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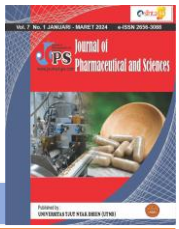

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Determinants of Stunting in Children Aged 24–59 Months at the Uluidanotae Community Health Center, South Nias Regency, 2025

Determinan Kejadian Stunting pada Anak Usia 24–59 Bulan di UPTD Puskesmas Uluidanotae Kabupaten Nias Selatan Tahun 2025

Kristian Laia [a]*, Agnes Purba [a], Laura M Siregar [a], Kesaktian Manurung [a], Taruli Rohana Sinaga [a]

[a] *Master of Public Health Study Program, Faculty of Pharmacy and Health Sciences, Sari Mutiara Indonesia University, Medan, Indonesia.*

Corresponding Authors: tianlaia24@gmail.com, laura.boeg@yahoo.co.id, kesaktianmanurung56@gmail.com, taruli1971@gmail.com

Abstract

Background: Stunting remains a concern in remote communities where child nutrition and preventive care may be difficult to sustain. This study examined associations of maternal education, exclusive breastfeeding, household income, and immunization status with stunting among children aged 24–59 months in the Uluidanotae Community Health Center service area, South Nias Regency. Methods: This cross-sectional study included 115 mother–child pairs. Data were obtained through interviews, height measurement, and assessment of immunization records and maternal recall. Stunting was defined as a height-for-age z-score below −2 according to the WHO Child Growth Standards. Categorical associations were examined using chi-square tests and multiple logistic regression. Results: Twenty-eight children (24.3%) had stunting. Stunting was less frequent among children with a history of exclusive breastfeeding than among those without this history (13.4% versus 51.5%; crude odds ratio [OR] 0.146, 95% confidence interval [CI] 0.057–0.370). Corresponding proportions were 17.1% and 35.6% for complete and incomplete immunization (crude OR 0.375, 95% CI 0.157–0.896). Household income was not associated with stunting ($p = 0.624$). In the reported multivariable model, breastfeeding and immunization status were associated with stunting ($p < 0.001$ and $p = 0.027$, respectively), whereas maternal education was not ($p = 0.107$). Conclusion: The findings identify breastfeeding support and continuity of immunization services as locally relevant priorities within integrated child nutrition care. These cross-sectional associations do not establish causal effects.

Keywords: stunting; exclusive breastfeeding; immunization; maternal education; cross-sectional study.

Abstrak

Latar belakang: Stunting masih menjadi masalah di wilayah terpencil yang menghadapi hambatan dalam mempertahankan kecukupan gizi dan kesinambungan pelayanan kesehatan anak. Penelitian ini menganalisis hubungan pendidikan ibu, pemberian ASI eksklusif, pendapatan keluarga, dan status imunisasi dengan stunting pada anak usia 24–59 bulan di wilayah kerja UPTD Puskesmas Uluidanotae, Kabupaten Nias Selatan. Metode: Penelitian potong lintang ini melibatkan 115 pasangan ibu–anak. Data diperoleh melalui wawancara, pengukuran tinggi badan, serta penelaahan catatan imunisasi dan ingatan ibu. Stunting ditetapkan berdasarkan z-score tinggi badan menurut umur kurang dari −2 sesuai Standar Pertumbuhan Anak WHO. Hubungan antarvariabel dianalisis menggunakan uji chi-square dan regresi logistik berganda. Hasil: Sebanyak 28 anak (24,3%) mengalami stunting. Proporsi stunting lebih rendah pada anak dengan riwayat ASI eksklusif dibandingkan dengan anak tanpa riwayat tersebut (13,4% versus 51,5%; odds ratio [OR] kasar 0,146; interval kepercayaan [IK] 95% 0,057–0,370). Proporsi pada kelompok imunisasi lengkap dan tidak lengkap masing-masing sebesar 17,1% dan 35,6% (OR kasar 0,375; IK 95% 0,157–0,896). Pendapatan keluarga tidak berhubungan dengan stunting ($p = 0,624$). Dalam model multivariabel yang dilaporkan, pemberian ASI dan status imunisasi berhubungan dengan stunting (masing-masing $p < 0,001$ dan $p = 0,027$), sedangkan pendidikan ibu tidak menunjukkan hubungan bermakna ($p = 0,107$). Kesimpulan: Temuan ini menunjukkan relevansi dukungan menyusui dan kesinambungan pelayanan imunisasi sebagai bagian dari pelayanan gizi anak yang terintegrasi. Hubungan yang ditemukan dalam penelitian potong lintang ini tidak membuktikan sebab-akibat.

Kata kunci: stunting; ASI eksklusif; imunisasi; pendidikan ibu; penelitian potong lintang.

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Introduction

Stunting, defined as a height-for-age z-score below −2 relative to the WHO Child Growth Standards, is a marker of impaired linear growth rather than a diagnosis of a single underlying disease. Growth faltering reflects interacting nutritional, infectious, and social exposures, often beginning before birth and during early childhood. Its importance extends beyond attained height because early-life undernutrition is associated with adverse developmental and later-life outcomes [1–4].

