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Household Wealth and Childhood Stunting in Indonesia: Evidence from the 2024 Indonesian Nutritional Status Survey

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ABSTRACT

Socioeconomic inequalities continue to shape childhood stunting distribution in Indonesia, yet nationally representative evidence from the post-pandemic context remains scarce. This analytical cross-sectional study examined the association between household wealth and childhood stunting among 164,215 children aged 24–59 months using data from the 2024 Indonesian Nutritional Status Survey (SSGI). Household wealth was measured using the SSGI wealth index, categorized into quintiles, and stunting was defined as height-for-age z-score <−2 SD. All analyses accounted for the complex survey design, including sampling weights, clustering, and stratification, and use survey-weighted Poisson regression to estimate adjusted prevalence ratios (aPRs). The stunting prevalence was 18.6%, with children from the poorest households having more than twice the prevalence compared with the richest (aPR = 2.035; 95% CI: 1.92–2.16). Low maternal education, rural residence, low birth weight, incomplete immunization, inadequate antenatal care, unimproved sanitation, unsafe drinking water, history of infection, and maternal unemployment were also independently associated with stunting. Household wealth demonstrated the strongest socioeconomic association with childhood stunting, underscoring persistent inequalities. As one of the first nationally representative analyses using the 2024 SSGI, this study provides updated evidence for equity-oriented strategies addressing socioeconomic disparities while strengthening maternal and child health services. Due to the cross-sectional design, findings should be interpreted as associations rather than causal relationships.

INTRODUCTION

Stunting remains a major global public health and nutrition challenge, reflecting chronic linear growth failure that results from prolonged nutritional deprivation and recurrent infections during the first 1,000 days of life.[1,2] According to the World Health Organization (WHO), stunting is defined as a length- or height-for-age below minus two standard deviations (<−2 SD) from the WHO Child Growth Standards.[3] Beyond impaired physical growth, stunting is associated with delayed cognitive development, poor educational achievement, lower economic productivity in adulthood, and an increased risk of non-communicable diseases across the life course.[2,4] Approximately 148 million children under five were stunted worldwide in 2024. Although global prevalence has declined over recent decades, progress remains insufficient to achieve the Sustainable Development Goal target of ending all forms of malnutrition by 2030.[5,6] Consequently, reducing childhood stunting requires not

only nutrition-specific interventions but also broader strategies addressing the underlying social determinants of health.[4,7,8]

Among these determinants, socioeconomic conditions have consistently been recognized as important drivers of childhood nutritional status.[9,10] The WHO Commission on Social Determinants of Health conceptualizes socioeconomic position as a structural determinant that shapes intermediary conditions, including access to nutritious food, healthcare, education, safe water, sanitation, adequate housing, and other resources essential for healthy child growth.[7] Likewise, Marmot's Social Gradient Theory proposes that health outcomes improve progressively with increasing socioeconomic position, whereas children living in disadvantaged households experience disproportionately poorer health outcomes.[8,9,11] These structural disadvantages influence child growth through multiple interconnected pathways. Households with greater economic resources are generally better able to ensure food security and dietary diversity, access healthcare services, maintain healthier living environments, and reduce children's exposure to recurrent infections.[12] Conversely, socioeconomic deprivation increases the likelihood of inadequate nutrient intake, poor environmental sanitation, repeated infectious diseases, and limited healthcare utilization, which collectively impair linear growth and increase the risk of stunting.[2,7,8] These pathways are consistent with the WHO Social Determinants of Health framework and the UNICEF Conceptual Framework on Maternal and Child Nutrition.[8,13,14]

In Indonesia, childhood stunting remains a major public health concern despite substantial progress in recent years. According to the 2024 Indonesian Nutritional Status Survey (SSGI), the national prevalence of stunting among children under five declined to 19.8% in 2024.[15] Despite this progress toward the national stunting reduction target, stunting still affects nearly one in five Indonesian children, highlighting the need for sustained multisectoral interventions to address its underlying social determinants.[6,15] Evidence from nationally representative studies using IDHS, Riskesdas, and earlier SSGI data has consistently identified household wealth, maternal education, place of residence, as well as environmental factors such as sanitation, as key determinants of childhood stunting in Indonesia.[16–21] However, these studies differed considerably in their data sources, study periods, and analytical approaches, leading to variations in the reported magnitude and relative importance of individual determinants.[21] Moreover, most were conducted before the full implementation of Indonesia's multisectoral stunting reduction strategy under Presidential Regulation No. 72 of 2021 on the Acceleration of Stunting Reduction, limiting their ability to reflect the country's current socioeconomic and policy context.[22]

