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SPATIAL AUTOCORRELATION BETWEEN POVERTY FACTORS AND EXCLUSIVE BREASTFEEDING INTAKE WITH STUNTING IN WEST JAVA PROVINCE AT 2018 – 2020

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ABSTRACT
Stunting is a condition of growth failure in toddlers that leads to reduced productivity and susceptibility to degenerative diseases. The prevalence of stunting in West Java Province was the highest on the island of Java in 2018-2020. The objective of this study was to analyze the distribution map and spatial autocorrelation for stunting prevalence in West Java Province, with considering the spatial effects. The present study employed an ecological design with a spatial approach. The research data was obtained from Open Data Jabar, which is freely accessible via the website. The analysis was conducted using GeoDa software. The results indicate an increase in the areas demonstrating spatial effects between stunting and breastfeeding each year (2018–2020). Concurrently, the spatial implications of poverty on stunting necessitate further examination in the western region of West Java Province, particularly in Sumedang, Tasikmalaya, and Indramayu.

Keywords: child health; exclusive breastfeeding; poor people; spatial analysis; stunting

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INTRODUCTION

Stunting is one of the targets of the Sustainable Development Goals (SDGs) included in the second sustainable development goal. According to the World Health Organization (WHO), stunting—also known as short stature—is defined as a linear growth disorder caused by chronic malnutrition or chronic or recurrent infectious diseases. This is indicated by a height-for-age z-score (HAZ) below -2 standard deviations (SD) (WHO, 2014). To date, nutrition issues, particularly stunting in infants, remain a major national concern. This is evidenced by the issuance of Presidential Regulation No. 72 of 2021 on Accelerating the Reduction of Stunting, with the president setting a target to reduce the prevalence of stunting to 14% by 2024. It is notable that Java is the most densely populated island in Indonesia. According to data from the 2019 Indonesian Health Profile, the rate of stunted children in West Java is 13.20%, which is higher than the national average of 12.80%. The results of the Indonesian Nutrition Status Study (SSGI) indicate that the highest prevalence of stunting in Java in 2021 was in West Java Province at 24.5%, which is slightly higher than the national stunting prevalence rate of 24.4%. Nevertheless, the results of the SSGBI (Indonesian Toddler Nutrition Status Study) in 2019 demonstrated that the prevalence of stunting in West Java Province was considerably lower than the national prevalence of stunting in Indonesia (26.2 vs 27.7).

In 2024, the prevalence of stunting in West Java Province decreased to 15.9% (Kementerian Kesehatan RI, 2025). This finding indicates that the efforts to reduce stunting in West Java Province are comparable to those in other provinces in Indonesia. The National Population and Family Planning Agency (BKKBN) has identified 12 provinces as being of particular importance for stunting intervention efforts in Indonesia. West Java Province is among the 12 provinces deemed to be of high priority. The West Java Provincial Health Office has been collecting routine data on stunting prevalence rates since 2014. Disparities in stunting prevalence among toddlers in districts/cities in West Java Province in 2019-2020 indicate differences in interventions between districts/cities, necessitating spatial analysis to identify interventions based on region. Moreover, a number of regions were designated as priority areas for stunting interventions in 2019. However, the prevalence of stunting among infants in 2020 did not demonstrate a decrease in the Sumedang, Garut, and Cirebon districts (Dinas Kesehatan Provinsi Jawa Barat, 2021).

A spatial analysis study conducted by Sipahutar (2020) found that these three areas are stunting hotspots in West Java Province, meaning that an increase in stunting can be influenced by high stunting rates in surrounding areas (Sipahutar, 2020). Therefore, hotspot areas need to receive more intervention, as do neighboring areas. The importance of spatial analysis in stunting is that risk factors for stunting, including environmental factors and health programs such as *posyandu* and the *Bina Keluarga Balita*, are factors that are closely related to the location of a region (Souris, 2019).

