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EXPLORATION OF RISK FACTORS FOR STUNTING IN CHILDREN AGED 6-23 MONTHS WITH AND WITHOUT ANEMIA IN INDONESIA

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ABSTRACT
The Indonesian Nutrition Status Survey shows that the prevalence of stunting decreased from 21.6% in 2022 to 19.8% in 2024; however, it still exceeds the national target of 14%. This study aimed to identify factors associated with stunting through stratified analyses among anemic and non-anemic children. This study used secondary data from the 2018 Indonesia Basic Health Survey (RISKESDAS). Among 26,933 children aged 6–23 months who had anthropometric data, only 670 underwent hemoglobin testing, including 363 anemic (Hb <11 g/dL) and 287 non-anemic children. Multiple logistic regression was used for analysis. Stunting prevalence was higher among anemic children (30.3%) than non-anemic children (25.8%). Stratified analysis showed that child nutritional status and age were associated with stunting in both groups. Among anemic children, those aged 6–12 months had a significantly lower risk of stunting (AOR = 0.26). Among non-anemic children, the absence of maternal iron supplementation during pregnancy increased the risk of stunting more than fivefold (AOR = 5.14), while older maternal age at delivery slightly reduced the risk (AOR = 0.91). These findings suggest that stunting prevention strategies may benefit from considering differences by anemia status, while recognizing that the observed associations rather than evidence of causal effects.

Keywords: anemia; growth disorders; Indonesia; risk factors.

INTRODUCTION
Stunting is a condition in children under five characterized by height-for-age below 2 standard deviations below the World Health Organization (WHO) child growth standards (Kusrini & Laksono, 2020; Li et al., 2019; World Health Organization, 2022). It is an irreversible consequence of inadequate nutrition and repeated infections during the first 1,000 days of life and remains a major global public health problem affecting millions of children. Stunting is associated with increased morbidity and mortality, impaired cognitive and physical development, reduced productivity, and a higher risk of chronic diseases in adulthood, thereby perpetuating the cycle of malnutrition and constraining economic development (Engidaye et al., 2019; Hasriani, 2023; Li et al., 2019; World Health Organization, 2022).

Stunting remains a major public health problem worldwide and in Indonesia. Globally, around 22–23% of children under five years of age are stunted, which is equivalent to approximately 150 million children in 2024 (World Health Organization, 2025). In Indonesia, the prevalence of stunting has consistently remained high, reaching 36.8% in 2007, slightly decreasing to 35.6% in 2010, increasing again to 37.2% in 2013, and remaining at a relatively high level of 30–39% in 2018, including 29.9% among children under two years and 30.8% among toddlers (Health Research and Development Agency, 2018). Although the prevalence declined to 27.67% in 2019 (BPS, 2019) and further decreased to 21.5% in 2023, this figure still exceeds the national target of 14% (Health Policy and Development Agency Ministry of Health Republic of Indonesia, 2023).

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Anemia among children under five remains a serious public health problem that requires urgent attention. Based on the Indonesian Basic Health Survey (RISKESDAS) from 2007 to 2018, the prevalence of anemia in children under five increased markedly from 19.7% in 2007 to 38.5% in 2018 (Health Research and Development Agency, 2018). Although the 2023 National Health Survey reported a decline in anemia prevalence among children under five to 23.8%, this level remains unacceptably high (Health Policy and Development Agency Ministry of Health Republic of Indonesia, 2023). Furthermore, a study conducted in Aceh Province documented an extremely high prevalence of anemia among children aged 1–3 years, reaching 76.1% (Randell et al., 2022).

Anemia constitutes a major barrier to stunting prevention in children, particularly during the critical early-life period of 0–23 months. Iron deficiency can impair linear growth through several biological pathways, including reduced oxygen transport capacity to tissues, disrupted cellular metabolism, and diminished growth hormone activity and immune function, which ultimately increase susceptibility to recurrent infections. These mechanisms render children with anemia more vulnerable to growth faltering than their non-anemic counterparts, suggesting that anemia may act as a modifier of the risk of stunting. This vulnerability is especially pronounced among children aged 6–23 months, a transitional phase to complementary feeding during which iron requirements rise sharply while dietary intake is often inadequate (Guja et al., 2025; Oktarina et al., 2024).

Conceptually, the determinants of stunting can be grouped into several key domains, namely nutritional, infectious, socioeconomic, environmental, and household-related factors. Nutritional factors include childhood anemia and other micronutrient deficiencies (Dessie et al., 2025; Gaston et al., 2022; Nugraheni et al., 2023), as well as non-exclusive breastfeeding during the first six months of life (Rachmi et al., 2016; Torlesse et al., 2016). Socioeconomic and household factors include low household economic status (Fernald et al., 2012), low parental education, large household size, and a high number of young children. Environmental and health service factors, including poor sanitation and limited access to health services, have been shown to substantially contribute to the high risk of stunting in Indonesia (Titaley et al., 2019).