Guided by the WHO Social Determinants of Health framework and the UNICEF Conceptual Framework on Maternal and Child Nutrition, this study conceptualizes childhood stunting as the result of interactions between structural socioeconomic determinants, intermediary conditions, and biological factors.[7,8] Household wealth, maternal education, and place of residence represent

structural determinants that shape children's living conditions by influencing household food security, caregiving practices, healthcare utilization, and access to safe water and sanitation.[7–9] These intermediary conditions subsequently affect children's biological vulnerability, including birth outcomes and susceptibility to infectious diseases, ultimately influencing linear growth and the risk of stunting.[2,4,8] Accordingly, this study examines household wealth as the primary exposure while simultaneously accounting for maternal education, place of residence, biological characteristics, healthcare utilization, and environmental factors to provide a comprehensive assessment of childhood stunting in Indonesia.

Despite extensive research on childhood stunting in Indonesia, several important knowledge gaps remain. First, relatively few nationally representative studies have evaluated the association between household wealth and childhood stunting while simultaneously accounting for maternal education, place of residence, and relevant biological, healthcare, and environmental covariates within a comprehensive social determinants of health framework.[16,21,23] Second, rapid socioeconomic changes, together with the implementation of nationwide stunting reduction programs, have created a need for updated, nationally representative evidence base on the most recent survey data.[15,22,24] Third, this study focuses on children aged 24-59 months because stunting at this age reflects the cumulative effects of nutritional deprivation and adverse social and environmental exposures during the first 1,000 days of life. By two years of age, linear growth faltering has largely occurred, making this age group particularly suitable for evaluating the long-term influence of structural socioeconomic determinants.[2,25,26]

Therefore, this study aimed to examine the association between household wealth and childhood stunting among Indonesian children aged 24–59 months using data from the 2024 Indonesian Nutritional Status Survey (SSGI) while adjusting for maternal education, place of residence, biological characteristics, healthcare utilization, and environmental factors. By providing updated nationally representative evidence within a social determinants of health framework, this study seeks to strengthen the evidence base for policies aimed at reducing socioeconomic inequalities in childhood stunting in Indonesia.

MATERIALS AND METHODS

Study Design and Data Source

This analytical cross-sectional study used secondary data from the 2024 Indonesian Nutritional Status Survey (SSGI) conducted by the Ministry of Health of the Republic of Indonesia. The SSGI is a nationally representative household survey designed to monitor the nutritional status of children under five years of age across all provinces in Indonesia. The survey employed a multistage stratified cluster sampling design based on the Central Statistics Agency's national

sampling frame, enabling the generation of representative estimates at both national and provincial levels.[15] The original SSGI dataset included 300,143 children under five years of age. For the present study, children aged 24–59 months were eligible because stunting at this age reflects cumulative linear growth deficits acquired during the first 1,000 days of life.[25,26] A total of 105,643 children aged 0–23 months were excluded because they did not meet the age eligibility criteria. Subsequently, 30,285 children (10.1% of the original sample) were excluded because of missing or incomplete information on anthropometric measurements or one or more study variables, including household wealth, maternal education, place of residence, and other covariates required for multivariable analysis. A complete case analysis was performed, resulting in a final analytical sample of 164,215 children aged 24–59 months.

Variables

The dependent variable was childhood stunting, defined as a height-for-age z-score (HAZ) below −2 standard deviations (<−2 SD) according to the WHO Child Growth Standards.[3] The primary independent variables were household wealth, maternal education, and place of residence. Household wealth was measured using the SSGI household wealth index, constructed from household asset ownership and housing characteristics via principal component analysis (PCA), and categorized into wealth quintiles (poorest, poorer, middle, richer, and richest).[27] Maternal education was classified by the highest level of formal education completed, and place of residence was categorized as urban or rural. Potential covariates included low birth weight (<2,500 g),[6] complete basic immunization (received all age-appropriate vaccines according to the Indonesian national immunization schedule),[28] adequate antenatal care (≥6 antenatal visits following the national guideline),[29] sanitation facilities (improved or unimproved),[30] drinking water source (improved or unimproved),[30] history of infection (reported episode of diarrhea or acute respiratory infection within the reference period), maternal employment status (working or not working), and maternal age (years).[15]