The WHO has indicated that nations must initiate a situational analysis to ascertain the number of stunted children and evaluate the determinants of stunting within the geographical context of endeavors to attain global stunting targets by 2025 (Berger et al., 2022)(World Health Organization, 2014). A proposed strategy for accelerating the reduction of stunting involves the involvement of district and city governments. These governments are expected to collaborate with the central government to regularly monitor the implementation of stunting prevention activities (Kementerian Kesehatan RI, 2018b).

A substantial body of research has demonstrated that numerous government policies have been implemented at the policy level with the objective of accelerating the control of stunting. However, the findings indicate that the decline in stunting rates has fallen significantly short of the targeted goals (Saputri & Tumangger, 2019). Some challenges in addressing nutrition issues include limited human resources and the lack of guaranteed budget availability (Probohastuti & Rengga, 2019). One approach that can be taken to minimize budget requirements and enhance human resource efficiency is to focus interventions on areas that have a significant impact on the high prevalence of stunting. This can be achieved through the use of spatial analysis.

A previous study assumed that if an area has a high percentage of stunting, then nearby areas will experience the same condition. Therefore, it is necessary to use statistical modeling methods that involve location information (Pramoedyo, Mudjiono, Fernandes, Ardianti, & Septiani, 2020). Studies in Africa showed that there is autocorrelation in Moran's I values for stunting prevalence, and some regions exhibit High-High (HH) patterns, meaning that the stunting rate is high in those regions and they are surrounded by other regions with high stunting rates, also known as stunting hotspots (Hailu et al., 2020). A spatial analysis of the issue of stunting in Indonesia identified five provinces as stunting hotspots. Each province has a different number of hotspots at the district and city levels (Sipahutar & Eryando, 2019).

According to the Ministry of Health, stunting is a form of malnutrition associated with past nutrient deficiencies, thereby classified as a chronic nutritional issue. Stunting is measured as a nutritional status indicator, taking into account the height or length of the body, age, and gender of infants. Based on data from the Basic Health Research (Riskesdas) in 2018, it was found that the

proportion of stunted infants increased compared to 2013, from 19.2% to 19.3% in 2018, while the proportion of very short infants decreased from 18.0% in 2013 to 11.5% in 2018. The proportion of stunting in Indonesia reached 30.8% in 2018, with around 18 provinces still above the national average (Kementerian Kesehatan RI, 2018a). Based on the results of the 2024 Indonesian Nutrition Status Survey (SSGI), the prevalence of short toddlers was 15.6% and very short toddlers was 4.2% (Kementerian Kesehatan RI, 2025). This shows a significant decline. The determinants of child stunting in Indonesia are very complex. Inadequate exclusive breastfeeding for the first six months and low household socioeconomic status are important determinants of child stunting in Indonesia (Beal, Tumilowicz, Sutrisna, Izwardy, & Neufeld, 2018). Low household income has been identified as a significant predictor of stunting in infants (Apriluana & Fikawati, 2018). Therefore, this study aimed to analyze the distribution map and spatial autocorrelation for stunting prevalence in West Java Province.

METHOD

Research Design

The present study employed a quantitative research design, utilizing an ecological study design. The decision to utilize an ecological study was made due to the fact that the research data was derived from published reports or open access reports, some of which contained data on stunting and its determinants at the district/city level (aggregate data). The present study was conducted in twenty-seven districts/cities in West Java Province. These locations were selected based on reports published between 2018 and 2020 on the Open Data Jabar website. The present study utilized secondary data obtained from Open Data Jabar, focusing on health issues, as reported by the Health Department, and poverty issues, as documented by the Central Statistics Agency. The research data is available for consultation via the internet, with no restrictions on access, by following the link below: https://opendata.jabarprov.go.id/.

Research Variables

The present study incorporated a range of variables, including stunting, the presence of healthy latrines, poor people, the proportion of nutritionists in community health centers, the percentage of infants receiving exclusive breastfeeding, the Community-Based Total Sanitation villages (STBM), and low birth weight (LBW). The data utilized in this study was of a secondary data and had been made available to the public.

