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Spatial distribution analysis and risk factors for stunting in Kerinci Regency, Jambi Province Indonesia

Analisis distribusi spasial dan faktor risiko stunting di Kabupaten Kerinci, Provinsi Jambi Indonesia

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Abstract

There are variations in the prevalence of stunting cases at the village level in Kerinci Regency. There have been no studies on the spatial distribution and risk factors of stunting cases in Kerinci Regency. This study aimed to determine the risk factors and spatial distribution of stunting. This research was conducted in Kerinci Regency from March to November 2020 using a case-control design and a total sampling technique. The study participants consisted of 223 patients and 223 controls. Children who experienced stunting were recorded at the health office. The controls were non-stunted children with an age range (±3 months) and sex who came from the same village as the cases—data collection through interview techniques and observation of the Mother and Child Health book. The chi-square test, logistic regression, and spatial distribution analysis were performed using the open-source software SatScan 10,1 and ArGIS 3,30. The analysis shows stunting cases clustered in Kayu Aro, Gunung Tujuh, and Keliling Danau Districts. A low father's education level (aOR=1,76), father's height <161 cm (aOR=1,52), mother's height <150 cm (aOR=1,83), and incomplete immunization status (aOR=1,6) were risk factors for stunting. In conclusion, cases of stunting clustered in three sub-districts, and the leading risk factor was mother's height. The health office should make specific intervention efforts before and during pregnancy, and focus on cluster-indicated areas.
Keywords: Education, immunization status, parental height, stunting

Abstrak

Terdapat variasi prevalensi kasus stunting pada tingkat desa/kelurahan di Kabupaten Kerinci. Belum ada studi distribusi spasial dan faktor risiko kasus stunting di Kabupaten Kerinci. Studi ini bertujuan untuk mengetahui faktor risiko dan distribusi spasial kasus stunting. Penelitian ini dilakukan di Kabupaten Kerinci dari Maret-November 2020 menggunakan desain *case-control.* Pengambilan sampel menggunakan teknik *total sampling*. Subjek penelitian terdiri atas 223 kasus dan 223 kontrol. Kasus adalah balita yang mengalami stunting tercatat di dinas kesehatan. Kontrol adalah balita bukan stunting yang memiliki rentang usia (±3 bulan), jenis kelamin, dan berasal dari desa yang sama dengan kasus. Pengumpulan data melalui teknik wawancara dan observasi buku Kesehatan Ibu dan Anak. Analisis menggunakan uji *chi-square,* regresi logistik, dan analisis distribusi spasial dengan *software open-source* SatScan 10.1 dan ArGIS 3.30**.** Hasil analisis menunjukkan kasus stunting mengelompok di wilayah Kecamatan Kayu Aro, Gunung Tujuh, dan Keliling Danau. Tingkat pendidikan ayah yang rendah (aOR=1,76), Tinggi Ayah <161 cm (aOR=1,52), Tinggi ibu <150 cm (aOR=1,83), dan status imunisasi yang tidak lengkap (aOR=1,6) sebagai faktor risiko kejadian stunting. Kesimpulan, kasus stunting mengelompok di 3 kecamatan dan faktor risiko utama adalah tinggi ibu. Dinas kesehatan agar melakukan

upaya intervensi spesifik pada saat sebelum dan selama hamil dan terfokus wilayah yang terindikasi klaster.
Kata Kunci: Pendidikan, status imunisasi, stunting, tinggi orang tua

Introduction

Health development in the 2020–2024 period is focused on three priority programs, one of which is the national stunting and wasting toddler prevalence reduction program (Kemenkes RI, 2020). The Indonesian Nutritional Status Survey (SSGI) report in 2022 shows a decrease in stunting prevalence nationally, but it is still far from the target of 14 percent. The same report also showed three provinces that experienced a significant decrease in the proportion of cases, namely South Kalimantan, North Kalimantan, and South Sumatra. The prevalence of stunting cases in Jambi Province, based on the 2022 SSGI report, is four points above the national target (Kemenkes RI, 2022). The district or city with the highest prevalence in Jambi Province is occupied by Muaro Jambi Regency, followed by Kerinci Regency (Kemenkes RI, 2022).