Statistical Analysis

Data processing included eligibility screening, data cleaning, consistency checking, variable coding, and data processing. Records with missing information on variables included in the multivariable analysis were excluded using a complete-case approach. Overall, 30,285 observations (10.1%) were excluded because of missing data. All statistical analyses accounted for the complex survey design by incorporating sampling weights, primary sampling units (PSUs), and stratification variables to obtain nationally representative estimates.[15] Descriptive statistics are presented as weighted proportions with corresponding 95% confidence intervals. Bivariate associations were examined using the Rao–Scott adjusted Chi-square test.[31] Variables were selected for multivariable analysis based primarily on the conceptual framework and previous epidemiological evidence rather

than statistical significance alone. Adjusted prevalence ratios (aPRs) and 95% confidence intervals were estimated using survey-weighted modified Poisson regression with a log link and robust variance estimator.[32] Multicollinearity was assessed using variance inflation factors (VIFs), and model adequacy was evaluated through appropriate goodness-of-fit procedures. Statistical significance was defined as a two-sided *p*-value <0.05. All analyses were performed in R using the 'survey' package.[33]

Ethical Considerations

This study was approved by the Health Research Ethics Committee, Faculty of Public Health, Universitas Andalas. The study used anonymized secondary data from the 2024 SSGI, obtained with the Ministry of Health of the Republic of Indonesia's permission.[15] All personal identifiers had been removed prior to data access to ensure participant confidentiality. Because this study involved secondary analysis of de-identified data, no additional informed consent from participants was required.

RESULTS

The distribution of child characteristics and study variables from the 2024 Indonesian Nutritional Status Survey (SSGI) data is presented in Table 1.

Table 1. Characteristics of Children and Study Variables

Variable	n	(%)
Stunting		
Yes	32,884	18.6
No	131,331	81.4
Household Wealth		
Quintile 1 (Poorest)	28,305	15.9
Quintile 2	33,064	20.4
Quintile 3	34,368	21.0
Quintile 4	33,414	20.8
Quintile 5 (Richest)	35,064	21.9
Maternal Education		
Low (≤Junior High School)	68,409	44.9
High (>Junior High School)	95,806	55.1
Place of Residence		
Rural	72,063	38.2
Urban	92,152	61.8
Basic Immunization		
None	14,758	6.7
Partial	71,341	40.2
Complete	78,116	53.0
Birth Weight		
Low Birth Weight	9,975	6.2
Normal Birth Weight	154,240	93.8
ANC Visits		
Incomplete	118,710	71.7
Complete	45,505	28.3

Variable	n	(%)
History of Infection		
Yes	58,009	40.1
No	106,206	59.9
Sanitation		
Unimproved	24,776	15.6
Improved	139,439	84.4
Drinking Water Source		
Unimproved	10,716	5.1
Improved	153,499	94.9
Maternal Employment		
Not Working	102,557	65.4
Working	61,658	34.6
Maternal Age		
At-Risk (<20 or >35 years)	55,109	32.3
Not At-Risk (20-35 years)	109,106	67.7

Note : n : unweighted sample size; % : weighted percentage based on the complex survey design.

Based on Table 1, the weighted prevalence of stunting among children aged 24–59 months was 18.6%. The weighted distribution of children across the household wealth quintiles was relatively balanced, with proportions ranging from 15.9% to 21.9%. Overall, 55.1% of children had mothers with education above junior high school, while 61.8% lived in urban areas. Most children were fully immunized (53.0%) and had normal birth weight (93.8%), while the majority of their mothers had incomplete antenatal care visits (71.7%). Most households also had improved sanitation (84.4%) and improved drinking water sources (94.9%). Additionally, 59.9% of children had no history of infection, 65.4% had mothers who were not employed, and 67.7% had mothers aged 20–35 years.