Data Analysis

The data was processed using the GeoDa application, which is available for open access. The spatial weighting used in this study was Queen Contiguity because the districts/cities in West Java Province are directly adjacent to one another and are not separated by oceans. Therefore, Queen Contiguity weighting is appropriate for use in areas that are adjacent to one another. Spatial autocorrelation analysis was conducted using Global Moran's I and Univariate LISA (Local Index Spatial Autocorrelation) tests to determine the effect of stunting prevalence between locations and which locations were clustered or formed clusters so that areas at risk of stunting could be identified. Patterns were identified using Moran's I index value criteria: if the value of $I > E(I)$, it means that the prevalence of stunting has a clustered pattern; if the value of $I < E(I)$, it means that the prevalence of stunting has a spreading pattern; and if the value of $I = E(I)$, it means that the prevalence of stunting has an uneven distribution pattern. LISA provides information about quadrants consisting of four types of spatial autocorrelation, namely (BioMedware, 2014)

a. High-High (HH): Quadrant 1 is in the upper right, positive spatial autocorrelation (hotspot)
b. High-Low (HL): Quadrant 2 is in the lower right, negative spatial autocorrelation
c. Low-Low (LL): Quadrant 3 is in the lower left, positive spatial autocorrelation (coldspot)
d. Low-High (LH): Quadrant 4 is in the upper left, negative spatial autocorrelation
e. *Not significant*

RESULT

Table 1 demonstrates that stunting in West Java Province exhibited a spatial correlation in 2018 with a significance level of 10% (0.0106) and in 2019 with a significance level of 5% (p = 0.047). Concurrently, in the year 2020, no evidence of spatial correlation was observed with regard to stunting in West Java Province. The determinants suspected to be associated with stunting and showing spatial correlation include poor population, breast milk, and low birth weight in 2018 and 2020. Meanwhile, in 2019, only poor population and low birth weight (LBW) had spatial correlation in West Java Province.

Table 1.
Spatial correlation of univariate Moran regarding stunting and the determinants in West Java 2018-2020

Year	Variable	I	E(I)	z-value	Pseudo value
2018	Stunting	-0.2154	-0.0385	-1.2625	0.106
	Poor people	0.4351	-0.0385	3.3583	0.001
	Breastfeeding	0.1945	-0.0385	1.7095	0.052
	Nutritionist	0.0798	-0.0385	0.9055	0.175
	Healthy latrine	0.0617	-0.0385	0.7662	0.206
	STBM	-0.1646	-0.0385	-0.8782	0.199
	LBW	0.113	-0.0385	1.2181	0.113
2019	Stunting	0.1944	-0.0385	1.7638	0.047
	Poor People	0.4419	-0.0385	3.4119	0.001
	Breastfeeding	0.0125	-0.0385	0.3863	0.345
	Nutritionist	0.0841	-0.0385	0.9388	0.171
	Healthy latrine	-0.0206	-0.0385	0.1572	0.157
	STBM	-0.1291	-0.0385	-0.6702	0.265
	LBW	0.654	-0.0385	4.7538	0.001
2020	Stunting	0.0378	-0.0385	0.495	0.313
	Poor people	0.4461	-0.0385	3.434	0.001
	Breastfeeding	0.2167	-0.0385	2.615	0.015
	Nutritionist	0.112	-0.0385	1.1402	0.126
	Healthy latrine	-0.191	-0.0385	-1.0964	0.13
	STBM	-0.0978	-0.0385	-0.4543	0.348
	LBW	0.7292	-0.0385	5.2285	0.001

Table 2.
Spatial Interaction between Stunting and its Determinants in West Java Province, 2018-2020