The impact of stunting can be divided into two categories: long-term impacts and short-term impacts. The short-term effects of stunting can increase mortality and morbidity, decrease brain development, motor nerves, and language skills, and increase health costs. Stunting will make children vulnerable to diseases, both infectious and degenerative; increase obesity and comorbidities; reduce reproductive health; reduce learning ability and achievement; and, in the future, reduce productivity. As a consequence, stunting will broadly hamper the economy, exacerbate poverty, and widen inequality (Akseer et al., 2022; Soliman et al., 2021; WHO, 2014).

Stunting is the failure to thrive in toddlers as a result of chronic malnutrition, especially in the first 1,000 days of life. Children are classified as stunting if their height according to age is lower than the existing national standard (Kementerian PPN/Bappenas, 2018).

The incidence of stunting in Indonesia, according to several studies, is a consequence of children who are not exclusively breastfed, household socioeconomic status, premature birth, short birth, short mothers, low paternal education levels, low maternal education, and maternal working status. Children who come from households that do not have qualified latrines or unqualified drinking water sources increase the risk of stunting. Social and community issues such as access to health services, living in rural, social, and cultural areas, agricultural systems, water, and sanitation also contribute to stunting in Indonesia (Batiro et al., 2017; Beal et al., 2018; Manggala et al., 2018; Nshimyiryo et al., 2019; Sugianti et al., 2023; Titaley et al., 2019). Other studies have also found a short relationship between parents (father and mother) and the incidence of stunting in toddlers (Miko & Al-Rahmad, 2017; Javid & Pu, 2020; Wu et al., 2021).

Various efforts have been made by the government to reduce stunting, which is generally divided into two things: human development through poverty reduction and improvement of basic services, as well as improving public health and nutrition services. Efforts to reduce the prevalence of stunting in children require programs that target populations that experience nutritional vulnerability as a result of social, economic, political, and healthcare problems (Kalinda et al., 2023). A preliminary study found variations in the prevalence of stunting cases at the village or neighborhood level in the Kerinci Regency (Dinkes Kabupaten Kerinci, 2021). The high variation in the number of cases between regions and limited resources require prioritizing intervention in areas indicated to have clusters (Sipahutar et al., 2021).

The determination of the area or geographic area that is the specific target of the intervention can be done by applying analysis through a spatial approach. According to the WHO, mapping using Geographic Information Systems (GIS) is useful in determining the geographic distribution of diseases, analyzing spatial and temporal trends of a disease, mapping at-risk populations, mapping risk factors, assessing resource distribution, and planning and determining interventions (WHO, 2022).

Many stunting risk factor studies have been conducted, but so far there have been no studies that spatially analyze stunting cases in Kerinci Regency. Based on these conditions, it is considered necessary to map cases and find out the risk factors for stunting in the Kerinci

Regency. The purpose of this study is to determine stunting risk factors and, at the same time, identify areas for grouping or clustering stunting cases.

Methods

Location and Time of Research

This study was conducted in Kerinci Regency. The total area of Kerinci Regency is 3,448.90 km2. Kerinci Regency consists of 16 sub-districts with 278 villages or neighborhoods. This research was conducted in 26 stunting locus village areas in Kerinci Regency in March–November 2020.

The selection of study locations in 26 stunting locus village areas was due to technical considerations in the field, considering that the study area is very wide and not all areas can be reached easily. A detailed map of Kerinci Regency is in Figure 1.

