related to IPKM indicators such as environmental health are that there is a positive/significant relationship with poor sanitation, low income, stunting aged 0-23 months (p < 0.05). Logistic regression shows that poor sanitation (OR: 1.46; 95% CI: 1.01-2.13) is a risk factor for stunting[23]. Multivariate analysis for determinants of stunting identified a significant relationship between sanitation and the influence of water at the household level for an interaction of 0.007 after controlling for potential covariates in households that consumed water without prior treatment; The adjusted odds of stunting were

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three times higher in households that used unimproved latrines (OR: 3.47, 95% CI: 1.73-7.28, P < 0.001; however, in households that consumed treated water they had The chance of stunting in children is not significantly higher in households using toilets that are not suitable for use (OR: 1.27.95% CI: 0.99-1.63, P = 0.06)[24].

Determining factors for the incidence of stunting in children under five using multivariate analysis provide identification of a significant interaction relationship between sanitation facilities and the influence of water at the household level (P interaction: 0.007 after controlling for potential covariates in households that consume water without prior treatment, odds adjusted for Child stunting was three times higher if households used unimproved latrines (OR: 3.47, 95% CI:1.73-7.28, P <0.001); however, in households that consumed treated water the chance of stunting in children was not significantly higher in households using unfit toilets (OR: 1.27, 95% CI; 0.99-1.63, P= 0.06)[24].

CONCLUSIONS

The prevalence of stunting in toddlers is 31.2%. Based on regional characteristics, 52.8% is a swampy area. The results of bivariate analysis showed that there was a significant relationship between the incidence of stunting and district/city characteristics based on swamp conditions, p=0.001, OR=1.230 (1.088-1.390). The results of the multivariate analysis with a significant value of 0.000, regencies/cities with non-swamp areas have a 1.469 times higher risk of stunting under five children compared to regencies with swamp areas after controlling for API, IPKM and LPP variables (95% CI: 1.208 - 1.788).

Stakeholders at the district/city level should increase coordination in carrying out sensitive and specific interventions to prevent and reduce stunting through access to health services and compliance with sanitation in areas characterized by swamp areas. Improving the quality of services for households with low family income is supported by food security problems at the household level.

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