RESEARCH PAPER

The Analysis of Factors to Predict Stunting Among Toddlers in Lampung: A Cross-Sectional Study

Dian Isti Angraini[1*], Rangga Firdaus[2], Merry Indah Sari[3], Efriyan Imantika[4]

[1]Departement of Community Medicine and Public Health, Faculty of Medicine, Universitas Lampung, Indonesia

[2]Master of Educational Technology Study Program, Faculty of Teacher Training and Education, Universitas Lampung, Indonesia

[3]Departement of Medical Education, Faculty of Medicine, Universitas Lampung, Indonesia

[4]Departement of Obstetrics and Gynaecology, Faculty of Medicine, Universitas Lampung, Indonesia

Emails: riditie@gmail.com[1*], rangga.firdaus@gmail.com[2], merry.indahsari@fk.unila.ac.id[3], rayan.rianto@gmail.com[4]

ABSTRACT

Background

The prevalence of stunting among toddlers in Lampung Province remains high, although a decreasing trend has been observed.

Aim

This study aimed to analyze the factors associated with stunting among toddlers in Lampung, Indonesia.

Methods

This cross-sectional study was conducted from August to December 2022 and involved 200 toddlers aged 24–59 months selected using multistage random sampling. Stunting was determined based on anthropometric measurements, defined as height-for-age below −2 standard deviations (SD) according to WHO growth standards. The analysis to predict stunting in toddlers was evaluated using binary logistic regression.

Results

The prevalence of stunting in toddlers was 31%. The risk factors for stunting in toddlers are household food availability ($p = 0.004$), mother's knowledge ($p = 0.029$), family income ($p = 0.041$), energy intake ($p = 0.027$), carbohydrate intake ($p < 0.000$), protein intake ($p = 0.003$), fat intake ($p = 0.006$), iron intake ($p = 0.000$), zinc intake ($p = 0.021$), and vitamin A intake ($p = 0.023$). The main predictors of stunting were household food availability, maternal knowledge, and key nutrient intakes (energy, carbohydrates, iron, and vitamin A).

Conclusion

The prevalence of stunting in Lampung province remains high due the risk factors of stunting are still uncontrolled. Comprehensive interventions addressing both nutritional intake and socio-economic determinants are needed to reduce stunting prevalence.

KEYWORDS: Stunting, toddlers, predictive factors.

How to cite this article: Angraini DI, Firdaus R, Sari MI, Imantika E. The Analysis of Factors to Predict Stunting Among Toddlers in Lampung: A Cross-Sectional Study. Int J Drug Deliv Technol. 2026;16(53s): 984-992. DOI: 10.25258/ijddt.16.53s.156

Source of support: Nil.

Conflict of interest: None.

INTRODUCTION

Stunting is a condition of chronic malnutrition characterized by impaired linear growth and reduced cognitive development. Globally, in 2017, approximately 22.2% of children aged 0-5 years were stunted (Ministry of Health Republic of Indonesia, 2018b). In Indonesia, data from the 2018 Basic Health Research (Riskesdas) reported that 30.8% of children under five years of age were stunted. At the provincial level, the prevalence of stunting in Lampung was 21.3%, with higher rates observed in Pesawaran (27.5%) and South Lampung (29.09%) districts. These two districts are among the five regions in Lampung Province with the highest stunting prevalence (Ministry of Health Republic of Indonesia, 2018a). Consequently, Pesawaran and South Lampung have been designated as priority areas for integrated stunting intervention programs in Indonesia (Ministry of National Development Planning/ Head of National Development Planning Agency Republic of Indonesia, 2019).

Stunting has both short-term and long-term adverse effects. In the short term, it disrupts brain development, cognitive function, physical growth, and metabolic processes (Yustati *et al.*, 2023). The long-term impact is

decreased cognitive ability and academic performance, weakened immunity, and an increased risk of chronic diseases such as diabetes, obesity, cardiovascular disease, cancer, stroke, and disability in old age. (Astarani, Idris and Oktavia, 2020).