Year	Variable	I	E(I)	z-value	Pseudo value
2018	Poor people	0.1084	-0.0385	1.0257	0.153
	Breastfeeding	0.164	-0.0385	1.4258	0.081
	Nutritionist	-0.0384	-0.0385	-0.3285	0.387
	Healthy latrine	-0.045	-0.0385	-0.4238	0.338
	STBM	0.0578	-0.0385	0.425	0.347
	LBW	0.02	-0.0385	0.1287	0.443
2019	Poor people	0.1762	-0.0385	1.6281	0.052
	Breastfeeding	0.2071	-0.0385	2.013	0.025
	Nutritionist	0.1439	-0.0385	1.3468	0.098
	Healthy latrine	-0.0639	-0.0385	-0.5756	0.274
	STBM	-0.0009	-0.0385	-0.0219	0.475
	LBW	0.2272	-0.0385	2.0916	0.024
2020	Poor people	0.0874	-0.0385	0.8818	0.184
	Breastfeeding	0.1474	-0.0385	1.4007	0.069
	Nutritionist	0.1975	-0.0385	1.8909	0.036
	Healthy latrine	-0.0049	-0.0385	0.0229	0.486

	STBM	-0.1539	-0.0385	-1.3554	0.089
	LBW	0.1104	-0.0385	1.0758	0.137

Table 2 shows that there is no significant spatial relationship between stunting prevalence and the variables analyzed. The highest I value was found in the breastfeeding variable (I = 0.1640, z = 1.4258, p = 0.081), indicating a tendency for areas with high breastfeeding coverage to be associated with high stunting rates, but this association is not yet statistically significant (p > 0.05). Concurrently, the variables of nutritionist, healthy toilets, and Community-Based Total Sanitation (STBM) exhibited negative I value, yet were not found to be statistically significant. This finding suggests the absence of a discernible spatial pattern between these variables and stunting.

The 2018 Bivariate Moran results show that there is no significant spatial relationship between stunting prevalence and the variables analyzed. The breastfeeding variable exhibited the highest value (I = 0.1640, z = 1.4258, p = 0.081), indicating a tendency for areas with high breastfeeding coverage to be associated with high stunting rates, but this association is not yet statistically significant (p > 0.05). Meanwhile, variables such as nutritionist, healthy latrine, and STBM showed negative I value, yet also not significant, indicating no strong spatial pattern between these variables and stunting.

In 2020, nutritionist showed a significant spatial association with stunting (I = 0.1975, z = 1.8909, p = 0.036), indicating that areas with a high number of nutritionists tended to cluster with areas with high stunting prevalence. Meanwhile, breastfeeding again showed a positive trend, although it was not yet significant (p = 0.069). Other variables such as STBM showed a negative and nearly significant relationship (I = -0.1539, p = 0.089), indicating the possibility of STBM's influence in reducing stunting spatially.

