Jurnal Kesehatan Vokasional, Vol. 11 No. 3 (August 2026)
ISSN 2541-0644 (print), ISSN 2599-3275 (online)
DOI https://doi.org/10.22146/jkesvo.124252

Maternal Care Practices, Family Income, and Household Food Availability as Determinants of Stunting in Children Aged 24–59 Months in Ainaro-Villa

Praktik Perawatan Ibu, Pendapatan Keluarga, dan Ketersediaan Pangan Rumah Tangga sebagai Penentu Stunting pada Anak Usia 24–59 Bulan di Ainaro-Villa

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ABSTRACT

Background: Stunting remains a major public health concern in Timor-Leste, particularly in rural municipalities. Evidence on the roles of maternal care, family income, and household food availability among children aged 24–59 months remains limited.

Objective: This study assessed the associations between maternal care, family income, household food availability, and stunting among children aged 24–59 months attending Ainaro-Villa Health Center, Ainaro Municipality, Timor-Leste.

Methods: An analytical cross-sectional study was conducted among 130 mother–child pairs selected using non-probability sampling and the Slovin formula. Data on maternal care, household income, and food availability were collected using a structured questionnaire. Stunting was assessed using height-for-age Z-scores based on WHO Child Growth Standards. Associations were analyzed using the chi-square test and crude odds ratios (ORs) with 95% confidence intervals.

Results: Stunting prevalence was 13.1% (17/130). Maternal care (p = 0.027; OR = 3.55), family income (p = 0.043; OR = 2.51), and household food availability (p = 0.047; OR = 3.10) were significantly associated with stunting.

Conclusion: Maternal care, family income, and household food availability were significantly associated with stunting among children aged 24-59 months in Ainaro Municipality. Integrated interventions addressing household food security, economic capacity, and caregiver nutrition education are warranted.

Keywords: Stunting; Maternal Care; Family Income; Household Food Availability; Children 24–59 Months

ABSTRAK

Latar Belakang: *Stunting masih menjadi masalah kesehatan masyarakat di Timor-Leste, terutama di wilayah pedesaan. Bukti mengenai hubungan praktik pengasuhan ibu, pendapatan keluarga, dan ketersediaan pangan rumah tangga dengan stunting pada anak usia 24–59 bulan masih terbatas.*

Tujuan*: Penelitian menganalisis hubungan praktik pengasuhan ibu, pendapatan keluarga, ketersediaan pangan rumah tangga, dan stunting pada anak usia 24–59 bulan yang berkunjung ke Puskesmas Ainaro-Villa, Kabupaten Ainaro, Timor-Leste.*

Metode: *Penelitian analitik dengan potong lintang melibatkan 130 pasangan ibu dan anak. Sampel dipilih menggunakan non-probability sampling berdasarkan rumus Slovin. Data praktik pengasuhan ibu, pendapatan keluarga, dan ketersediaan pangan dikumpulkan menggunakan kuesioner terstruktur. Status stunting ditentukan berdasarkan tinggi badan menurut umur menggunakan standar pertumbuhan anak WHO. Analisis menggunakan uji chi-square dan odds ratio (OR) dengan tingkat kepercayaan 95%.*

Hasil: *Prevalensi stunting 13,1% (17/130). Praktik pengasuhan ibu (p = 0,027; OR = 3,55), pendapatan keluarga (p = 0,043; OR = 2,51), dan ketersediaan pangan rumah tangga (p = 0,047; OR = 3,10) berhubungan signifikan dengan stunting.*

Kesimpulan: *Praktik pengasuhan ibu, pendapatan keluarga, dan ketersediaan pangan rumah tangga berhubungan signifikan dengan stunting pada anak usia 24–59 bulan di Kabupaten Ainaro. Intervensi terpadu yang mencakup ketahanan pangan, penguatan ekonomi keluarga, dan edukasi gizi bagi pengasuh diperlukan.*

Kata Kunci: *Stunting; Perawatan Ibu; Pendapatan Keluarga; Ketersediaan Pangan Rumah Tangga; Anak Usia 24–59 Bulan*

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Submitted 02 July 2026 **Revised** 16 August 2026 **Accepted** 20 August 2026

https://jurnal.ugm.ac.id/jkesvo
Published online August 31, 2026

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INTRODUCTION

Stunting is a symptom of chronic growth failure caused by long-term nutritional inadequacies, repeated infections, poor sanitation, and inadequate psychosocial stimulation in the early stages of a child's development rather than a disease. When the height-for-age Z-score (HAZ) was more than −2 standard deviations below the WHO kid Growth Standards median, the kid was considered stunted (Soliman et al., 2021). One of the most prevalent types of childhood malnutrition in the world, stunting affects not just physical development but also cognitive growth, academic performance, and adult economic production (Awaludin et al., 2025).

