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Determinants of trends in stunting prevalence in Indonesia: An ecological study (2019–2022)

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Abstract

Stunting is a significant health concern that contributes to economic burden and increases the risk of future diseases. The government has been tackling stunting through sensitive and specific interventions. However, until now, the stunting prevalence in Indonesia remains relatively high (>20%), indicating a need for a deeper understanding of the determinants that influence the trend of stunting, so that they can provide more effective and sustainable policy recommendations and prevention programs. This research aims to investigate the determinants that influence the trends of stunting in Indonesia. This research employs an ecological study design, utilizing secondary data from the Health Research and Development Agency, the Ministry of Health of the Republic of Indonesia, the Ministry of Social Affairs, and Statistics Indonesia for 2019, 2021, and 2022. Multiple linear regression analysis was performed to identify the factors associated with the trend of stunting. The results indicate that diarrhea (r= -0.719, p<0.001), exclusive breastfeeding (r= -0.963, p<0.001), and postpartum family planning (r= -0.097, p=0.002) were negatively correlated with the trend of stunting. Conversely, female-headed households (r= 0.368, p= 0.011), food expenditure (r= 2.156, p<0.001), and supplementary feeding for pregnant women CED (r= 0.269, p=0.005) showed positive associations. This regression model indicates that these factors significantly influence 75.9% of the trend in stunting (Adjusted R^2=0.759). Improving exclusive breastfeeding practices, preventing diarrhea, and promoting postpartum family planning are effective strategies to reduce stunting prevalence. In addition, special attention to female-headed households and nutrition intervention efforts for pregnant women has a positive impact on reducing stunting.

Keywords: Determinants; Ecological study; Indonesia; Trend of stunting

1. Introduction

Stunting is a significant public health issue impacting millions of children globally. In 2022, approximately 148.1 million children under five (22.3%) of the global population were stunted [1]. This condition is defined by a height that is below the expected standard for a specific age [2]. Stunting not only hinders children's physical growth but also reduces cognitive abilities, decreases economic productivity, and increases the risk of non-communicable diseases in adulthood [3].

In Indonesia, the 2022 Indonesian Nutrition Status Study (SSGI) reported a decrease in the national stunting prevalence from 31% in 2018 to 21.6% in 2022. Although there has been a consistent decline, the stunting prevalence remains relatively high and continues to be a significant health issue in Indonesia. Furthermore, there is still a considerable disparity in stunting rates among different provinces, which contributes to the overall high prevalence of stunting across the country [4]. This achievement is still significantly below the national target, which aims to lower stunting prevalence to 14% by 2024, making preventing stunting a top priority in the national health development agenda, and is crucial for achieving the Sustainable Development Goals (SDGs) [5].

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Problem stunting is influenced by various factors that can be categorized as drivers and inhibitors. The drivers of stunting arise from multidimensional interactions, which include health conditions, access to healthcare facilities, and socioeconomic factors such as poverty and low levels of education [6].

Factors that inhibit stunting include specific and sensitive interventions. According to Presidential Regulation No. 72 of 2021, the Indonesian government has implemented nutrition interventions aimed at vulnerable groups to prevent and address stunting [7]. Studies in Yogyakarta show that convergent interventions can reduce the stunting prevalence by 2.06% per year [8].

So far, there has been limited comprehensive analysis of the factors affecting the trend of stunting at the provincial level using longitudinal data. Furthermore, integrated multivariate analyses encompassing nutritional, infectious, environmental, healthcare access, socioeconomic factors, and multisectoral interventions using recent national survey data are lacking. This reseach aims to identify and analyze the determinants influencing the trend in stunting prevalence in Indonesia and provide evidence-based recommendations for formulating policies and programs for the sustainable prevention of stunting

2. Material and methods

This research is an ecological study that utilizes secondary data obtained from official public sources available for online download. The data is sourced from the Ministry of Health of the Republic of Indonesia, the Health Research and Development Agency, the Ministry of Social Affairs, and Statistics Indonesia. The population consists of 34 provinces in Indonesia and includes data from three years: 2019, 2021, and 2022, providing a thorough analysis based on data availability and completeness.

