Does Tin Mining Impact Spillover Stunting Toddlers?

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Abstract. The reduction in stunting in Bangka Belitung Islands Province, Indonesia's largest tin producer, is in the medium category. This study was conducted to see whether tin mining has an impact on stunting or not. The sample in this study consisted of 67 stunting toddlers. The data used are primary data obtained from interviews with mothers of toddlers. The study was conducted by spatial regression using the odd ratio test. The results found that tin mining did not have a spillover impact on stunting in Bangka Belitung Islands Province. The odd ratio value was more significant than 0.05 percent, the probability is 62 percent. However, judging from the distribution area of stunting toddlers in mining and non-mining areas on Bangka Island is clustered, while on Belitung Island it is random. This study was limited to the distribution of stunting toddlers in the tin mining area of Bangka Belitung Islands Province. It would be better if this spillover test were carried out in other mining areas throughout Indonesia. This research contributes to helping the Bangka Belitung Islands Provincial government focus on stunting reduction to the highest probability of stunting. It is hoped that with this research, the government can also provide optimal assistance for stunting toddlers.

Keywords: stunting, spillover, tin mining

1 Introduction

Regulation of the Minister of Health of the Republic of Indonesia (PERMENKESRI) No. 02 of 2020 concerning Child Anthropometry Standards reveals that a child who is stunted or very short (severaly stunted) may not necessarily have malnutrition conditions because the measurement is based on body length and height. While stunting is a condition of malnutrition since toddlers are 1000 days of life, especially if toddlers aged 0-24 months experience a linear growth slowdown or are at the threshold (z-score) of <-2 standard deviation.

Indonesia's prevalence position in 2021 has decreased by 24.4 percent, but maximum efforts are still needed to reduce stunting to 15.6 percent so that the target in 2025 is achieved. But the Indonesian government targets a 14 percent reduction in stunting prevalence by 2024(Kemeterian Kesehatan Republik Indonesia & Survei Status Gizi Indonesia (SSGI), 2021).

Some stunting studies such as those conducted by Nepal, 2018; Takele et al., 2020; Zegeye et al., 2020 see the low care and practice of nutritious feeding of children related to parental education, especially aspect mothers. Other stunting studies see that the stunting aspect of child nutrition interventions will not be realized if there are obstacles in human development (Desmond, 2021). But there is still little evidence to show an important role for

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the environment in stunting. Even if there is research that discusses the environmental aspects of stunting, it is only limited to the availability of sanitation as researched by Chambers & Medeazza, 2013;Augsburg & Rodríguez-lesmes, 2018; Yuliani Soeracmad, 2019; Das et al., 2020. Though the interaction between environmental factors and stunting can result in changes in health status.

Research by Puspita et al., 2020 examining the risk of stunted children living in small-scale gold mining areas found that stunted children are very vulnerable to mercury exposure either by inhalation by inhalation of mercury vapor or ingestion by consuming foods or drinks containing mercury. The mining sector can also affect health, with indications of the discovery of incidents of heavy metal poisoning and the compilation of diseases for newborns (Goltz & Barnwal, 2018; Rozo, 2020).

Bangka Belitung Islands Province is one of the tin producing areas, which even provides people to exploit tin conventionally. Even the Decree of the Minister of Industry Number 146/MPP/Kep/4/1999 dated April 22, 1999 categorizes tin as free goods (not supervised). This mining factor causes a high environmental risk of stunting in Bangka Belitung Islands Province.

Bangka Belitung Islands Province, based on the special index for stunting handling (IKPS) in 2019 of 60.7 percent, is included in the 11th rank of provinces that have not reached Indonesia's ikps, which is 66.1 percent. Even the achievements of the IKPS of Bangka Belitung Islands Province in 2020-2021 are included in the medium category because the performance of stunting reduction is not significant and is still under the Indonesian IKPS (LIKPS, 2021; *LIKPS*, 2022). So based on this background, this study will examine whether there is spillover of tin mining areas and non-tin mining against stunting in Bangka Belitung Islands Province.