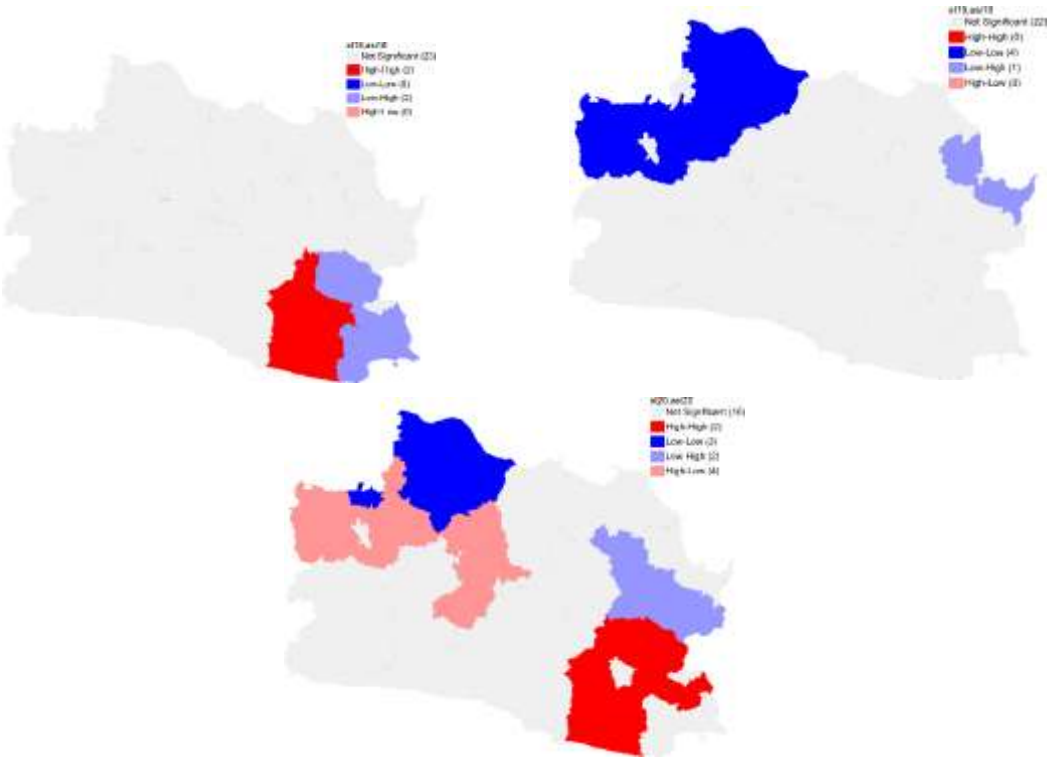

Figure 1 Cluster Map of Stunting and Breastfeeding in West Java Province, 2018–2020

The results show that there is a spatial correlation between stunting incidents and exclusive breastfeeding rates between cities/districts in West Java Province. The map shows areas that fall into the Low-High quadrant, including in 2018 (Ciamis, Pangandaran), 2019 (Cirebon), and 2020 (Majalengka, Kuningan). The Low-High quadrant refers to areas with low exclusive breastfeeding

rates and high stunting rates. the initiation of breastfeeding before the completion of the sixth month of life, in conjunction with the introduction of complementary foods prior to the attainment of adequate digestive system development, has been demonstrated to be a contributing factor to the increased prevalence of stunting. This is due to the fact that the infant's digestive system is not yet fully developed, rendering them more vulnerable to the onset of infectious diseases, including diarrhea and respiratory infections (Friska, 2013). Children who are not exclusively breastfed are more likely to experience stunting compared to those who are exclusively breastfed. This may be due to regional characteristics and cultural practices, such as dietary restrictions for pregnant or breastfeeding women, including prohibitions on eating eggs, fish, and certain types of vegetables and fruits. The reason mothers are not allowed to eat fish is that it can cause itching in the breasts and interfere with the breastfeeding process. This results in both the quantity and quality of breast milk being poor, leading to inadequate nutrient intake for the baby, which can affect the child's growth, including their height.