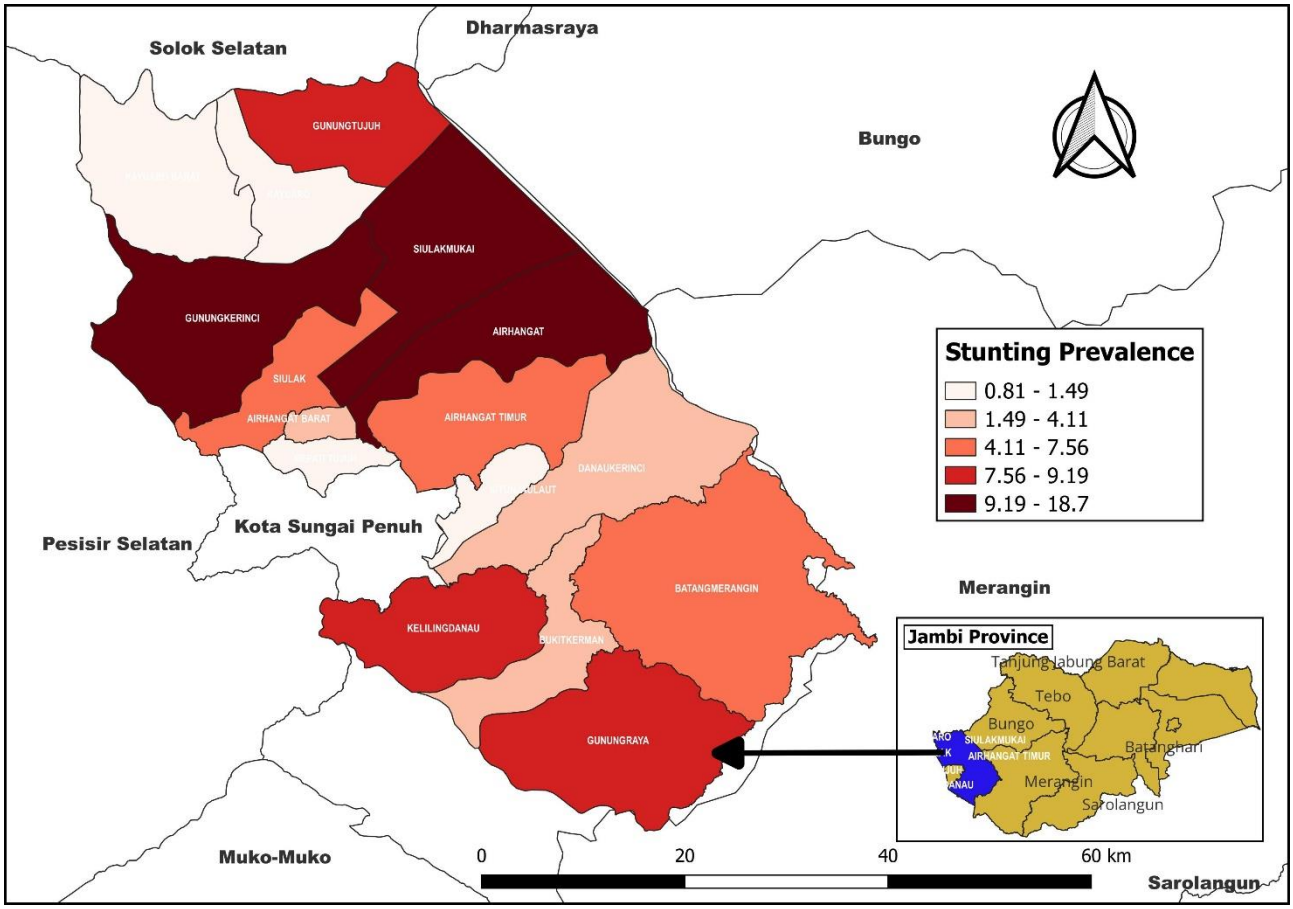

Figure 1. Location of research and prevalence of stunting in Kerinci Regency in 2020

Research Design

This study is observational-analytic, with a case-control approach supported by spatial analysis. A spatial analysis was conducted to see the distribution pattern of stunting cases in the study area. The subjects in this study were toddlers in Kerinci Regency in 26 stunting locus villages. Sampling is carried out using the total sampling technique. The total sampling technique is used to adjust the spatial analysis.