Empirical evidence indicates that iron deficiency anemia remains a major public health problem in developing countries, including Indonesia, and is consistently associated with stunting (Oktarina et al., 2024). However, most previous studies using the 2018 RISKESDAS data have treated anemia solely as an independent risk factor and have not examined whether anemia modifies the relationship between other determinants and linear growth. This distinction is important because anemia may reflect underlying biological vulnerability that alters children's susceptibility to nutritional, environmental, and socioeconomic risks. Ignoring this heterogeneity may lead to uniform stunting interventions that are less effective for anemic children. Therefore, this study addresses this gap by stratifying the analysis of stunting determinants among children aged 6–23 months by anemia status, with the aim of providing evidence for more targeted.

METHOD

Study Design and Data Source

This study used secondary data from the 2018 RISKESDAS, a nationally representative cross-sectional survey conducted by the Ministry of Health, Republic of Indonesia. RISKESDAS employs a multistage cluster sampling design to generate population-level health estimates. Given the cross-sectional nature of the data, the analyses are intended to identify associations rather than establish temporal or causal relationships.

Study Population and Sample Selection

The target population of RISKESDAS 2018 comprised households across all provinces and districts/cities in Indonesia (34 provinces, 416 districts, and 98 cities). Among 26,933 children aged 6–23 months with valid anthropometric measurements, hemoglobin concentration was measured in only 670 children during the survey, resulting in substantial missing data for this variable. Consequently, the analytical sample was restricted to children aged 6–23 months who had complete data on stunting status, hemoglobin concentration, and all key covariates included in the analysis.

A complete case analysis was therefore employed, in which observations with missing data on any of the variables of interest were excluded. This restriction was applied to ensure consistency and validity in stratified analyses by anemia status, which was the primary focus of the study. Given the study's cross-sectional design and the absence of auxiliary variables to support reliable imputation, no statistical imputation methods were applied. The potential for selection bias due to missing hemoglobin data is acknowledged and is considered in the interpretation of the findings.

Variables and Operational Definitions

Stunting was defined as length- or height-for-age below −2 standard deviations from the median of the WHO Child Growth Standards for age and sex. Childhood anemia was defined as a hemoglobin concentration <11 g/dL, measured using a portable hemoglobin meter. Child-level variables included age (6–12, 13–18, and 19–23 months), sex, and history of diarrhea within the previous month. Nutritional and caregiving factors comprised maternal iron supplementation, complete immunization status, early initiation of breastfeeding, exclusive breastfeeding, and early weaning (cessation of breastfeeding before two years of age). Maternal factors included maternal education level (≤ high school or university), employment status, pregnancy intention, number of antenatal care visits (<4 or ≥4), and access to health services. Access to health services was classified as "easy" when health facilities could be reached without major barriers related to distance, transportation, or cost, and as "difficult" when one or more of these barriers were present, in accordance with RISKESDAS operational guidelines. Environmental factors included the drinking water source and child feces disposal practices. Drinking water sources were categorized as "improved" (e.g., piped water, protected wells, or bottled water) or "unimproved" (e.g., surface water or unprotected wells), while feces disposal practices were classified as "appropriate" when a household latrine was used and "inappropriate" when open defecation or unsafe disposal occurred, consistent with national and WHO classifications. All operational definitions followed the National RISKESDAS 2018 report.

Statistical Analysis

The total population was divided into 2 groups based on anemia status (57.1% anemic, and 42.9% not anemic), and then cross-tabulation analysis was performed for each group. Logistic regression analysis was used to identify significant factors associated with stunting in children aged 6-23 months, stratified by anemia status. Model fit and prediction accuracy were evaluated using metrics such as Akaike Information Criterion (AIC) and number of observations (N) in the anemia and non-anemia groups. All analyses were conducted using RStudio, with statistical significance set at $p < 0.05$. Given the complex survey design of RISKESDAS, findings were interpreted with caution due to limitations in fully accounting for survey weights and clustering in the present analysis.

Ethical Considerations

The RISKESDAS 2018 survey protocol received ethical approval from the Health Research Ethics Committee of the National Institute of Health Research and Development, Ministry of Health of the Republic of Indonesia. Official permission to use the anonymized secondary data was obtained, and no additional ethical approval was required for this analysis.

RESULTS AND DISCUSSION

The cross-tabulation analysis of risk factors for stunting in children aged 6-23 months with anemia showed that the prevalence of stunting in this population was 30.3%. Child age was associated with stunting prevalence, with children aged 6–12 months having a lower prevalence (19.7%) than those aged 13–18 months (35.2%) and 19–24 months (39.4%) ($p < 0.001$). Nutritional status, as indicated by BMI, also differed between groups, with stunted children having a lower mean BMI (15.89) than non-stunted children (17.11) ($p < 0.001$). Meanwhile, diarrhea (27.6% vs. 30.9%, $p = 0.57$) and maternal employment status (32.4% vs. 29.5%, $p = 0.57$) showed no statistically significant association with stunting.

Table 1: Factors associated with stunting among anemic children aged 6–23 months.