The causes of stunting can be classified into direct and indirect factors. Direct factors include inadequate nutritional intake and poor health status. Indirect factors are related to food security (access to nutritious food), caregiving practices (infant and young child feeding), access to health services, and environmental conditions such as water and sanitation. These indirect determinants are further influenced by structural factors, including income inequality, economic conditions, urbanization, food systems, social protection, health systems, agricultural development, and women's empowerment (Huriah *et al.*, 2021).

Previous studies have identified various determinants of stunting. A study conducted in Jember District found that maternal education, family income, maternal nutritional knowledge, exclusive breastfeeding, timing of complementary feeding, zinc and iron adequacy, history of infectious diseases, and genetic factors were associated with stunting (Aridiyah *et al.*, 2015). Similarly, research in Grobogan District reported that nutritional status, child health conditions, consumption of instant foods, and maternal height were significant factors (Yuwanti, Mulyaningrum and Susanti, 2021). National-level analysis using Riskesdas 2018 data also identified father's education (AOR 1, 56; 95% CI 1.22-1.99), mother's education (AOR 1.44; 95% CI 0.89-1.23) mother's height (AOR 2.32; 95%CI 1.94-2.77); father's BMI (AOR 1.15; 95%CI 0.98-1.36), and place of delivery (AOR 1.63; 95%CI 1.35-1, 96) as significant determinants of stunting father's education (Aditianti *et al.*, 2020).

Other studies have highlighted the importance of both nutritional and socio-economic factors. Research in East Aceh District found that energy and protein adequacy, maternal knowledge, maternal education, and family income were associated with stunting (Tanzil and Hafriani, 2021). A literature review in developing countries and Southeast Asia further emphasized that low birth weight, maternal education, household income, and poor sanitation are key risk factors (Apriluana and Fikawati, 2018).

Early detection of stunting is essential to enable timely and appropriate interventions which can reduce its long-term impacts (Goudet *et al.*, 2019). Many studies have been conducted to examine the risk factors for stunting in toddlers, but limited research has comprehensively analyzed both direct and indirect determinants simultaneously. Therefore, a more integrated approach is needed to improve the accuracy of early detection and intervention strategies. The purpose of this study was to analyze direct and indirect factors as risk factors for stunting among toddlers in Lampung, Indonesia. The findings of this study can be used as a basis for making web or mobile-based stunting prediction tools and provide evidence for policymakers to improve child feeding practices and strengthen family support systems.

METHODS

Study Population

This study employed a cross-sectional design conducted from August to December 2022 in Lampung Province, Indonesia. The study population comprised all toddlers aged 24–59 months in the province. A total of 200 toddlers were included as study participants, selected from Pesawaran and South Lampung districts. The sampling process used a multistage random sampling technique. In the first stage, Pesawaran and South Lampung districts were purposively selected due to their relatively high prevalence of stunting. In the second stage, two primary health centers (Puskesmas) were randomly selected from each district using simple random sampling. In the final stage, eligible toddlers aged 24–59 months were selected from Posyandu registration lists within the selected Puskesmas areas using disproportionate random sampling to ensure adequate representation across clusters. Data collection was carried out at integrated health service posts (Posyandu) with the assistance of trained health cadres. Toddlers who met the inclusion criteria were recruited, and informed consent was obtained from their parents or caregivers, both verbally and in written form prior to participation.

Stunting

Stunting was obtained from an anthropometric examination in the form of height. The participant's height was measured without shoes by a wall stadiometer with a sensitivity of 0.1 cm. Stunting is determined based on indicators of height per age according to the Indonesian Ministry of Health.

Direct factor

Nutrient intake is all food and drinks consumed by toddlers in the last 3 months. Nutrient intake includes intake of energy, protein, fat, carbohydrates, iron, zinc, and vitamin A. Nutrient intake will provide an estimate of the average intake of nutrients per day. Estimation of nutrient intake will be compared with the recommended daily allowance (RDA). The comparison of the estimation results with the RDA is called the level of nutritional adequacy. Nutrient intake data were categorized into inadequate and adequate based on semiquantitative food questionnaire.

Indirect factors

Data on family income (less and more than provincial minimum wage), food availability (less and sufficient), access to food (difficult and easy), and food affordability (difficult and easy) were taken using a questionnaire. Data on mothers' knowledge (poor and good) and food taboo (present and absent) were taken using a validated questionnaire.

