



Determinants of stunting among children aged 6–59 months in Banten Province: A cross-sectional analysis of the 2021 Indonesian Nutrition Status Survey (INSS)

Dian Isnaini Arifianti^{1*}, Trini Sudiarti², Triyanti², Asih Setiarni², Kusharisupeni Djokosujono²

¹Public Health Center of Cireundeu, East Ciputat, South Tangerang City, Indonesia

²Department of Public Health Nutrition, Universitas Indonesia, Depok, Indonesia

*Correspondence: arifiantigz@gmail.com

ABSTRAK

Latar Belakang: Stunting adalah kondisi gagal tumbuh karena kekurangan zat gizi kronik dan infeksi berulang yang berdampak jangka panjang. Data SSGI 2021 menunjukkan stunting masih menjadi masalah kesehatan masyarakat di Provinsi Banten karena prevalensinya masih tinggi (24,5%).

Tujuan: Penelitian ini bertujuan untuk mengetahui determinan stunting balita 6-59 bulan di Provinsi Banten.

Metode: Desain penelitian cross sectional dengan jumlah sampel 1.643 balita 6-59 bulan menggunakan data SSGI 2021. Variabel independen adalah faktor anak (umur, jenis kelamin, berat lahir, panjang lahir, keragaman pangan); faktor ibu (pendidikan ibu, pekerjaan ibu); faktor kerawanan pangan; faktor kesehatan lingkungan (kepemilikan jamban), faktor penyakit infeksi (riwayat ISPA, diare, pneumonia, TBC); faktor pelayanan kesehatan (pemberian vitamin A pengobatan balita sakit di fasilitas kesehatan). Analisis menggunakan univariat, bivariat (chi-square), dan multivariat (regresi logistik ganda).

Hasil: Proporsi stunting sebesar 22,7%. Determinan stunting balita 6-59 bulan adalah jenis kelamin (AOR 1,351; CI 95% 1,047 – 1,744); pendidikan ibu (AOR 1,484; CI 95% 1,103 – 1,998); panjang lahir (AOR 2,094; CI 95% 1,512 – 2,899); kerawanan pangan (AOR 1,629; CI 95% 1,131 – 2,347)..

Kesimpulan: Stunting merupakan masalah kesehatan masyarakat di Provinsi Banten dengan faktor dominan yaitu panjang lahir pendek (AOR 2.09). Keluarga bayi dengan panjang lahir pendek, khususnya ibu perlu mendapatkan pendampingan (termasuk program gizi dan kesehatan) dan informasi pencegahan stunting sebagai upaya mengejar ketertinggalan agar bayi panjang lahir pendek dapat tumbuh dan memiliki panjang badan normal pada tahun-tahun berikutnya. Pemantauan kesehatan secara rutin bayi PBL pendek juga dianjurkan.

KATA KUNCI: balita; determinan; panjang lahir; stunting

ABSTRACT

Background: Stunting is a growth failure due to chronic malnutrition and recurrent infections long-term impacts. In Banten Province, the prevalence remains high at 24.5%.

Objectives: To identify determinants of stunting among toddlers aged 6-59 months in Banten.

Methods: The cross-sectional study analyzed 1.643 toddlers aged 6-59 months using INSS 2021 data. Independent variables included child factors (age, sex, birth weight, birth length, dietary diversity); maternal factors (education, occupation); food insecurity; environmental health factors (latrine ownership), infectious disease (ARI, diarrhea, pneumonia, tuberculosis); health services (vitamin A, treatment in health facilities). Data were analyzed using univariate, chi-square, and multiple logistic regression.

Results: Stunting prevalence was 22.7%. Significant determinants were male gender (AOR 1.351; 95% CI 1.047 – 1.744); low maternal education (AOR 1.484; 95% CI 1.103 – 1.998); short birth length (AOR 2.094; 95% CI 1.512 – 2.899); and food insecurity (AOR 1.629; 95% CI 1.131 – 2.347).

Conclusions: Stunting remains a public health issue in Banten. The most dominant determinant is short birth length (AOR 2.09). Families of infants with Short Birth Length should receive targeted assistance through nutrition and health programs, education on stunting prevention, and monthly growth monitoring to support catch up growth..

KEYWORD: birth length; determinant; stunting; toddler

Article info:

Article submitted on October 24, 2024

Articles revised on December 24, 2024

Articles received on April 12, 2025

INTRODUCTION

Stunting is characterized by a Body Length/Height for Age (HAZ) below -2 SD, originates in prenatal life, leading to low birth weight and impaired growth within the first two years, often irreversible (1). According to the 2021 Indonesian Nutrition Status Survey (INSS), the prevalence of stunting in Banten Province was reported at 24.5%, slightly surpassing the national average of 24.4%. Subsequent data indicated a decline to 20.0% in the 2022 INSS, followed by an increase to 23.9% in the 2023 Indonesian Health Survey (IHS), before declining again to 21.1% in the 2024 INSS. Over the three-year period from 2021 to 2024, the province experienced a net reduction of 3.4 percentage points in stunting prevalence. While the overall trend suggests progress, the fluctuations highlight the need for sustained and targeted interventions. (2–5). Indonesia aims to reduce stunting to 14% by 2024 (6). A considerable disparity persists between the stunting prevalence in Banten Province in 2024 (21.1%) and the national target of 14%, reflecting a shortfall of 7.1 percentage points. This gap highlights the urgency of implementing more robust, evidence-based strategies tailored to the regional context to achieve national stunting

reduction goals. Stunting impairs not only physical growth but also organ development, including the brain, heart, and kidneys, leading to cognitive deficits and metabolic disorders that increase susceptibility to Non-Communicable Diseases (NCDs) (7). UNICEF (1990) identifies nutritional deficiencies and infections as direct causes, while food insecurity, poor parenting, inadequate healthcare, and unsanitary environments act as indirect contributors. Structural drivers include poverty, low education, limited food access, and economic instability (8). Childhood growth is most rapid in the first year, with a notable deceleration thereafter. During the first two years, body length increases by approximately 30–35 cm. By one year, it reaches 1.5 times the birth length, doubling by age two (7).

