Exploring The Determinants of Stunting in Children Aged 12-24 Months: A Case Study in Malang Regency

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Abstract. Stunting remains a major public health issue, particularly in low- and middle-income countries, including Indonesia. It is a multifaceted problem, can caused by inadequate nutrition, poor sanitation, and socioeconomic conditions. This study aimed to analyse the determinants of stunting among children aged 12–24 months. A cross-sectional study was conducted in Pujon and Ngantang subdistricts, Malang regency, involving 69 pairs of mothers and children. Data on anthropometry, dietary intake, socio-demographics, hygiene and sanitation were collected using structured questionnaires and direct measurements. The study found that 33.3% of children were stunted and severely stunted. Bivariate analysis showed no statistically significant associations between the examined risk factors and stunting ($p>0.05$). However, non-significant trends indicated that adequate energy (OR=0.22; p=0.090) and protein (OR=0.54; p=0.233) intake, as well as good parenting style (OR=0.50; p=0.208), may be associated with a reduced risk of stunting. Further studies with larger samples and longitudinal designs are needed to explore the complex interactions between nutritional, environmental, and socioeconomic factors in childhood stunting.

Keywords: Stunting, Energy, Protein, Parenting Style, Children Under Two

1 Introduction

Stunting is a significant public health issue affecting many countries worldwide, particularly low-income and developing nations. This condition is associated with long-term adverse outcomes, including impaired cognitive development, reduced educational attainment, and lower economic productivity in adulthood. According to data from the 2023 Indonesian Health Survey, the prevalence of stunting among children under five in Indonesia was 21.5%, a decline from 24.4% in 2021 and 21.6% in 2022. However, despite this decrease, the prevalence has not yet reached the national target of 14% set for 2024. At the provincial level, the prevalence of stunting among children under five in East Java was reported at 17.7% in 2023 [1]. In Malang Regency, the highest stunting prevalence was found in Pujon and Ngantang subdistricts.

The causes of stunting are multifactorial, with various interrelated determinants. Direct causes of stunting are primarily associated with inadequate nutritional intake and the

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presence of infectious disease [2]. Households with limited access to diverse and nutritious food sources are at higher risk of childhood stunting, as insufficient dietary diversity can lead to chronic nutrient deficiencies. The presence of infectious diseases, including recurrent respiratory infections and intestinal parasites, further compounds the problem by increasing metabolic demands and impairing growth [3], [4].

Indirect causes include socioeconomic, parenting style, sanitation and hygiene as well as housing conditions. Poor sanitation and hygiene conditions also significantly contribute to stunting by increasing exposure to infections, particularly diarrheal diseases and environmental enteropathy, which impair nutrient absorption [5]. A lack of access to clean drinking water and proper sanitation facilities exacerbates this risk, especially in densely populated or impoverished areas. Furthermore, socioeconomic disparities influence stunting prevalence, as children from low-income households often experience multiple overlapping risk factors, including inadequate parental education, limited healthcare access, and suboptimal infant and young child feeding practices [6], [7].

Addressing stunting requires an integrated approach that encompasses both nutritional and non-nutritional determinants. This study focuses on the Pujon and Ngantang subdistricts in Malang Regency to develop an innovative education model and community-based intervention strategies. A clear understanding of the underlying risk factors is essential to ensure effective and targeted interventions. Therefore, this study aims to analyze the risk factors associated with stunting among children aged 12–24 months in these subdistricts.

2 Methods

This was a cross-sectional study used for analytical observational purposes. The study took place in Ngantang and Pujon subdistricts, Malang Regency, East Java, Indonesia between August and October 2024. The population of this study included all children aged 12–24 months in Ngantang and Pujon subdistricts. The purposive sampling method was employed. Inclusion criteria were children aged 12-24 months at the time of study, apparently healthy, and the mothers or caregivers willing to be interviewed. While the exclusion criteria were children who suddenly get sick or move during the study.