Statistical analysis

Data were analyzed using descriptive statistics (frequency distribution) and inferential analysis, including the chi-square test and binary logistic regression, to identify predictors of stunting among toddlers. All statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS). Statistical significance was set at $p < 0.05$.

RESULTS

The results of this study showed that the prevalence of stunting in Lampung province was 31%. The characteristics of the respondents in relation to stunting are shown in Table 1. A sample of 200 toddlers aged 24-59 months were included in the study. A high proportion of respondents had inadequate nutrient intake, including energy (57%), carbohydrates (63.5%), protein (51%), iron (60%), zinc (56.5%), and vitamin A (55%). In contrast, 47.5% of respondents had adequate fat intake. Most households had sufficient food availability (84.5%), easy access to food (92%), and affordable food (69.5%). However, a large proportion of mothers had poor nutritional knowledge (76.5%), low family income (63%), and reported the presence of food taboos (63%).

The risk of stunting is higher in toddlers with inadequate nutrient intake (energy 37.7%, carbohydrates 40.9%, protein 41.2%, fat 41.1%, iron 40.8%, zinc 38.1%, vitamin A 38.2%), low food availability (54.8%), poor mother's knowledge (35.3%), low family income (36.5), and had food taboo (32.5%). When compared with the stunting group who had adequate intake, sufficient food availability, good mother's knowledge, more family income (36.5%), and there no food taboo.

The mean energy intake of respondents was 1183 kcal, with 1030 kcal in the stunted group and 1252 kcal in the non-stunted group. The Recommended Dietary Allowance (RDA) for energy is 1350 kcal for children aged 2–3 years and 1400 kcal for those aged 4–5 years. The mean energy intake in both groups was below the RDA, with a difference of 222 kcal between the groups.

The mean carbohydrate intake was 154 g, with 126 g in the stunted group and 166 g in the non-stunted group. The RDA for carbohydrates is 215 g (2–3 years) and 220 g (4–5 years). The mean intake in both groups was below the RDA, with a difference of 40 g.

The mean protein intake was 28 g, with 24 g in the stunted group and 30 g in the non-stunted group. The RDA for protein is 20 g (2–3 years) and 25 g (4–5 years). The mean protein intake in the stunted group met the RDA, while the non-stunted group exceeded it. The difference between the groups was 6 g.

The mean fat intake was 52 g, with 44 g in the stunted group and 55 g in the non-stunted group. The RDA for fat is 45 g (2–3 years) and 50 g (4–5 years). The stunted group had slightly lower intake than the RDA, whereas the non-stunted group exceeded it. The difference between the groups was 11 g.

The mean iron intake was 7.3 mg, with 6.5 mg in the stunted group and 7.6 mg in the non-stunted group. The RDA for iron is 7 mg (2–3 years) and 10 mg (4–5 years). The stunted group had intake below the RDA, while the

non-stunted group met the requirement. The difference between the groups was 1.1 mg.

The mean zinc intake was 4 mg, with 3.5 mg in the stunted group and 4.2 mg in the non-stunted group. The RDA for zinc is 3 mg (2–3 years) and 5 mg (4–5 years). The mean intake in both groups was within the RDA, with a difference of 0.7 mg.

The mean vitamin A intake was 363 RE, with 338 RE in the stunted group and 374 RE in the non-stunted group. The RDA for vitamin A is 400 RE (2–3 years) and 450 RE (4–5 years). The mean intake in both groups was below the RDA, with a difference of 36 RE.

The chi-square test showed that several variables were significantly associated with stunting, including energy intake ($p = 0.027$), carbohydrate intake ($p < 0.001$), protein intake ($p = 0.003$), fat intake ($p = 0.006$), iron intake ($p < 0.001$), zinc intake ($p = 0.021$), vitamin A intake ($p = 0.023$), household food availability ($p = 0.004$), maternal knowledge ($p = 0.029$), and family income ($p = 0.041$). In contrast, food access, food affordability, and food taboos were not significantly associated with stunting ($p = 0.576$; $p = 0.233$; $p = 0.648$).