Prior research links stunting with gender, low birth weight, birth length, maternal employment and education, and dietary diversity (9–14). Food insecurity limits access to essential nutrients, particularly animal proteins, weakening immunity and increasing infection susceptibility (7,15,16). Acute respiratory infections (ARI) triple stunting risk, while diarrhea raises it 2.8 times (11). Tuberculosis history is also a significant predictor

of stunting (17). Environmental factors such as latrine ownership correlate with stunting incidence, as poor sanitation facilitates disease transmission (18,19). Vitamin A supplementation plays a critical role in enhancing immunity (7), with deficiencies linked to a 2.311 times greater stunting risk (20). Early treatment of stunting risk factors is expected to minimize the risk of stunting and reduce the impact of losses caused by stunting in children under five.

MATERIALS AND METHODS

This study uses secondary data from the 2021 Indonesian Nutritional Status Survey (INSS) in Banten Province with the following variables: child characteristics, maternal characteristics, dietary diversity, food insecurity, history of infectious diseases, sanitation, and access to health services. The dataset was obtained through an official request submitted to the Secretariat of the Health Policy and Development Agency, Ministry of Health of the Republic of Indonesia, through the institutional data access platform at www.badankebijakan.kemkes.go.id. This is a cross-sectional to analyze the relationship

between child factors (age, sex, birth weight, birth length, and dietary diversity), maternal factors (mother's education, mother's occupation), food insecurity, factors with a history of infectious diseases (ARI, diarrhea, pneumonia, tuberculosis), environmental health factors (latrine ownership), and health service factors (giving vitamin A and treating sick toddlers in health facilities) with stunting among toddlers aged 6–59 months in Banten Province.

This study was conducted between February and May 2023, the study included 1.643 eligible toddlers age 6-59 months, with strict inclusion and exclusion criteria ensuring data reliability (**Figure 1**). Ethical approval was granted by the University of Indonesia's Public Health Faculty Ethics Commission (Ket-240/UN2.F10. D11/PPM.00. 02/2023) on May 15, 2023. Statistical analyses were performed using SPSS Statistics (IBM, version 20), encompassing data filtering, editing, cleaning, coding, and transformation. Univariate analysis, bivariate analysis (Chi-square), and multivariate analysis (multiple logistic regression) were employed to assess associations and identify key determinants of stunting.