Stunting Risk Factors n (%)	Stunting Status n (%)			P-value
	Normal 267 (69.7)	Stunting 116 (30.3)	Total 383 (100.0)	
Diarrhea Status				
Yes, <1 month	55 (72.4)	21 (27.6)	76 (100.0)	
No	212 (69.1)	95 (30.9)	307 (100.0)	0.57
Sex				
Male	142 (66.0)	73 (34.0)	215 (100.0)	
Female	125 (74.4)	43 (25.6)	168 (100.0)	0.08
Child Age Category				
6–12 months	122 (80.3)	30 (19.7)	152 (100.0)	
13–18 months	79 (64.8)	43 (35.2)	122 (100.0)	
19–24 months	66 (60.6)	43 (39.4)	109 (100.0)	0.00
Immunization History				
No	207 (70.6)	86 (29.4)	293 (100.0)	
Yes	60 (66.7)	30 (33.3)	90 (100.0)	0.47
Early Initiation of Breastfeeding (EIBF)				
No	99 (67.3)	48 (32.7)	147 (100.0)	
Yes	168 (71.2)	68 (28.8)	236 (100.0)	0.43
Exclusive Breastfeeding				
No	9 (60.0)	6 (40.0)	15 (100.0)	
Yes	258 (70.1)	110 (29.9)	368 (100.0)	0.40
Early Weaning				
Already weaned	44 (65.7)	23 (34.3)	67 (100.0)	
Not yet weaned	223 (70.6)	93 (29.4)	316 (100.0)	0.43
Supplementary Feeding (PMT)				
No	136 (66.3)	69 (33.7)	205 (100.0)	
Yes	131 (73.6)	47 (26.4)	178 (100.0)	0.12
Maternal Iron Tablet Supplementation				
No	16 (59.3)	11 (40.7)	27 (100.0)	
Yes	251 (70.5)	105 (29.5)	356 (100.0)	0.22
Maternal Employment Status				
Employed	73 (67.6)	35 (32.4)	108 (100.0)	
Unemployed	194 (70.5)	81 (29.5)	275 (100.0)	0.57
Maternal Education Level				
≤ High school	255 (69.1)	114 (30.9)	369 (100.0)	
College/university	12 (85.7)	2 (14.3)	14 (100.0)	0.18
Pregnancy Intentions				
Unwanted	5 (50.0)	5 (50.0)	10 (100.0)	
Wanted	262 (70.2)	111 (29.8)	373 (100.0)	0.17
ANC Visits				
<4 visits	139 (69.8)	60 (30.2)	199 (100.0)	
≥4 visits	128 (69.6)	56 (30.4)	184 (100.0)	0.95
Pregnancy Complications				
Yes	31 (64.6)	17 (35.4)	48 (100.0)	
No	236 (70.4)	99 (29.6)	335 (100.0)	0.41
Maternal Mental Health Status				
Yes	136 (68.3)	63 (31.7)	199 (100.0)	
No	131 (71.2)	53 (28.8)	184 (100.0)	0.54
Health Insurance Ownership				
No	149 (71.0)	61 (29.0)	210 (100.0)	
Yes	118 (68.2)	55 (31.8)	173 (100.0)	0.56
Residential Area				
Rural	132 (69.5)	58 (30.5)	190 (100.0)	
Urban	135 (69.9)	58 (30.1)	193 (100.0)	0.92

Stunting Risk Factors n (%)	Stunting Status n (%)			P-value
	Normal 267 (69.7)	Stunting 116 (30.3)	Total 383 (100.0)	
Healthcare Access				
Difficult	45 (71.4)	18 (28.6)	63 (100.0)	
Easy	222 (69.4)	98 (30.6)	320 (100.0)	0.75
Number of Adult Household Members				
>3 adults	220 (69.8)	95 (30.2)	315 (100.0)	
≤3 adults	47 (69.1)	21 (30.9)	68 (100.0)	0.91
Number of Under-5 Household Members				
≥2 children	53 (66.3)	27 (33.8)	80 (100.0)	
<2 children	214 (70.6)	89 (29.4)	303 (100.0)	0.45
Child Stool Disposal				
Improper	141 (71.2)	57 (28.8)	198 (100.0)	
Proper	126 (68.1)	59 (31.9)	185 (100.0)	0.51
Drinking Water Source				
Poor	239 (68.9)	108 (31.1)	347 (100.0)	
Good	28 (77.8)	8 (22.2)	36 (100.0)	0.27
Child Nutritional Status (BMI); Mean (SD)	15.89 (2.18)	17.11 (2.81)	16.26 (2.45)	0.00
Maternal Age at First Birth; Mean (SD)	21.58 (6.36)	21.38 (4.51)	21.52 (5.86)	0.76
Gestational Age at Birth; Mean (SD)	38.07 (2.04)	37.74 (2.26)	37.97 (2.11)	0.16

Source: Calculated by authors, 2025.