Table 1: Stunting and Characteristics of Participants

Variables (n=200)	n (%)	Stunting in Toddlers, n (%)		p
		Yes	No	
Toddler Stunting	62			
Yes	(31)			
No	138			
	(69)			
Energy Intake				0.027 *
Inadequate	114 (57)	43 (37.7)	71 (62.3)	
Adequate	86 (43)	19 (22.1)	67 (77.9)	
Carbohydrate Intake				< 0.001 *
Inadequate	127 (63.5)	52 (40.9)	75 (59.1)	
Adequate	73 (36.5)	10 (13.7)	63 (86.3)	
Protein Intake				0.003 *
Inadequate	102 (51)	42 (41.2)	60 (58.8)	
Adequate	98 (49)	20 (20.4)	78 (79.6)	
Fat Intake				0.006 *
Inadequate	95 (47.5)	39 (41.1)	56 (58.9)	
Adequate	105 (52.5)	23 (21.9)	82 (78.1)	
Iron Intake				< 0.001 *
Inadequate	120 (60)	49 (40.8)	71 (59.2)	
Adequate	80 (40)	13 (16.2)	83.8	
Zinc Intake				0.021 *
Inadequate	113 (56.5)	43 (38.1)	70 (61.9)	
Adequate	87 (43.5)	19 (21.8)	68 (78.2)	
Vitamin A Intake				0.023 *
Inadequate	110 (55)	42 (38.2)	68 (61.8)	
Adequate	90 (45)	20 (22.2)	70 (77.8)	
Food Availability in the Household	31 (15.5)	17 (54.8)	14 (45.2)	0.004 *
Less	169 (84.5)	45 (26.6)	124 (73.4)	
Sufficient				
Access To Food				0.576
Difficult	16 (8)	6 (37.5)	10 (62.5)	
Easy	184 (92)	56 (30.4)	128 (69.6)	

Food Affordability	61 (30.5)	23 (37.7)	38 (62.3)	0.233
Difficult				
Easy	139 (69.5)	39 (28.1)	100 (79.1)	
Mother Knowledge	153 (76.5)	54 (35.3)	99 (64.7)	0.029*
Poor				
Good	47 (23.5)	8 (17)	39 (83)	
Family Income	126 (63)	46 (36.5)	80 (63.5)	0.041*
Less than Provincial Minimum Wage	74 (37)	16 (21.6)	58 (78.4)	
More than the Provincial Minimum Wage				
Food Taboo				0.648
Yes	126 (63)	41 (32.5)	85 (67.5)	
No	74 (37)	21 (28.4)	53 (71.6)	

*$p<.05$ (p-value by X^2 test)
Source: Primary Data, 2022

The hierarchical backward selection was carried out by eliminating access to food and food taboo from one of the rows ($p > 0.25$). Table 2 shows the final model of Hierarchical logistic regression analysis. The most significant predictors of stunting among toddlers were inadequate energy intake ($p = 0.007$), inadequate carbohydrate intake ($p < 0.001$), inadequate protein intake ($p = 0.020$), inadequate iron intake ($p < 0.001$), inadequate vitamin A intake ($p = 0.045$), and poor maternal knowledge ($p = 0.003$). Among these variables, the strongest predictors were inadequate carbohydrate intake (OR = 4.5), inadequate iron intake (OR = 4.4), and poor maternal knowledge (OR = 4.4).

Table 2: The Final Model for Logistic Regression Stunting in Toddlers

Predictors of Stunting	SE	p	OR	95% CI Lower	95% CI Upper
Inadequate Energy Intake	.395	0.007	2.8	1.329	6.243
Inadequate Carbohydrate Intake	.423	<0.001	4.5	1.964	10.332
Inadequate Protein Intake	.370	0.020	2.3	1.145	4.877
Inadequate Iron Intake	.411	<0.001	4.4	2.009	10.052
Inadequate Vitamin A Intake	.372	0.045	2.1	1.016	4.361
Poor Mother's Knowledge	.501	0.003	4.4	1.679	11.941
Constanta	-1.57				

Abbreviations: SE, standard error; OR, odds ratio; CI, confidence intervals.
Source: Primary Data, 2023

DISCUSSION

This study reports on risk factors in predicting stunting among toddlers. Based on the results of this study, the prevalence of stunting in Lampung province is relatively high at 31%. The results of this study are higher than the prevalence reported in the 2021 Indonesian Nutritional Status Survey which was 18.5% (Ministry of Health Republic of Indonesia, 2021). The discrepancy may be attributed to differences in data collection and coverage, not all activities for monitoring the growth and development of toddlers can be carried out routinely.