The minimum sample size was estimated using a single population proportion formula based on an expected stunting prevalence of 21.5% reported in the 2023 Indonesian Health Survey, a 95% confidence level, and a 10% margin of error. However, due to the limited number of eligible children aged 12–24 months in the selected villages and logistical constraints during field data collection, all eligible participants who met the inclusion criteria were recruited, resulting in a final sample of 69 mother–child pairs. This limitation was considered when interpreting the findings. All the participants agreed to participate in this study, proven by signed informed consent. The study protocol was approved by the Ethical Committee of Faculty of Health Sciences, Universitas Brawijaya with Ethical Approval Letter No.: 11896/UN10.F17.10.4/TU/2024.

All data obtained was primary data. Anthropometric measurements, including weight and length, were obtained using standardized procedures and recorded in duplicate.

Weight was measured using a portable electronic scale and length using a length board. Dietary intake was assessed through a validated semi-quantitative food frequency questionnaire (SQ-FFQ) with one-month period. The total intake of each food was analysed using Nutrisurvey software to estimate daily energy and protein intake. Socio-demographic information, including household economic status, parental education, occupation, and child information (age, gender, birth weight, breastfeeding history, and hygiene sanitation), was collected through structured interviews with mothers or primary caretakers.

Parenting style was assessed using a structured parenting questionnaire adapted from Baumrind's parenting style framework. The questionnaire consisted of items evaluating parental responsiveness and demandingness and classified parenting into democratic (authoritative), authoritarian, permissive, and neglectful styles. For bivariate analysis, parenting style was recategorized into good (democratic) and not good (authoritarian, permissive, and neglectful). The questionnaire had been previously validated for use in the Indonesian population [1].

Nutritional status was determined using z-scores for height-for-age (HAZ), with stunting classified as a z-score <-2 SD. Adequacy level of macronutrient intake was compared with the age-specific Indonesian Recommended Dietary Allowances (Angka Kecukupan Gizi; AKG 2019) [2]. Intake levels were categorized according to the Indonesian Total Diet Survey (2015): deficit (<70% of AKG), modest (70–119% of AKG), and high (≥120% of AKG) [3].

The data were then statistically analyzed using SPSS 25.0 for Windows (IBM). Univariate analysis was conducted to describe the frequency distribution of each variable. Associations between categorical variables and stunting were initially assessed using Chi-square tests. For variables with expected cell counts of less than five, Fisher's Exact Test was applied because it provides a more reliable estimate for small sample sizes. Odds ratios (ORs) and 95% confidence intervals (CIs) were also calculated. Statistical significance was defined as $p<0.05$.

3 Result

3.1 Characteristics of the Study Participants

This study included 69 children aged 12–24 months from Pujon (31.9%) and Ngantang (68.1%) subdistricts, Malang Regency. Data on general characteristics of study participants are presented in Table 1. The mean age of the children was 18.48±0.50 months. Slightly more participants were male (52.2%) than female (47.8%). Most children had a normal birth weight (88.4%). Overall, 72.5% of children received exclusive breastfeeding during the first six months of life. Based on height-for-age z-scores, 66.7% of children had normal nutritional status, whereas 24.6% were classified as stunted and 8.7% as severely stunted (mean HAZ = −1.44±1.27). Regarding dietary intake, most children had deficient energy (91.3%) and protein (49.3%) intakes. Recent diarrhea was reported in 11.6% of children, and most households practiced good child hygiene for their children (75.4%).

Table 1. Characteristics of study participants.

Variable	N (%)
Gender	
Male	36 (52.2)
Female	33 (47.8)
Birth weight	
Low	8 (11.6)
Normal	61 (88.4)
Nutritional status	
Very stunted	6 (8.7)
Stunted	17 (24.6)
Normal	46 (66.7)
Exclusive breastfeeding*	
No	19 (27.5)
Yes	50 (72.5)
Energy Intake Level	
Low	63 (91.3)
Modest	4 (5.8)
High	2 (2.9)
Protein Intake Level	
Low	34 (49.3)
Modest	6 (8.7)
High	29 (42.0)
Diarrhea last 2 weeks	
Yes	8 (11.6)
No	61 (88.4)
Child hygiene	
Poor hygiene	17 (24.6)
Good hygiene	52 (75.4)

*) child receiving only breast milk, without any additional food or drink except prescribed medicines or vitamin/mineral supplements, during the first six months of life.

