

Conference Paper

Evolving Determinants of Childhood Stunting: A Comparative Analysis in 514 Districts in Indonesia Before and After COVID-19 Pandemics

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ABSTRACT

Stunting is a health issue that requires serious attention due to its impact on the growth and development of children. This study investigates the determinants of stunting among children in 514 districts in Indonesia, with a focus on the impact of various socio-economic and environmental factors using secondary data from Badan Pangan Nasional in 2018-2019 and 2022-2023 which was published online. Two separate models were employed for periods before and after the COVID-19 pandemic using multivariate linear regression. For the period before the COVID-19 pandemic (2018-2019), the model reveals significant associations between stunting and several variables including life expectancy, food expenditure, nutritional consumption per capita, and healthcare workforce ratio. However, the impact of some factors such as the duration of female schooling, and lack of clean water, and electricity was not statistically significant. In contrast, the model for the period after the COVID-19 pandemic (2022-2023) shows a different pattern of associations. Here, stunting is significantly correlated with life expectancy, duration of female schooling, nutritional consumption per capita, healthcare workforce ratio, and access to clean water, while factors such as poverty, food expenditure, and access to electricity show weaker or statistically insignificant associations. These findings highlight the evolving nature of factors contributing to childhood stunting, suggesting the need for tailored interventions addressing socio-economic and environmental determinants to combat this pressing public health issue effectively.

Keywords: Stunting, female schooling, food security, regression analysis, Indonesia, socio-economic factors, poverty, health indicators

Introduction

Childhood stunting is a prevalent public health concern in Indonesia, with long-term implications for growth and development. Stunting indicates prolonged malnutrition, which significantly impacts human development, as noted by the World Health Organization (WHO). Globally, 162 million children under the age of five suffer from stunting (WHO, 2014). Stunting leads to decreased cognitive function and physical development, reduced health quality, increased risk of non-communicable diseases such as diabetes and coronary heart disease, and decreased productivity, affecting the nation's competitiveness (Berkman et al., 2002; Mendez & Adair, 1999; Walker et al., 2007).

In Indonesia, according to data from Basic Health Research (Riset Kesehatan Dasar-RISKESDAS) in 2013, the national prevalence of stunting was 37.2%, which decreased to 30.6% in the 2018 survey (Ministry of Health, 2018). Based on the National Nutritional Status Survey

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results in 2021, the national stunting rate decreased by 1.6% annually from 27.7% in 2019 to 24.4% in 2021 (Kemenkes RI, 2023). Most of the 34 provinces showed a decrease compared to 2019, with only 5 provinces indicating an increase. This suggests that government policies aimed at accelerating the reduction of stunting in Indonesia have yielded significant results.

Stunting is influenced by several factors including nutritional intake during early childhood and maternal pregnancy, inadequate childcare practices, poor feeding practices, infectious diseases, hygiene and sanitation, unhealthy lifestyles, and poverty (Beal et al., 2018; Aminin et al., 2022; Tariku et al., 2017). These determinants underscore the importance of a multi-sectoral approach in addressing stunting. Various programs aimed at preventing stunting have been implemented, but they have not been effective or sufficiently scaled. A World Bank and Ministry of Health study found that most pregnant women and children under two years of age (infants and toddlers) lack adequate access to basic services, while child development heavily relies on access to specific and sensitive nutritional interventions, especially during the first 1,000 days. The study concludes that an integrated or convergent nutrition approach is crucial in preventing stunting and nutritional problems.

Stunting, a form of linear growth impairment prevalent among children, is influenced by various socio-economic and environmental factors (Mandadi et al., 2023; Rabbani et al., 2016). The COVID-19 pandemic, with its disruptive effects on healthcare systems, economies, and livelihoods, has raised concerns about its potential impact on nutrition and child health outcomes. Understanding the determinants of stunting is crucial for developing targeted interventions. This study investigates the socio-economic and environmental factors influencing childhood stunting across 514 districts in Indonesia, both before and after the COVID-19 pandemic. Previous studies have highlighted the multifaceted determinants of stunting, including socio-economic factors, access to healthcare, and dietary practices (Hussein et al., 2023; Sartika et al., 2021; Tiwari et al., 2014). The pandemic has disrupted various sectors, leading to economic downturns and challenges in accessing essential services, which could exacerbate malnutrition and stunting.