The cross-tabulation analysis of risk factors for stunting in children aged 6–23 months without anemia showed that the prevalence of stunting was lower (25.8%) compared to children with anemia. Among this population, child age was significantly associated with stunting, with the lowest prevalence in children aged 6–12 months (15.5%) compared to those aged 13–18 months (33.3%) and 19–24 months (29.0%) ($p = 0.01$). Children who did not receive blood supplement tablets had a higher prevalence of stunting (52.6%) than those who received them (23.9%) ($p = 0.01$). In addition, the average maternal age at delivery was lower among stunted children (20.74 years) than among non-stunted children (22.97 years) ($p = 0.02$). Other variables did not show statistically significant associations with stunting ($p \geq 0.05$).

Table 2. Factors associated with stunting among non-anemic children aged 6–23 months.

Stunting Risk Factors n (%)	Stunting Status n (%)			P-value
	Normal 213 (74.2)	Stunting 74 (25.8)	Total 287 (100.0)	
Diarrhea Status				
Yes, <1 month	27 (67.5)	13 (32.5)	40 (100.0)	
No	186 (75.3)	61 (24.7)	247 (100.0)	0.30
Sex				
Male	109 (70.8)	45 (29.2)	154 (100.0)	
Female	104 (78.2)	29 (21.8)	133 (100.0)	0.15
Child Age Category				
6–12 months	82 (84.5)	15 (15.5)	97 (100.0)	
13–18 months	60 (66.7)	30 (33.3)	90 (100.0)	
19–24 months	71 (71.0)	29 (29.0)	100 (100.0)	0.01
Immunization History				
No	163 (75.8)	52 (24.2)	215 (100.0)	
Yes	50 (69.4)	22 (30.6)	72 (100.0)	0.28
Early Initiation of Breastfeeding (EIBF)				
No	83 (75.5)	27 (24.5)	110 (100.0)	
Yes	130 (73.4)	47 (26.6)	177 (100.0)	0.71

Stunting Risk Factors n (%)	Stunting Status n (%)			P-value
	Normal 213 (74.2)	Stunting 74 (25.8)	Total 287 (100.0)	
Exclusive Breastfeeding				
No	15 (65.2)	8 (34.8)	23 (100.0)	
Yes	198 (75.0)	66 (25.0)	264 (100.0)	0.30
Early Weaning				
Already weaned	56 (76.7)	17 (23.3)	73 (100.0)	
Not yet weaned	157 (73.4)	57 (26.6)	214 (100.0)	0.57
Supplementary Feeding (PMT)				
No	104 (75.9)	33 (24.1)	137 (100.0)	
Yes	109 (72.7)	41 (27.3)	150 (100.0)	0.53
Maternal Iron Tablet Supplementation				
No	9 (47.4)	10 (52.6)	19 (100.0)	
Yes	204 (76.1)	64 (23.9)	268 (100.0)	0.01
Maternal Employment Status				
Employed	63 (75.0)	21 (25.0)	84 (100.0)	
Unemployed	150 (73.9)	53 (26.1)	203 (100.0)	0.85
Maternal Education Level				
≤ High school	202 (74.3)	70 (25.7)	272 (100.0)	
College/university	11 (73.3)	4 (26.7)	15 (100.0)	0.94
Pregnancy Intentions				
Unwanted	6 (85.7)	1 (14.3)	7 (100.0)	
Wanted	207 (73.9)	73 (26.1)	280 (100.0)	0.48
ANC Visits				
<4 visits	109 (77.3)	32 (22.7)	141 (100.0)	
≥4 visits	104 (71.2)	42 (28.8)	146 (100.0)	0.24
Pregnancy Complications				
Yes	32 (71.1)	13 (28.9)	45 (100.0)	
No	181 (74.8)	61 (25.2)	242 (100.0)	0.60
Maternal Mental Health Status				
Yes	119 (74.8)	40 (25.2)	159 (100.0)	
No	94 (73.4)	34 (26.6)	128 (100.0)	0.79
Health Insurance Ownership				
No	115 (71.9)	45 (28.1)	160 (100.0)	
Yes	98 (77.2)	29 (22.8)	127 (100.0)	0.31
Residential Area				
Rural	131 (77.5)	38 (22.5)	169 (100.0)	
Urban	82 (69.5)	36 (30.5)	118 (100.0)	0.13
Healthcare Access				
Difficult	20 (64.5)	11 (35.5)	31 (100.0)	
Easy	193 (75.4)	63 (24.6)	256 (100.0)	0.19
Number of Adult Household Members				
>3 adults	178 (72.7)	67 (27.3)	245 (100.0)	
≤3 adults	35 (83.3)	7 (16.7)	42 (100.0)	0.14
Number of Under-5 Household Members				
≥2 children	52 (81.3)	12 (18.8)	64 (100.0)	
<2 children	161 (72.2)	62 (27.8)	223 (100.0)	0.14
Child Stool Disposal				
Improper	108 (75.0)	36 (25.0)	144 (100.0)	
Proper	105 (73.4)	38 (26.6)	143 (100.0)	0.76
Drinking Water Source				
Poor	182 (73.1)	67 (26.9)	249 (100.0)	
Good	31 (81.6)	7 (18.4)	38 (100.0)	0.27