3.2 Family Sociodemographic Characteristics

Family sociodemographic characteristics are presented in Table 2. The mean ages of mothers and fathers were 28.64±6.01 years and 34.00±7.21 years, respectively. The largest proportion of mothers had completed junior high school (37.7%) and were housewives (66.7%). Fathers were predominantly farmers (60.9%). Overall, the respondents' families can be categorized as lower middle class, with low income and dependence on the agricultural sector as the main source of income.

The dominant family structure is the nuclear family (88.4%). Household income was predominantly between IDR 2,500,000 and 5,000,000 per month (44.9%), while 63.8% of households reported low food expenditures. Democratic parenting was reported in 31.9% of households, whereas 68.1% reported authoritarian, permissive, or neglectful parenting styles. Good environmental sanitation was observed in 62.3% of households.

Table 2. Family sociodemographic characteristics.

Variable	N (%)
Mother's educational level	
Elementary school	7 (10.1)
Junior high school	26 (37.7)
Senior high school	23 (33.3)
College	13 (18.8)
Mother's occupation	
Farmer	4 (5.8)
Employee	9 (13.0)
Self-employed	9 (13.0)
Housewife	46 (66.7)
Other	1 (1.4)
Father's educational level	
Elementary school	17 (24.6)
Junior high school	18 (26.1)
Senior high school	19 (27.5)
College	12 (17.4)
Other	3 (4.3)
Father's occupation	
Farmer	42 (60.9)
Employee	10 (14.5)
Self-employed	15 (21.7)
Other	2 (2.9)
Type of family	
Nuclear family	61 (88.4)
Extended family	8 (11.6)
Household income	
<2.500.000	28 (40.6)
2.500.000-5.000.000	31 (44.9)
5.000.000-7.500.000	5 (7.2)
>7.500.000	5 (7.2)
Household expenses	
< 2.500.000	32 (46.4)
2.500.000-5.000.000	27 (39.1)
5.000.000-7.500.000	7 (10.1)
>7.500.000	3 (4.3)
Food expenses	
Low	44 (63.8)
High	25 (36.2)
Parenting style	
Democratic	22 (31.9)
Authoritarian	13 (18.8)
Permissive	13 (18.8)
Neglect	21 (30.4)
Environment sanitation	
Poor sanitation	26 (37.7)
Good sanitation	43 (62.3)

3.3 Bivariate Analysis Result of Possible Risk of Stunting in Children Age 12-24 Months

Table 3 presented the bivariate analysis of possible risk factors with stunting categories (stunted and non-stunted). Independent variables with more than two categories were recategorized so that all variables were presented in a 2×2 table format. The bivariate analysis showed no statistically significant associations between the possible risk factors and stunting ($p>0.05$). Odds ratios below one was observed for adequate energy intake (OR=0.22; 95%CI: 0.04–1.28; p=0.090), adequate protein intake (OR=0.54; 95%CI: 0.20–1.50; p=0.233), and good parenting style (OR=0.50; 95%CI: 0.18–1.37; p=0.208). Variables including birth weight, exclusive breastfeeding, parental education, household income, household expenditure, food expenditure, child hygiene, and environmental sanitation were also not significantly associated with stunting.

Table 3. Bivariate analysis results of possible risk of stunting in children age 12-24 months.