The 2025 UNICEF/WHO/World Bank Group Joint Child Malnutrition Estimates estimated that 150.2 million children younger than five years, or 23.2% of this age group globally, had stunting in 2024. In Indonesia, the 2024 Indonesian Nutritional Status Survey (SSGI), released in 2025, reported a national prevalence of 19.8%. These figures demonstrate the continuing public health relevance of linear growth faltering, although national estimates cannot describe the circumstances of every health-center catchment area [5,6].

Evidence from Indonesia identifies determinants operating at the child, household, and community levels. A national multilevel analysis by Wicaksono and Harsanti and a subsequent analysis of the Indonesian Family Life Survey by Siramaneerat et al. demonstrate the importance of examining socioeconomic and geographic context alongside individual characteristics. Reviews of Indonesian and Southeast Asian studies likewise describe multiple pathways involving early growth, maternal characteristics, feeding, and living conditions rather than a uniform explanation applicable to all settings [7–11].

Within this framework, maternal education and household resources may influence access to information, food, and services, whereas feeding practices and infection prevention operate closer to the child. These pathways can overlap: education may facilitate service use, but knowledge alone cannot remove financial or geographic barriers. The distinction between underlying social conditions and more immediate exposures provides a useful basis for examining associations without assuming that a single measured factor determines a child's growth [12–16].

Uluidanotae serves a geographically dispersed population across 11 villages in South Nias Regency. The service area is described as remote, with difficult access to some settlements. These conditions make the continuity of breastfeeding support, routine immunization, and growth monitoring particularly relevant. Findings from national surveys provide context but do not directly establish which measured characteristics distinguish children with and without stunting in this local service population. This study therefore examined associations of maternal education, exclusive breastfeeding, household income, and immunization status with stunting among children aged 24–59 months in the Uluidanotae Community Health Center service area.

Methods

Study design and setting

An analytical cross-sectional study was conducted in the service area of the Uluidanotae Community Health Center, South Nias Regency, North Sumatra. The study period extended from September 2025 to February 2026. A cross-sectional approach was used to examine the distribution of stunting and its associations with the selected characteristics within the study sample. Because growth status was assessed at a single observation and earlier feeding was recalled retrospectively, the design does not establish causal effects or longitudinal growth trajectories.

The health center is a non-inpatient facility serving 11 villages. Some villages are accessible primarily by motorcycle or on foot. The study setting is relevant to service continuity, but geographic accessibility was not included as an individual-level exposure in the analysis. The location of the health center is shown in Figure 1.

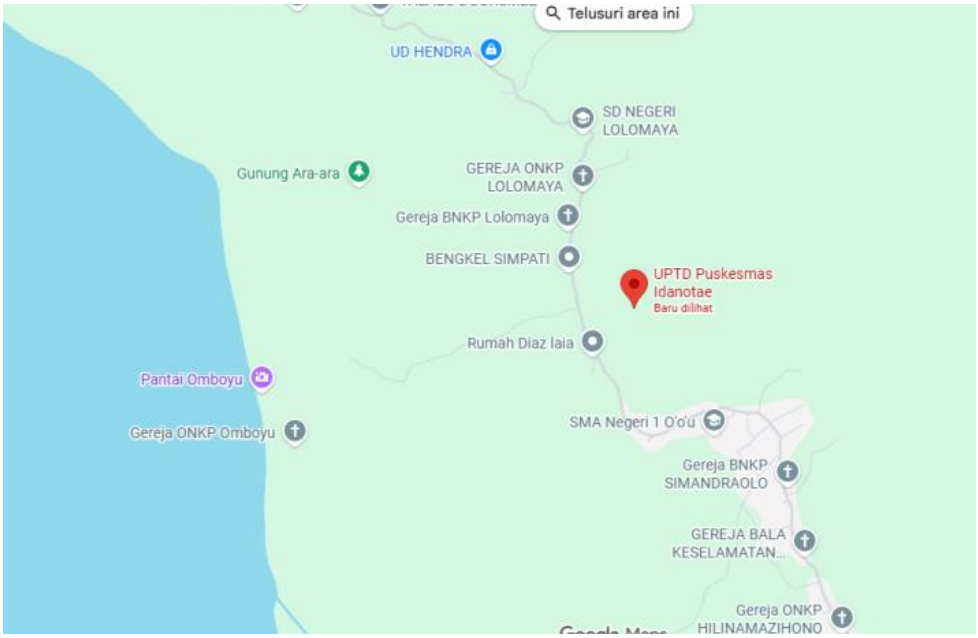

Figure 1. Location of the Uluidanotae Community Health Center in South Nias Regency.

Participants and sample size

The target population comprised mothers or caregivers of children aged 24–59 months who resided in the health-center service area. The population list was reported to contain 162 children, and 115 mother–child pairs were included in the analysis. Eligible participants resided in the study area and provided informed consent. Children with severe congenital abnormalities affecting physical growth and records with incomplete identity information or questionnaires were excluded according to the study criteria.

Sample size was estimated using $n = N/(1 + Ne^2)$, with $N = 162$ and $e = 0.05$, giving $n = 115.3$. The achieved analytical sample contained 115 participants.

Outcome and exposure assessment

Standing height was measured using a microtoise stadiometer with a 2-m capacity and a stated precision of 0.1 cm. Height-for-age was evaluated against the WHO Child Growth Standards. Children with a height-for-age z-score below −2 were classified as having stunting; those with a z-score of −2 or higher were classified as not having stunting [1].