The research variable identified several critical factors associated with the trend of stunting, including risk factors and interventions. These factors are a history of diarrhea, basic health facilities, poverty rate, female-headed households, mean years of schooling, food expenditure, iron supplements for pregnant women, supplementary feeding for pregnant women with chronic energy deficiency (CED), exclusive breastfeeding, postpartum family planning, health insurance, and non-cash food assistance.

Pearson and Spearman tests were used to assess the correlation between risk factors and stunting prevalence in each variable group. Variables with a $p<0.25$ were included in a backward double linear regression test to examine the determinants of trends in stunting prevalence in Indonesia. Before performing regression analysis, it is essential to meet several classical assumptions, including normality, multicollinearity, heteroscedasticity, and autocorrelation tests. Significance was determined at $p \leq 0.05$. The general equation used for the multivariate linear regression analyses is provided below

$$Y=\beta o+\beta 1X1+\beta 2X2+\beta 3X3+....+\beta 12X12$$

where Y:Trend of stunting; βo:Slope; β1- βn : Regression coefficient; X1 : History of diarrhea; X2 : Basic health facilities; X3 : Poverty rate; X4 : Female-headed households; X5 : Mean years school X6 : Food expenditures; X7 : Iron supplements for pregnant women; X8 : Supplementary feeding of pregnant women with CED; X9: Exclusive breastfeeding; X10 : Postpartum family planning; X11 : Health insurance; X12 : Non-cash food assistance.

3. Results

3.1. Descriptive Statistics

Table 1 shows characteristics of the research subjects during the 3 years (2019, 2021, and 2022). The stunting prevalence shows a significant downward trend ($\overline{v}$ = -8.91, p = 0.009), with the interquartile range narrowing, indicating that the variation in stunting rates between regions is decreasing. This trend reflects an improvement in the nutritional status of children under five over this period.

Table 1 Characteristics of Research Subjects

Variables	2019 Mean±SD	2021 Mean±SD	2022 Mean±SD	$\bar{v}$ (%)	$p^{\dagger}$
Stunting prevalence	27,96 ± 6,31	25,21 ± 5,63	23,29 ± 6,47	-8,91	0,009*
History of diarrhea	17,38 ± 2,86	15,41 ± 2,37	15,34 ± 2,26	-5,34	0,000*
Access to basic health facilities	75,26 ± 9,87	78,74 ± 10,21	78,83 ± 9,64	2,51	0,043*
Poverty level	10,24 ± 5,52	10,43 ± 5,41	10,29 ± 5,29	1,38	0,959
Female-headed households	14,23 ± 3,50	13,32 ± 2,91	11,95 ± 2,66	-7,82	0,026*
Average years of schooling	8,96 ± 0,84	9,16 ± 0,83	9,25 ± 0,82	1,61	0,355
Food expenditures	49,63 ± 3,80	49,63 ± 4,00	50,91 ± 4,40	1,27	0,126
Iron supplement for pregnant women	78,49 ± 18,78	78,53 ± 16,15	79,55 ± 16,59	2,24	0,751
Supplementary feeding for pregnant women with CED	93,79 ± 6,73	88,73 ± 13,11	91,06 ± 8,58	0,69	0,109
Exclusive breastfeeding	65,07 ± 7,79	68,61 ± 7,84	68,89 ± 7,33	3,13	0,077
Postpartum family planning	40,91 ± 18,81	45,74 ± 18,93	46,05 ± 22,08	10,23	0,495
Health insurance coverage	34,69 ± 12,73	40,36 ± 12,61	42,39 ± 12,79	12,30	0,013*
Non-Cash Food Assistance	6,00 ± 5,75	16,03 ± 7,12	16,62 ± 8,56	168,23	0,000*

However, there are still outliers in certain areas where stunting rates are significantly higher or lower than the national average, and according to the cutoff set by the WHO, The prevalence of stunting in Indonesia remains high (20% to <30%) (Figure 1).