Stunting Risk Factors n (%)	Stunting Status n (%)			P-value
	Normal 213 (74.2)	Stunting 74 (25.8)	Total 287 (100.0)	
Child Nutritional Status (BMI); Mean (SD)	16.13 (2.44)	18.81 (11.02)	16.82 (6.07)	0.00
Maternal Age at First Birth; Mean (SD)	22.97 (7.74)	20.74 (4.29)	22.40 (7.07)	0.02
Gestational Age at Birth; Mean (SD)	37.98 (2.46)	37.82 (2.73)	37.94 (2.53)	0.65

Source: Calculated by authors, 2025.

Table 3 presents multivariable logistic regression models examining factors associated with stunting among children aged 6–23 months, stratified by anemia status. Variables included in the models were selected based on prior empirical evidence and conceptual frameworks on child undernutrition, encompassing child-, maternal-, and environmental-level characteristics. Stratification by anemia status was conducted to explore potential effect modification.

After adjustment for relevant covariates, child age remained significantly associated with stunting in both groups ($p < 0.001$). Among children in the anemia group, those aged 6–12 months had a lower odd of stunting compared with older children (AOR = 0.262; 95% CI: 0.137–0.502), reflecting age-related differences within this subgroup. In the non-anemia group, maternal iron tablet supplementation during pregnancy was significantly associated with stunting status; children whose mothers did not receive iron supplementation had higher odds of being stunted (AOR = 5.138; 95% CI: 1.637–16.120). Maternal age at delivery was also inversely associated with stunting in the non-anemia group (AOR = 0.909; 95% CI: 0.849–0.973), which may reflect broader socio-demographic or intergenerational nutritional contexts rather than a direct effect. Other variables, including recent diarrhea, immunization status, and maternal mental health, were not independently associated with stunting after adjustment. Model fit was assessed using the Akaike Information Criterion (AIC). The lower AIC observed in the non-anemia model (AIC = 321.6) compared with the anemia model (AIC = 464.1) indicates a relatively better balance between model fit and model complexity in the non-anemia subgroup, supporting the analytical relevance of stratified modeling.

Table 3: Logistic regression results of the incidence of stunting in children aged 6-23 months with anemia and without anemia.

Stunting Risk Factors	Anemia Status	
	Anemia AOR (95% CI)	Non-Anemia AOR (95% CI)
Diarrhea Status (Yes, <1 month)	0.699 (0.376—1.298)	1.169 (0.499—2.738)
Sex (Female)	0.615 (0.370—1.021)	0.788 (0.414—1.498)
Child Age Category (6–12 months)	0.262*** (0.137—0.502)	0.252** (0.106—0.600)
Immunization History (No)	0.891 (0.490—1.621)	0.871 (0.427—1.779)
Early Initiation of Breastfeeding (No)	1.201 (0.711—2.030)	0.699 (0.354—1.380)
Exclusive Breastfeeding (No)	1.091 (0.323—3.679)	1.434 (0.463—4.440)
Early Weaning (Already weaned)	0.988 (0.517—1.889)	1.488 (0.706—3.134)
Supplementary Feeding (No)	1.299 (0.785—2.150)	1.178 (0.626—2.219)
Child Nutritional Status	1.315*** (1.175—1.472)	1.253*** (1.111—1.413)
Maternal Iron Tablet Supplementation (No)	1.919 (0.767—4.800)	5.138** (1.637—16.120)
Maternal Employment Status (Employed)	1.023 (0.524—1.999)	1.095 (0.499—2.405)
Maternal Education Level (≤High school)	2.143 (0.398—11.55)	0.829 (0.179—3.832)
Pregnancy Intentions (Unwanted)	3.157 (0.742—13.43)	0.680 (0.0663—6.973)
ANC Visits (<4 visits)	1.140 (0.691—1.878)	0.571 (0.301—1.085)
Pregnancy Complications (Yes)	1.024 (0.483—2.171)	1.039 (0.438—2.469)
Maternal Mental Health Status (Yes)	0.911 (0.499—1.663)	0.869 (0.409—1.848)
Health Insurance Ownership (No)	0.771 (0.461—1.291)	1.196 (0.623—2.293)
Maternal Age at First Birth	0.999 (0.955—1.044)	0.909** (0.849—0.973)
Gestational Age at Birth	0.920 (0.821—1.032)	1.023 (0.906—1.155)

Stunting Risk Factors	Anemia Status	
	Anemia AOR (95% CI)	Non-Anemia AOR (95% CI)
Residential Area (Rural)	1.042 (0.613—1.773)	0.829 (0.434—1.584)
Health Care Access (Difficult)	0.775 (0.385—1.561)	1.222 (0.455—3.283)
Drinking Water Source (Poor)	1.607 (0.622—4.155)	1.638 (0.560—4.793)
Number of Adult Household Members (>3 adults)	1.022 (0.536—1.949)	1.727 (0.653—4.571)
Number of Under-5 Household Members (≥2 children)	1.222 (0.654—2.283)	0.526 (0.225—1.229)
Child Stool Disposal (Improper)	0.927 (0.560—1.536)	0.811 (0.433—1.520)
Constants	0.072 (0.001—11.520)	0.025 (0.001—12.079)
AIC	464.1	321.6
N	383	287

*** p < 0.001; ** p < 0.01; * p < 0.05

Source: Calculated by authors, 2025.