The cases in this study are all stunted children recorded in surveillance data for the period January 1 to December 2019 at the Kerinci District Health Office, community health centers, and records of village midwives and cadres, for a total of 223 children. The controls in this study were non-stunted toddlers who had an age range of ± 3 months, gender, and came from the same village, with cases totaling 223 children. The inclusion criteria in this study were children who were cared for by biological mothers. The exclusion criterion is a child suffering from a mental disability.

The independent variables in this study were the father's education level, mother's type

of occupation, mother's education level, father's type of work, family income level, mother's age, baby's birth weight, exclusive breastfeeding, father's height, mother's height, and child's immunization status. The dependent variable is stunting in children, according to the criteria set by the Indonesian Ministry of Health. Data in this study were collected through interviews using structured questionnaires and observations of Maternal and Child Health (MCH) books. Data on immunization status, birth weight obtained from MCH books, and other data such as the level of education of mothers and fathers, family income levels, types of work of fathers and mothers, and maternal age were obtained by the interview method. The height of the mother and father is measured directly using a stature meter. The variable analyzed spatially is stunting. Case coordinates are collected with the help of the Global Positioning System (GPS).

Data Analysis

Statistical analysis with a chi-square test followed by logistic regression to see the dominant risk factor of stunting with the help of the SPSS 16,0 application Spatial analysis using purely spatial poisson restrospective models using open-source software SatScan 10,1 and Quantum GIS 3,30 The poisson model was used to identify and determine villages with clustered stunting cases during the period January 1 to December 2019. The most likely cluster is seen from the largest likelihood ratio (LLR) value; another grouping is called a secondary cluster (Kulldorff, 2020).

This study has received ethical approval from the Health Research Ethics Committee of the Health Polytechnic of the Ministry of Health of Jambi Province with number LB.02.06/2/340/2020.

Result and Discussion

Characteristics of Respondents

Single data processing aims to describe the characteristics of respondents in both case and control groups. Based on the results of the processing carried out, the distribution of fathers' education levels in the dominant case group graduated from high school (45,3%), and at least graduated from elementary school (14,3%). In the control group, fathers graduated from high school (48,4%) and at least graduated from elementary school (11,9%).

Table 1. Characteristics of the research subject

Characteristics of respondents	Case		Control		Total	
	n	%	n	%	n	%
Father's Education						
Graduated from elementary school	32	14,3	21	9,4	53	11,9
Graduated from junior high school	53	23,8	37	16,6	90	20,2
Graduated from high school	101	45,3	115	51,6	216	48,4
Graduated from PT	37	16,6	50	22,4	87	19,5
Types of Father's Work						
Civil servants/Soldiers/Police	9	4,0	8	3,6	17	3,8
SOE Employees	0	0,0	1	0,4	1	0,2
Private Employees	10	4,5	9	4,0	19	4,3
Self-employed/Trader	26	11,7	33	14,8	59	13,2
Farmer	178	79,8	172	77,1	350	78,5
Father's Age						
< 20 years	0	0,0	2	0,9	2	0,4
20-25 years	23	10,3	32	14,3	55	12,3
26-30 years	64	28,7	72	32,2	136	30,5
31-35 years	53	23,8	42	18,8	95	21,3
36-40 years	39	17,5	46	20,6	85	19,1
>40 years	44	19,7	29	13,0	73	16,4
Mother's Education Level						
Graduated from elementary school	25	11,2	20	9,0	45	10,1
Graduated from junior high school	64	28,7	47	21,1	111	24,9
Graduated from high school	98	43,9	115	51,6	213	47,8