Table 2. Bivariate Analysis of Factors Associated with Childhood Stunting

Variable	Stunting				Total	p-value	PR (95%CI)
	Yes		No				
	n	%	n	%			
Household Wealth							
Quintile 1	8,421	28.0	19,884	72.0	28,305	<0.001	2.594 (2.45–2.75)
Quintile 2	7,721	21.9	25,343	78.1	33,064	<0.001	2.032 (1.92–2.15)
Quintile 3	6,857	18.6	27,511	81.4	34,368	<0.001	1.726 (1.63–1.83)
Quintile 4	5,689	16.4	27,725	83.6	33,414	<0.001	1.517 (1.43–1.61)
Quintile 5	4,196	10.8	30,868	89.2	35,064	<0.001	1.000 (Ref)
Maternal Education							
Low (≤JHS)	16,561	22.4	51,848	77.6	68,409	<0.001	1.446 (1.40–1.49)
High (>JHS)	16,323	15.5	79,483	84.5	95,806		
Place of Residence							
Rural	16,544	21.2	55,519	78.8	72,063	<0.001	1.250 (1.21–1.30)
Urban	16,340	17.0	75,812	83.0	92,152		
Basic Immunization							
None	3,649	23.6	11,109	76.4	14,758	<0.001	1.467 (1.39–1.55)
Partial	15,819	21.1	55,522	78.9	71,341	<0.001	1.309 (1.27–1.36)
Complete	13,416	16.1	64,700	83.9	78,116		1.000 (Ref)
Birth Weight							

Variable	Stunting				Total	p-value	PR (95%CI)
	Yes		No				
	n	%	n	%			
Low Birth Weight	3,225	30.2	6,750	69.8	9,975	<0.001	1.700 (1.61–1.78)
Normal	29,659	17.8	124,581	82.2	154,240		
ANC Visits							
Incomplete	26,184	20.6	92,526	79.4	118,710	<0.001	1.518 (1.46-1.58)
Complete	6,700	13.6	38,805	86.4	45,505		
Sanitation							
Unimproved	6,102	23.8	18,674	76.2	24,776	<0.001	1.348 (1.29–1.41)
Improved	26,782	17.6	112,657	82.4	139,439		
Drinking Water Source							
Unimproved	2,776	24.6	7,940	75.4	10,716	<0.001	1.348 (1.27–1.43)
Improved	30,108	18.3	123,391	81.7	153,499		
Infection History							
Yes	12,001	19.3	46,008	80.7	58,009	<0.001	1.060 (1.03–1.10)
No	20,883	18.1	85,323	81.9	106,206		
Maternal Employment							
Not Working	21,615	19.6	80,942	80.4	102,557	<0.001	1.174 (1.14–1.22)
Working	11,269	16.7	50,389	83.3	61,658		
Maternal Age							
At-Risk	11,339	19.1	43,770	80.9	55,109	0.014	1.041 (1.01–1.08)
Not At-Risk	21,545	18.3	87,561	81.7	109,106		

Note : n : unweighted sample size; % : weighted percentage based on the complex survey design.
PR = prevalence ratio; CI = confidence interval; Ref = reference category.

Table 2 presents the bivariate associations between the study variables and childhood stunting. All study variables showed statistically significant associations with childhood stunting. Household wealth showed the strongest socioeconomic gradient, with children from the poorest households having 2.59 times the prevalence of stunting compared with those from the richest households (PR = 2.594; 95% CI: 2.45–2.75). Low birth weight also showed a relatively strong association (PR = 1.70; 95% CI: 1.61–1.78). Moderate associations were observed for low maternal education, no basic immunization, incomplete antenatal care, unimproved sanitation, and unimproved drinking water. In contrast, rural residence, maternal unemployment, a history of infection, and maternal age at risk showed relatively modest associations with childhood stunting, although they reached statistical significance.

Table 3. Multivariate Analysis of Factors Associated with Childhood Stunting (Full Model)

Variable	*p-value*	aPR	95% CI	
			Lower	Upper
Household Wealth (Ref: Quintile 5)				
Quintile 1	<0.001	2.036	1.92	2.16
Quintile 2	<0.001	1.690	1.59	1.79
Quintile 3	<0.001	1.489	1.40	1.58
Quintile 4	<0.001	1.375	1.29	1.46
Place of Residence (Rural)	<0.001	1.081	1.05	1.12
Maternal Education (Low)	<0.001	1.132	1.09	1.17
No Immunization	<0.001	1.401	1.33	1.48

Variable	*p-value*	aPR	95% CI	
			Lower	Upper
Partial Immunization	<0.001	1.237	1.20	1.28
Low Birth Weight	<0.001	1.643	1.56	1.73
Incomplete ANC	<0.001	1.208	1.16	1.26
Infection History	<0.001	1.063	1.03	1.10
Unimproved Sanitation	<0.001	1.149	1.10	1.20
Unimproved Water Source	<0.001	1.129	1.07	1.19
Maternal Employment (Not Working)	<0.001	1.045	1.01	1.08
Maternal Age (At-Risk)	0.545	1.010	0.98	1.04

Note: aPR = adjusted prevalence ratio; CI = confidence interval; Ref = reference category.