Variable	Nutritional status		OR	95% CI	p
	Stunted (n=23)	Non-stunted (n=46)			
Birth weight					
Low	4 (50)	4 (50)	2.21	0.50 – 9.79	0.426[1]
Normal	19 (31.1)	42 (68.9)			
Exclusive breastfeeding					
No	7 (36.8)	12 (63.2)	1.24	0.41 – 3.74	0.703[2]
Yes	16 (32)	34 (68)			
Energy Intake Level					
Deficit	19 (30.2)	44 (69.8)	0.22	0.04 – 1.28	0.090[1]
Normal	4 (66.7)	2 (33.3)			
Protein Intake Level					
Deficit	9 (26.5)	25 (73.5)	0.54	0.20 – 1.50	0.233[1]
Normal	14 (40)	21 (60)			
Mother's educational level	12 (36.4)	21 (63.6)	1.30	0.48 - 3.54	0.609[2]
Low	11 (30.6)	25(69.4)			
High					
Father's educational level					
Low	12 (34.3)	23 (65.7)	1.50	0.52 – 4.35	0.454[2]
High	8 (25.8)	23 (74.2)			
Type of family					
Nuclear family	20 (32.8)	41 (67.2)	0.82	0.18 – 3.75	1.000[1]
Extended family	3(37.5)	5 (62.5)			
Household income					
Low	20 (33.9)	39 (66.1)	1.20	0.28 – 5.13	1.000[1]
High	3 (30)	7 (70)			
Household expenses					
Low	19 (32.2)	40 (67.8)	0.71	0.18 – 2.83	0.721[1]
High	4 (40)	6 (60)			

Food expenses					
Low	16 (36.4)	28 (63.6)	1.47	0.51 – 4.27	0.598[1]
High	7 (28)	18 (72)			
Parenting style					
Not Good	14 (41.2)	20 (58.8)	0.50	0.18 – 1.37	0.208[2]
Good	9 (25.7)	26 (74.3)			
Child hygiene					
Poor hygiene	6 (35.3)	11 (64.7)	1.12	0.36 – 3.55	1.000[2]
Good hygiene	17 (32.7)	35 (67.3)			
Environment sanitation					
Poor sanitation	10 (38.5)	16 (61.5)	1.44	0.52 – 4.01	0.600[2]
Good sanitation	13 (30.2)	30 (69.8)			

[1]Fisher's exact test; [2]Chi-square test

4 Discussion

This study aimed to identify the determinants of stunting among children aged 12–24 months in Pujon and Ngantang subdistricts, Malang Regency. Overall, none of the examined nutritional, socioeconomic, caregiving, hygiene, or sanitation factors showed statistically significant associations with stunting. However, adequate energy intake, adequate protein intake, and good parenting style were associated with lower odds of stunting, although these associations were not statistically significant.

Despite the high prevalence of normal birth weight and exclusive breastfeeding, one-third of the children were classified as stunted or severely stunted. It has suggested that postnatal factors play a more decisive role in shaping growth outcomes. The high proportion of children with inadequate energy and protein intake indicates that complementary feeding practices may be insufficient to meet the increasing nutritional demands during the critical first two years of life period. This aligns with evidence showing that inadequate dietary quantity and quality during the complementary feeding stage are major contributors to linear growth faltering, even among children who were appropriately breastfed [4],[5]. Furthermore, while breastfeeding provides important nutritional and immunological benefits, it is not sufficient on its own beyond six months of age without adequate complementary foods, emphasizing the need for improved feeding practices during this transition period [6].

Although the prevalence of recent diarrhea was relatively low and most households reported good hygiene practices, the presence of infection remains relevant, as even sporadic episodes can impair nutrient absorption and increase metabolic demands, thereby contributing to growth deficits. Previous studies have demonstrated that repeated or even occasional enteric infections can have cumulative effects on child growth through mechanisms such as intestinal inflammation and reduced appetite [7],[8].