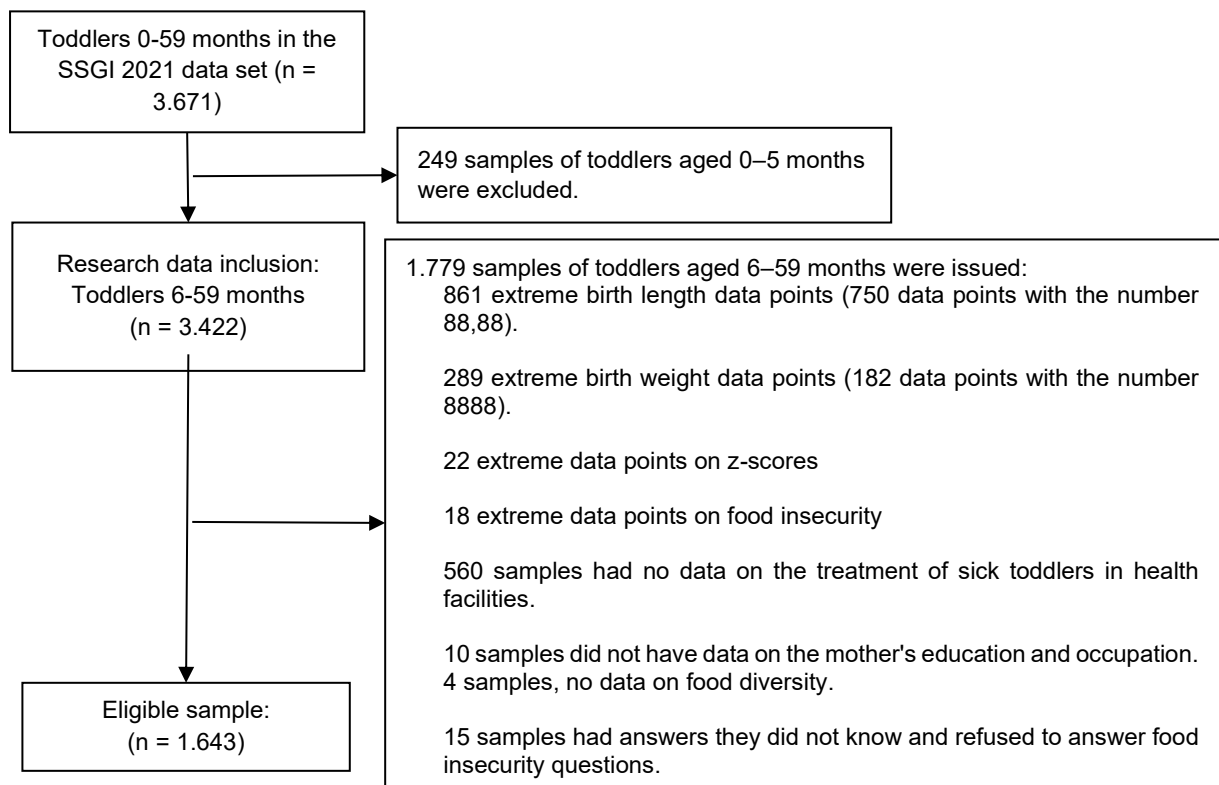


Figure 1. Sample Selection Flow

Table 1. Characteristics of Research Subjects

Variable	Total (N)	Percentage (%)	95% CI
Nutritional Status			
Severely stunted	81	5.0	
Stunted	291	17.7	
Normal	1271	77.3	
Age			
6-23 months	648	39.5	37.0 – 42.0
24-59 months	995	60.5	58.0 – 63.0
Gender			
Male	805	49	46.2 – 51.8
Female	838	51	48.2 – 53.8
Birth Weight			
Low (<2500)	69	4.2	3.2 – 5.5
Normal (≥2500)	1574	95.8	94.5 – 96.8
Birth Length			
Short (<48)	319	19.4	17.3 – 21.8
Normal (≥48)	1324	80.6	78.2 – 82.7
Food Diversity			
Low (<4 out of 7 for 24-59 months; <5 out of 8 for 6-23 months)	575	35	31.8 – 38.4
Normal (≥4 out of 7 for 24-59 months; ≥5 out of 8 for 6-23 months)	1068	65	61.6 – 68.2
Mother's Education Status			
Lower (completing middle school or lower)	795	48.4	44.8 – 52.0
Higher (completing high school or higher)	848	51.6	48.0 – 55.2
Mother's Occupation Status			
Employed	498	30.3	27.6 – 33.2
Housewife	1145	69.7	66.8 – 72.4
Food Insecurity			
Yes (5-8)	200	12.2	10.0 – 14.8
No (0-4)	1443	87.8	85.2 – 90.0
ARI history			
Yes	515	31.4	27.6 – 35.4
No	1128	68.6	64.6 – 72.4
Diarrhea history			
Yes	215	13.1	11.0 – 15.5
No	1428	86.9	84.5 – 89.0
Pneumonia history			
Yes	26	1.6	1.0 – 2.3
No	1617	98.4	97.7 – 99.0
TBC history			
Yes	16	1	0.5 – 1.9
No	1627	99	98.1 – 99.5
Latrine Ownership			
No	90	5,5	3.9 – 7.6
Yes	1553	94,5	92.4 – 96.1
Vitamin A Supplementation			
No	741	45.1	41.2 – 49.1
Yes	902	54.9	50.9 – 58.8
Treatment of Sick Toddlers in Health Facilities			
No	52	3.2	2.3 – 4.3
Yes	1591	96.8	95.7 – 97.7

RESULTS AND DISCUSSIONS

The Indonesian government aimed to cut stunting in children under five to 21.1% by 2021 (21) and 14% by 2024 (6). However, a significant gap persists in 2021, with prevalence exceeding 20% among those aged 6–59 months, necessitating robust, multidimensional stunting interventions. The stunting prevalence among toddlers aged 6–59 months in this study was 22.7% (372 cases), with 5% (81 cases) classified as severely stunted and 17.7% (291 cases) as stunted. This research assessed child, maternal, food insecurity, infection history, environmental, and healthcare factors influencing stunting. Among 1,643 toddlers, 39.5% were aged 6–23 months, and 49% were male. Low birth weight affected 4.2%, and 19.4% had short birth length.

Inadequate food diversity was found in 35% of children. Low maternal education was prevalent in 48.4%, and 30.3% of mothers were employed. Food insecurity affected 12.2% of households. Respiratory infections (31.4%), diarrhea (13.1%), pneumonia (1.2%), and tuberculosis (0.9%) were reported. Only 5.5% lacked latrines; 45.1% consume vitamin A, and 3.2% of sick toddlers were not treated in health facilities (**Table 1**). The average toddler age is 30.39 months, ranging from 6 to 59 months. Mean birth weight is 3.117 grams (2.080–4.200 grams), while average birth length is 48.79 cm (45–53 cm). Dietary diversity among infants (6–23 months) averages 4.38 food groups, with a range of 1–8 groups, whereas toddlers (24–59 months) consume an average of 4.43 food groups, ranging from 1 to 7 groups (**Table 2**).