Table 3 presents the full multivariable model, which included all study variables simultaneously to assess their independent associations with childhood stunting while controlling for potential confounding. After adjustment, maternal age (at-risk) was not statistically significant (p = 0.545). Given the large sample size, we applied a conservative significance level (p<0.25) for retention in the final model to ensure that only the most robust predictors were included. Based on this criterion, maternal age was excluded, and the model was re-estimated (Table 4).

Table 4. Multivariate Analysis of Factors Associated with Childhood Stunting (Final Model)

Variable	*p-value*	aPR	95% CI	
			Lower	Upper
Household Wealth (Ref: Quintile 5)				
Quintile 1	<0.001	2.035	1.92	2.16
Quintile 2	<0.001	1.689	1.59	1.79
Quintile 3	<0.001	1.488	1.40	1.58
Quintile 4	<0.001	1.374	1.29	1.46
Place of Residence (Rural)	<0.001	1.080	1.05	1.12
Maternal Education (Low)	<0.001	1.133	1.10	1.17
No Immunization	<0.001	1.402	1.33	1.48
Partial Immunization	<0.001	1.237	1.20	1.28
Low Birth Weight	<0.001	1.644	1.56	1.73
Incomplete ANC	<0.001	1.208	1.16	1.26
Infection History	<0.001	1.063	1.03	1.10
Unimproved Sanitation	<0.001	1.148	1.10	1.20
Unimproved Water Source	<0.001	1.129	1.07	1.19
Maternal Employment (Not Working)	0.001	1.044	1.01	1.08

Note: aPR = adjusted prevalence ratio; CI = confidence interval; Ref = reference category.

Table 4 presents the final multivariable model after excluding maternal age, which was not statistically significant in the full model. After adjustment for potential confounders, household wealth remained the strongest factor associated with childhood stunting, with children in the poorest households having more than twice the prevalence of stunting compared with those in the richest households (aPR = 2.035; 95% CI: 1.92–2.16). Low birth weight remained the strongest non-socioeconomic factor. Low maternal education, no basic immunization, incomplete antenatal care, unimproved sanitation, and unimproved drinking water also remained independently associated with

childhood stunting, whereas rural residence, history of infection, and maternal unemployment showed weaker but statistically significant associations.

DISCUSSION

Household wealth showed the strongest socioeconomic association with childhood stunting, with a clear gradient across wealth quintiles. Low maternal education, rural residence, and low birth weight were also independently associated. These findings suggest structural socioeconomic inequalities outweigh individual factors, supporting equity-oriented stunting prevention.

Household Wealth

Household wealth was the socioeconomic factor most strongly associated with childhood stunting in this study, and the observed gradient across wealth quintiles indicates that the relationship extends beyond a simple contrast between poor and rich households. The persistence of this association after adjustment for maternal education, place of residence, biological characteristics, healthcare utilization, and environmental conditions suggests that household wealth captures broader socioeconomic circumstances that continue to influence child growth independently of these measured factors. Rather than reflecting household income alone, the wealth index represents the cumulative availability of material resources, living conditions, and social opportunities that shape children's nutritional and health outcomes throughout early life.[7,8]

The present findings are consistent with previous studies from Indonesia, where children living in poorer households consistently experience a higher prevalence of stunting than those from wealthier households.[16,19] Similar socioeconomic gradients have also been reported in other low- and middle-income countries. For example, Shange and Tsawe, using pooled Demographic and Health Survey data from Ethiopia, Malawi, Nigeria, and Zambia, found that household poverty remained one of the strongest socioeconomic factors associated with childhood stunting after adjustment for maternal and environmental characteristics.[34] Likewise, a systematic review and meta-analysis by Kassaw et al. demonstrated that children from poorer households in Ethiopia had significantly higher odds of stunting than those from wealthier households, reinforcing the consistency of this association across diverse settings.[35] Together, these findings suggest that socioeconomic disadvantage remains a fundamental dimension of childhood stunting across low- and middle-income countries.