The findings confirm that inadequate nutrient intake particularly energy, carbohydrates, protein, iron, and vitamin A is associated with stunting. These results are consistent with previous studies highlighting the critical role of both macronutrients and micronutrients in supporting linear growth and child development (Elisanti *et al.*, 2023). Inadequate dietary intake over a prolonged

period may result in chronic energy deficiency, which disrupts metabolic processes and impairs physical and cognitive development (Roberts *et al.*, 2022).

Among all variables, carbohydrate intake emerged as one of the strongest predictors of stunting. This finding emphasizes the importance of adequate energy supply in early childhood. Carbohydrates serve as the primary energy source required for daily activities and brain function, and insufficient intake may lead to energy deficits that hinder growth (Holesh, Aslam and Martin, 2023). When energy intake is insufficient, the body may utilize protein for energy rather than growth, thereby compromising linear development (Mulyani *et al.*, 2025). This is in line with multivariate analysis, which shows that inadequate carbohydrate intake is the strongest predictive factor for stunting in toddlers.

Protein intake was also significantly associated with stunting, supporting evidence that protein plays a vital role in tissue formation and hormonal regulation, including the production of Insulin-like Growth Factor-1 (IGF-1), which is essential for bone growth (Millward, 2017; Escobedo-Monge *et al.*, 2025). Although the average protein intake in this study appeared adequate in some groups, the quality of protein or low consumption of animal-source foods may explain its limited contribution to optimal growth.

Insufficient fat intake in the diet will result in insufficient energy or calories for metabolic processes and physical activity. Fat is the largest source of energy, dissolves vitamins, protects organs, and regulates body temperature (Azmy and Mundiastuti, 2018).

Micronutrient deficiencies especially iron, vitamin A, and zinc were also identified as important predictors. Iron deficiency has been widely linked to impaired immunity and increased susceptibility to infections, which can further exacerbate growth faltering (Flora et al., 2022; Elisanti et al., 2023). Similarly, vitamin A deficiency affects cell growth and immune function, increasing the risk of infections that indirectly contribute to stunting (Rao *et al.*, 2025). Zinc deficiency also plays a critical role in stunting. Zinc is essential for growth, appetite regulation, and immune function. Inadequate zinc intake may lead to reduced appetite, which in turn decreases overall nutrient intake and contributes to chronic nutritional deficiencies. Zinc deficiency has been associated with growth retardation and gastrointestinal disturbances (Priyantini, Nurmalitasari and Am, 2023). Young children are particularly vulnerable to zinc deficiency due to their increased physiological needs during rapid growth periods (Patil *et al.*, 2023). These findings reinforce the importance of not only sufficient caloric intake but also adequate micronutrient consumption.

In addition to dietary factors, maternal knowledge was found to be a significant predictor of stunting. This supports previous research indicating that maternal knowledge influences feeding practices, food selection, and overall childcare behaviors (Firmansyah, Rahman and Marliany, 2024). Mothers with better nutritional knowledge are more likely to provide balanced diets and appropriate feeding frequency, which are essential for preventing chronic undernutrition (Durotunisa and Mukminin, 2025).

Family income also showed a significant association with stunting, reflecting the broader socio-economic determinants of child nutrition. Limited household income restricts access to diverse and nutrient-rich foods, often resulting in diets that are sufficient in quantity but poor in quality (Limardi, Hasanah and Utami, 2022). This finding aligns with the conceptual framework that positions economic status as a key underlying determinant of nutritional outcomes.

Interestingly, factors such as food accessibility, affordability, and food taboo were not significantly associated with stunting in this study. This may suggest that, within the study context, the availability of food and knowledge-related factors play a more dominant role than cultural or access-related barriers. However, these findings should be interpreted cautiously, as such factors may vary across different settings.