DISCUSSION

Stunting among children aged 6–23 months remains a significant public health problem in Indonesia, given its adverse effects on linear growth, cognitive development, and long-term health outcomes (World Health Organization, 2020). The findings of this study indicate a higher prevalence of stunting among children with anemia (30.3%) than among those without anemia (25.8%), reinforcing evidence that anemia is a vulnerability factor that exacerbates growth impairment (Wilson et al., 2023). These findings are consistent with the UNICEF conceptual framework on the determinants of stunting, which emphasizes the complex interactions among biological, nutritional, infectious, and environmental factors influencing child growth (Akindutire et al., 2025; UNICEF, 1991; Vaivada et al., 2020).

Logistic regression analysis among anemic children indicated that child age was significantly associated with stunting, with children aged 6–12 months showing a lower prevalence of stunting compared with those older than 12 months. This pattern may reflect differences related to the transition to complementary feeding, a period during which energy and micronutrient needs increase, while the quality of complementary foods in Indonesia is often suboptimal, particularly with respect to iron, protein, and other micronutrients important for linear growth (Martín-Rodríguez et al., 2022; Sağlam et al., 2019). In addition, increased susceptibility to infections after 6 months of age may further exacerbate the risk of stunting by impairing nutrient absorption and increasing metabolic demands (Vilcins et al., 2018).

This study found that maternal iron tablet supplementation during pregnancy was significantly associated with stunting only among non-anemic children, whereby children whose mothers did not receive supplementation had a higher risk of stunting (AOR = 5.138; 95% CI: 1.637–16.120). This finding suggests that child anemia status may act as an effect modifier, such that the impact of maternal factors on child growth varies by the child's anemia status. Among non-anemic children, maternal supplementation may serve as a biological reserve that supports postnatal linear growth. In contrast, among anemic children, chronic iron deficiency, recurrent infections, and poor-quality complementary feeding may obscure the protective effect of maternal supplementation (Adu-Afarwuah, 2020; Sowe et al., 2025).

Maternal age at childbirth was significantly associated with stunting among non-anemic children, with older maternal age showing a protective effect (AOR = 0.909; 95% CI: 0.849–0.973). This finding can be interpreted from a life course and intergenerational malnutrition perspective. Mothers who become pregnant during adolescence are more likely to experience biological immaturity, suboptimal nutritional status, and socioeconomic constraints, which may impair fetal growth and increase the risk of stunting in their children (Duncan et al., 2018; Falster et al., 2018). This framework helps explain how stunting can recur across generations and underscores the importance of delaying age at pregnancy and ensuring adequate maternal nutritional interventions.

Several determinants that are theoretically expected to be associated with stunting—such as diarrhea, immunization status, breastfeeding practices, and sanitation indicators—were not

statistically significant in this analysis. This finding may be attributable to the relative homogeneity of the analytical sample, limited variability in key exposures, potential maternal reporting bias, residual confounding, and possible selection bias from restricting the analysis to children with complete hemoglobin and covariate data. In addition, cross-sectional study design limits the ability to assess temporal directionality or infer causality; therefore, these observed associations should be interpreted with caution and warrant further investigation using longitudinal or more comprehensive data.

The multivariable regression models yielded AIC values of 464.1 for the anemia group and 321.6 for the non-anemia group, indicating a moderate model fit. The lower AIC in the non-anemia model suggests a better balance between model complexity and goodness of fit. Although a wide range of variables was included, other unmeasured determinants may still exist, highlighting the need for further research to explore both direct and indirect pathways of stunting risk.

These findings emphasize the need for integrated strategies to prevent stunting by addressing maternal, child, and environmental factors. Interventions during the first 1,000 days of life—including maternal iron supplementation, improved quality of complementary feeding, delayed adolescent pregnancy, and enhanced WASH practices—are critical to breaking the intergenerational cycle of malnutrition in Indonesia. Linking these findings to national policies, such as antenatal care coverage and maternal iron supplementation programs, is essential for evidence-based intervention planning. This study used RISKESDAS 2018 data on direct hemoglobin measurements in children, conducted by trained personnel. However, the cross-sectional design limits causal inference, and potential recall bias and unmeasured confounding cannot be ruled out. Nevertheless, this analysis provides important insights into the interaction between maternal and child factors in shaping stunting risk in Indonesia.