Several mechanisms may explain this relationship. Children living in economically disadvantaged households are more likely to experience food insecurity, limited dietary diversity, inadequate housing conditions, poor sanitation, delayed utilization of maternal and child healthcare services, and repeated exposure to infectious diseases, all of which may impair linear growth during the first 1,000 days of life.[4,8,10] These interconnected pathways illustrate how material deprivation may

influence child growth through biological, behavioral, healthcare, and environmental mechanisms rather than through a single isolated pathway.[1,9]

The findings also align with the WHO Commission on Social Determinants of Health framework, which recognizes socioeconomic position as a structural determinant influencing access to material resources, education, healthcare, and healthy living environments.[7,10] Likewise, Marmot's social gradient theory proposes that health inequalities occur progressively across the socioeconomic spectrum rather than being confined to the poorest populations.[11] Although formal mediation analysis was beyond the scope of this study, the persistence of the wealth gradient after multivariable adjustment suggests that household wealth may reflect contextual influences not captured by the available survey variables. From a policy perspective, these findings indicate that reducing socioeconomic inequalities in childhood stunting requires integrated strategies combining poverty reduction, social protection, equitable access to quality maternal and child healthcare, nutrition services, safe drinking water, and improved sanitation, consistent with the WHO Social Determinants of Health framework and Indonesia's National Strategy for Stunting Reduction.[7,22]

Maternal Education

Maternal education remained independently associated with childhood stunting after adjustment for household wealth and other study variables, suggesting that educational attainment may influence children's nutritional status beyond family economic circumstances. Although the magnitude of this association was smaller than that observed for household wealth, its persistence indicates that maternal education represents an important dimension of social inequality that may shape childcare practices, health-related decision-making, and access to health information.[7,8]

The present findings are consistent with previous evidence from Indonesia, where lower maternal educational attainment has been associated with a higher prevalence of childhood stunting.[16,21] Similar associations have been observed across a wide range of low- and middle-income countries. A recent systematic review and meta-analysis demonstrated that higher maternal education was consistently associated with improved linear growth and lower odds of childhood stunting, particularly in middle-income countries.[36] Together, these findings suggest that the relationship between maternal education and child growth is remarkably consistent across different populations despite variations in culture, healthcare systems, and socioeconomic development.

Several pathways may explain this association. Mothers with higher educational attainment generally possess greater health literacy, are more likely to adopt appropriate infant and young child feeding practices, utilize antenatal and child healthcare services, adhere to childhood immunization schedules, and practice better hygiene and caregiving behaviors.[9] These advantages may improve their ability to recognize childhood illness, seek timely healthcare, and provide nutritionally adequate care during the first 1,000 days of life, thereby supporting optimal child growth.[10]

These findings further support the broader WHO Social Determinants of Health framework, which recognizes education as a structural determinant that expands opportunities to acquire knowledge, access healthcare, and make informed health decisions throughout the life course.[7] Although mediation analysis was beyond the scope of this study, part of the observed association may operate through improved health literacy, greater utilization of maternal and child health services, healthier feeding behaviors, and enhanced caregiving capacity. From a policy perspective, these findings suggest that reducing childhood stunting requires not only nutrition-specific interventions but also sustained investments in girls' education, maternal health literacy, and equitable access to high-quality maternal and child healthcare services. Such investments strengthen families' capacity to promote healthy child growth regardless of household economic status

Place of Residence

Place of residence remained independently associated with childhood stunting after adjustment for household wealth, maternal education, and other study variables. However, the magnitude of this association was modest compared with the effects observed for household wealth and low birth weight. This finding suggests that geographic disparities in childhood stunting may not be explained solely by individual or household socioeconomic characteristics but may also reflect broader contextual differences in access to health-promoting resources and services.[7]

The present findings are consistent with previous studies from Indonesia reporting a higher prevalence of childhood stunting among children living in rural communities.[16,19] Recent evidence from a systematic review and meta-analysis of Indonesian studies also identified rural residence as an independent factor associated with childhood stunting.[21] Furthermore, a recent systematic review comparing determinants of stunting in urban and rural Indonesia concluded that persistent rural–urban disparities are largely attributable to inequalities in healthcare accessibility, environmental conditions, and socioeconomic resources.[37] Together, these findings suggest that geographic disparities in childhood stunting remain a consistent feature of child nutrition in Indonesia. However, much of the observed difference may reflect broader structural inequalities rather than residence itself.