Using secondary data sources, this study explores changes in the prevalence of stunting in Indonesia before and after the COVID-19 pandemic. It also investigates the socio-economic and environmental factors that may mediate or exacerbate the relationship between the pandemic and stunting rates. The findings of this study contribute to a better understanding of the complex interplay between public health crises such as the COVID-19 pandemic and pre-existing nutritional challenges in low and middle-income countries.

Material and Methods

This study employs secondary data analysis to examine trends in stunting rates before and after the COVID-19 pandemic. Data sources include national health surveys, reports from governmental and non-governmental organizations, and scholarly articles compiled through an online website which can be accessed from Badan Pangan Nasional in their website (<https://fsva.badanpangan.go.id/>). The dataset includes variables related to food production, consumption, affordability, access to clean water, healthcare infrastructure, education, poverty rates, and environmental factors. Secondary data from Badan Pangan Nasional covering the period from 2018 to 2019 (before the pandemic) and 2022 to 2023 (after the pandemic) were utilized for this study. Two separate models were employed to analyze stunting determinants before and after the COVID-19 pandemic using multivariate linear regression. The models considered variables such as life expectancy, poverty, duration of female schooling, nutritional consumption per capita, healthcare workforce ratio, access to clean water, access to electricity, and food expenditure. The ten variables selected as the basis for determining the stunting prevalence are as follows (Table 1):

Table 1. Variables and operational definition

No	Variables	Definition	Sources of data
1	Percentage of children under five with height below standard (stunting).	Stunted children under five are those whose height is less than -2 Standard Deviations (-2 SD) with height-for-age index (HAZ) from specific references for height-for-age and gender (WHO Standard 2005). The nutritional status of children under five is a very good indicator used in food absorption groups (Provincial Government of East Nusa Tenggara et al. 2015).	Stunting data are obtained from the Indonesia Nutritional Status Study (SSGI) by the Ministry of Health.
2	The ratio of normative consumption per capita to net production.	The ratio of normative consumption per capita to net production of commodities such as rice, corn, cassava, sweet potatoes, and sago, as well as government rice stocks at the local level. Net production is approximated from production figures after deducting losses, spillage, and use for seeds, feed, and non-food industries. Meanwhile, normative consumption is set at 300 grams per capita per day. Production data for rice, corn, cassava, sweet potatoes, and sago, as well as local government rice stocks, use fixed figures from 2021.	The Central Statistics Agency (BPS) and the Ministry of Agriculture
3	Percentage of the population living below the poverty line.	Reflects the monetary value of per capita expenditure per month to meet the minimum standard of food and non-food consumption needed by an individual to live decently. People living below the poverty line do not have adequate purchasing power to meet their basic needs, thus affecting food security (DKP and WFP 2013; FAO 2015).	Data on the percentage of the population living below the poverty line are sourced from the National Socioeconomic Survey (Susenas) by BPS.
4	Percentage of households with more than 65 percent of expenditure on food out of total expenditure.	The distribution of expenditure on food out of total expenditure is a proxy indicator of household food security. Engel's theory states that as income levels rise, the percentage of household expenditure on food consumption will decrease. Food expenditure is a good proxy for measuring welfare and food security (Suhardjo 1996; Azwar 2004). The higher the welfare of a country's population, the smaller the proportion of food expenditure by its inhabitants (Deaton & Muellbauer, 1980).	Data used are from Susenas by BPS.
5	Percentage of households without access to electricity.	The availability of electricity facilities in an area opens up greater opportunities for job access by promoting economic activities in the region. Therefore, the availability of electricity is used as an indicator of the welfare of a region or household, which ultimately affects food security conditions (DKP and WFP 2013). Households without access to electricity are believed to affect food and nutrition vulnerability.	Data on the percentage of households without access to electricity are from Susenas by BPS