Exclusive breastfeeding was defined as receiving only breast milk during the first six months, apart from permitted medicines or vitamin preparations. Breastfeeding history was obtained through a three-item maternal interview. A score of 3 was classified as exclusive breastfeeding, and a score below 3 as non-exclusive breastfeeding. Maternal education was grouped according to the highest completed formal education: low, comprising no schooling or primary education; secondary, comprising junior or senior secondary education; and higher, comprising diploma or university education. These were study-defined categories.

Household income represented the combined average monthly income of household members. The study grouped income relative to the applicable regency or provincial minimum wage: low, below 50%; medium, 50–99%; and high, above 100%. Maternal age, child age, child sex, and maternal employment were recorded as descriptive characteristics.

Immunization status was categorized as complete or incomplete according to the basic immunizations assessed in the study: BCG, polio, DPT–HB–Hib, and measles or measles–rubella. A child was classified as incomplete if one or more required immunizations had not been received. Information was obtained from maternal interviews and available Maternal and Child Health (KIA) or child health records.

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Data collection and statistical analysis

Data were collected through face-to-face interviews using a structured questionnaire and checklist, together with direct height measurement. The questionnaire was adapted from instruments used in previous studies. The source instruments were described as having Cronbach's alpha coefficients of 0.821–0.896. Questionnaire responses were edited, coded, and tabulated before analysis.

Categorical variables were summarized as frequencies and percentages. Stunting proportions within exposure categories were calculated using the number of children in each category as the denominator. Pearson's chi-square tests were used to assess unadjusted categorical associations at a two-sided significance level of 0.05. Crude odds ratios (ORs) and 95% confidence intervals (CIs) were calculated from the tabulated counts using the log-OR method. The non-exclusive breastfeeding, higher-income, and incomplete-immunization categories served as the corresponding reference groups. ORs describe odds, not prevalence ratios or relative risks.

The smallest expected cell counts for the breastfeeding, income, and immunization comparisons were 8.03, 5.84, and 10.96, respectively, supporting the expected-frequency requirement for Pearson's chi-square test in those tables. Percentages were rounded to one decimal place and may therefore not sum to exactly 100.0%.

Multiple logistic regression was used to examine associations of maternal education, breastfeeding, and immunization status with the binary growth outcome. These variables met the study's reported bivariate screening threshold of $p < 0.25$; household income did not. Regression coefficients, exponentiated coefficients, 95% CIs, and p-values are presented for the three-variable model.

Ethical considerations

Participation was voluntary. Mothers or caregivers provided written informed consent after receiving an explanation of the study objectives and procedures. Participant identities were replaced with study codes, and results were presented in aggregate to protect confidentiality.

Results

Participant characteristics and exposure distributions

The analysis included 115 mother–child pairs. Most mothers were aged 20–35 years, and the largest child age group was 36–47 months. Girls accounted for 60.0% of the sample, and 65.2% of mothers were not employed (Table 1).

Table 1. Characteristics of mothers and children (n = 115).

Characteristic	n	%
Maternal age, years		
<20 or >35	44	38.3
20–35	71	61.7
Child age, months		
24–35	41	35.7
36–47	56	48.7
48–59	18	15.7
Child sex		
Male	46	40.0
Female	69	60.0
Maternal employment		
Employed	40	34.8
Not employed	75	65.2

Percentages use n = 115 as the denominator. The child-age percentages total 100.1% because of rounding.

Higher education was reported by 47.0% of mothers. A history of exclusive breastfeeding was reported for 71.3% of children, 47.0% of households were in the medium-income category, and 60.9% of children had complete immunization according to the study classification (Tables 2–5).

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Table 2. Maternal educational attainment (n = 115).

Education	n	%
Higher (diploma/university)	54	47.0
Secondary (junior/senior secondary)	39	33.9
Low (none/primary)	22	19.1
Total	115	100.0

Table 3. Exclusive breastfeeding history (n = 115).

Breastfeeding history	n	%
Exclusive	82	71.3
Non-exclusive	33	28.7
Total	115	100.0

Table 4. Household income category (n = 115).

Household income	n	%
High	24	20.9
Medium	54	47.0
Low	37	32.2
Total	115	100.0

Percentages may not sum to exactly 100.0% because of rounding.

Table 5. Immunization status (n = 115).

Immunization status	n	%
Complete	70	60.9
Incomplete	45	39.1
Total	115	100.0

Stunting was identified in 28 children (24.3%); the remaining 87 children (75.7%) did not have stunting (Table 6). This proportion describes the study sample and should not be interpreted as a representative estimate for all children in South Nias Regency.

Table 6. Stunting status (n = 115).

Growth status	n	%
Stunting	28	24.3
No stunting	87	75.7
Total	115	100.0

Bivariate associations

Among children whose mothers had higher or secondary education, stunting was present in 9 of 54 (16.7%) and 9 of 39 (23.1%), respectively. The reported overall comparison across maternal education categories yielded p = 0.029 (Table 7).

Table 7. Maternal education and stunting (n = 115).