Table 2. Overview of research subjects based on univariate analysis

Variable	Mean	SD	Min	Max	95% CI
Z-Score (HAZ)	-1.154	1.50	-4.14	1.87	-1.227 - -1.081
Age (months)	30.39	17.15	6	59	29.55 – 31.22
Birth Weight (g)	3.117	0.486	2.080	4.200	3.094 – 3.141
Birth Length (cm)	48.79	1.85	45.0	53.0	48.71 – 48.89
Food Diversity 6-23 months (Group)	4.38	3.25	1	8	4.22 – 4.54
Food Diversity 24-59 months (Group)	4.43	2.17	1	7	4.33 – 4.54

The bivariate analysis identifies several significant determinants of stunting in toddlers. Among child-related factors, males exhibit a higher susceptibility than females (OR=1.298; $p=0.039$), while birth length under 48 cm substantially elevates the risk (OR=2.050; $p=0.001$). Maternal factors also exert a notable influence, with lower maternal education levels correlating with increased stunting prevalence (OR = 1.638; $p=0.001$) and maternal employment serves as a protective determinant, mitigating the likelihood of stunting in children. (OR=0.730; $p=0.040$). Moreover, severe food insecurity markedly heightens the likelihood of stunting (OR=1.743; $p=0.002$). However, age, birth weight, dietary diversity, disease history, latrine ownership, vitamin A supplementation, and access to healthcare for sick toddlers do not demonstrate statistically significant associations with stunting ($p > 0.05$) (**Table 3**).

The multiple logistic regression identifies four significant determinants ($p < 0.05$) contributing to an increased stunting risk. Male gender (OR= 1.351; 95%CI:1.047–1.744) elevates susceptibility by 35.1% compared to females. Low maternal education (OR = 1.484; 95% CI: 1.103–1.998) and food insecurity (OR=1.629; 95% CI: 1.131–2.347) further exacerbate the risk. The most influential factor is short birth length (OR=2.094; 95% CI: 1.512–2.899), indicating that infants born with shorter lengths are more than twice as likely to have stunting (**Table 4**).

The study found no statistically significant relationship between stunting and factors such as age, birth weight, dietary diversity, illness history, latrine ownership, vitamin A supplementation, and sick medical treatment at health facilities. Stunting prevalence was similar across age groups, implying that early-life nutritional inadequacies hinder optimal linear growth.

Table 3. Results of bivariate analysis on the determinants of stunting incidence

Variable	Stunting				Total		P-value	OR (95% CI)
	Yes		No					
	n	%	n	%	n	%		
Age (months)								
6-12	142	21.9	506	78.1	648	100	0.65	0.93
24-59	230	23.1	767	76.9	995	100		(0.69-1.26)
Gender								
Male	291	25.0	604	75.0	805	100	0.04*	1.29
Female	171	20.4	667	79.6	838	100		(1.01-1.66)
Birth Weight (g)								
Low (<2500)	24	34.5	45	65.5	69	100	0.07	1.85
Normal (≥2500)	348	22.1	1226	77.9	1574	100		(0.92-3.71)
Birth Length (cm)								
Short (<48)	108	33.8	211	66.2	319	100	0.001*	2.05
Normal (≥48)	264	19.9	1060	80.1	1324	100		(1.49-2.81)
Food Diversity (food groups)								
Low (<4 out of 7 for 24-59 months;<5 out of 8 for 6-23 months)	129	22.5	446	77.5	575	100	0.908	0.98
Normal (>4 out of 7 for 24-59 months;>5 out of 8 for 6-23 months)	243	22.7	825	77.3	1068	100		(0.749-1.29)
Mother's Education Status								
Lower (completing middle school or lower)	215	27.1	580	72.9	795	100	0.001*	1.63
Higher (completing high school or higher)	157	18.5	691	81.5	848	100		(1.222-2.190)
Mother's Occupation Status								
Employed	94	18.9	403	81.1	498	100	0.040*	0.73
Housewife	278	24.3	867	75.7	1145	100		(0.54-0.98)
Food Insecurity (FIES point)								
Yes (5-8)	64	32.1	136	67.9	200	100	0.002*	1.74
No (0-4)	308	21.3	1134	78.7	1443	100		(1.21-2.50)
History of ARI (Acute Respiratory Infection)								
Yes	121	23.6	394	76.4	515	100	0.586	1.07
No	250	22.2	877	77.8	1128	100		(0.81-1.42)

Variable	Stunting				Total		P-value	OR (95% CI)
	Yes		No					
	n	%	n	%	n	%		
History of Diarrhea								
Yes	61	28,5	153	71.5	215	100	0.057	1.43
No	311	21.8	1117	78.2	1428	100		(0.98-2.07)
History of Pneumonia								
Yes	8	30.7	18	69.3	26	100	0.327	1.52
No	364	22.5	1253	77.5	1617	100		(0.65-11.61)
History of TBC (Tuberculosis)								
Yes	7	43.5	9	56.5	16	100	0.174	2.66
No	365	22.4	1262	77.6	1627	100		(0.61-11.61)
Latrine Ownership								
No	26	28.4	65	71.6	90	100	0.25	1.38
Yes	346	22.3	1206	77.7	1553	100		(0.785-2.43)
Vitamin A Supplementation								
No	173	23.3	568	76.7	741	100	0.64	1.06
Yes	200	22.1	703	77.9	902	100		(0.80-1.41)
Treatment of Sick Toodlers in Health Facilities								
No	10	20.2	41	79.8	52	100	0.645	0.85
Yes	362	22.7	1230	77.3	1591	100		(0.44-1.64)