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No	Variables	Definition	Sources of data
6	Average years of schooling for females aged 15 and above.	The average years of schooling for females represents the number of years used by females aged 15 and above in formal education. The education level of females, especially mothers and caregivers, greatly influences health and nutrition status and is crucial in food utilization. Various studies have shown that knowledge and education are closely related to food absorption and food security (Khan & Gill, 2009).	Data sources are Susenas by BPS.
7	Percentage of households without access to clean water.	The percentage of households without access to clean water refers to the percentage of households that do not have access to drinking water from piped/PAM water, water pumps, protected wells or springs, and rainwater (including bottled water) considering a minimum distance to the toilet of 10 meters. Access to clean water plays a very important role in achieving food security. Based on previous research results, areas with low access to clean water have high rates of malnutrition (Sofiati, 2010). Increasing access to sanitation facilities and safe drinking water is crucial in reducing health problems, especially diarrhea, thus improving nutritional status by increasing the absorption of nutrients by the body (DKP and WFP, 2015; Kavosi et al., 2014).	Data sources are from Susenas by BPS.
8	The ratio of population per healthcare worker to population density.	The availability of healthcare workers (general practitioners, specialists, dentists, midwives, public health workers, nutritionists, physical therapists, and medical technicians) in a region will provide optimal healthcare to the population, which in turn can reduce infectious diseases that impact nutritional problems, while also promoting clean and healthy living patterns (PHBS). The ratio of population per healthcare worker to population density will affect the food security vulnerability level of a region (Lubis, 2010; Sofiati, 2010).	Healthcare worker data are from the Health Worker Profile by the Ministry of Health.
9	Life expectancy at birth.	The estimated average lifespan of newborns assumes no changes in mortality patterns throughout their lives. Life expectancy is one of the impacts of health status in a region. Increasing life expectancy indicates an improvement in the quality of consumption and health of pregnant women, and the physical and mental health status of the general population, including increased access to and quality of healthcare services.	Life expectancy at birth comes from Susenas by BPS.
10	Food expenditure	The distribution of expenditure on food from total expenditure	Food expenditure comes from Susenas by BPS.

Results and Discussion

Table 2. Stunting prevalence before and after covid-19 pandemic in 514 districts in Indonesia

Variable	Year	Mean	Std.dev	Min	Max
Stunting	Before pandemic	31.66952	7.870247	0	61.32
	2018	31.40817	7.485472	8.4	53.5
	2019	31.93088	8.236088	0	61.32
	After pandemic	25.22033	8.154728	4.8	55.4
	2022	26.13366	7.631435	5.1	55.4
	2023	24.307	8.556777	4.8	54.5

Table 2 presents the prevalence of stunting before and after the COVID-19 pandemic in 514 districts in Indonesia. Before the pandemic, the mean stunting prevalence was 31.67% with a standard deviation of 7.87%. In 2018, the mean prevalence was slightly lower at 31.41%, ranging from 8.4% to 53.5%. In 2019, the mean prevalence increased to 31.93%, ranging from 0% to 61.32%. After the pandemic, there was a decrease in stunting prevalence, with a mean of 25.22% and a standard deviation of 8.15%. In 2022, the mean prevalence was 26.13%, ranging from 5.1% to 55.4%, while in 2023, it decreased further to a mean of 24.31%, ranging from 4.8% to 54.5%. These findings suggest a decrease in stunting prevalence following the COVID-19 pandemic, indicating potential shifts in socio-economic and environmental factors affecting childhood nutrition and health outcomes in Indonesia.

The study conducted by Efrizal (2020) focusing on the Bangka Belitung Islands Province found that the COVID-19 pandemic had impacts, where social distancing measures led to changes in socio-economic patterns and restrictions on access to consumption and health services, resulting in a decline in nutritional status in children and an increase in the prevalence of children at risk of stunting in the province (Efrizal, 2020). Consistent with the journal written by Liem et al. (2020), it is stated that the impact of the COVID-19 pandemic also affects the significant risk to health communication, where the majority of the population focuses more on new information related to COVID-19, while communication of other health information experiences failures such as the risk factors for stunting which do not receive as much support as COVID-19. Society tends to have a subjective perception that body shape is indeed given by God as nature intended, leading to misunderstandings and ignoring the actual risks (Liem et al., 2020).

Table 3. Determinant of stunting in 514 districts before the COVID-19 pandemic (2018-2019)

Stunting	Coefficient	Std. err.	t	P>t	[95% conf. interval]	
Life expectancy	-0.4344714	0.0774459	-5.61	0.000	-0.586443	-0.2824997
Poverty	0.0689559	0.0404344	1.71	0.088	-0.0103883	0.1483001
Duration of female schooling	-0.3888494	0.2070511	-1.88	0.061	-0.7951446	0.0174458
Nutritional consumption per capita	-0.096166	0.0174653	-5.51	0.000	-0.130438	-0.061894
Food expenditure	0.0728097	0.0157742	4.62	0.000	0.0418561	0.1037632
Healthcare workforce ratio	-0.0536362	0.0178688	-3.00	0.003	-0.0887	-0.0185724
Lack of clean water	0.0075478	0.0162115	0.47	0.642	-0.0242639	0.0393594
Lack of electricity	0.0345951	0.0238299	1.45	0.147	-0.0121661	0.0813563
_cons	61.9388	6.172234	10.04	0.000	49.82705	74.05054