Maternal education	Stunting, n	No stunting, n	Total, n	Crude OR (95% CI)	p
Higher	9	45	54	1 (reference)	0.029
Secondary	9	30	39	1.500 (0.534–4.214)	
Low	5	12	22	—	
Total	28	87	115	—	

OR, odds ratio; CI, confidence interval. The p-value refers to the overall comparison. —, not estimated.

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Children with a history of exclusive breastfeeding had a lower observed stunting proportion than those without this history: 13.4% versus 51.5% ($p < 0.001$). The crude OR was 0.146 (95% CI 0.057–0.370), using non-exclusive breastfeeding as the reference (Table 8).

Table 8. Exclusive breastfeeding and stunting (n = 115).

Breastfeeding history	Stunting, n (%)	No stunting, n (%)	Total, n	Crude OR (95% CI)	p
Exclusive	11 (13.4)	71 (86.6)	82	0.146 (0.057–0.370)	<0.001
Non-exclusive	17 (51.5)	16 (48.5)	33	1 (reference)	
Total	28 (24.3)	87 (75.7)	115	—	

Percentages are calculated within rows. ORs and Wald 95% CIs were calculated from the displayed counts. Pearson $\chi^2 = 18.54$, df = 1.

Stunting was observed in all three income groups, with within-group proportions of 18.9%, 27.8%, and 25.0% in the low-, medium-, and high-income categories, respectively. There was no evidence of an overall association in this sample ($p = 0.624$). The wide CIs for the category-specific ORs indicate limited precision rather than equivalence between income groups (Table 9).

Table 9. Household income and stunting (n = 115).

Household income	Stunting, n (%)	No stunting, n (%)	Total, n	Crude OR (95% CI)	p
Low	7 (18.9)	30 (81.1)	37	0.700 (0.203–2.412)	0.624
Medium	15 (27.8)	39 (72.2)	54	1.154 (0.384–3.464)	
High	6 (25.0)	18 (75.0)	24	1 (reference)	
Total	28 (24.3)	87 (75.7)	115	—	

Percentages are calculated within rows. Higher household income is the reference category. Pearson $\chi^2 = 0.94$, df = 2.

The proportion of children with stunting was 17.1% among those with complete immunization and 35.6% among those with incomplete immunization. Complete immunization was associated with lower crude odds of stunting (OR 0.375, 95% CI 0.157–0.896; $p = 0.025$; Table 10). Figure 2 presents the observed stunting proportions for breastfeeding and immunization categories.

Table 10. Immunization status and stunting (n = 115).

Immunization status	Stunting, n (%)	No stunting, n (%)	Total, n	Crude OR (95% CI)	p
Complete	12 (17.1)	58 (82.9)	70	0.375 (0.157–0.896)	0.025
Incomplete	16 (35.6)	29 (64.4)	45	1 (reference)	
Total	28 (24.3)	87 (75.7)	115	—	

Percentages are calculated within rows. Incomplete immunization is the reference category. Pearson $\chi^2 = 5.04$, df = 1.

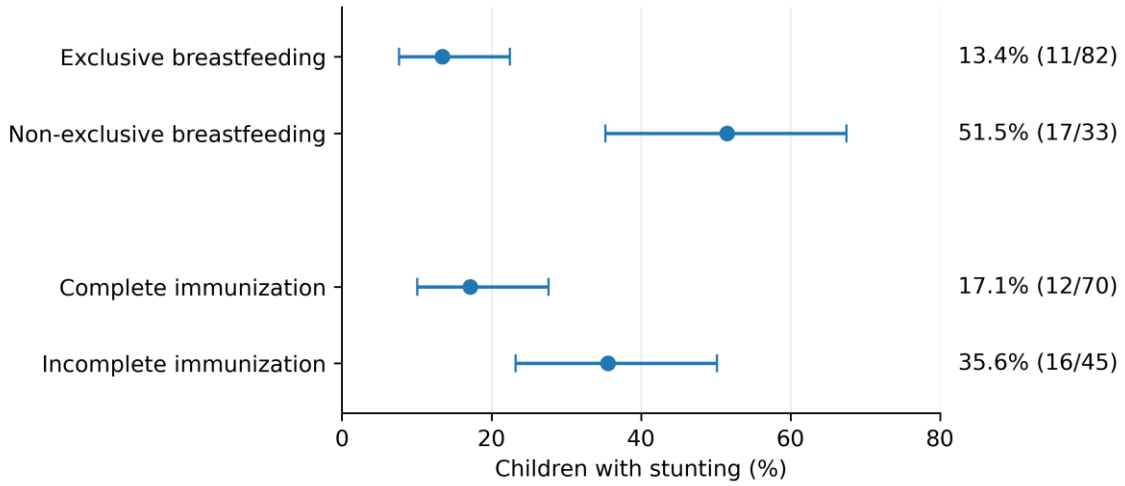

Figure 2. Observed stunting proportions by exclusive breastfeeding history and immunization status. Points indicate within-group proportions; error bars indicate Wilson 95% confidence intervals. Labels show the percentage and the number with stunting/number in the category. Both comparisons use the same study sample; the groups are not four independent samples. Source: counts in Tables 8 and 10.