Characteristics of respondents	Case		Control		Total	
	n	%	n	%	n	%
Graduated from PT	36	16,1	41	18,4	77	17,3
Types of Mother's Work						
Housewives	137	61,4	142	63,7	279	62,6
Civil servants/Soldiers/Police	5	2,2	5	2,2	10	2,2
SOE Employees	2	0,9	1	0,4	3	0,7
Private Employees	4	1,8	3	1,3	7	1,6
Self-employed/Trader	6	2,7	8	3,6	14	3,1
Farmer	69	30,9	64	28,7	133	29,8
Mother's Age						
< 20 years	7	3,1	6	2,7	13	2,9
20-25 years	61	27,4	79	35,4	140	31,4
26-30 years	51	22,9	61	27,4	112	25,1
31-35 years	58	26,0	38	17,0	96	21,5
36-40 years	25	11,2	31	13,9	56	12,6
>40 years	21	9,4	8	3,6	29	6,5
Total	223	100,0	223	100,0	446	100,0

The distribution of fathers' occupations in the case and control groups was most dominant among farmers (79,8%) and 77,1% in the control group. The age of fathers in the case and control groups was equally dominant in the age group of 26-30 years, in the case group (28,7%) and in the control group (32,2%). The mother's education level was generally high school completion in both the case (43,9%) and control (51,6%) groups. The most common type of maternal occupation in the case group was housewife (61,4%), while in the control group, it was 63,7%. The age group of mothers in the 20-25 years group was the most dominant in both the case group (27,4%) and the control group (35,4%).

Risk Factors for Stunting

Based on Table 2, the results of the 11 variables studied were obtained. There were 4 variables that were risk factors for the incidence of stunting in toddlers in Kerinci Regency, namely immunity status, maternal height, father's height, and father's education level.

Table 2. Analysis of stunting risk factors in toddlers in Kerinci Regency in 2020

Characteristics of respondents	Case		Control		OR (95% CI)	p-value
	n	%	n	%		
Father's Education Level						
Low	85	38,1	60	26,9	1,63 (1,12-2,49)	0,015*
High	138	61,9	163	73,1		
Types of Father's Work						
No fixed income	201	90,1	197	88,3	1,20 (0,66-2,19)	0,647
Fixed income	22	9,9	26	11,7		
Mother's Education Level						
Low	90	40,4	66	29,6	1,61 (1,08-2,38)	0,220*
High	133	59,6	157	70,4		
Types of Mother's Work						
Does not work	138	61,9	140	62,8	0,963 (0,65-1,41)	0,922
Work	85	38,1	83	37,2		
Family Income Level						
Low	185	83,0	177	79,4	1,26 (0,78-2,03)	0,397
High	38	17,0	46	20,6		
Mother's Age						
Risk	46	20,6	43	19,3	1,08 (0,68-1,73)	0,813
No risk	177	79,4	180	80,7		

Characteristics of respondents	Case		Control		OR (95% CI)	p-value
	n	%	n	%		
Baby Birth Weight						
Risk (<3000 grams)	80	35,9	81	27,4	1,48 (0,99-2,22)	0,067*
No risk (≥3000grams)	143	64,1	162	72,8		
Exclusive Breastfeeding						
Breast milk is not exclusive	33	14,8	26	11,7	1,31 (0,75-2,28)	0,402
Exclusive breastfeeding	190	85,2	197	88,3		
Dad's Height						
Risk (<162 cm)	124	55,6	94	42,2	1,71 (1,18-2,50)	0,006*
No risk (≥162 cm)	99	44,4	129	57,8		
Mother's height						
Risk (<150 cm)	101	45,3	67	30,0	1,92 (1,30-2,84)	0,001*
No risk (≥150 cm)	122	54,7	158	70,0		
Immunization Status						
Incomplete	63	28,3	44	19,7	1,60 (1,03-2,48)	0,046*
Complete	160	71,7	179	80,3		
Total	223	100,0	223	100,0	446 100,0	

* Multivariate Test Candidate

Multivariate Analysis

Table 3 shows multiple logistic regressions for risk factors for stunting events in Kerinci District. The variables that showed a significant relationship after the chi square test was carried out to select candidates who entered the modeling were the father's education level, mother's education level, baby's birth weight, father's height, mother's height, and immunization status. Variables that still have a relationship after multiple logistical tests are carried out include the father's education level, father's height, mother's height, and immunization status.