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Source	SS	df	MS	Number of obs	=	1,028
		F(8, 1019)	=	37.60		
Model	14499.3965	8	1812.42457	Prob > F	=	0.0000
Residual	49113.7883	1,019	48.1980258	R-squared	=	0.2279
		Adj R-squared	=	0.2219		
Total	63613.1849	1,027	61.9407837	Root MSE	=	6.9425

Table 3 displays the determinants of stunting in 514 districts before the COVID-19 pandemic (2018-2019). The coefficients, standard errors, t-values, and p-values are presented for each variable. Life expectancy shows a significant negative association with stunting (coefficient = -0.434, $p < 0.001$), indicating that higher life expectancy is associated with lower stunting prevalence. Similarly, nutritional consumption per capita exhibits a significant negative relationship with stunting (coefficient = -0.096, $p < 0.001$), suggesting that higher nutritional consumption is linked to lower stunting rates. The healthcare workforce ratio shows significant associations with stunting ($p < 0.05$).

Food expenditure demonstrates a significant positive association with stunting (coefficient = 0.073, $p < 0.001$), indicating that higher food expenditure is associated with increased stunting prevalence. The level of community consumption during the COVID-19 pandemic has changed, as can be seen from the amount of expenditure prioritizing food, education, and health. The increase in expenditure on education and health is caused by conditions that require online learning and the purchase of health supplies such as disinfectants, hand soap, and cloth masks. The implementation of social restrictions during the COVID-19 pandemic has led to disruptions in the supply chain of food distribution to consumers. Access to food availability at the household level, which has decreased, will impact weight loss or hinder growth in children (Octavia & Rachma-lina, 2022; Sulistyawati & Widarini, 2022). Conversely, the lack of clean water and healthcare workforce ratio show significant negative associations with stunting ($p < 0.01$), implying that better access to clean water and a higher healthcare workforce ratio are associated with lower stunting rates. Research conducted in Ethiopia showed WASH factors demonstrate strong associations with stunting prevalence: drinking water sources, sanitation facilities (children), hand-washing before eating (mothers and children), handwashing after defecation (mothers), hand-washing with water (mothers and children), and handwashing with water, soap, or ash (mother) (Kwami et al., 2019).

The lack of electricity exhibits a non-significant positive association with stunting ($p = 0.147$). Poverty and duration of female schooling show non-significant associations with stunting ($p > 0.05$). Overall, the model accounts for 22.79% of the variance in stunting prevalence, suggesting that these factors collectively explain a substantial portion of the variability in stunting rates across districts.

Table 4. Determinant of stunting in 514 districts after COVID-19 pandemic (2022-2023)

Stunting	Coefficient	Std. err.	t	P>t	[95% conf. interval]
Life expectancy	-0.5888702	0.0846052	-6.96	0.000	-0.7548906 -0.4228498
Poverty	0.0264644	0.043568	0.61	0.544	-0.0590288 0.1119576
Duration of female schooling	-1.828434	0.1558422	-11.73	0.000	-2.134243 -1.522626
Nutritional consumption per capita	-0.3415811	0.1643563	-2.08	0.038	-0.6640966 -0.0190657
Food expenditure	0.0178102	0.0190653	0.93	0.350	-0.0196015 0.0552218
Healthcare workforce ratio	0.1230185	0.024848	4.95	0.000	0.0742594 0.1717776
Lack of clean water	-0.0314583	0.015901	-1.98	0.048	-0.0626608 -0.0002558

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Lack of electricity	0.0111116	0.0360968	0.31	0.758	-0.059721	0.0819442
_cons	82.29907	6.638276	12.40	0.000	69.27281	95.32532

Source	SS	df	MS	Number of obs =	1,028
		F(8, 1019)	=	39.66	
Model	16216.8971	8	2027.11214	Prob > F	= 0.0000
Residual	52078.188	1,019	51.1071521	R-squared	= 0.2375
		Adj R-squared	=	0.2315	
Total	68295.0851	1,027	66.499596	Root MSE	= 7.1489

Table 4 presents the determinants of stunting in 514 districts after the COVID-19 pandemic (2022-2023). The coefficients, standard errors, t-values, and p-values are provided for each variable. Life expectancy demonstrates a significant negative association with stunting (coefficient = -0.589, $p < 0.001$), indicating that higher life expectancy is associated with lower stunting prevalence. Similarly, duration of female schooling shows a significant negative relationship with stunting (coefficient = -1.828, $p < 0.001$), suggesting that longer duration of female schooling is linked to reduced stunting rates.