2 Methods

This research was designed with quantitative and spatial descriptive methods. Spatial method research analyzes the relationship between variables with several other variables, using spatial impacts based on the observation area (Anselin, 1988; Haining, 2004; Sanders, 2001). This study uses primary data, namely data obtained through investigations of respondents consisting of questionnaire methods, interviews, observations / observations, exams or tests (Sudaryono, 2017).

Data on stunting toddlers collected as many as 346 toddlers in 184 villages/kelurahan of Bangka Belitung Islands Province. Then from 346 toddlers this was grouped by mining area and not mine. So it was obtained that 64 toddlers lived in mining areas and 63 non-mining areas on Bangka Island. While the other 35 toddlers live in mining areas and 19 non-mining areas on Belitung Island. The analysis was conducted separately to see more clearly the stunting toddler cluster in the mining area and not the mining are.

The Getis Ord G test is performed to group the concentration of attribute X variables across spatially distributed region i. Getis Ord G describes whether locally there is a spatial spillover interaction between region i and nearby neighboring regions at a given time period. Getis Ord G test equation formula(Haining, 2004; Sanders, 2001; Walter A Shewhart, 2004; Yoshiki Yamagata, 2020):

$$G = \frac{\sum_i^n \sum_{j\neq 1}^n w_{ij} y_i \, y_j}{\sum_i^n \sum_{j\neq 1}^n y_i \, y_j}$$

Description:
G = Z value
n = many observations (location) y_
i = Observation value at the i-th location y_
j = Observation value at the j-th location
wij = Elements of the spatial weighting matrix of the i-th row of the j-th column

Ord G Getis test hypotheses include

a. H0: received if p > 0.05 (there is no spatial spillover interaction at one value against neighboring values.)
b. H1: accepted if p < 0.05 (there is a spatial spillover interaction in one value against neighboring values).

Moran's Scatterplot is a diagram that shows the relationship between the observed value at a standardized location and the average of its neighbors. This scatterplot consists of four quadrants as shown in figure 1.

Quadrant 2 (Low-High)	Quadrant I (High - High)
Quandrant 3 (Low-Low)	Quadrant 4 (High – Low)

Fig. 1. Moran's Scatterplot

a. Quadrant 1; High-High (HH). HH indicates a location that has a high intensity value surrounded by a location that has a high intensity value.
b. Quadrant 2; Low-High (LH), indicating a location that has a low intensity value surrounded by a location that has a high intensity value of
c. Quadrant 3; Low-Low (LL), LL indicates a location that has a low intensity value surrounded by a location that has a low intensity value.
d. Quadrant 4; High-Low (HL), designates a location that has a high intensity value surrounded by a location that has a low intensity value

3 Results and Discussion

The distribution of stunting toddlers in mining areas is less than in non-mining areas. Normal toddlers are also more in non-mining areas than tin mining areas. The distribution of stunting in several mining areas is not evenly distributed throughout the Bangka Belitung Islands Province. Factor testing of mining and non-tin mining areas on stunting and normal toddler cases using Getis Odds Ratio (OR) can be seen in the Table 1.

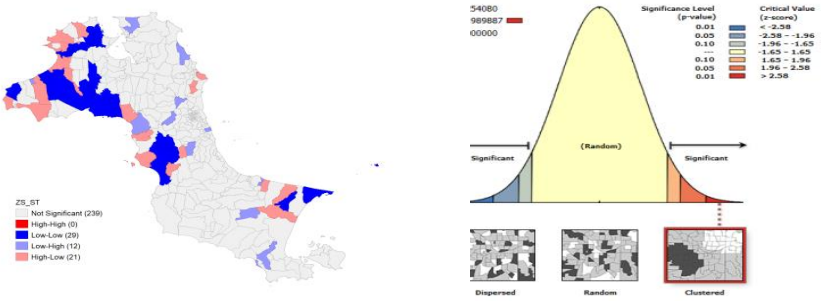
Table 1. *Odds Ratio* (OR) Test Result

Area	Toddler Condition				Total	
	Stunting		Normal			OR (97,5%)
			n	%)		
Tin Minning	50	7)	93	(42,3)	(42,2)	
Not Tin Minning	76	3)	127	(57,7)	(58,7	1,13
Total		(100)		(100)		

Source: processed (2023)

The table shows a Getis Odd Ratio (OR) value of 1.13 which means greater than 0.05 (1.13>0.05). This means that there is no spatial spillover interaction between mining and non-mining areas on the incidence of stunting toddlers. If the prediction of the opportunity for stunting toddlers in the mining area of Bangka Belitung Islands Province, then the highest probability of 62.1 percent is in East Belitung Regency.