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Multivariable analysis

Maternal education, breastfeeding history, and immunization status met the study's reported screening threshold for inclusion in the multivariable model (Table 11). Household income did not meet this threshold and was not included in the reported model.

Table 11. Bivariate screening for the multivariable model.

Variable	p	Model inclusion
Maternal education	0.029	Included
Breastfeeding history	<0.001	Included
Immunization status	0.025	Included
Household income	0.624	Not included

The screening threshold reported in the study was $p < 0.25$.

In the reported three-variable model, the breastfeeding term had an exponentiated coefficient of 0.142 (95% CI 0.052–0.388; $p < 0.001$), and the immunization term had an exponentiated coefficient of 0.325 (95% CI 0.120–0.883; $p = 0.027$). The maternal education term was not statistically significant (Exp[B] 0.595, 95% CI 0.316–1.119; $p = 0.107$; Table 12).

Table 12. Reported multiple logistic regression coefficients.

Model term	B	Exp(B)	95% CI for Exp(B)	p
Maternal education	−0.520	0.595	0.316–1.119	0.107
Breastfeeding history	−1.953	0.142	0.052–0.388	<0.001
Immunization status	−1.124	0.325	0.120–0.883	0.027

B, logistic regression coefficient; Exp(B), exponentiated coefficient; CI, confidence interval. All three displayed terms were included in the reported model.

Discussion

Principal findings and interpretation

Approximately one-quarter of the children in this sample had stunting. The clearest unadjusted differences involved breastfeeding history and immunization status, whereas the income comparison was imprecise and did not show statistical evidence of an association. The findings describe variation within one health-center service population; they do not establish the population prevalence of stunting for the regency or identify a single cause of impaired growth. A multifactorial interpretation is consistent with Indonesian reviews and with the WHO framework for childhood stunting [9,12,13].

The focus on children aged 24–59 months captures attained height after much of the period in which early growth faltering commonly develops. However, a single height measurement cannot determine when a deficit began, distinguish persistent faltering from subsequent recovery, or exclude continuing dietary and infectious exposures. The early-life emphasis should therefore support prevention without implying that appropriate nutrition and clinical assessment are unimportant after the second birthday [2,3].

Exclusive breastfeeding and subsequent feeding

The substantially lower observed stunting proportion among children with a history of exclusive breastfeeding is compatible with the nutritional and anti-infective benefits of breastfeeding. Breast milk provides nutrients and bioactive components that support infant health, while breastfeeding support may reduce exposure to unsafe replacement feeding in settings where water and sanitation are inadequate. These mechanisms provide biological plausibility, but they do not establish that breastfeeding itself accounts for the entire observed association in this sample [17,18].

Breastfeeding history was recalled after an interval of several years, making exposure misclassification a substantive concern. Mothers may differ in how they interpret small amounts of water, formula, or prelacteal feeds when describing exclusivity. Breastfeeding also co-occurs with maternal health, household support, and use of preventive services. The crude OR should consequently be interpreted as a contrast in observed odds between groups, not as a causal percentage reduction in stunting risk. The magnitude of an OR is also not directly comparable with the magnitude of a prevalence ratio when the outcome is relatively common.

Protection during infancy does not remove the need for appropriate feeding thereafter. UNICEF's report on early childhood diets and the WHO complementary-feeding guideline emphasize the importance

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of adequate, diverse, age-appropriate foods during the transition from milk feeding. A 2025 analysis from West Java by Surmita et al. found an association between inadequate minimum dietary diversity and stunting after adjustment for several measured characteristics. This provides relevant context for factors not measured in the Uluidanotae study, rather than evidence that dietary diversity mediated its breastfeeding association [19–21].

The practical implication is to connect breastfeeding support with follow-up on complementary feeding and growth, rather than treating an affirmative history of exclusive breastfeeding as sufficient evidence of nutritional adequacy. The 2023 Lancet breastfeeding analysis also emphasizes that breastfeeding practices are shaped by social, health-system, and commercial conditions. Counseling is therefore more likely to be useful when families also receive practical support and continuity of care, rather than messages that place responsibility solely on mothers [18,22].

Maternal education and household resources

Maternal education was not statistically significant in the reported adjusted model. This does not demonstrate that education is irrelevant to child growth or that its association is fully explained by breastfeeding and immunization. In the Mosley–Chen framework, social characteristics can operate through more immediate determinants of child health; education may improve comprehension of advice, decision-making, and the ability to obtain services. However, inclusion of correlated behaviors in one regression model does not constitute a formal mediation analysis [14,15].

Several explanations for a change in statistical significance remain possible, including overlapping information across predictors, residual confounding, limited precision, and sensitivity to the way education is coded. A three-level education variable represented by one coefficient additionally imposes a different model structure from one represented by two indicator variables. Without a prespecified causal model and suitable temporal information, the present analysis cannot distinguish these explanations or estimate an indirect effect of education through health behaviors.

The absence of an income association should likewise not be read as evidence that economic constraints are unimportant. Monthly household income is a limited measure of the resources available to a child: it does not incorporate household size, food prices, debt, asset ownership, or food security. The CIs around the crude category estimates encompass both lower and higher odds. International evidence on the social determinants of undernutrition and on nutrition-sensitive interventions supports attention to material conditions even when a small local study does not detect an income gradient [15,16,23].