A. Global and Regional Load

By 2024, an estimated 150 million children under five roughly one in five children worldwide will suffer from stunting, according to secondary data from the UNICEF/WHO/World Bank Group Joint Child Malnutrition Estimates (JME). The 2030 Sustainable Development Goal aim to eradicate all kinds of children malnutrition at risk is motivated by the fact that although the prevalence of stunting has declined globally from 26.4% in 2012, the rate of decline has slowed significantly in recent years (World Bank Group, 2024). The majority of child stunting worldwide is still concentrated in Asia and Sub-Saharan Africa, with South Asia alone accounting for around two-fifths of instances (World Health Organization; United Nations Children's Fund; The World Bank Group, 2025).

B. National Trends in Timor-Leste

The prevalence of stunting in children under five years old fell from nearly 58% in 2009–2010 to 50.2% in 2013 and then continued to decline to 47% in 2012, according to secondary data from the Timor-Leste Food and Nutrition Survey and the Demographic and Health Surveys (DHS) conducted over various time periods (Carvalho et al., 2025; Matsumoto-Takahashi et al., 2023). Timor-Leste still has one of the highest rates of child stunting in Southeast Asia and the world, despite the nominal decrease. The number of stunted children doesn't decline as substantially throughout this period due to population growth (TATOLI Agência Noticiosa de Timor-Leste, 2024).

In order to reduce the country's stunting rate to less than 25% by 2030, the government of Timor-Leste is collaborating with UNICEF, the World Bank, and Nutrition International on the National Multisectoral Nutrition Action Plan. This will be accomplished by making investments in both nutrition-related and nutrition-focused fields, including food at home, health and safety, education, and child care services (Timor-Leste Reinforces Commitment to Nutrition and Food Security at National Workshop « Government of Timor-Leste, 2025).

C. Municipal Context

There are significant differences in the prevalence of stunting between 13 municipalities in Timor-Leste, according to secondary data at the subnational level. Ainaro has a stunting prevalence of 60.3%, which is higher than the national average of around 47% for the same reporting period and the second highest among all municipalities in the nation, after Ermera (63.4%), according to validated data gathered by UNICEF and the Ministry of Health. There is a high pattern of malnutrition risk in the municipalities in the central highlands, as seen by nearby municipalities like Aileu (53.9%) and Bobonaro (50.3%) above the national average (Food and Nutrition Survey 2020).

Because they create barriers to food distribution infrastructure and access to health and nutrition services, mountainous topography, a large rural population distribution, and reliance on subsistence agriculture are thought to be significant

structural factors contributing to this inequality. According to official statistics from the local administration, the municipality of Ainaro has an area of about 869.80 km², divided into four administrative posts, and an estimated population of around 84,500 persons (43,030 men and 41,470 women), divided into about 18,122 homes. Ainaro Municipality. By 2024, the municipal health workforce will consist of 23 general practitioners, 43 nurses, 37 midwives, one licensed nutritionist, and no resident specialist physician. The district's nutrition counseling and growth monitoring services are limited in scope and intensity due to the human resource condition (Autoridade Municipal Ainaro, 2026).

D. Determining Factors and Reasons for This Study

The causal pathway to stunting still identifies three interconnected deciding factors: household food availability, family income, and maternity care behaviors. Child nutrient intake and infection exposure are directly impacted by maternal care, which includes complementary feeding techniques, meal frequency and variety, food hygiene habits, and health service-seeking behavior (Putri & Rong, 2021).

The quality of the home environment, access to health care, and the ability to buy wholesome food are all influenced by family income. According to certain Indonesian studies, children from low-income households are more likely than those from high-income households to have stunting (Sari et al., 2025). Household food availability, on the other hand, is a mediator between income and dietary sufficiency at the individual level and represents the household's physical and financial access to providing enough, varied, and stable food.

Stunting is significantly predicted by household food security status and wealth index, according to data from Indonesia and Lao PDR (Niesa & Mardiana, 2024; Saraswati et al., 2021; Vongsakit et al., 2025). Additionally, regional data connects stunting in Asian nations to poor feeding and parenting techniques (Munawar et al., 2024). It finds that other biological and demographic characteristics, such as low birth weight and short maternal height, are complimentary predictors in similar situations (Makbul et al., 2025).

There is a dearth of evidence evaluating maternal care, family income, and food availability in relation to stunting in children aged 24-59 years. Based on the secondary data reviewed, there seems to be little evidence of specificity for Timor-Leste, despite the fact that each of these determinants has been studied individually or in pairs in studies in Indonesia and low- and middle-income settings. Ainaro became a crucial epidemiological setting to examine the combined influence of these three factors due to its greatest stunting prevalence at the municipal level, restricted health workforce capability, and structural reliance on subsistence farming.