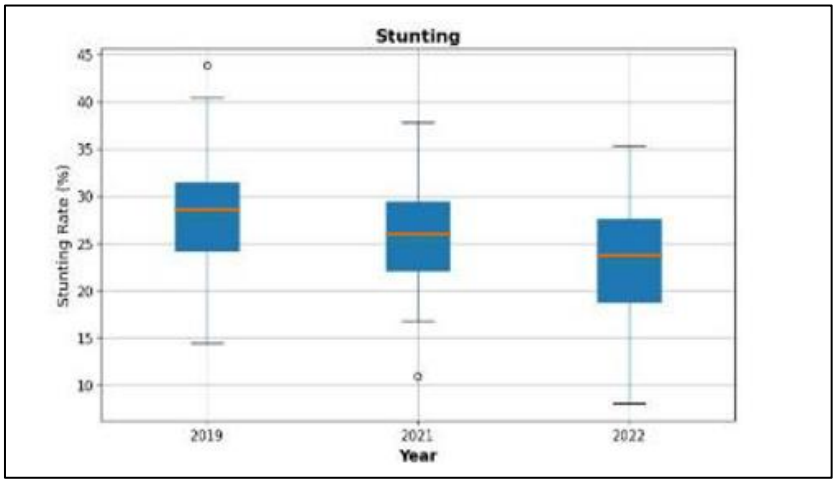

Figure 1 The stunting prevalence among three-year-olds in Indonesia

During this period, a decrease in the history of diarrhea indicates progress in controlling diarrhea, which may positively affect stunting prevalence ($\bar{v}$ = -5.34, p<0.000). Although access to basic health facilities is improving ($\bar{v}$ = 2.51, p=0.043), the data show that access to quality and affordable health services is still uneven in Indonesia. Therefore, it is important to prioritize the improvement of the quality and distribution of health services. The proportion of female-headed households has decreased ($\bar{v}$ = -7.82, p=0.026), indicating a change in family structure and socioeconomic dynamics.

The increased coverage of health insurance interventions ($\bar{v}$ = 12.3, p=0.013) and non-cash food assistance interventions ($\bar{v}$ = 1.68, p<0,001) reflect improved access to health services and food security in the community. While these interventions are crucial for supporting the welfare of vulnerable groups, the average number of recipients remains low. Therefore, efforts must be made to expand the coverage and effectiveness of these programs.

Table 2 indicates that various factors are significantly associated with the incidence of stunting. The history of diarrhea, poverty levels, female-headed households, and food expenditure consistently showed positive correlations with stunting.

Table 2 Analysis of Risk Factors Associated with Stunting

Variables	2019		2021		2022		Rate	
	r	p†	r	p†	r	p†	r	p†
History of diarrhea (x1)	0.220	0.211	0.358	0.038*	0.304	0.080	- 0.491	0.003*
Access to basic health facilities (x2)	-0.163	0.356	-0.340	0.049*	-0.294	0.092	-0,399	0,019*
Poverty level (x3)	0.465	0.006*	0.447	0.008*	0.497	0.003*	-0,147	0,408
Female-headed households (x4)	0.365	0.034*	0.254	0.147	0.223	0.205	.342	0.048*
Average years of schooling (x5)	-0.471	0.005*	-0.404	0.018*	-0.414	0.015*	-0,016	0,929
Food expenditures (x6)	0.526	0.001*	0.575	0.000*	0.392	0.022*	00.317	0.068
Iron supplement for pregnant women (x7)	-0.456	0.007*	-0.648	0.000*	-0.661	0.000*	0,358	0,038*
Supplementary feeding for pregnant women with CED (x8)	-0.346	0.045*	-0.453	0.007*	-0.488	0.003*	0.401	0.019*
Exclusive breastfeeding (x9)	0.076	0.670	0.043	0.811	0.064	0.719	-0.255	0.145
Postpartum family planning (x10)	-0.204	0.246	-0.230	0.190	-0.389	0.023*	-0.394	0.021*
Health insurance (x11)	-0,063	0,122	0,320	0,065	0,273	0,118	-0,432	0,011*
Non-Cash Food Assistance (x12)	0,603	0,723	0,289	0,097	0,128	0,472	0,264	0,132