These considerations favor an integrated response. Health education can improve understanding, but its practical value may be constrained when nutritious foods, transportation, or preventive services are difficult to obtain. Conversely, an increase in resources alone does not document how food and care are distributed within a household. Caregiving and nutrition should therefore be considered jointly, without assuming that maternal employment or non-employment necessarily confers an advantage [22,23].

Immunization and continuity of preventive care

The observed immunization association is consistent with the hypothesis that prevention of vaccine-preventable illness can support child health and growth. In a national analysis of 70,267 Indonesian children aged 12–59 months, Purwanti et al. reported higher stunting prevalence among children with incomplete immunization (adjusted prevalence ratio 1.18, 95% CI 1.15–1.22) and among those with no immunization (1.27, 95% CI 1.17–1.37), compared with fully immunized children. These results provide a relevant comparison, although their prevalence ratios should not be directly equated with the odds ratios reported here [24].

Immunization status can also serve as an indicator of access to and engagement with preventive services. Families who complete immunization may differ in transportation, continuity of contact with health workers, maternal health literacy, or use of growth monitoring. Those features were not comprehensively measured. The present association consequently cannot separate the contribution of disease prevention from the broader influence of service access. Nor should basic immunization be described as preventing every infection that may impair growth [2,11,24].

The immunization finding supports efforts to identify and follow up children with missed vaccinations while maintaining accurate records. It does not justify substituting vaccination for nutrition assessment, dietary support, or evaluation of recurrent illness. Clinical assessment of impaired growth should integrate anthropometric findings with feeding and medical history, recognizing that children with similar attained height may have different underlying needs [2,25].

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Local implications and future research

For the Uluidanotae service area, a reasonable programmatic priority is coordinated outreach across the 11 villages. Lactation counseling can be linked to antenatal and postnatal contacts, with follow-up for feeding difficulties and age-appropriate complementary feeding. Immunization registers can help identify children with missed doses and guide contact through village health workers or outreach sessions. These are proposed service responses to the observed associations, not interventions evaluated by this study [18,20,24].

Growth monitoring should connect detection to assessment and support. Where additional feeding is considered, attention to the child's actual dietary gap, household circumstances, and follow-up is important; provision of food alone does not establish that all causes of growth faltering have been addressed. The broader literature on supplementary feeding and nutrition-sensitive programs supports linking direct nutritional support with caregiving and accessible services [23,26].

Future studies should distinguish maternal age at pregnancy from age at interview, account for child age and sex, and measure prenatal growth, birth weight, maternal height, diet, infection history, food security, and water and sanitation conditions. Sex-related differences reported elsewhere cannot be inferred merely from the proportion of girls in this sample. Prospective measurement would improve temporal assessment, while qualitative work could investigate local barriers to breastfeeding and immunization. Evaluations of outreach or counseling programs would then be needed to test whether the proposed service changes improve coverage and growth outcomes [8,9,27,28].

Study limitations

The cross-sectional design limits causal interpretation, and the single-center sample limits transferability to other service areas. Recruitment from a health-center population may introduce selection bias, especially if access to care influences inclusion. The sample contained only 28 children with stunting, limiting the precision of estimates and the extent of multivariable adjustment. Differences in p-values between unadjusted and adjusted analyses should not be used to rank causal importance.

Retrospective reporting of breastfeeding and income is vulnerable to recall and social-desirability bias. Immunization records were not comprehensively verified for every participant, creating a further possibility of exposure misclassification. The measurement properties of the adapted questionnaire in this population remain uncertain. These limitations can affect both the estimated strength and direction of associations.

Maternal height and nutritional status, birth weight, prematurity, detailed nutrient intake, household food security, and environmental sanitation were not included in the reported model. Consequently, residual confounding remains plausible. The income categories also provide less information than measures of household consumption or economic security. A model containing only education, breastfeeding, and immunization cannot establish the relative importance of determinants that were not measured or modeled.

Conclusions

Stunting was present in 24.3% of children in this study sample. A history of exclusive breastfeeding and complete immunization were associated with lower observed stunting proportions, whereas household income did not show a statistically significant association. The reported multivariable model identified associations for breastfeeding and immunization but not for maternal education. These findings support locally adapted breastfeeding support and continuity of immunization within comprehensive child nutrition services, while recognizing that the cross-sectional design does not establish causal effects. Prospective studies with broader assessment of early growth, diet, infection, and household conditions are needed to guide and evaluate targeted interventions.

Conflict of Interest

The authors declare that they have no financial or non-financial conflicts of interest related to the research, authorship, or publication of this article.

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References

[1] WHO Multicentre Growth Reference Study Group. WHO child growth standards: length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: methods and development. Geneva: World Health Organization; 2006. https://www.who.int/publications/i/item/924154693X (accessed September 15, 2026).

[2] Black RE, Victora CG, Walker SP, Bhutta ZA, Christian P, de Onis M, et al. Maternal and child undernutrition and overweight in low-income and middle-income countries. Lancet 2013;382:427–451. https://doi.org/10.1016/S0140-6736(13)60937-X.

[3] Victora CG, de Onis M, Hallal PC, Blössner M, Shrimpton R. Worldwide timing of growth faltering: revisiting implications for interventions. Pediatrics 2010;125:e473–e480. https://doi.org/10.1542/peds.2009-1519.