CONCLUSION

The analysis found a higher prevalence of stunting among children with anemia compared with those without anemia; however, this finding reflects an association and should not be interpreted as evidence of causality. Across both groups, child age and nutritional status were consistently associated with stunting, underscoring the importance of early life as a critical period for child growth. Iron supplementation during pregnancy was significantly associated with a lower prevalence of stunting among children without anemia, suggesting a potential role of adequate maternal nutrition in supporting linear growth. Overall, these findings highlight the need to strengthen maternal and child nutrition programs, particularly those that address maternal iron supplementation and appropriate feeding practices during infancy and early childhood (6–23 months). Such efforts should be considered within the context of observed associations and interpreted alongside the study's design limitations when informing strategies to address stunting in Indonesia.

Artificial Intelligence (AI) Use Disclosure

The authors declare that artificial intelligence (AI) tools were used solely for language editing and to improve readability. No AI tools were used for data analysis, interpretation, or generation of scientific content. The authors have reviewed and approved the final manuscript and take full responsibility for its integrity and accuracy.

REFERENCES

Adu-Afarwuah, S. (2020). Impact of nutrient supplementation on maternal nutrition and child growth and development in Sub-Saharan Africa: the case of small-quantity lipid-based nutrient supplements. *Maternal & Child Nutrition*, *16*(S3), e12960. https://doi.org/10.1111/mcn.12960

Akindutire, O. R., Ramroop, S., & Habyarimana, F. (2025). Determinants associated with anemia level among children under 5 years in Gambia: a structural equation modelling approach.

Frontiers in Public Health, *13*, 1598157. https://doi.org/10.3389/fpubh.2025.1598157

Dessie, G., Li, J., Nghiem, S., & Doan, T. (2025). Prevalence and determinants of stunting-anemia and wasting-anemia comorbidities and micronutrient deficiencies in children under 5 in the least-developed countries: A systematic review and meta-analysis. *Nutrition Reviews*, *83*(2), e178–e194. https://doi.org/10.1093/nutrit/nuae063

Duncan, G. J., Lee, K. T. H., Rosales-Rueda, M., & Kalil, A. (2018). Maternal age and child development. *Demography*, *55*(6), 2229–2255. https://doi.org/10.1007/s13524-018-0730-3

Engidaye, G., Melku, M., & Wondimeneh, Y. (2019). Under nutrition, maternal anemia and household food insecurity as risk factors of anemia among preschool aged children in Menz Gera Midir district, Ethiopia. *BMC Public Health, 19*, 968. https://doi.org/10.1186/s12889-019-7293-0

Falster, K., Hanly, M., Banks, E., Lynch, J., Chambers, G., Brownell, M., Eades, S., & Jorm, L. (2018). Maternal age and offspring developmental vulnerability at age five: A population-based cohort study of Australian children. *PLOS Medicine*, *15*(4), e1002558. https://doi.org/10.1371/journal.pmed.1002558

Fernald, L. C. H., Kariger, P., Hidrobo, M., & Gertler, P. J. (2012). Socioeconomic gradients in child development in very young children: Evidence from India, Indonesia, Peru, and Senegal. *Proceedings of the National Academy of Sciences*, *109*(supplement_2), 17273–17280. https://doi.org/10.1073/pnas.1121241109

Gaston, R. T., Habyarimana, F., & Ramroop, S. (2022). Joint modelling of anaemia and stunting in children less than five years of age in Lesotho: a cross-sectional case study. *BMC Public Health*, *22*(1), 285. https://doi.org/10.1186/s12889-022-12690-3

Guja, H., Belgiu, M., Baye, K., & Stein, A. (2025). Prevalence and determinants of stunting and anaemia in children aged 6–23 months: A multilevel analysis from rural Ethiopia. *Maternal & Child Nutrition*, *21*(1), e13736. https://doi.org/10.1111/mcn.13736

Hasriani. (2023). Implications of stunting on children's health and development in Pangkajene and Kepulauan. *Jurnal Keluarga Berencana, 8*(2), 59–69. https://doi.org/10.37306/kkb.v8i2.184

Health Policy and Development Agency Ministry of Health Republic of Indonesia. (2023). *Results of the 2023 Indonesian Health Survey (IHS)*. https://www.badankebijakan.kemkes.go.id/en/hasil-ski-2023/

Health Research and Development Agency. (2018). *National Report of the 2018 Indonesian Basic Health Survey (RISKESDAS)*. https://repository.badankebijakan.kemkes.go.id/id/eprint/3514/

Kusrini, I., & Laksono, A. D. (2020). Regional disparities of stunted toddler in Indonesia. I*ndian Journal of Forensic Medicine & Toxicology, 14*(3), 1685–1691. https://doi.org/10.37506/v10/i12/2019/ijphrd/192113

Li, C., Zeng, L., Wang, D., Allen, S., Jaffar, S., Zhou, J., et al. (2019). Growth in early life and physical and intellectual development at school age: A cohort study. *British Journal of Nutrition, 121*(8), 866–876. https://doi.org/10.1017/S0007114519000060