Overall, this study highlights that stunting is influenced by a complex interplay of nutritional and socio-economic factors. The findings underscore the importance of integrated interventions that not only improve dietary intake but also strengthen maternal knowledge and household economic capacity. Future interventions should prioritize context-specific strategies that address both immediate and underlying determinants of stunting.

CONCLUSION

The prevalence of stunting in Lampung Province has reached 31%, with primary risk factors being inadequate nutritional intake (especially energy and carbohydrates), low maternal knowledge, and low family income. Specifically, stunted toddlers experience a significant nutritional deficit compared to normal toddlers, with a difference of 222 kcal of energy and 40 grams of carbohydrates, with the average intake of both nutrients for all respondents still below the Recommended Intake (RDA).

It is recommended that stunting interventions focus not only on protein but also prioritize increasing total energy and carbohydrate intake to close the critical calorie deficit. Intensive nutrition education programs need to be promoted to increase maternal knowledge and eliminate food taboos that hinder children's nutritional needs. Furthermore, family economic empowerment strategies are needed to increase access and purchasing power for nutritious food, given the high proportion of low-income families in the population.

Acknowledgement

We would like to thank the Pesawaran and South Lampung District Health Office as partners in this research.

Conflict of Interest

There was no conflict of interest in this research.

Funding Statement

We would like to thank the HETI Project, University of Lampung, for funding this research.

REFERENCES

Aditianti *et al.* (2020) 'Prevalence and Stunting Risk Factors in Children 24-59 Months in Indonesia: Analysis of Basic Health Research Data 2018', *Penelitian Gizi dan Makanan*, 43(2), pp. 51–64.

Apriluana, G. and Fikawati, S. (2018) 'Analysis of Risk Factors for Stunting Incidence in Toddlers (0-59 Months) in Developing Countries and Southeast Asia.', *Media Litbangkes*, 28(4), pp. 247–256.

Aridiyah, F.O. *et al.* (2015) 'The Factors Affecting Stunting on Toddlers in Rural and Urban Areas', *e-Jurnal Pustaka Kesehatan*, 3(1), pp. 163–170.

Astarani, K., Idris, D.N.T. and Oktavia, A.R. (2020) 'Prevention of Stunting Through Health Education in Parents of Pre-School Children', *STRADA Jurnal Ilmiah Kesehatan*, 9(1), pp. 70–77. Available at: https://doi.org/10.30994/sjik.v9i1.270.

Azmy, U. and Mundiastuti, L. (2018) 'Konsumsi Zat Gizi pada Balita Stunting dan Non-Stunting di Kabupaten Bangkalan Nutrients Consumption of Stunted and Non-Stunted Children in Bangkalan', *Amerta Nutr*, pp. 28–37. Available at: https://doi.org/10.2473/amnt.v2i3.2018.292-298.

Durotunisa, W. and Mukminin, A. (2025) 'The Relationship Between Mother's Knowledge About Nutritious Food and the Incidence of Stunting in Toddlers in Gunungagung Village', *BELIA Early Childhood*, 14(1), pp. 10–18. Available at: https://journal.unnes.ac.id/journals/belia.

Elisanti, A.D. *et al.* (2023) 'Macronutrient intake in stunted and non-stunted toddlers in Jember, Indonesia', *Journal of Public Health Research*, 12(3). Available at: https://doi.org/10.1177/22799036231197178.

Escobedo-Monge, M.F. *et al.* (2025) 'The Biological Value of Proteins for Pediatric Growth and Development: A Narrative Review', *Nutrients* . Multidisciplinary Digital Publishing Institute (MDPI). Available at: https://doi.org/10.3390/nu17132221.

Firmansyah, B., Rahman, I.A. and Marliany, H. (2024) 'Maternal Knowledge Levels on Nutrition in Toddlers: An Overview', *Genius Journal*, 05(02), pp. 289–298. Available at: https://doi.org/10.56359/gj.