*significantly different at a 95% confidence level

Birth weight was not directly linked to stunting, as different anthropometric measures capture distinct nutritional outcomes. Dietary diversity did not significantly influence stunting, likely because it does not reflect the intake of nutrient-rich foods, particularly animal protein, which is critical for height development. Short-term infection history (a month) also lacked a correlation, reinforcing the notion that stunting results from chronic nutritional deficits and recurrent illnesses rather than a month health episode. The lack of association between latrine ownership and stunting may be due to the limited sample size of those without latrine. Children with stunting were more likely to receive medical care, possibly indicating increased monitoring of stunting cases by health facilities as a priority of health programs. Vitamin A supplementation did not demonstrate a definitive impact on stunting, indicating that other factors play a more dominant role in determining stunting risk. The bivariate analysis identified maternal employment as a protective factor against stunting, as it enhances household economic stability and improves access to nutrient-rich foods, particularly animal protein sources

essential for optimal growth (7). However, multivariate analysis revealed that maternal employment is not an independent determinant of stunting, suggesting that other factors exert a more significant influence on childhood growth outcomes beyond maternal employment status. The divergence from theoretical expectations underscores the necessity for further research employing more robust analytical methodologies and larger, more representative samples to enhance the validity and generalizability of findings.

Multivariate analysis identified four key determinants of stunting among toddlers (6–59 months) in Banten Province: short birth length, low maternal education, food insecurity, and male gender. Birth length is the dominant determinant of stunting, with multivariate analysis confirming a significant association. Infants with short birth length (SBL) face a 2.094-fold higher risk of stunting, even after adjusting for maternal education, gender, and food insecurity. Findings align with previous studies which showed a significant link between birth length and stunting (22–25).

Table 4. Results of multivariate analysis (multiple logistic regression)

Variable	B	p-value	OR	CI 95%
Male's Gender	0.301	0.021*	1.351	1.047 – 1.744
Low Mother's Education	0.395	0.009*	1.484	1.103 – 1.998
Short Birth Length	0.739	0.001*	2.094	1.512 – 2.899
Food Insecurity	0.488	0.009*	1.629	1.131 – 2.347
Intercept	0.000		1.000	

As a key indicator of fetal nutrition, SBL reflects prenatal protein and energy deficits, often resulting from maternal malnutrition, which impairs fetal growth and height potential (26). Stunting originates from impaired fetal linear growth, crucial for organ development. While some organs continue maturing postnatally, short birth length (SBL) signals early growth disruptions. Developmental plasticity allows fetal adaptation to external stressors, but malnutrition during the first 1,000 days hampers cell division, resulting in smaller, less functional organs and increased susceptibility to environmental stressors. Early growth failure has lasting consequences, as postnatal catch-up growth though possible with optimal nutrition and minimal infections rarely

matches the efficacy of proper early development (7). A study examined the causes and development of stunting in the first year of life by tracking 1,017 infants in Burkina Faso, focusing on how birth and socio-demographic factors affect growth. This study found that premature birth, twin status, and early stunting significantly increase the risk of continued stunting during the first year of life. It highlights the importance of addressing maternal health and nutrition before and during pregnancy, and recommends a multi-sectoral approach to effectively prevent early childhood stunting (27).

Birth length is a primary determinant of stunting, directly corresponding to the body length-for-age index. While birth weight does not

independently predict stunting, its strong correlation with birth length underscores its influence on early growth, particularly in the neonatal phase. This dynamic suggests that birth weight, though not a direct stunting indicator, contributes to overall height development (26). Government interventions during first six months may have contributed to accelerated growth and development post-birth. Rapid Weight Gain during the first 6 months was strongly associated with higher BMI z-scores through age 6, although height did not differ significantly between groups (28).

Low maternal education significantly increases stunting risk after adjusting for birth length, sex, and food insecurity. Extensive research underscores the strong link between maternal education and stunting. In Pakistan, high school and higher education reduced stunting risk by 29% and 54%, respectively (29). Similar associations were found in Nepal, Malaysia, Bangladesh, Ethiopia, and Aceh, with odds ratios ranging from 1.57 to 18.64 (30–33). Pakistan's 2012–2013 survey showed low maternal education increased stunting risk 2.55 times (34). Ethiopian data confirmed education as a protective factor, with higher education further lowering risks. Maternal education enhances nutrition, sanitation awareness, and healthy practices, making it a vital strategy to combat stunting (35). Maternal education is pivotal in shaping nutrition and health outcomes, directly influencing feeding practices and long-term child development. Limited education impairs food selection, preparation, and health knowledge application, while higher education fosters informed parenting and optimal nutritional choices. As primary caregivers, mothers with greater educational attainment make superior dietary decisions, enhancing their children's nutritional status. Parenting practices, influenced by maternal education, family size, nutritional status, and occupation, are crucial in early childhood development (7,31,36,37).

Household food insecurity significantly contributes to stunting among children aged 6–59 months in Banten Province. After adjusting for sex, birth length, and maternal education, food-insecure households face a 1.629-fold higher risk of stunting. This underscores the critical need for

targeted interventions to enhance food security and mitigate childhood malnutrition.