[4] Victora CG, Adair L, Fall C, Hallal PC, Martorell R, Richter L, et al. Maternal and child undernutrition: consequences for adult health and human capital. Lancet 2008;371:340–357. https://doi.org/10.1016/S0140-6736(07)61692-4.

[5] UNICEF, World Health Organization, World Bank Group. Levels and trends in child malnutrition: UNICEF/WHO/World Bank Group joint child malnutrition estimates: key findings of the 2025 edition. Geneva: World Health Organization; 2025. https://www.who.int/publications/i/item/9789240112308 (accessed September 15, 2026).

[6] Kementerian Kesehatan Republik Indonesia. Survei Status Gizi Indonesia (SSGI) 2024. Jakarta: Kementerian Kesehatan Republik Indonesia; 2025.

[7] Wicaksono F, Harsanti T. Determinants of stunted children in Indonesia: a multilevel analysis at the individual, household, and community levels. Kesmas 2020;15:48–53. https://doi.org/10.21109/kesmas.v15i1.2771.

[8] Siramaneerat I, Astutik E, Agushybana F, Bhumkittipich P, Lamprom W. Examining determinants of stunting in Urban and Rural Indonesian: a multilevel analysis using the population-based Indonesian family life survey (IFLS). BMC Public Health 2024;24:1371. https://doi.org/10.1186/s12889-024-18824-z.

[9] Beal T, Tumilowicz A, Sutrisna A, Izwardy D, Neufeld LM. A review of child stunting determinants in Indonesia. Matern Child Nutr 2018;14:e12617. https://doi.org/10.1111/mcn.12617.

[10] Masdalena. Factors affecting stunting in Indonesia: a study PRISMA (Preferred Reporting Items for Systematic Review & Meta-Analysis). Journal of Pharmaceutical and Sciences 2024;7:159–174. https://doi.org/10.36490/journal-jps.com.v7i2.504.

[11] Azriani D, Masita, Qinthara NS, Yulita IN, Agustian D, Zuhairini Y, et al. Risk factors associated with stunting incidence in under five children in Southeast Asia: a scoping review. J Health Popul Nutr 2024;43:174. https://doi.org/10.1186/s41043-024-00656-7.

[12] UNICEF. Improving Child Nutrition: The achievable imperative for global progress. New York: UNICEF; 2013.

[13] World Health Organization. Global nutrition targets 2025: stunting policy brief. Geneva: World Health Organization; 2014.

[14] Mosley WH, Chen LC. An analytical framework for the study of child survival in developing countries. Popul Dev Rev 1984;10:25–45. https://doi.org/10.2307/2807954.

[15] Smith LC, Haddad L. Reducing child undernutrition: past drivers and priorities for the post-MDG era. World Dev. 2015;68:180–204. https://doi.org/10.1016/j.worlddev.2014.11.014.

[16] Solar O, Irwin A. A conceptual framework for action on the social determinants of health. Geneva: World Health Organization; 2010.

[17] Victora CG, Bahl R, Barros AJD, França GVA, Horton S, Krasevec J, et al. Breastfeeding in the 21st century: epidemiology, mechanisms, and lifelong effect. Lancet 2016;387:475–490. https://doi.org/10.1016/S0140-6736(15)01024-7.

[18] Pérez-Escamilla R, Tomori C, Hernández-Cordero S, Baker P, Barros AJD, Bégin F, et al. Breastfeeding: crucially important, but increasingly challenged in a market-driven world. Lancet 2023;401:472–485. https://doi.org/10.1016/S0140-6736(22)01932-8.

[19] UNICEF. Fed to fail? The crisis of children's diets in early life. 2021 Child Nutrition Report. New York: UNICEF; 2021.