Several mechanisms may explain these findings. Children living in rural areas often have more limited access to quality maternal and child healthcare services, shortages of trained health personnel, poorer transportation and referral systems, and lower availability of safe drinking water and improved sanitation.[10] These conditions may reduce the timely utilization of preventive and curative health services while increasing exposure to infectious diseases and environmental risks that adversely affect child growth.[1] The relatively modest association observed after multivariable adjustment further suggests that part of the rural–urban disparity may operate through household wealth, maternal education, healthcare access, and environmental conditions, all of which are closely linked to place of residence rather than acting independently.

These findings further emphasize that geographic inequalities reflect broader social and structural disparities in access to healthcare, infrastructure, and healthy living environments, consistent with the WHO Social Determinants of Health framework.[7] From a policy perspective, the relatively small independent effect of residence indicates that reducing geographic disparities in childhood stunting requires strengthening the systems that support healthy living in disadvantaged communities. Expanding primary healthcare coverage, improving transportation and referral networks, ensuring equitable distribution of health personnel, and increasing access to safe water and sanitation are likely more effective than interventions targeting place of residence alone.[22]

Biological, Healthcare, and Environmental Factors

Beyond the primary social determinants, low birth weight (LBW) was the strongest non-socioeconomic factor associated with childhood stunting in this study, highlighting the importance of fetal growth and early-life conditions in shaping subsequent linear growth. This finding is consistent with evidence from Indonesia and other low- and middle-income countries, where LBW has consistently been identified as one of the strongest biological factors associated with childhood stunting.[16,21] A recent systematic review and meta-analysis further confirmed that children born with LBW are at significantly greater risk of becoming stunted during early childhood.[38] The remaining associated factors primarily represented deficiencies in healthcare utilization and living environments, including inadequate antenatal care, incomplete immunization, poor water and sanitation conditions, and exposure to infectious diseases, suggesting that childhood stunting arises from the cumulative interaction of biological vulnerability, limited preventive healthcare, and adverse environmental conditions.[9,10] The relatively modest association observed for maternal employment further suggests that employment status alone may not adequately represent women's socioeconomic position, as its influence is likely mediated by income security, educational attainment, household support, and childcare arrangements. Collectively, these findings reinforce the multifactorial nature of childhood stunting and support integrated interventions that combine maternal and child healthcare, immunization, nutrition programs, and water, sanitation, and hygiene (WASH) improvements with broader poverty-reduction and social-protection strategies.[7,22]

Strengths and Limitations

This study has several limitations. First, its cross-sectional design precludes establishing temporal or causal relationships between the identified factors and childhood stunting. Second, the use of secondary survey data limited the analysis to variables collected in the 2024 Indonesian Nutritional Status Survey (SSGI); therefore, potentially important factors such as dietary intake, household food security, infant and young child feeding practices, parental stature, and genetic influences were unavailable, leaving the possibility of residual confounding. Third, several variables were based on caregiver reports and may therefore be subject to recall bias or misclassification. In

addition, a complete-case analysis was performed because records with missing data were excluded, which may have introduced selection bias if the missingness was not completely at random.

Despite these limitations, this study has several important strengths. It used a large, nationally representative sample from the 2024 SSGI. It applied appropriate complex survey analyses that accounted for sampling weights, clustering, and stratification, thereby enhancing the validity and generalizability of the findings to Indonesian children aged 24–59 months. Furthermore, as one of the first nationally representative analyses using the 2024 SSGI, this study provides contemporary evidence on the social determinants of childhood stunting in Indonesia during the post-pandemic period. By simultaneously examining socioeconomic, biological, healthcare, and environmental factors within a single analytical framework, the study offers a more comprehensive understanding of the multiple pathways associated with childhood stunting. It provides evidence to support equity-oriented policies and multisectoral strategies for stunting reduction.

CONCLUSION

This nationally representative study found that household wealth was the socioeconomic factor most strongly associated with childhood stunting among Indonesian children aged 24–59 months. A clear socioeconomic gradient was observed, with children from poorer households consistently experiencing a higher prevalence of stunting than those from wealthier households, even after adjustment for maternal education, place of residence, and biological, healthcare, and environmental factors. These findings underscore the importance of addressing socioeconomic inequalities alongside improvements in maternal and child health services and living conditions as part of comprehensive stunting-reduction efforts. Future research should employ longitudinal and multilevel study designs to understand better the pathways through which socioeconomic disadvantage and contextual factors interact to influence childhood stunting over time.

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