



## Socio-Economic Indicator of Childhood Stunting in Indonesia: A GMM Analysis

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### Abstract

The purpose of this study is to analyze the short-term and long-term effects of socio-economic indicators on the prevalence of stunting in Indonesia in 2018-2022. The estimation used to analyze the spatial dynamic panel data model in this study is the Generalized Method of Moment (GMM). Based on the results of the analysis, the variables that have a significant positive effect on the prevalence of stunting in Indonesia are GRDP per capita and poverty, while the variables of literacy, sanitation and HDI have a negative effect on the prevalence of stunting. Although the effect of GRDP per capita on stunting is weak, if followed by low poverty, increasing literacy spirit, awareness of the importance of sanitation and the continued growth of Indonesia's human development index, it is hoped that every household can provide the nutritional needs of toddlers to quickly reduce the prevalence of stunting in Indonesia.

**Keywords:** Stunting, Socio-Economic, GMM, Dynamic Panel

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### INTRODUCTION

Food insecurity is a result of global conflict, economic contraction and inequality (Food and Agriculture Organization et al., 2022), and extreme climate change (Krishnamurthy et al., 2014; Richardson et al., 2018). The impacts of food insecurity events include hunger and

malnutrition, both of which are still priority problems for every country in the world. Prolonged hunger will cause serious health impacts, one of which is malnutrition.

Food and Agriculture Organization et al., (2023) stated that there are around 690 to 783 million people in the world who suffer from

hunger and there are 148.1 million stunted toddlers in 2022. Projections reported by the FAO that until 2030 the world will still be faced with the problem of 600 million people suffering from hunger and this is a considerable challenge for the achievement of the Sustainable Development Goals (SDGs) target. One form of Indonesia's serious commitment in implementing SDGs programs is Presidential Regulation number 72 of 2021 which regulates the target of reducing stunting by 14% by 2024. According to data from the central statistics agency (2023) in 2018-2022 there has been a decrease in the prevalence of stunting toddlers by less than 2% each year.

The reduction in the prevalence of stunting is an effort made by both the government and the community through stunting-specific intervention programs in the pre- and postnatal period. These intervention programs include nutritional intake of pregnant women, exclusive breastfeeding, and complementary feeding (Ginting & Hadi, 2023). So far, the interventions carried out to accelerate the reduction in the prevalence of stunting still focus on health factors that are considered to need to be improved. But in reality, in the community there are still socio-cultural factors that need attention and can weaken the government's goal of reducing the prevalence of under-five.

Community behaviors that affect the slow achievement of stunting targets in Indonesia include the culture of abstinence from consuming certain foods that contain good nutrition for the growth of pregnant women, nursing mothers, infants and children such as pregnant women having abstinence from consuming squid, stingrays (Paramita et al., 2022), shrimp, octopus, seaweed crabs, ducks,

moringa leaves and banana hearts because it is feared that the baby born will have dark skin, smell fishy, grow humpbacked like a shrimp (Putriana et al., 2020) and the mother's labor will be difficult (Barahima et al., 2019). In postpartum breastfeeding mothers, abstain from consuming foods with oil, coconut milk and salt content (Nurbiah et al., 2019). Meanwhile, children are prohibited from consuming fish and eggs for fear of suffering from worms and itching (Nasution et al., 2021; Putriana et al., 2020).

In addition to the influence of community behavior, socio-economic phenomena in the community are also taken into consideration in the stunting reduction program in Indonesia. As in the research (Renyot et al., 2016) which states that the incidence of stunting has an impact on economic losses in Indonesia, in 2013 the average economic loss suffered was between Rp.96 billion and Rp.430 billion. Likewise (Win, 2016) stated that the same thing happened in Myanmar that early childhood in Myanmar who lacked nutrition would cost the national Gross Domestic Product by 2.4%. In addition, poverty also exacerbates the number of stunted toddlers (Usman & Kopczewska, 2022). Households with low incomes and food insecurity have a significant influence on the increasing incidence of stunting in Nepal (Vatsa et al., 2023).

The number of toddlers who are categorized as stunted is a threat to the future of the nation because of the limited potential of individuals who can hinder development, both at the individual level and society. stunting is a condition in which toddlers experience chronic malnutrition, causing a decrease in cognitive abilities, neurological development and low cognitive function, and are at risk of suffering from chronic diseases in adulthood (de Onis & Branca, 2016).