Although it does not have a spatial spillover effect between tin and non-tin mining areas on stunting, what is the pattern of stunting toddler clusters in the area. So in figures 2 and 2 it will be clear the relationship between stunting clusters between villages / villages.

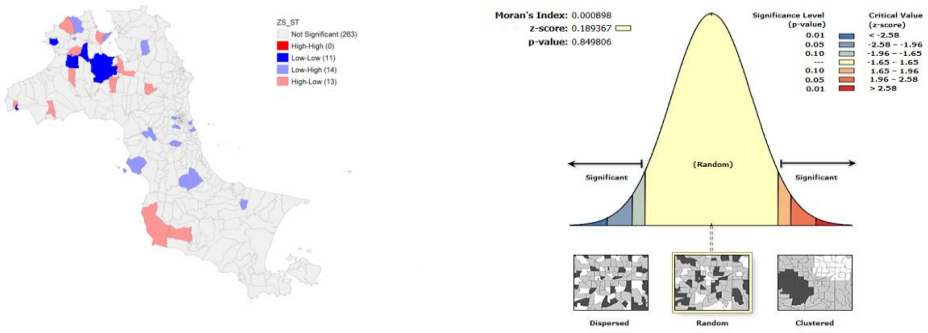


a) LISA's cluster b) Moran's Index

Fig. 2. Stunting Toddler Cluster in Tin Minning Area, Bangka Island
Source: processed (2023)

Figure 2 shows that the distribution of stunting toddlers in the Bangka Island mining area is cluster, because the Moran z-skore Index value of 10.989887 is more than 2.58 (figure 2b). This means that villages/kelurahan that have stunting toddlers in the mining area are in groups or there is a relationship between stunting toddlers among close neighboring villages/kelurahan. But none of the groups that are close to one have stunting in quadrant 1, namely high-high (HH). The group pattern formed is quadrant 4 (HL) adjacent to quadrant 3 (LL) or vice versa. For example, in Mentok District, West Bangka Regency, Air Putih Village/Kelurahan is quadrant 3 (LL) in groups with Sungai Daeng Village/Kel and Air Putih which is quadrant 4 (HL). In West Bangka Regency, Simpang Teritip, Jebus and Parittiga sub-districts are actually grouped between quadrant 4 (HL).

The stunting toddler cluster in the non-mining area of Bangka Island is random, can be seen in figure 3.