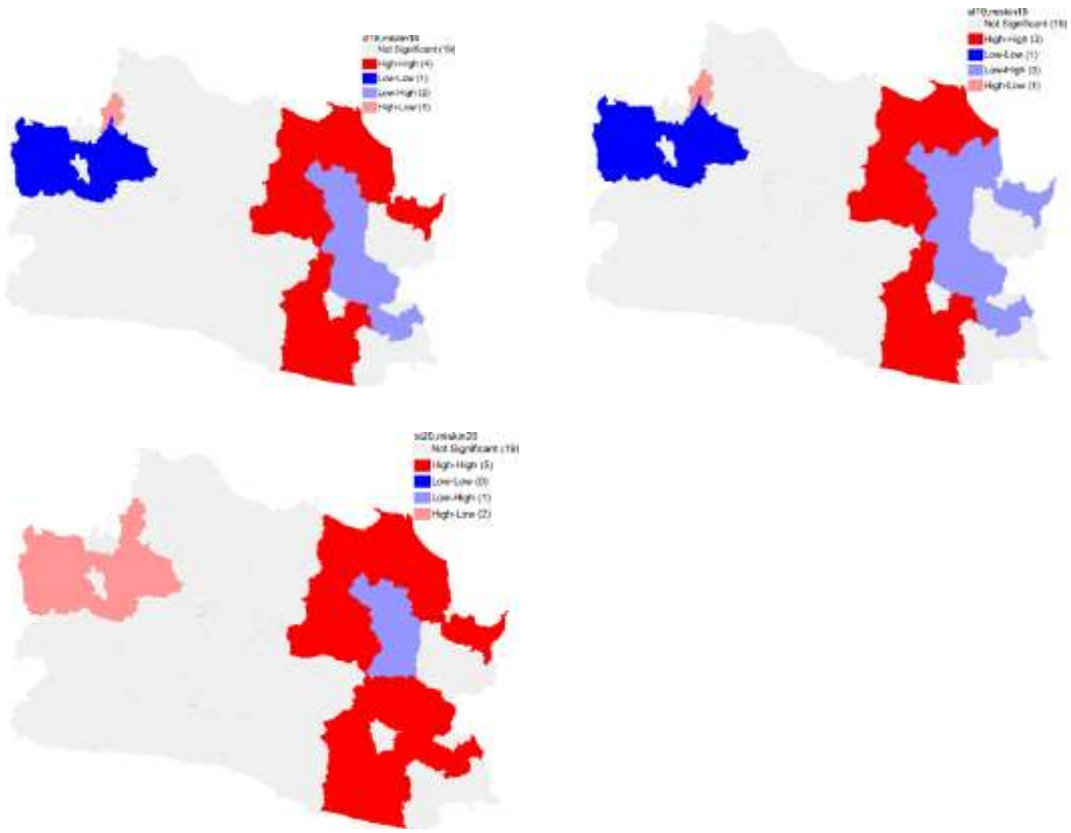

Figure 2. Cluster Map between Stunting and Poor Population in West Java Province in 2018–2020

Figure 2 show that there is a spatial correlation between stunting incidents and the number of poor people between cities/districts in West Java Province. The spatial pattern formed from 2018 to 2020 shows that the areas prone to stunting from the aspect of poverty are in the western part of West Java Province. In 2018, the areas classified as high-high were Indramayu, Sumedang, Tasikmalaya, and Cirebon. In 2019, the high-high areas were Indramayu, Sumedang, and Tasikmalaya. In 2020, the high-high areas were Indramayu, Sumedang, Tasikmalaya, Cirebon, and Ciamis. The term "high-high" is used to denote regions with elevated stunting rates, which are often characterized by the presence of high poverty rates. Meanwhile, the city of Bekasi has been in the "high-low" quadrant for three consecutive years, indicating that it is an area with elevated poverty rates that is surrounded by regions with low stunting rates.

DISCUSSION

Poverty is defined as the state of being unable to obtain the right quality and quantity of food to meet one's nutritional needs. This deficiency impacts their capacity for physical labor, resulting in low income and poverty. Malnutrition is thus linked to the vicious cycle of poverty (Pacheco, 2017). Family income ≥ minimum wage so that they have adequate nutrition to support child growth, including height. Adequate family income will support child growth and development, as respondents can provide for all of their children's needs, both primary and secondary (Putra, 2016). Socioeconomic conditions have also been demonstrated to be related to stunting. Households with limited financial resources may encounter challenges in ensuring adequate nutrition. This phenomenon has been observed to occur most frequently among infants from low-income families (Pacheco et al., 2017). Low-income families manage their expenses by relying on limited income. Although basic needs and side dishes may be met daily, the quality and quantity are often neglected, so that low economic status indirectly contributes to stunting in infants (Rahma & Mutalazimah, 2022). Infants from families with low economic status are more likely to experience stunting compared to infants from families with high economic status (Putra, 2016).