Various studies have shown that stunting can have long-term effects on high mortality (Ponum et al., 2020), birth quality and cognitive development (Dewey & Begum, 2011), decreased school achievement (Picauly & Toy, 2013), and decreased work productivity in adulthood (Ponum et al., 2020; Renyoet et al., 2016).

Based on various studies that have been conducted previously, it is agreed that addressing childhood stunting is a top priority to reduce the global burden of disease and to promote economic development. The purpose of this study is to analyze the short-term and long-term effects of socioeconomic indicators on the prevalence of stunting in Indonesia in 2018-2022.

## RESEARCH METHODS

The type of data used in this study is secondary data. The variables in this study consisted of dependent variables and independent variables. The dependent variable is the prevalence of stunting. The independent variables are Gross Regional Domestic Product per capita (GRDP per capita), Poverty, Literacy, Sanitation, and Human Development Index (HDI).

The data used in this study came from the Ministry of Health and the Central Bureau of Statistics. The scope of this research is 34 provinces in Indonesia with a research period of 2018 to 2022. Software application used as a data processing tool is STATA 17.

The spatial dynamic panel data model is used to describe the relationship between variables which is basically a dynamism, namely variables that are not only influenced by variables at the same time but also influenced by variables at the previous time and spatial linkages between regions (Mala et al., 2019). This dynamic panel model can be seen from the

presence of the lag of the dependent variable among the regressor variables that are correlated with errors. While spatial interaction is shown through a spatial weight matrix (Mala et al., 2019). The spatial weight used in this study is the inverse distance weight (Das et al., 2024). The spatial dynamic panel data model equation is shown as follows:

$$Y = \delta y(i, t-1) + \lambda WN y(i, t) + X'it \beta + uit$$

Description:  $y$  = unit observation (dependen variable);  $WN$  = spatial weighting matrix;  $\lambda$  = spatial autoregressive coefficient that measures the effect of the interaction between endogenous variables;  $\beta$  = short-run effect;  $X'it$  = independent variable of the  $i$  cross section unit at the  $t$  time period;  $uit$  = error component;  $i = 1, 2, \dots, N$ ;  $t = 1, 2, \dots, T$ . The coefficient represents the short-run effect of changes in  $X'it$  (Lai et al., 2008). While the long-term effect of changes in  $X'it$  it is denoted by  $(\beta / (1 - \delta))$ .

The equation used in this study based on the spatial dynamic panel data estimation model is as follows:

$$PBSit = \beta_0 + \beta_1 PBS(i, t-1) + \lambda WN PBS(i, t) + PDRBit + \beta_7 POVit + \beta_8 literasiit + \beta_9 sanitasiit + \beta_{10} IPMit + uit$$

Where  $\beta_0$  is scalar quantities,  $\beta_1, \dots, \beta_{10}$  is estimated parameter coefficient values for the variables of GRDP per capita, poverty, literacy, sanitation, and HDI,  $u$  is error component  $i$  is province,  $t$  is year/period. The estimator used to analyze dynamic panel data in this study is the Generalized Method of Moment (GMM) system. This estimator was deliberately chosen because it is considered more efficient (Baltagi, 2005) on data that has a short time series.

## RESULTS AND DISCUSSION

The results of parameter estimation using the system generalized method of moment (sys-GMM) model show that the data used in this study have met the criteria for valid, consistent, unbiased instruments and significant variables both simultaneously and partially. To achieve these test results, the following steps are taken.

1. The statistical test consists of two tests, namely the simultaneous test (wald test) and partial test. the  $\text{prob} > \chi^2$  value in the wald test is 0,000 which is smaller than  $\alpha$  of 0,01, meaning that GRDP per capita, poverty, literacy, sanitation, and HDI jointly affect the prevalence of stunting. The partial test value of each variable gives similar results. log GRDP per capita, poverty, literacy, sanitation, and HDI variables have a significance value below 0,05 so that these variables are partially significant to the prevalence of stunting.

The model specification test consists of three types, namely consistency test (Arellano-bond test), instrument validity test (sargan test), and unbiased test. The consistency test results in the study were seen in the p-value  $m_1$  of 0,504 and the p-value  $m_2$  of 0,071. The model estimation results are declared consistent if the p-value  $m_1$  is significant and the p-value  $m_2$  is not significant at  $\alpha < 0,05$ .