r = coefficient of correlation; †p-value calculated using Pearson test for parametric variables and Spearman test for nonparametric variables; * p ≤ 0,05

In contrast, the average years of schooling exhibited a significant negative correlation with stunting. Additionally, access to health facilities, supplementary feeding for pregnant women with CED, and health insurance coverage also demonstrated negative correlations during certain years of observation. On the other hand, factors such as exclusive breastfeeding and non-cash food assistance were not found to be significant during the study period.

3.2. Regression Result

Table 3 presents a multivariate analysis showing that the overall influence of factors in the regression model contributes 75.9% of the trend in stunting (R^2 = 0.729). The regression analysis model in this reseach is as follows

$$Y= -8.788 - 0.719x1 + 0.368x4 + 2.156x6 + 0.269x8 - 0.963x9 - 0.097x10$$

The research has identified six key factors significantly associated with the trend of stunting, such as history of diarrhea (x1) (r= -.0.719; p<0.001), proportion of female-headed households (x4) (r= 0.368; p=0.011), percentage of food expenditure (x6) (r= 2.156; p<0.001), percentage of supplementary feeding for pregnant women with CED (x8) (r= 0.269; p=0.005), history of exclusive breastfeeding (x9) (r= -0.963; p<0.001), and percentage of postpartum family planning (x10) (r= -0.097; p=0.002) (Table 3).

Table 3 Multiple Linear Regression Analysis of Determing to the Trend of Stunting

Risk factors	B	t	p†	Adjusted R Square
Intercept	-8.788	-5.600		
Rate of diarrhea history (x1)	-0.719	-5.835	0,000	
Rate of female-headed households (x4)	0.368	2.729	0,011	
Rate of food expenditures (x6)	2.156	6.179	0,000	0.759
Rate of supplementary feeding for pregnant women with CED (x8)	0.269	3.042	0,005	

Rate of exclusive breastfeeding (x9)	-0.963	-4.326	0,000	
Rate of postpartum family planning (x10)	-0.097	-3.402	0,002	

† p-value calculated using Backward multiple linear regression; *p ≤ 0,05

4. Discussion

Stunting prevalence in children under five in Indonesia indicates a consistent decline. Diarrhea is an infectious disease that significantly affects nutritional status and contributes to children's linear growth disorders, especially stunting. Children who experience chronic or recurrent diarrhea are at an increased risk of impaired growth due to the challenges of catch-up growth [9].

This condition inhibits child development by decreasing food intake, impairing nutrient absorption, increasing metabolic requirements, and reducing the secretion of vital growth hormones, such as IGF-1 (Insulin Growth Factor 1), which is essential for proper growth [10]. If diarrhea is not appropriately managed, it can exacerbate nutritional deficiencies and adversely impact growth outcomes.

The high prevalence of diarrhea is linked to inadequate environmental conditions, including inadequate access to clean water and sanitation, and a lack of knowledge regarding hygiene practices. Diarrhea is primarily transmitted through the fecal-oral pathway, which occurs when food or beverages become contaminated with pathogenic bacteria, such as Escherichia coli, or through vectors such as flies [11]. Studies in Sub-Saharan Africa show that moderate to severe diarrhea significantly increases the risk of stunting (aOR=1.3; 95%CI:1.05–1.62) [12]. Furthermore, studies in Ethiopia and Ghana have demonstrated an increased risk of stunting in children who have had diarrhea in the past two weeks or have recurrent diarrhea [13], [14].