Studies confirm a strong correlation, with food-insecure children facing up to a 1.18 to 6.9-fold higher stunting risk (30,31,38,39). Rooted in economic and political instability, food insecurity disrupts nutrient access, amplifying stunting risks. Poverty-induced scarcity deprives children of essential proteins, vitamins, and minerals, weakening immunity and impairing nutrient absorption. This exacerbates vulnerability to infections, hindering growth. Animal proteins are a key dietary source of glycoproteins, macromolecules consisting of proteins covalently bonded to carbohydrate chains. These glycoproteins play a fundamental role in the regulation and execution of immune responses. Glycoproteins contribute to immune function through several mechanisms, such as They facilitate proper protein folding and structural stability, which are essential for the functional maturation of immune molecules. They mediate antigen presentation, particularly through major histocompatibility complex (MHC) molecules, enabling T cell recognition and activation. They are involved in cell signaling, receptor activation, adhesion, and migration, all of which are critical for coordinated immune responses. Key immune-related glycoproteins include immunoglobulins (IgG, IgA, IgE), MHC class I and II molecules, and various complement proteins. The biosynthesis and glycosylation of these proteins occur primarily in the endoplasmic reticulum (ER) and Golgi apparatus, where precise post-translational modifications determine their stability and immunological function. Disruptions in glycosylation pathways can result in misfolded or non-functional glycoproteins, impairing immune signal and increasing susceptibility to autoimmune conditions, infections, and malignancies. In summary, glycoproteins derived from animal protein intake are essential for maintaining immune competence, highlighting the importance of adequate protein nutrition for immune health. Additionally, inadequate food access fosters poor feeding practices and limits healthcare, clean water, and sanitation, perpetuating a cycle of malnutrition and developmental deficits. (7,16). Indonesia's first COVID-19 case emerged on March 2, 2020, with the pandemic officially ending

on December 30, 2023. The crisis exacerbated health, social, and economic disparities, severely impacting household food security and increasing stunting risks. Economic disruptions led to widespread income loss, rising poverty, and employment instability, reducing access to adequate nutrition for pregnant women, infants, and young children. A 2020 report revealed that 77% of households experienced income declines, 56.7% struggled to afford food, and nearly half faced difficulties purchasing essential nutrition. Inflation, fluctuating food prices, and inadequate infrastructure further restricted access to quality food, disproportionately affecting vulnerable families (7,40,41).

Male gender is a significant predictor of stunting among toddlers aged 6–59 months in Banten Province, with boys facing a 1.351-fold higher risk than girls, even after adjusting for birth length, maternal education, and food insecurity. Research consistently indicates a higher stunting risk among male toddlers. In Ethiopia, boys exhibited greater vulnerability despite similar socioeconomic conditions (35). Environmental stressors like infections, toxins, and pollution further exacerbate gender disparities (42). Studies show males face a 24.11% higher stunting risk (43), with factors such as increased energy expenditure and cultural norms favoring girls' food access (44). In Rwanda, boys were 1.51 times more likely to be stunted, while a multi-country Sub-Saharan study found females had a 0.82 times lower risk. Similarly, in the Philippines, male toddlers were nearly twice as likely to experience stunting (10,15,45). Male fetuses and infants grow faster and have lower fat reserves and weaker immune systems, making them more vulnerable to malnutrition and infections. Their larger size and higher metabolism also increase calorie needs, heightening their risk in times of food shortage or illness (46). Boys face a higher stunting risk due to biological, behavioral, and environmental factors. Their greater energy demands and infection susceptibility hinder growth, especially in food-insecure settings. Increased physical activity elevates energy expenditure, while socio-cultural factors expose them to irregular feeding and higher infection risks. Additionally, heightened sensitivity to toxins and pollution further impairs development (47).

CONCLUSION AND RECOMMENDATIONS

Stunting among toddlers in Banten Province remains a major public health issue, driven by short birth length (SBL), male gender, low maternal education, and food insecurity, with SBL being the most critical factor. Effective prevention requires targeted health interventions for adolescents, prospective brides, and pregnant women. Structured support for families of SBL infants, through health and nutrition programs including stunting education, is essential to promote catch-up growth. Regular health monitoring is crucial for tracking growth and implementing timely interventions. Efforts to prevent stunting must begin during teenager and pregnancy.

REFERENCES

1. WHO. Nutrition Landscape Information System (NLIS) country profile indicators: interpretation guide. [Internet]. Geneva: World Health Organization; 2019 [dikutip 12 September 2022]. Tersedia pada: <https://apps.who.int/nutrition/landscape/help.aspx?menu=0&helpid=391&lang=EN>
2. Kementerian Kesehatan RI. Survei Kesehatan Indonesia (SKI) Tahun 2023. Jakarta: Kementerian Kesehatan RI; 2023. 1–965 hal.
3. Kementerian Kesehatan RI. Buku saku hasil Studi Status Gizi Indonesia (SSGI) tahun 2022 [Internet]. 2022. 1–14 hal. Tersedia pada: <https://www.badankebijakan.kemkes.go.id/buku-saku-hasil-survei-status-gizi-indonesia-ssgi-tahun-2022/>
4. Kementerian Kesehatan RI. SSGI 2024 Dalam Angka. Jakarta; 2025. 1–391 hal.
5. Kementerian Kesehatan RI. Buku saku hasil Studi Status Gizi Indonesia (SSGI) tingkat Nasional, Provinsi dan Kabupaten/Kota tahun 2021. Jakarta: Kementerian Kesehatan RI; 2021. 1–14 hal.
6. Presiden RI. Peraturan Presiden Nomor 72 Tahun 2021 Tentang Percepatan Penurunan Stunting [Internet]. Indonesia; 2021 hal. 75. Tersedia pada: <https://stunting.go.id/perpres-nomor-72-tahun-2021-tentang-percepatan-penurunan-stunting/>