A case-control study in southern Ethiopia on infants aged 24–59 months found that infants who were not exclusively breastfed (<6 months) were 3.7 times more likely to be stunted than infants who were exclusively breastfed (AOR 3.7. 95% CI: 1.21–8.82) (Fikadu, Assegid, & Dube, 2014). A study in India found a trend toward reduced stunting among children who were exclusively breastfed (Kumar & Singh, 2015). A study in 15 villages in Barru District, South Sulawesi, showed that breastfeeding barriers are associated with impaired height growth (Fanny et al., 2016). Additionally, early weaning can lead to stunting (Stewart, Iannotti, Dewey, Michaelsen, & Onyango, 2013). Exclusive breastfeeding and complementary foods have a statistically significant impact on stunting rates (Fauziyyah, Dewi, Wekadigunawan, & Adriani, 2019).

Failure to achieve exclusive breastfeeding can increase the risk of stunting, especially in early life. The calcium content in breast milk is more efficiently absorbed by the body than formula milk, thus playing a role in maximizing growth (Simbolon & Putri, 2024). Failure to achieve exclusive breastfeeding can be due to various factors. Research findings indicate that over 90% of failures in exclusive breastfeeding are due to insufficient milk production (Yaqub & Gul, 2013). Other studies indicate that failure to achieve exclusive breastfeeding is due to the mother working, lack of family support, insufficient maternal knowledge, illnesses suffered by the mother or baby, promotion of formula milk, and insufficient maternal awareness of the importance of exclusive breastfeeding (Senghore, Omotosho, Ceesay, & Williams, 2018; Hadi et al., 2021; Nathalia, Rahmawati, Nastiti, & Salmarini, 2024). Maternal income is associated with adequate knowledge about exclusive breastfeeding. Mothers with higher incomes typically come from modern communities and thus have greater access to information from electronic and print media (Senghore et al., 2018).

Socioeconomic problems can be identified from various factors such as parental income and family food security. A family's low income level will indirectly cause children to experience stunting (Lestari, Margawati, & Rahfiludin, 2014). Family income is known to be a significant predictor of stunting (Ni'mah & Nadhiroh, 2015). family income has been demonstrated to be a substantial predictor of stunting. The issue of family poverty has the potential to compromise household food security, given the limited access to and affordability of nutritious and healthy food that this economic condition often engenders. Therefore, the loss of household income has been demonstrated to increase the risk of children experiencing nutritional problems, including stunting (UNICEF, 2020).

Other research findings indicate that family income is associated with stunting in toddlers (p=0.048) (Nurmayasanti & Mahmudiono, 2019). Family income has been identified as a prominent factor associated with stunting (Devi et al., 2025; Ratnawati & Rahfiludin, 2020). Previous

studies have shown a relationship between economic status (p= 0.003 and OR=5.333)(Astutik, Rahfiludin, & Aruben, 2018). A study using an ecological approach in East Java Province found that poverty is significantly associated with stunting (Laksono & Kusrini, 2020). Meanwhile, a study in India using spatial data analysis found that poverty is a significant factor in stunting (Puri, Khan, Shil, & Ali, 2020). A study on child stunting in Malang City demonstrated no spatial dependence of stunting; however, the robust error value ($p < 0.05$) was met, thus necessitating the implementation of a structural equation model (SEM). One of the results: if other factors are held constant, it was found that if the number of poor people in a district increases by 1 unit, the stunting rate will increase by 14.6186 units (Yudono, Purnomo, & Damayanti, 2021).

CONCLUSION

The study concluded that there was spatial autocorrelation of stunting in West Java Province in 2019, meaning that stunting in one area was related to stunting in neighboring areas. Concurrently, during the years 2018 and 2020, the phenomenon of stunting exhibited a random distribution across the province of West Java. The spatial interaction between stunting and breastfeeding indicates that in 2018, the phenomenon was significant in areas proximate to DKI Jakarta. In 2019, its significance was observed in areas close to Central Java. Finally, in 2020, its significance was observed in areas close to DKI Jakarta and Central Java. This finding suggests a growing correlation between stunting and breastfeeding in West Java Province, indicating a potential synergistic relationship between these two factors. Furthermore, the spatial interaction between stunting and poor population demonstrates that from 2018 to 2020, the phenomenon manifested as a significant phenomenon in the western part of West Java and in areas proximate to Central Java.

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