However, according to (Mileva, 2007) testing on  $m_2$  is more important because this order can recognize autocorrelation at the unit level, meaning that the model estimation results in table 1 are consistent and there is no autocorrelation. The sargan test results give a p-value of 0,705  $> 0,05$ . The higher the probability value in the sargan test, the more valid the instrument being tested (Mileva, 2007). This means that the instrument variables in this estimation result are valid or the instrument

variables are not correlated with errors and over-identifying restrictions are valid.

Finally, the unbiased test is conducted by comparing the lag coefficient value of the sys-GMM estimate with the lag coefficient value of the fixed effect and pooled least square where the values of the lag coefficient of the sys-GMM, fixed effect and pooled least square estimates are 0.069; 0.068; and 0.912 because the lag coefficient value of the sys-GMM estimate is between the fixed effect and pooled least square values, the estimation results are unbiased.

Based on the statistical test results, the p-value of the stunting lag is significantly less than 1%. This means that if there is an increase in the prevalence of stunting in other provinces in the previous period or year by 1%, it will be responded by other provinces by reducing the prevalence of stunting in the next period by 0,069%.

The dynamism of this data is supported by the existence of spatial dependence between regions through the stunting weighting variable on the dependent variable, namely stunting prevalence. The stunting weighting variable in this study is used to see the spatial effects between regions in Indonesia which are thought to influence the prevalence of stunting in 34 provinces from 2018-2022. It can be seen in table 1 that the p-value of the stunting weighting variable is 0,000 or smaller than 0,05.

The statistical test results show that the elasticity coefficient of GRDP per capita in the short term is 2,671 with a probability of 0,000  $< 0,01$ . Meanwhile, the elasticity coefficient of GRDP per capita in the long term is 2,551 with a probability of 0,000  $< 0,01$ . This means that every GRDP per capita increases by 1%, the elasticity of the increase in stunting prevalence is 2,671% in the short term and 2,551% in the long term,

assuming other variables are constant. The statistical test results of the GRDP per capita variable in this study have a positive effect on the prevalence of stunting consistently both in the short and long term, this is different from what is expected that the GRDP per capita variable has a negative effect on the prevalence of stunting in the short and long term.

These results are supported by research (Septiani et al., 2023) which states that economic growth proxied by GRDP has a positive effect on the prevalence of stunting in 34 provinces in Indonesia. (Harttgen et al., 2013) stated that GDP per capita has a positive influence on the prevalence of stunting in 28 sub-saharan African countries.

The statistical test results show that the elasticity coefficient of the poverty variable in the short term is 0.703 with a probability of  $0,000 < 0,01$ . Meanwhile, the elasticity coefficient of the poverty variable in the long term is 0,638 with a probability of  $0,000 < 0,01$ . This means that for every 1% increase in poverty, the elasticity of the increase in stunting prevalence is 0,703% in the short term and 0,638% in the long term, assuming other variables are constant.

The poverty variable has a positive influence on the decline in stunting prevalence. Karyati & Julia, (2021) in their research stated the same thing that the number of poor people has a positive and significant relationship with the prevalence of stunting in Indonesia. Poverty is one of the causes of stunting in the 10 research areas, economic limitations make people unable to meet the needs of balanced nutrition for toddlers.

Vatsa et al. (2023) stated that poverty has an indirect effect on household nutritional status. Even Saleh et al. (2021) in their research stated that the indirect effect between poverty

and stunting is at a significance of less than 10%. Poverty that results in food insecurity in the long term will have an impact on the health of children under five because in the age range of the first 5 years of life is a golden period to achieve optimal physical and mental development (Vatsa et al., 2023). In fact, according to Joulaei et al. (2021), some of the fundamental causes of malnutrition are the ignorant attitude of the community towards the fulfillment of human rights, the behavior of prolonging poverty and easy access to resources.

Meanwhile, the variables of literacy, sanitation and human development index have a significant negative effect on reducing the prevalence of stunting both in the short and long term. The statistical test results of the literacy variable show that the short-term elasticity coefficient value is -0,703 with a probability of  $0,000 < 0,01$ .

Meanwhile, the elasticity coefficient of the literacy variable in the long term is -0,768 with a probability of  $0,000 < 0,01$ . This means that for every 1% increase in literacy, the elasticity of the decrease in stunting prevalence is 0,703% in the short term and 0,768% in the long term, assuming other variables are constant.