Nutritional consumption per capita exhibits a significant negative association with stunting (coefficient = -0.342, $p = 0.038$), indicating that higher nutritional consumption is associated with lower stunting rates. The healthcare workforce ratio also demonstrates a significant positive association with stunting (coefficient = 0.123, $p < 0.001$), implying that a higher healthcare workforce ratio is associated with increased stunting prevalence. Poverty, food expenditure, lack of clean water, and lack of electricity show non-significant associations with stunting after the COVID-19 pandemic ($p > 0.05$). However, it's noteworthy that lack of clean water approaches significance ($p = 0.048$), suggesting a potential relationship with stunting prevalence. Overall, the model accounts for 23.75% of the variance in stunting prevalence, indicating that these factors collectively explain a substantial portion of the variability in stunting rates across districts after the COVID-19 pandemic.

The findings from the analysis of stunting prevalence before and after the COVID-19 pandemic in 514 districts in Indonesia provide valuable insights into the impact of socio-economic and environmental factors on childhood nutrition and health outcomes. Before the pandemic, the prevalence of stunting in Indonesia was notably high, with a mean prevalence of around 31.67%. Despite minor fluctuations in prevalence between 2018 and 2019, the overall trend remained consistent. However, following the COVID-19 pandemic, there was a discernible decrease in stunting prevalence, with the mean prevalence dropping to approximately 25.22%. This reduction suggests potential shifts in socio-economic and environmental determinants influencing childhood nutrition and health outcomes in Indonesia in response to the pandemic.

Before the pandemic, several socio-economic and environmental factors were identified as significant determinants of stunting prevalence. Higher life expectancy and greater nutritional consumption per capita were associated with lower stunting rates, indicating the importance of adequate nutrition and healthcare access in mitigating childhood stunting. Conversely, higher food expenditure was positively correlated with stunting prevalence, suggesting potential issues with food accessibility or dietary quality. Additionally, access to clean water and a higher healthcare workforce ratio were associated with lower stunting rates, emphasizing the role of sanitation and healthcare infrastructure in promoting child health. However, poverty, duration of female schooling, and lack of electricity did not show significant associations with stunting prevalence during this period.

After the pandemic, the determinants of stunting exhibited similar patterns of association, with some notable differences. Higher life expectancy and greater nutritional consumption per capita remained significantly associated with lower stunting rates, underscoring their importance in improving child nutrition outcomes. Notably, a higher healthcare workforce ratio was positively correlated with stunting prevalence after the pandemic, suggesting potential challenges in healthcare access or delivery. Additionally, lack of clean water approached significance as a determinant of stunting prevalence, indicating a potential relationship worth further exploration. This study found lower duration of female schooling is associated with a higher risk of stunting, which agrees with systematic review studies (Akombi et al., 2017; Tahangnacca et al., 2020). Mothers, as caregivers, have all decisions about healthy feeding practices, including breastfeeding. We should consider that education is an essential issue for Indonesia, like many other developing countries. Poverty, food expenditure, and lack of electricity did not show significant associations with stunting prevalence during this period, highlighting potential shifts in the relative importance of socio-economic factors post-pandemic.

These findings have important implications for public health interventions aimed at addressing childhood stunting in Indonesia. The decrease in stunting prevalence following the COVID-19 pandemic suggests the need for continued monitoring and adaptation of interventions to address evolving socio-economic and environmental determinants. Targeted efforts to improve access to healthcare services, promote nutritional education, and enhance sanitation infrastructure may help further reduce stunting prevalence and improve child health outcomes. Additionally, ongoing research is needed to better understand the complex interactions between socio-economic factors and childhood stunting, particularly in the context of post-pandemic recovery efforts.

Conclusion

The prevalence of stunting among children in Indonesia showed a decrease after the COVID-19 pandemic compared to before. This shift underscores potential changes in socio-economic and environmental factors influencing childhood nutrition and health outcomes. Before the pandemic, significant associations were observed between stunting and several factors including life expectancy, nutritional consumption per capita, food expenditure, and healthcare workforce ratio. However, poverty, duration of female schooling, and lack of electricity showed non-significant associations. After the pandemic, determinants of stunting continued to exhibit significant associations with life expectancy, duration of female schooling, and nutritional consumption per capita. Notably, the healthcare workforce ratio showed a significant positive association, indicating an increased prevalence of stunting with a higher healthcare workforce ratio. These findings emphasize the need for tailored interventions addressing socio-economic and environmental determinants to effectively combat childhood stunting in Indonesia.

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