Low levels of fathers' education increase the chances of toddlers being stunted, with an AOR of 1,76 (95% CI: 1,16-2,66) and a p<0,05 value. Father's height and mother's height that are below standard also contribute to the incidence of stunting, where respectively AOR= 1,52 (95% CI: 1,03-2,24) with p value = 0,034 and AOR= 1,83 (95% CI: 1,22-2,74) with p value= 0,03. The same thing also happened to the immunization status variable, where the AOR value was 1,6 (95% CI: 1,01-2,52) with a p value= 0,041.

Table 3. Dominant factors for stunting risk events

Variable	Crude OR (95%CI)	p-value	Adjusted OR (95% CI)	p-value
Father's education level	1,65 (1,06-2,58)	0,26	1,76 (1,16-2,66)	0,07
Father's height	1,47 (0,9-0,21)	0,52	1,52 (1,03-2,24)	0,034
Mother's height	1,78 (1,19-2,67)	0,005	1,83 (1,22-2,74)	0,03
Immunization status	1,53 (0,973-2,42)	0,065	1,6 (1,01-2,52)	0,041

Spatial Analysis

At the spatial analysis stage, grouping analysis is carried out using the purely spatial analysis method with the Poisson probability model. Using spatial circular windows, a maximum of ≤25% of the total population (Figure 2) These clusters are presented in order of most likely cluster to least likely cluster. There are four grouping points for stunting cases in Kerinci Regency in 2020.

The area in the cluster includes areas in Gunung Tujuh District and Kayu Aro District. The second cluster is located at coordinates 2,180222 S and 101,483154 E, with a radius of 8,91 km. There are 28 cases with an RR value of 17,18. An RR value of 17,18 indicates that toddlers in the cluster have a 17,18 times higher chance of experiencing stunting compared to those outside the cluster. The area in this second cluster is Keliling Danau District. Details related to this can be seen in the table and Figure 2.

Table 4. Spatial cluster of stunting cases using the poisson model

Type	Coordinates/radius	Case observation	Case expectations	Relative Risk	Log Likelihood Ratio	p-value
Most likely Cluster	2,180222-101,483154/8,91 Km	15,15	1,85	17,18	51,56	<0,001
Cluster 1	1,970029-101,358569/0,25 Km	12,64	0,79	13,18	16,35	<0,001
Cluster 2	2,128937-101,554289/0,14 Km	10,59	0,66	10,90	10,27	0,0019
Cluster 3	1,989202-101,371417/0,69 Km	19,15	0,21	19,49	8,05	0,015
Cluster 4	2,006083-101,405186/0,11 Km	28,88	0,10	29,26	7,21	0,0031