Some previous studies that are in line with these results include research conducted by Meshram et al., (2014); Tariq et al., (2023); Usman & Kopczewska, (2022) stated that the influence of parental literacy, especially mothers, can reduce the prevalence of stunting in children under 5 years of age. Maternal literacy is more able to reduce the prevalence of stunted toddlers compared to paternal literacy (Khan et al., 2022). the number of stunted toddlers will decrease when the number of women's literacy and their acceptance of mass media increases (Usman & Kopczewska, 2022). One way to

reduce stunting is to implement maternal nutrition literacy interventions (Sirajuddin et al., 2021). Limited health knowledge in mothers is one of the indirect impacts of stunting in toddlers (Siswati et al., 2021).

The statistical test results of the sanitation variable show that the short-term elasticity coefficient value is -0,378 with a probability of  $0,000 < 0,01$ . Meanwhile, the elasticity coefficient of the sanitation variable in the long term is -0,444 with a probability of  $0,000 < 0,01$ . This means that for every 1% increase in sanitation, the elasticity of the decrease in stunting prevalence is 0,378% in the short term and 0,444% in the long term, assuming other variables are constant.

Research conducted in Papua and West Papua provinces, where the variable percentage of households accessing proper sanitation has a significant negative effect on the prevalence of stunting (Astuti, 2022). Based on these results, the provinces of Papua and West Papua need to increase the number of households that have access to proper sanitation in order to reduce the prevalence of stunting in accordance with the target of at least 20%.

Similarly, research by Priatmadani et al. (2023) showed that proper sanitation variables have a significant negative effect on the incidence of stunting in Indonesia. Research conducted with this spatial model approach added that there is a significant positive effect on the percentage of stunting between adjacent provinces.

Likewise, research conducted by Maliga et al. (2022) who conducted research in the West Nusa Tenggara region stated that there was a significant influence between sanitation risk and the incidence of stunting where access to healthy toilets and clean water sources that meet

Health requirements are risk factors for growth delays.

Table 1. Sys-GMM estimation result

Variable	coef/short-term effect	P-Value	Long-term effect
Lag stunting	0,069	0,014	-
weight stunting	0,727	0,000	-
Log GRDP per capita	2,617	0,000	2,551
Poverty	0,703	0,000	0,638
Literacy	-0,703	0,000	-0,768
Sanitation	-0,378	0,000	-0,444
HDI	-0,428	0,034	-0,493
Cons	51,913	0,002	
<b>Wald Test</b>			
Wald chi2 (7)		0,000	
<b>Fix Effect</b>			
Lag stunting	0,068	0,447	
<b>PLS</b>			
Lag stunting	0,912	0,000	
<b>AB test</b>			
m <sub>1</sub>		0,504	
m <sub>2</sub>		0,071	
<b>Sargan test</b>			
Chi2 (23)		0,705	

Source: processing data, 2024

The results of the HDI variable statistical test show that the short-term elasticity coefficient is -0,428 with a probability of  $0,034 < 0,05$ . Meanwhile, the elasticity coefficient of the sanitation variable in the long term is -0,493 with a probability of  $0,010 < 0,05$ . This means that for every 1% increase in HDI, the elasticity of the decrease in stunting prevalence is 0,428% in the short term and 0,493% in the long term, assuming other variables are constant. In line

with the research of Septiani et al., (2023), Anam & Saputra, (2021) and Ssentongo et al., (2021) where the human development index has a negative influence on the prevalence of stunting. Likewise, research by Joulaei et al., (2021); Vatsa et al., (2023) states that regions with a high number of stunted toddlers have a low HDI value.

The three dimensions that make up the human development index are longevity and healthy living, knowledge, and decent living standards. stunting itself in the HDI is reflected in the longevity and healthy living dimension related to the health sector and the knowledge dimension which is described in the expected number of years of schooling and average years of schooling (Suryana & Azis, 2023).

## CONCLUSION

According to the results of spatial dynamic panel data analysis with the sys-GMM estimator, all variables have a significant effect on the prevalence of stunting in 34 Indonesian provinces consistently both in the short and long term. The variables of GDP per capita and poverty have a positive significant effect while the variables of literacy, sanitation and HDI have a negative significant effect.

Although the effect of GRDP per capita on stunting is weak, if followed by low poverty, increasing literacy spirit, awareness of the importance of sanitation and the continued growth of Indonesia's human development index, it is hoped that every household can meet the nutritional needs of toddlers, public knowledge, especially parents related to the fulfillment of nutritious food for toddlers will also increase, as well as awareness of proper sanitation of the housing environment so as to provide a healthy living environment for

toddlers and the realization of optimal public health status in order to achieve the goal of development, namely creating a decent quality of life for the community, including being healthy, being able to enjoy a long life, and running a productive life.

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