However, the research results indicated that for every increase in diarrhea cases among children under five, there was a decrease in stunting incidence of 0.719. Several confounding factors may influence this significant negative correlation, including the coverage of nutritional interventions, improved access to clean water and sanitation, health education, regional characteristics, and consumption patterns during the study period. Despite this, diarrhea remains a critical factor in determining stunting, which highlights the need for effective prevention and treatment measures as part of a comprehensive strategy to decrease stunting rates in children under five.

The gender of the family head significantly influences children's nutrition by affecting decisions on resource allocation, including food and nutrition needs [15]. This research indicated that for every increase in female-headed households, correlates with a 0.368 rise in stunting prevalence. Studies in Uganda and Nigeria show that female-headed households have a greater incidence of stunting than those headed by males [16]–[18].

Households headed by females are generally more vulnerable to food insecurity than those headed by males [19]. This vulnerability is linked to the socioeconomic limitations that female heads of households often experience, such as lower incomes, higher poverty rates, and limited access to basic services [20], [21]. Structural barriers such as gender discrimination in employment, low education levels, inequality in food distribution, and the dual role of being the breadwinner and primary caregiver further increase the risk of stunting in children [22], [23]. This condition is worsened by increased food insecurity and the limited ability of female heads of households to provide adequate nutrition for their children's needs. As a result, children's health and nutritional status suffer, raising the risk of stunting.

Similarly, the development of food expenditure, where every unit increased, increased the trend of stunting by 2.156. Household expenditure is an essential indicator for evaluating families' purchasing power and welfare, directly affecting their access to food, health care, and other basic needs. According to Engel's Law, a high proportion of food expenditure signifies restricted purchasing power and a lower level of food security, especially in households with limited economic means, which can ultimately heighten the risk of stunting [24]. The increase in food expenditure reflects changes in the allocation of household budgets, influenced by factors like income, social assistance, and the socio-economic dynamics across different regions [25].

Low-income households often allocate over 60% of their total expenditure to food consumption [26], which leads them to opt for inexpensive yet nutritionally inadequate food sources. Consequently, the diversity and quality of children's nutritional intake suffer. High food expenditure also reduces the ability of households to fulfill other essential needs crucial for children's growth and development, further heightening the risk of stunting [25]. Structural factors, such as the number of family members, also significantly impact resource distribution. Larger households are particularly at risk of an imbalance in nutritional needs, increasing vulnerability to stunting [27].

The supplementary feeding program is a nutritional intervention designed to address chronic energy deficiency (CED) among pregnant women, which is the main risk factor for stunting [2]. Pregnant women with CED have a higher risk of giving birth to babies with reduced fetal growth and low birth weight, which increases the likelihood of stunting [28].

This program is usually distributed through Posyandu or Puskesmas in the form of fortification biscuits for 90 days, which are specifically formulated to meet the macro, and micronutrient needs essential for preventing fetal growth disorders and reducing stunting risks [29]. Consuming these nutritional supplements regularly for at least 90 days can increase the weight and upper arm circumference of pregnant women by 10-20%30, thus contributing to improving the nutritional status of pregnant women and reducing the risk of complications associated with stunting.

However, this research showed that every increase in supplementary feeding for pregnant women with chronic energy deficiency (CED) is linked to a 0.269 increase in the trend of stunting. A positive correlation between supplementary feeding coverage and an increase in the trend of stunting is suspected to be due to program allocation bias, where regions with a high rate of stunting are given priority for intervention, resulting in contradictory relationships. These findings contrast with other research indicating a significant negative correlation, where increased supplementary feeding coverage was associated with decreased stunting prevalence ($r = -0.57$) [10].

The effectiveness of supplementary feeding depends on program continuity, family involvement, pregnant women's nutritional knowledge, and health worker support31. Implementation challenges, such as uneven distribution, delivery delays, inappropriate targets, low compliance with supplementary feeding consumption, and sharing supplementary feeding with family members, also reduce the program's impact, so efforts to reduce stunting are less effective [30].