Overall, the respondents' families can be categorized as lower middle class, with low income and dependence on the agricultural sector as the main source of income. The dominant family structure is the nuclear family, which indicates a pattern of smaller families that are separate from the extended family. Low food expenditures suggest

limited household purchasing power, which may constrain access to diverse and nutrient-dense foods, thereby influencing overall dietary quality. Similar findings have been reported in previous studies showing that low socioeconomic status is strongly associated with food insecurity and suboptimal child nutrition outcomes [9],[10]. In addition, more than one-third of households had poor sanitation conditions, which may increase exposure to environmental pathogens and contribute to repeated infections, a known risk factor for impaired child growth [11]. Taken together, these factors highlight the importance of addressing broader socioeconomic and environmental determinants alongside nutrition-specific interventions to effectively improve child health and prevent stunting [12].

Although none of the examined variables reached statistical significance, adequate energy and protein intakes showed odds ratios below one. However, these estimates should be interpreted cautiously because of the small sample size, wide confidence intervals, and lack of statistical significance. Larger studies are required to determine whether these observed associations represent true effects. Malnutrition, particularly in the form of inadequate energy and protein intake, has been widely recognized as a key risk factor for stunting [12],[13],[14]. This underscores the importance of ensuring adequate and balanced nutrition for young children, particularly in low-income households where food insecurity may be prevalent [13], [14].

Parenting style is widely recognized as an important underlying determinant of child nutritional status, including stunting, although its effect is often indirect and mediated through feeding practices, caregiving behavior, and health-seeking actions. In the present study, parenting style was associated with lower odds of stunting, although the association was not statistically significant. Therefore, this finding should be interpreted cautiously and cannot be considered evidence of a protective effect.

This finding is consistent with the broader conceptual framework proposed by UNICEF, which identifies caregiving practices, including responsive feeding, psychosocial stimulation, and health care utilization; as key immediate and underlying determinants of child growth outcomes [13]. Positive parenting practices are thought to improve dietary intake, ensure appropriate feeding frequency and diversity, and promote better hygiene behaviors, all of which contribute to optimal linear growth. A responsive and supportive caregiving is associated with improved child dietary adequacy and reduced risk of growth faltering [13]. Similarly, a systematic review on maternal and child undernutrition emphasizes that suboptimal caregiving environments contribute to growth delay through poor feeding practices and increased susceptibility to infections [13],[14].

Other variables, including low birth weight, exclusive breastfeeding, socioeconomic factors, hygiene, and sanitation, were also not significantly associated with stunting. Although the direction of several effect estimates was consistent with previous literature, the wide confidence intervals indicate substantial uncertainty around these estimates. Nevertheless, some variables showed expected risk directions, such as low birth weight and poorer sanitation, which are consistent with the biological and epidemiological understanding that early life conditions and environmental exposures can influ-

ence linear growth outcomes [13]. The lack of significance in this study may be influenced by limited sample size and reduced statistical power, which can lead to wide confidence intervals and an inability to detect modest associations.

These findings should be interpreted considering existing evidence. Global studies, including those from UNICEF and World Health Organization, consistently highlight low birth weight, inadequate breastfeeding practices, poverty, and poor water, sanitation, and hygiene (WASH) conditions as key determinants of stunting [13],[14] Large-scale analyses also confirm their role in shaping early growth trajectories [15],[16].

This study has several limitations that should be considered when interpreting the findings. First, the relatively small sample size reduced the statistical power to detect modest associations, as reflected by the wide confidence intervals observed for several variables. Second, the cross-sectional design precludes conclusions regarding temporal or causal relationships between the examined factors and stunting. Finally, several exposure variables were obtained through caregiver interviews and questionnaires, making them susceptible to recall bias. Nevertheless, the study provides valuable baseline information on nutritional, caregiving, socioeconomic, and environmental characteristics among children in two high-stunting subdistricts of Malang Regency. Future studies with larger sample sizes and longitudinal designs are needed to better understand the complex interactions among these determinants and to establish more effective stunting prevention strategies.