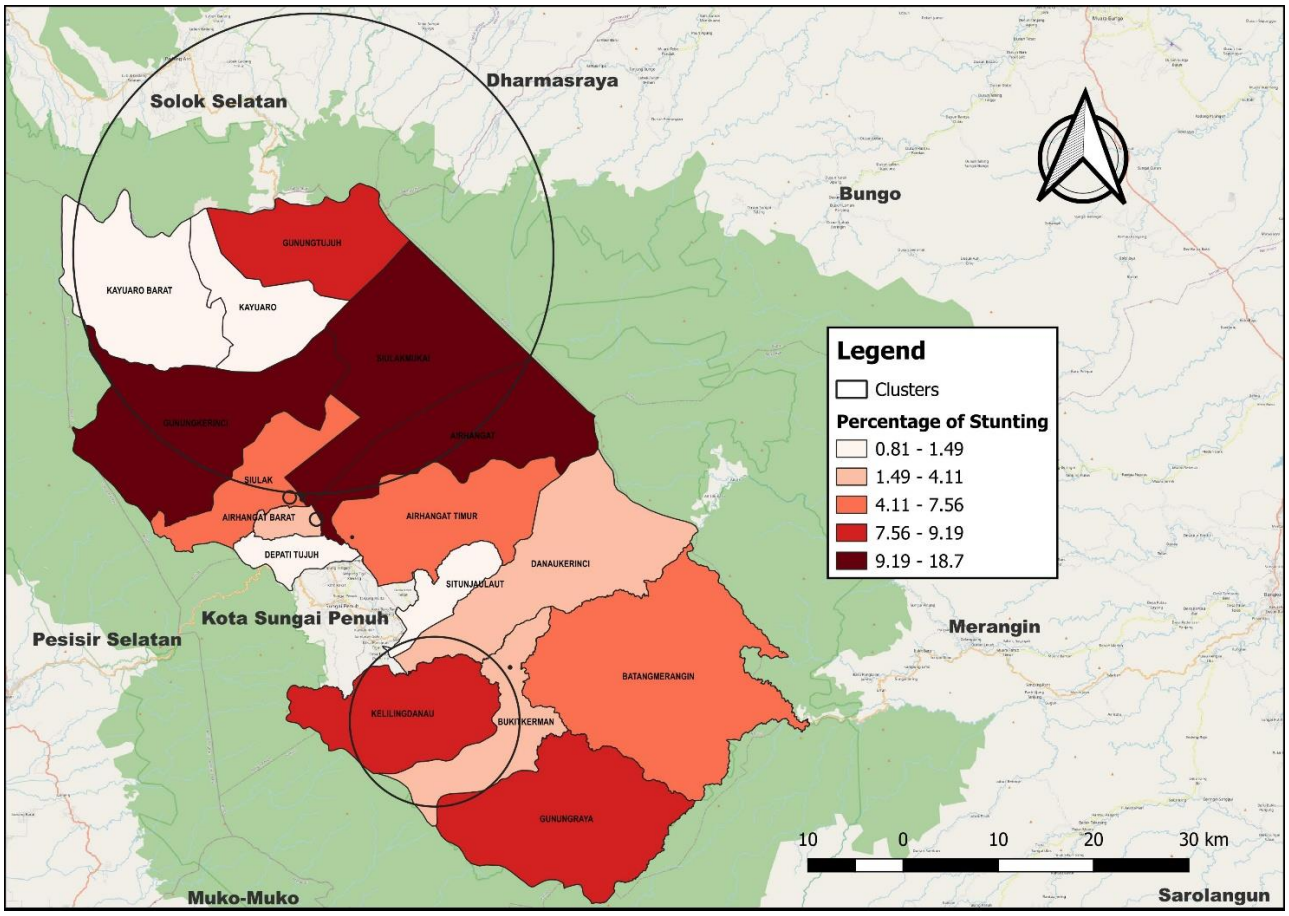

Figure 2. Map of the Kerinci Regency stunting cluster in 2020

This study found several variables as risk factors for stunting events, namely father's education level, father's height, mother's height, and immunization status. The results of this study confirm several previous findings that show the relationship of the above factors with the incidence of stunting. Low levels of fathers' education correlate with the incidence of stunting in toddlers. The results of this study are supported by previous research that showed a relationship between low paternal education and the incidence of stunting (Beal et al., 2018). Like other developing countries, education is an important issue in Indonesia. Low paternal education is a risk factor for children's nutritional status, which then becomes the cause of stunting.

Longitudinal research conducted in Bogor found that parents with higher education levels have a better understanding of nutrition and the dietary needs that should be given to children during their development compared to parents with low education levels (Mediani, 2020).