Furthermore, this reseach shows that every increase in exclusive breastfeeding coverage is associated with a 0.963 decrease in the trend of stunting prevalence. Breast milk is the primary source of nutrition recommended for infants during the first six months to support their optimal growth and development. A primary factor contributing to stunting is inadequate exclusive breastfeeding. Children who are exclusively breastfed have a reduced risk of stunting by 20% to 50%33. Studies conducted in Ghana and Tanzania indicate that children who are not exclusively breastfed have a higher risk of stunting[14], [31]. Breast milk contains colostrum, immunoglobulins, and nutrients that increase the baby's immunity [32].

Early cessation of breastfeeding or introducing complementary foods before six months increases the risk of infection and growth disorders. Studies in Ethiopia and Mexico indicate that early weaning and complementary foods before six months of age significantly increase the risk of stunting [33]–[35].

Several factors influence exclusive breastfeeding, including maternal education, family support, and the socio-cultural environment39. Low rates of exclusive breastfeeding can be attributed to insufficient milk production, difficulties infants face while breastfeeding, maternal employment outside the home, and the impact of formula milk advertising. Additionally, a mother's knowledge and socio-cultural support significantly contribute to the effective practice of exclusive breastfeeding [36].

Finally, this reseach shows that every increase in postpartum family planning use is associated with a 0.097 decrease in the trend of stunting prevalence. Postpartum birth control has an important role in optimal pregnancy management and strengthening family nutritional status. This strategy effectively regulates birth spacing to prevent high-risk pregnancies and improve maternal and child health [37].

The increased use of postpartum contraceptives reflects the success of reproductive health interventions that have the potential to reduce stunting prevalence through pregnancy management and improvement of maternal and child nutritional status [38]. Short birth intervals (< 24 months) are associated with a higher risk of malnutrition in mothers due to inadequate recovery time, as well as contribute to increasing the risk of intrauterine growth restriction (IUGR), low birth weight, prematurity, and malnutrition in infants, which can ultimately lead to stunting [39], [40]. Families with closely spaced births often encounter difficulties in distributing attention, resources, and access to food and health services, which negatively impacts the development and growth of children [41].

In addition, postpartum birth control also plays a role in preventing unwanted pregnancies and high parity, which contributes to a decrease in the quality of childcare and nutritional status. Unwanted pregnancies increase the risk of stunting by 2.6 times [42], while high parity can significantly increase the risk of stunting in children [35]. Several factors influence a mother's decision to use postpartum family planning, including marital status, the mother's education level, ANC visits, husband's work, history of contraceptive use, and the return of menstruation [43], [44].

5. Conclusion

The trend of stunting in Indonesia has declined significantly, although it is still relatively high. This research identified several main factors contributing to the trend of stunting at the provincial level, including a history of diarrhea, female-headed households, food expenditure, and supplementary feeding for pregnant women with CED, which are associated with an increase in stunting trends. Conversely, exclusive breastfeeding and postpartum family planning were correlated with a decline in the trend of stunting.

Recommendation

This research recommends policies and programs to reduce stunting in Indonesia. These include enhancing diarrhea prevention by increasing access to clean water, sanitation, and hygiene practices, and evaluating the supplementary feeding program for targeting and consumption compliance. Targeted interventions for vulnerable households, such as empowering women and implementing social protection measures, are advised to mitigate the effects of high food expenditure on stunting. Furthermore, promoting exclusive breastfeeding and postpartum family planning at Posyandu and health facilities, complemented with future multilevel analyses to control for confounding factors.

Compliance with ethical standards

Disclosure of conflict of interest

There is no conflict of interest in this research.

Statement of informed consent

In this study, the analysis is conducted based on survey data obtained without direct interaction between the researcher and participants. Although the survey does not involve direct responses from participants, the principles of informed consent are still highly upheld.

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