Flora, R. *et al.* (2022) 'Factors Associated with Iron Deficiency in Elementary School Children', *Open Access Macedonian Journal of Medical Sciences*, 10, pp. 97–

100. Available at: https://doi.org/10.3889/oamjms.2022.7800.

Goudet, S.M. *et al.* (2019) 'Nutritional interventions for preventing stunting in children (Birth to 59 months) living in urban slums in low-and middle-income countries (LMIC)', *Cochrane Database of Systematic Reviews*, 2019(6). Available at: https://doi.org/10.1002/14651858.CD011695.pub2.

Holesh, J.E., Aslam, S. and Martin, A. (2023) *Physiology, Carbohydrates*. StatPearls [Internet].: https://www.ncbi.nlm.nih.gov/books/NBK459280/.

Huriah, T. *et al.* (2021) 'The determinant factors of stunting among children in urban slums area, Yogyakarta, Indonesia', *Open Access Macedonian Journal of Medical Sciences*, 9(T4), pp. 1–5. Available at: https://doi.org/10.3889/oamjms.2021.5593.

Limardi, S., Hasanah, D.M. and Utami, N.M.D. (2022) 'Dietary intake and stunting in children aged 6-23 months in rural Sumba, Indonesia', *Paediatrica Indonesiana(Paediatrica Indonesiana)*, 62(5), pp. 341–356. Available at: https://doi.org/10.14238/pi62.5.2022.341-56.

Millward, D.J. (2017) 'Nutrition, infection and stunting: The roles of deficiencies of individual nutrients and foods, and of inflammation, as determinants of reduced linear growth of children', *Nutrition Research Reviews*. Cambridge University Press, pp. 50–72. Available at: https://doi.org/10.1017/S0954422416000238.

Ministry of Health Republic of Indonesia (2018a) *Basic Health Research in Indonesia 2018*. Jakarta.

Ministry of Health Republic of Indonesia (2018b) *The Situation of Short Toddlers (Stunting) in Indonesia*. Jakarta.

Ministry of Health Republic of Indonesia (2021) *Nutriton Status Report in Indonesia 2021*. Jakarta.

Ministry of National Development Planning/ Head of National Development Planning Agency Republic of Indonesia (2019) *Focus Locations for Integrated Stunt Reduction Interventions in 2020*. Jakarta.

Mulyani, A.T. *et al.* (2025) 'Understanding Stunting: Impact, Causes, and Strategy to Accelerate Stunting Reduction—A Narrative Review', *Nutrients* . Multidisciplinary Digital Publishing Institute (MDPI). Available at: https://doi.org/10.3390/nu17091493.

Patil, R. *et al.* (2023) 'Zinc: an essential trace element for human health and beyond', *Food and Health*, 5(3), p. 13. Available at: https://doi.org/10.53388/fh2023013.

Priyantini, S., Nurmalitasari, A. and Am, M. (2023) 'Zinc Intake Affects Toddler Stunting: A Cross-Sectional Study on Toddlers Aged 3 Years', *Amerta Nutrition*, 7(1), pp. 20–26. Available at: https://doi.org/10.20473/amnt.v7i1.2023.20-26.

Rao, S. *et al.* (2025) 'Vitamin A and Its Related Diseases', *Food Science and Nutrition*. John Wiley and Sons Inc. Available at: https://doi.org/10.1002/fsn3.70630.

Roberts, M. *et al.* (2022) 'The Effects of Nutritional Interventions on the Cognitive Development of Preschool-Age Children: A Systematic Review', *Nutrients*. MDPI. Available at: https://doi.org/10.3390/nu14030532.

Tanzil, L. and Hafriani (2021) 'Factors Influencing the Occurrence of Stunting in Toddlers Aged 24-59 Months', *Jurnal Kebidanan*, 7(1), pp. 25–31.

Yustati, E. *et al.* (2023) 'RISK FACTORS OF EVENTS STUNTING IN TODDLERS AGED 1-5 YEARS', *Indonesian Journal of Global Health Research*, 5(2), pp. 399–406. Available at: https://doi.org/10.37287/ijghr.v5i2.1894.

Yuwanti, Mulyaningrum, F. and Susanti, M. (2021) 'Factors Affecting Stunting in Toddlers in Grobogan Regency', *Journal*

of Nursing and Public Health, 10(1), pp. 74–84.