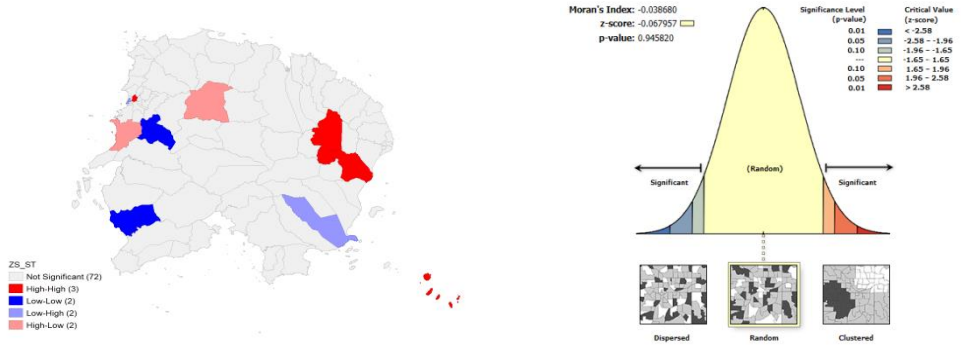


a) LISA's cluster b) Moran's Index

Fig. 3. Stunting Toddler Cluster in Not Tin Minning Area, Bangka Island

In figure 3b, the z-score of 0.189367 is smaller than 2.58, proving that the spread of stunting toddlers is diffuse or random. Villages/villages that have quadrant 3 (LL) and quadrant 4 (HL) categories tend to be close together between their own quadrants. One example of quadrant 4 (HL) is villages / kelurahan in Kelapa District such as Beruas Village, Kelapa and Pusuk each other are (HL) or quadrant 4. Even Tanjung Pura Village/Kelurahan in Central Bangka Regency which is category 2 quadrant (LH) is not neighboring other clusters.

Furthermore, the spread of stunting toddlers in the tin mining area of Belitung Island, is also random or spreading, can be seen in figure 4.



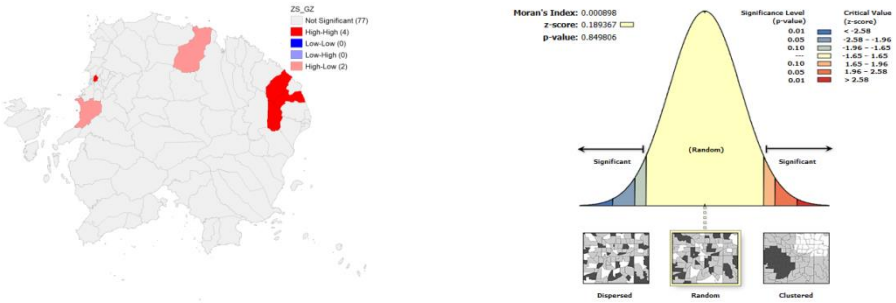
a) LISA's cluster b) Moran's Index

Fig. 4. Stunting Toddler Cluster in Tin Minning Area, Belitung Island

The spread of stunting toddlers in the Belitung Island mining area is diffuse because the z-score value of -0.067957 is smaller than 2.58, can be seen in figure 4b. Distribution based on clusters, quadrant 1 (HH) stunting toddlers are found in 3 villages/villages in East Belitung Regency, namely Simpang Pesak, Tanjung Kelumpang and Buding. Quadrant 2 (LH) is located in two villages/kelurahan in East Belitung Regency,

namely Limbongan Village/Kelurahan and Balok. Quadrant 4 (HL) is located in Belitung Regency, namely Pelepak Putek Village/Village (figure 4a).

Stunting toddlers in non-mining areas of Belitung Island also spread randomly, can be seen in figure 5.



a) LISA's cluster b) Moran's Index

Fig. 5. Stunting Toddler Cluster in Not Tin Minning Area, Belitung Island

The z-value of the spread of stunting toddlers in non-mining areas of Belitung Island is 0.189367 smaller than 2.58. Mengkubang and Sukamandi Villages/Villages in Belitung Regency are included in quadrant 1 (HH) category. This means that the quadrants of the spread of stunting toddlers in this region are scattered, not clustered with each other.

So the tin mining area in Bangka Belitung Islands Province does not cause spatial spillover of stunting toddlers as conducted by Puspita et al., 2020 and like the incidence of other diseases in the mining area conducted by Goltz &; Barnwal, 2018; Rozo, 2020. But it does not rule out the possibility that other mining areas have an impact on toddlers, stunting, or other diseases.

4 Conclusion

The results found that tin mining did not have a spillover impact on stunting in Bangka Belitung Islands Province. The odd ratio value was more significant than 0.05 percent, the probability is 62 percent. However, judging from the distribution area of stunting toddlers in mining on Bangka Island is clustered, while on Belitung Island an not tin minning on Bangka Island it is random.

This research would be better if it reached out to stunting research in other mining areas in Indonesia, considering the limited funds so that stunting research in mining areas, especially tin, was only carried out in the Bangka Belitung Islands Province. This research will be continued by looking at the effect of maternal human capital, health investment and maternal time allocation on the nutrition of stunting toddlers in Bangka Belitung Islands Province.

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