7. Achadi LE, Achadi A, Aninditha T. Pencegahan stunting, pentingnya peran 1000 hari pertama kehidupan. Depok: PT Raja Grafindo Persada; 2020.
8. Rusliani N, Hidayani WR, Sulistyoningih H. Literature review: Faktor-Faktor yang berhubungan dengan kejadian stunting pada balita. *Bul Ilmu Kebidanan dan Keperawatan*. 2022;1(01):32–40.
9. Rice AL, Sacco L, Hyder A, Black RE. Malnutrition as an underlying cause of childhood deaths associated with infectious diseases in developing countries. *Bull World Health Organ* [Internet]. 30 Juni 2000 [dikutip 26 Januari 2023];78(10):1207–21.
10. Yaya S, Oladimeji O, Odusina EK, Bishwajit G. Household structure, maternal characteristics and children's stunting in sub-Saharan Africa: Evidence from 35 countries. *Int Health*. 2022;14(4):381–9.
11. Saputri RA, Tumangger J. Hulu-hilir penanggulangan stunting di Indonesia. *J Polit Issues*. 2019;1(1):1–9.
12. Syah NF. Faktor-faktor yang berhubungan dengan kejadian stunting pada anak usia 6-23 bulan di wilayah kerja Puskesmas Pisangan Kota Tangerang Selatan tahun 2018. UIN Syarif Hidayatullah Jakarta; 2019.
13. Nugroho MR, Sasongko RN, Kristiawan M. Faktor-faktor yang mempengaruhi kejadian stunting pada anak usia dini di Indonesia. *J Obs J Pendidik Anak Usia Dini*. 2021;5(2).
14. Suryawan AE, Ningtyias FW, Hidayati MN. Hubungan pola asuh pemberian makan dan skor keragaman pangan dengan kejadian stunting pada balita usia 24–59 bulan. *Ilmu Gizi Indones*. 2022;6(1):23.
15. Guirindola MO, Goyena EA, Maniego ML V. Risk factors of stunting during the complementary feeding period 6-23 months in the Philippines. *Malays J Nutr*. 2021;27(1):123–40.
16. Tian M, Li X, Yu L, Qian JX, Bai XY, Yang J, et al. Glycosylation as an intricate post-translational modification process takes part in glycoproteins related immunity. *Cell Commun Signal*. 2025;23(1).
17. Nadila NN. Hubungan status gizi stunting pada balita dengan kejadian tuberkulosis. *J Med Utama*. 2021;02(02):475–9.
18. Kemenkes RI. Buku bacaan kader posyandu: "Jangan sebar kotoranmu! Ayo pakai jamban sehatmu!" [Internet]. Jakarta: Kementerian Kesehatan RI; 2022. Tersedia pada: <https://promkes.kemkes.go.id/buku-bacaan-kader-posyandu-jangan-sebar-kotoranmu-ayo-pakai-jamban-sehatmu>
19. Anggraini W, Febriawati H, Amin M. Akses jamban sehat pada balita stunting. *J Keperawatan Silampari*. 2022;6(1):117–23.
20. Rimawati VE, Yanti DE, Aryastuti N. Stunting dan faktor determinannya pada balita usia 6–59 bulan di Kabupaten Lampung Tengah. *Holistik J Kesehat*. 2021;15(3):554–71.
21. Kemenkes RI. Indikator program kesehatan masyarakat dalam RPJMN dan Renstra Kementerian Kesehatan 2020-2024. Jakarta: Kementerian Kesehatan RI; 2020.
22. Sawitri AJ, Purwanto B, - I. Birth weight and birth length affecting stunting incident in toddler. *Indones Midwifery Heal Sci J*. 2021;5(3):325–32.
23. Akib RD, Syahriani., Nurbaya S. Hubungan panjang badan lahir dan berat badan Lahir dengan terjadinya stunting pada balita di daerah lokus dan non lokus stunting di kabupaten Sidrap. *Sehat rakyat (Jurnal Kesehat Masyarakat)*. 2022;1(3):267–72.
24. Swathma D, Lestari H, Teguh R. Analisis faktor risiko BBLR, panjang badan bayi saat lahir dan riwayat imunisasi dasar terhadap kejadian stunting pada balita usia 12-36 bulan di wilayah kerja Puskesmas Kandai Kota Kendari. *JIMKesmas*. 2016;1–10.
25. Wahyuningrum E. Hubungan berat badan lahir panjang badan lahir dan pemberian ASI eksklusif dengan kejadian stunting di Puskesmas Gatak [Internet]. Universitas Muhammadiyah Surakarta; 2020. Tersedia pada: <http://eprints.ums.ac.id/88878/>
26. Antun R. Hubungan berat badan dan panjang badan lahir dengan kejadian stunting anak 12-59 bulan di Provinsi Lampung. *J Keperawatan*. 2016;XII(2):209–18.
27. Mwangome M, Ngari M, Brals D, Bawhere P, Kabore P, McGrath M, et al. Stunting in the first year of life: Pathway analysis of a birth cohort. *PLOS Glob Public Heal* [Internet]. 2024;4(2 February):1–14. Tersedia pada:

- <http://dx.doi.org/10.1371/journal.pgph.0002908>
28. Flores-Barrantes P, Iguacel I, Iglesia-Altaba I, Moreno LA, Rodríguez G. Rapid weight gain, infant feeding practices, and subsequent body mass index trajectories: The calina study. *Nutrients*. 2020;12(10):1–14.
 29. Ali A, Hussain S. The impact of household socio-economic status on child stunting in Pakistan. In: *Proc 18th International Conference on Statistical Sciences*. Lahore, Pakistan; 2021. hal. 93–102.
 30. Budhathoki SS, Bhandari A, Gurung R, Gurung A, Kc A. Stunting among under 5-year-olds in Nepal: Trends and risk factors. *Matern Child Health J* [Internet]. 2020;24(s1):39–47. Tersedia pada: <https://doi.org/10.1007/s10995-019-02817->
 31. Sarma H, Khan JR, Asaduzzaman M, Uddin F, Tarannum S, Hasan MM, et al. Factors influencing the prevalence of stunting among children aged below five years in Bangladesh. *Food Nutr Bull* [Internet]. 2017 [dikutip 26 Januari 2023];38(3):291–301.
 32. Berhe K, Seid O, Gebremariam Y, Berhe A, Etsay N. Risk factors of stunting (chronic undernutrition) of children aged 6 to 24 months in Mekelle City, Tigray Region, North Ethiopia: An unmatched case-control study. *PLoS One* [Internet]. 1 Juni 2019 [dikutip 26 Januari 2023];14(6):e0217736.
 33. Murtaza SF, Gan WY, Sulaiman N, Shariff ZM. Factors associated with stunting among Orang Asli preschool children in Negeri Sembilan, Malaysia. *Malays J Nutr*. 2018;24(2):215–26.
 34. Khan S, Zaheer S, Safdar NF. Determinants of stunting, underweight and wasting among children < 5 years of age: Evidence from 2012-2013 Pakistan demographic and health survey. *BMC Public Health*. 2019;19(1):1–15.
 35. Gebru KF, Haileselassie WM, Temesgen AH, Seid AO, Mulugeta BA. Determinants of stunting among under-five children in Ethiopia : a multilevel mixed- effects analysis of 2016 Ethiopian demographic and health survey data. *BMC Pediatr*. 2019;19:1–13.
 36. Lubis SZ. Determinan kejadian stunting di Puskesmas Alue Bilie Kabupaten Nagan Raya. *J SAGO Gizi dan Kesehatan*. 2022;3(1):74.
 37. Apriluana G, Fikawati S. Analisis Faktor-Faktor Risiko terhadap Kejadian Stunting pada Balita (0-59 Bulan) di Negara Berkembang dan Asia Tenggara. *Media Litbangkes*. 2018;28(4):247–56.
 38. Musyayadah, Adiningsih S. Hubungan ketahanan pangan keluarga dan frekuensi diare dengan stunting pada balita di kampung surabaya. *Amerta Nutr* [Internet]. 2019;3(4):257–62. Tersedia pada: <https://e-journal.unair.ac.id/AMNT/article/view/15050>
 39. Donkor WES, Mbai J, Sesay F, Ali SI, Woodruff BA, Hussein SM, et al. Risk factors of stunting and wasting in Somali pre-school age children: results from the 2019 Somalia micronutrient survey. *BMC Public Health* [Internet]. 2022;22(1):1–11. Tersedia pada: <https://doi.org/10.1186/s12889-021-12439-4>
 40. Balitbang Kemenkes RI. Laporan Nasional SSGI 2020. Jakarta: Badan Penelitian dan Pengembangan Kesehatan; 2020. 1–169 hal.
 41. Kementerian Sekretariat Negara RI. Pemerintah resmi cabut kebijakan PPKM mulai hari ini. [Internet]. Kementerian Sekretariat Negara RI. 2022. Tersedia pada: https://www.setneg.go.id/baca/index/pemerintah_resmi_cabut_kebijakan_ppkm_mulai_hari_ini
 42. Pillai VK, Ortiz-Rodriguez J. Child malnutrition and gender preference in India : The role of culture. *Heal Sci J*. 2015;9(6):8.
 43. Angelina F C, Perdana AA, Humairoh. Faktor kejadian stunting balita berusia 6-23 bulan di Provinsi Lampung. *J Dunia Kesmas*. 2018;3085(3):127–34.
 44. Akombi BJ, Agho KE, Hall JJ, Merom D, Astell-Burt T, Renzaho AMN. Stunting and severe stunting among children under-5 years in Nigeria: A multilevel analysis. *BMC Pediatr* [Internet]. 2017;17(1):1–16. Tersedia pada: <http://dx.doi.org/10.1186/s12887-016-0770-z>
 45. Nshimyiryo A, Hedi-Gauthier B, Mutaganzwa C, Kirk CM, Beck K, Ndayisaba A, et al. Risk factors for stunting among children under five years: A cross-sectional population-based study in Rwanda using the 2015

- Demographic and Health Survey. BMC Public Health. 2019;19(1):1–10.
46. Thompson AL. Greater male vulnerability to stunting? Evaluating sex differences in growth, pathways and biocultural mechanisms. Ann Hum Biol. 2021;48(6):466–73.
47. Atamou L. Hubungan determinan stunting dengan kejadian stunting pada balita di desa lokus stunting. Universitas Indonesia; 2022.