Electronic ISSN : 2656-3088
Homepage: https://www.journal-jps.com

[20] World Health Organization. WHO guideline for complementary feeding of infants and young children 6-23 months of age. Geneva: World Health Organization; 2023. https://www.who.int/publications/i/item/9789240081864 (accessed September 15, 2026).
[21] Surmita S, Sekartini R, Kekalih A, Chandra DN. The role of dietary diversity and other factors to stunting among infants and toddlers in West Java, Indonesia. Egypt Pediatric Association Gaz 2025;73:71. https://doi.org/10.1186/s43054-025-00415-1.
[22] Engle PL, Menon P, Haddad L. Care and nutrition: concepts and measurement. World Dev. 1999;27:1309–1337. https://doi.org/10.1016/S0305-750X(99)00059-5.
[23] Ruel MT, Alderman H. Nutrition-sensitive interventions and programmes: how can they help to accelerate progress in improving maternal and child nutrition?. Lancet 2013;382:536–551. https://doi.org/10.1016/S0140-6736(13)60843-0.
[24] Purwanti ED, Masitoh S, Ronoatmodjo S. Association between basic immunization status and stunting in toddlers aged 12-59 months in Indonesia. J Prev Med Public Health 2025;58:298–306. https://doi.org/10.3961/jpmph.24.230.
[25] Kliegman RM, St. Geme JW III, editors. Nelson textbook of pediatrics. 22nd ed. Philadelphia: Elsevier; 2025. https://www.clinicalkey.com/dura/browse/bookChapter/3-s2.0-C2020103101X (accessed September 15, 2026).
[26] Beaton GH, Ghassemi H. Supplementary feeding programs for young children in developing countries. Am J Clin Nutr 1982;35:863–916. https://doi.org/10.1093/ajcn/35.4.864.
[27] Wamani H, Åstrøm AN, Peterson S, Tumwine JK, Tylleskär T. Boys are more stunted than girls in Sub-Saharan Africa: a meta-analysis of 16 demographic and health surveys. BMC Pediatr. 2007;7:17. https://doi.org/10.1186/1471-2431-7-17.
[28] Danaei G, Andrews KG, Sudfeld CR, Fink G, McCoy DC, Peet E, et al. Risk factors for childhood stunting in 137 developing countries: a comparative risk assessment analysis at global, regional, and country levels. PLoS Med 2016;13:e1002164. https://doi.org/10.1371/journal.pmed.1002164.
[29] Indonesia KKR. Profil Kesehatan Indonesia Tahun 2021 / Petunjuk Teknis Pencegahan Stunting. Jakarta: Kemenkes RI; 2022.
[30] Azriani. Determinants of Stunting in Children: A Global Perspective and Linear Growth Delay. Int. J. Public Health 2024.
[31] Shinta. Faktor Dominan Kejadian Stunting pada Balita. Jurnal Gizi dan Kesehatan Masyarakat 2022.
[32] Manuaba IAC. Ilmu Kebidanan, Penyakit Kandungan, dan KB. Jakarta: EGC; 2010.
[33] Bobak IM. Buku Ajar Keperawatan Maternitas (Maternity Nursing). Jakarta: EGC; 2010.
[34] Cunningham FG. Obstetri Williams (Williams Obstetrics 24th ed.). Jakarta: EGC; 2014.
[35] Rahmawati A. Hubungan Pemberian ASI Eksklusif dengan Kejadian Stunting pada Anak Usia 24–59 Bulan di Wilayah Kerja Puskesmas Samigaluh I Kulon Progo. Jurnal Kesehatan Ibu dan Anak 2022.
[36] Handayani S. Hubungan Pemberian ASI Eksklusif dengan Kejadian Stunting pada Balita Usia 24–60 Bulan di Wilayah Kerja Puskesmas Selopampang. Jurnal Kesehatan Masyarakat Indonesia 2021.
[37] Asprika D. Hubungan Pemberian ASI Eksklusif dengan Kejadian Stunting pada Balita Usia 24–59 Bulan di Wilayah Kerja Puskesmas Cempaka Putih. Jurnal Kesehatan Masyarakat 2023;11.
[38] Marliani L. Hubungan Pemberian ASI Eksklusif dengan Kejadian Stunting pada Anak Usia 6–59 Bulan di Kabupaten Bogor. Jurnal Kesehatan Masyarakat Indonesia 2024.
[39] Imelda S. Faktor-Faktor yang Mempengaruhi Kejadian Stunting pada Anak Balita. Jurnal Ilmu Kesehatan 2020.
[40] Rindani F. Evaluasi Praktik Pemberian ASI Eksklusif dan MP-ASI terhadap Pertumbuhan Anak. Jurnal Gizi Klinik Indonesia 2020.
[41] Alifah S. Hubungan Pendapatan Keluarga dan Pola Asuh dengan Kejadian Stunting pada Balita. Jurnal Kesehatan Masyarakat 2021.
[42] Wati L, Prasetyo B. Hubungan Tingkat Pendapatan Keluarga dengan Kejadian Stunting pada Balita di Wilayah Kerja Puskesmas Gatak Sukoharjo. Jurnal Ilmu Kesehatan 2023.
[43] Sari D, Zelharsandy R. Hubungan Tingkat Pendapatan Keluarga dengan Kejadian Stunting pada Balita di Desa Bansari Kabupaten Temanggung. Jurnal Kesehatan Masyarakat 2022.
[44] Lubis Z. Analisis Faktor Risiko Kejadian Stunting pada Balita di Desa Panyabungan Jae. Jurnal Gizi dan Kesehatan 2019.
[45] Sari. Analisis Hubungan Pendapatan dan Pengetahuan Ibu dengan Kejadian Stunting pada Balita. Jurnal Kesehatan Komunitas 2024.

Electronic ISSN : 2656-3088
Homepage: https://www.journal-jps.com

[46] Khairani N, Effendi R. Hubungan Status Imunisasi Dasar dengan Kejadian Stunting pada Balita di Wilayah Kerja Puskesmas Andalas Kota Padang. Jurnal Kesehatan Medika Saintika 2020.
[47] Maysyura. Hubungan Status Imunisasi dengan Risiko Stunting pada Balita. Jurnal Kebidanan dan Kesehatan Masyarakat 2023.
[48] Imuni.id. Analisis Hubungan Imunisasi Dasar dengan Kejadian Stunting pada Anak Indonesia. 2024.
[49] Trisnawati. Analisis Faktor-Faktor Kejadian Stunting pada Balita di Wilayah Kerja Puskesmas Cimahi Selatan. Jurnal Kesehatan Masyarakat 2023.

Electronic ISSN : 2656-3088
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