Martín-Rodríguez, A., Bustamante-Sánchez, Á., Martínez-Guardado, I., Navarro-Jiménez, E., Plata-SanJuan, E., Tornero-Aguilera, J. F., & Clemente-Suárez, V. J. (2022). Infancy dietary patterns, development, and health: An extensive narrative review. *Children (Basel, Switzerland)*, *9*(7), 1072. https://doi.org/10.3390/children9071072

Nugraheni, A., Muniroh, M., Nindita, Y., Wahyudi, F., & Hariyana, B. (2023). Association between stunting and anemia among toddlers: Stratified by characteristic of family and immunization status in Mlonggo District, Jepara Regency. *Jurnal Kedokteran Diponegoro (Diponegoro Medical Journal)*, *12*(4), 196–206. https://doi.org/10.14710/dmj.v12i4.38561

Oktarina, C., Dilantika, C., Sitorus, N. L., & Basrowi, R. W. (2024). Relationship between iron deficiency anemia and stunting in pediatric populations in developing countries: A systematic review and meta-analysis. *Children*, *11*(10), 1268. https://doi.org/10.3390/children11101268

Rachmi, C. N., Agho, K. E., Li, M., & Baur, L. A. (2016). Stunting coexisting with overweight in 2·0–4·9-year-old Indonesian children: prevalence, trends and associated risk factors from repeated cross-sectional surveys. *Public Health Nutrition*, *19*(15), 2698–2707. https://doi.org/10.1017/S1368980016000926

Randell, M., Li, M., Rachmi, C. N., Jusril, H., Fox, O., Wibowo, L., Rah, J. H., Pronyk, P., Harmiko, M., Phebe, N., Ahmad, A., Ariawan, I., Negin, J., & Raynes-Greenow, C. (2022). Prevalence of, and factors associated with anaemia in children aged 1–3 years in Aceh, Indonesia: A cross-sectional study. *Nutrition and Health*, *32*(1), 259–268. https://doi.org/10.1177/02601060221116195

Sağlam, N. Ö., Bülbül, L., Kazancı, S. Y., & Hatipoğlu, S. S. (2019). Factors affecting breastfeeding and complementary feeding choices for children aged 24 to 48 months. *Şişli Etfal Hastanesi Tıp Bülteni*, *53*(2), 165. https://doi.org/10.14744/SEMB.2018.91328

Sowe, A., Wood, E., & Gautam, S. (2025). Maternal anemia as a predictor of childhood anemia: evidence from gambian health data. *Nutrients*, *17*(5), 879. https://doi.org/10.3390/nu17050879

Titaley, C. R., Ariawan, I., Hapsari, D., Muasyaroh, A., & Dibley, M. J. (2019). Determinants of the stunting of children under two years old in Indonesia: A multilevel analysis of the 2013 Indonesia basic health survey. *Nutrients*, *11*(5), 1106. https://doi.org/10.3390/nu11051106

Torlesse, H., Cronin, A. A., Sebayang, S. K., & Nandy, R. (2016). Determinants of stunting in Indonesian children: evidence from a cross-sectional survey indicate a prominent role for the water, sanitation and hygiene sector in stunting reduction. *BMC Public Health*, *16*, 669. https://doi.org/10.1186/s12889-016-3339-8

UNICEF. (1991). Strategy for improved nutrition of children and women in developing countries. *The Indian Journal of Pediatrics*, *58*(1), 13–24. https://doi.org/10.1007/BF02810402

Vaivada, T., Akseer, N., Akseer, S., Somaskandan, A., Stefopulos, M., & Bhutta, Z. A. (2020). Stunting in childhood: An overview of global burden, trends, determinants, and drivers of decline. *The American Journal of Clinical Nutrition*, *112*(Suppl 2), 777S-791S. https://doi.org/10.1093/ajcn/nqaa159

Vilcins, D., Sly, P. D., & Jagals, P. (2018). environmental risk factors associated with child stunting: A systematic review of the literature. *Annals of Global Health*, *84*(4), 551–562. https://doi.org/10.9204/aogh.2361

World Health Organization. (2020). *Malnutrition in children*. https://www.who.int/data/nutrition/nlis/info/malnutrition-in-children

World Health Organization. (2022). *Malnutrition (including stunting) in children under 5 years*. https://www.who.int/news-room/fact-sheets/detail/malnutrition

World Health Organization. (2025). *Joint child malnutrition estimates (JME) UNICEF-WHO-WB.* https://www.who.int/data/gho/data/themes/topics/joint-child-malnutrition-estimates-unicef-who-wb

Wilson, S. E., Rogers, L. M., Garcia-Casal, M. N., Barreix, M., Bosman, A., Cunningham, J., Goga, A., Montresor, A., & Tunçalp, Ö. (2023). Comprehensive framework for integrated action on the prevention, diagnosis, and management of anemia: An introduction. *Annuals of the New York Academy of Sciences*, *1524*(1), 5–9. https://doi.org/10.1111/nyas.14999