5 Conclusion

In conclusion, none of the examined nutritional, socioeconomic, caregiving, hygiene, or sanitation factors showed statistically significant associations with stunting among children aged 12–24 months in this study. Although several variables, including energy intake, protein intake, and parenting style, were associated with lower odds of stunting, these findings were not statistically significant and should be interpreted with caution because of the limited sample size. Future studies with larger samples and longitudinal designs are needed to better understand the multifactorial determinants of childhood stunting.

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References

1. M. of H. R. of Indonesia, Permenkes No 28 Tahun 2019 tentang Angka Kecukupan Gizi. 2019.
2. Ministry of Health Republic of Indonesia, “Permenkes No 28 Tahun 2019 tentang Angka Kecukupan Gizi,” 2019, Kementerian Kesehatan Republik Indonesia, Jakarta.
3. N. Muslihah, I. Fahmi, A. Maulidiana, and I. Habibie, Prinsip dan aplikasi metodologi penelitian gizi. Malang: Universitas Brawijaya Press, 2021.
4. World Health Organization, Infant and young child feeding: Model chapter for textbooks for medical students and allied health professionals. 2025.
5. T. Beal, A. Tumilowicz, A. Sutrisna, D. Izwardy, and L. M. Neufeld, “A review of child stunting determinants in Indonesia,” Matern. Child Nutr, vol. 14, p. e12617, 2018, doi: 10.1111/mcn.12617.
6. J. M. White, F. Bégin, R. Kumapley, C. Murray, and J. Krasevec, “Complementary feeding practices: Current global and regional estimates,” Matern. Child Nutr, vol. 13, p. e12505, 2017, doi: 10.1111/mcn.12505.
7. UNICEF, the state of the world’s children: Children, food and nutrition: Growing well in a changing world. 2022.
8. A. Prüss-Ustün et al., “Burden of disease from inadequate water, sanitation and hygiene for selected adverse health outcomes: An updated analysis with a focus on low- and middle-income countries,” Int. J. Hyg. Environ. Health, vol. 222, pp. 765–777, 2019, doi: 10.1016/j.ijheh.2019.05.004.
9. V. Owino et al., “Environmental enteric dysfunction and growth failure/stunting in Global Child Health,” Pediatrics, vol. 138, p. e20160641, 2016, doi: 10.1542/peds.2016-0641.
10. L. C. Smith and L. Haddad, “Reducing child undernutrition: Past drivers and priorities for the post-MDG era,” World Dev, vol. 68, pp. 180–204, 2015, doi: 10.1016/j.worlddev.2014.11.014.
11. R. E. Black et al., “Maternal and child undernutrition and overweight in low-income and middle-income countries,” 2013, doi: 10.1016/S0140-6736(13)60937-X.
12. D. A. Ilmani and S. Fikawati, “Nutrition intake as a risk factor of stunting in children aged 25–30 months in Central Jakarta, Indonesia,” J. Gizi dan Pangan, vol. 18, pp. 117–126, 2023, doi: 10.25182/jgp.2023.18.2.117-126.
13. A. Ayuningtyas, D. Simbolon, and A. Rizal, “Asupan zat gizi makro dan mikro terhadap kejadian stunting pada balita,” J. Kesehat, vol. 9, pp. 445–450, 2018, doi: 10.26630/jk.v9i3.960.
14. I. S. Aisyah and A. E. Yunianto, “Hubungan asupan energi dan asupan protein dengan kejadian stunting pada balita (24-59 bulan) di Kelurahan Karanganyar Kecamatan Kawalu Kota Tasikmalaya,” J. Kesehat. Komunitas Indones, vol. 17, pp. 240–246, 2021, doi: 10.37058/jkki.v17i1.3603.
15. G. Danaei et al., Risk factors for childhood stunting in 137 developing countries: A comparative risk assessment analysis at global, regional, and country levels, vol. 13. 2016. doi: 10.1371/journal.pmed.1002164.
16. H. Torlesse, A. A. Cronin, S. K. Sebayang, and R. Nandy, “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, 2016, doi: 10.1186/s12889-016-3339-8.