Substandard maternal height is also a risk factor for stunting. The height of mothers who do not meet the standards is associated with failure to thrive in children, and mothers with substandard height are also more likely to have stunted children. The relationship between maternal height that does not meet standards and child development is likely caused by genetic factors and environmental aspects that mothers are not aware of, such as hygiene, adequate nutritional intake, and reproductive health problems (Manggala et al., 2018; Al Rahmad et al., 2020).

Mothers whose height does not meet the standards are also suspected of having abnormal metabolic and anatomic systems that have an impact on the health of mothers and babies during pregnancy, such as low sugar levels or insufficient protein and energy intake (Manggala et al., 2018). This causes abnormal development in infants, which is the main cause of children experiencing stunting (Utami et al., 2018). Several studies conducted in developing countries also confirm the relationship between maternal height and the incidence of stunting (Ferreira et al., 2009; Javid & Pu, 2020; Khatun et al., 2019; Sinha et al., 2018).

Strong evidence also found a link between maternal height, abnormal uterine development, and low birth weight, where maternal height plays a role as a predictor of infant mortality and abnormal development. The mother's height also interferes with blood flow during pregnancy and the development of the uterus, placenta, and fetus, which then inhibits the development and height both in childhood and after adulthood (Halimatussakdiah & Miko, 2016; Utami et al., 2018).

A father's height is also a risk factor for stunting. Several studies have found that there is a high relationship between fathers and the incidence of stunting (Miko & Al-Rahmad, 2017; Sari & Sartika, 2021; Wu et al., 2021). It is critical to understand the pattern of development and height of parents in order to understand the pattern of child development. The influence of genetic factors cannot be directly witnessed when the child is born, but the child appears when the child reaches the age of 2-3 years (Sindhughosa & Arimbawa, 2020). The correlation between parental height and child height is not strong enough at the age of 2 years; the correlation will be seen to be stronger when children reach adolescence, as found in several previous studies (Garza et al., 2013).

The cluster analysis aims to see whether or not there is a stunting grouping in Kerinci Regency. The results of the analysis using purely spatial analysis with probability model poisson analysis obtained four clusters of stunting cases in Kerinci Regency in 2020. Of the four clusters, there are two clusters with a considerable number of cases, namely the first cluster with coordinates 1.738424 S, 101,368530 E, and a radius of 25,18 KM, where there are 107 cases with a value of p = <0,001. The relative risk (RR) value is 17,68, which means that toddlers who are in the cluster are 17,68 times more likely to experience stunting than toddlers who feel outside the cluster.

The area in the cluster includes areas in Gunung Tujuh District and Kayu Aro District. The second cluster is at coordinates 2,180222 S and 101,483154 E, with a radius of 8,91 KM, where there are 28 cases with an RR value of 17,18. An RR value of 17,18 shows that toddlers in the cluster have a 17,18 times higher chance of stunting compared to those outside the cluster. The area in this second cluster is Keliling Danau District.

The existence of stunting clusters in Kerinci Regency shows a greater risk of stunting in the area and in surrounding areas. Toddlers in these areas generally experience stunting at relatively close times and places, so they are more clustered than other sufferers. If viewed further by analyzing the risk factors found, these variables also cluster in areas where stunting cases are clustered, so that it can be concluded that there is a correlation between the case cluster and the risk factor cluster. The mother's height, father's height that does not meet the standards, and incomplete immunization status cluster in areas where stunting cases are clustered, namely in the sub-districts of Kayu Aro, Gunung Tujuah, and Keliling Danau.

Conclusion

Based on the results of the study, it can be concluded that a low level of father's education, a high mother, a high father, and immunization

status are risk factors for stunting in toddlers in Kerinci Regency. The results of the spatial analysis show areas that should be the focal point of efforts to reduce stunting cases, namely the Kayu Aro, Gunung Tujuh, and Keliling Danau sub-districts.

Given the limited resources, health offices should pay more attention to reducing stunting in areas that have a tendency to cluster by carrying out specific interventions before and during pregnancy.

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