Thus, the purpose of this study is to measure the degree of risk associated with the odds ratio and to examine the relationship between maternal care practices, family income, household food availability, and the incidence of stunting in children aged 24–59 months attending Ainaro-Villa Health Center, Ainaro Municipality, Timor-Leste.

MATERIALS AND METHODS

A. Study Design

The exposure (maternal care, family income, and household food availability) and the outcome (stunting status) were examined simultaneously at a single time point in this cross-sectional, analytical quantitative study.

B. Place and Time

The Ainaro-Villa Internal Health Center, situated in the Ainaro

Administrative Post, Ainaro Municipality, Timor-Leste, served as the study's site. Primary health services, such as nutrition, immunizations, growth monitoring, and mother and child health, are offered at this medical center. The data collection period in 2026 was roughly one month, from May to June.

C. Population, Sample and Sampling Technique

Based on secondary data from the Demographic and Health Registration (DHS) health center for the months of January through October 2025, the source population comprised 193 cases of mothers with children aged 24 to 59 who were registered at the Health Center Ainaro-Villa. $N \cdot e^2) = 193 / (1 + 193 \times 0.05^2) = 193 / 1.4825 \approx 130$.

N is the population size (193), and e is the error margin (0.05). Using a non-probability sampling strategy and a random method, 130 mother-child pairs were recruited. Respondents who visited the health center during the data collection period and satisfied the eligibility requirements were added sequentially.

Mothers and caregivers of children between the ages of 24 and 59 who were registered at the study site, resided in the health center service area, had complete anthropometric records, and were willing to provide informed permission were the requirements for inclusion. Children who were categorized as underweight due to acute ailments and underwent separate clinical therapy, as well as children with chronic diseases or other medical issues that impeded growth, such as genetic disorders, hormonal disorders, and serious illnesses, were not included.

D. Variables and Measurement

Maternal care practices, household food availability, and family income were the independent variables. Each was classified or split according to the results of a standardized questionnaire. The dependent variable, stunting status, was assessed using the height-for-age Z-score (HAZ), which was computed using WHO Anthro software using measurements from a calibrated microtoise/stadiometer for children ≥24 months in the standing position. Growth monitoring chart (GMC) records were used to confirm the results. Stunting was defined as having a HAZ < −2 SD, whereas normal was defined as having a HAZ ≥ −2 SD.

E. Data Collection

Anthropometric measurements, structured interviews using pre-tested questionnaires, and direct observation were used to gather primary data. In order to confirm and supplement the original data, secondary data such as growth monitoring documents and records was gathered from health center administrative records.

F. Data Analysis

Before being analyzed using Microsoft Excel and SPSS version 21.0, data were edited, coded, tabulated, and cleaned. The frequency and percentage distributions of study variables and respondent characteristics were described using univariate analysis. The Pearson chi-square test (χ^2) was employed in bivariate analysis to examine the relationship between each independent variable and stunting status; statistical significance was established at $p < 0.05$. A crude odds ratio (OR) with a 95% confidence interval (CI) was computed from a 2x2 contingency table using the formula $OR = (a \times d)/(b \times c)$ to evaluate the amount of risk.

G. ETHICAL CONSIDERATIONS

This study received ethical approval from the Institute National of Public Health Timor-Leste, Research Ethics and Technical Committee (INSP-TL-UEPD), under Ethical Clearance Reference No. 390/INSP-TL/UEPD-AL/V/2026, dated May 18, 2026.

RESULT AND DISCUSSION

A. Result

Respondent Characteristics

The study included 130 mother-child pairings in total. 80.0% of mothers were housewives, and the majority (83.8%) were in the ideal reproductive age range of 20–34. In terms of maternal education, 28.5% attained university level and 55.4% finished secondary school. The bulk of the children were younger than the appropriate age range (24–32 months), and more than half of them were male (55.4%). Table 1 displays specific sociodemographic features.

Table 1. Sociodemographic characteristics of respondents (N = 130)

Characteristic	n	%
Maternal age (years)		
< 20	3	2.3
20–34	109	83.8
≥ 35	18	13.8
Maternal occupation		
Housewife	104	80.0
Employee	24	18.5
Teacher	1	0.8
Technician	1	0.8
Maternal education		
Never attended school	4	3.1
Senior high school	72	55.4
University	37	28.5
Other levels (elementary/junior secondary) [a]	17	13.1
Child sex		
Male	72	55.4
Female	58	44.6
Child age group		
24–28 months	45	35.4
25–28 months[b]	33	25.4
29–32 months	23	17.7
33–59 months[a]	29	22.3

[a] *Residual/other categories not individually itemized in the original field data.*

[b] *Reported age-group boundaries as recorded in the source data; overlapping boundaries reflect the original categorization used in data collection.*

Source: Primary data, Centro Saúde Ainaro-Villa, 2026.

Distribution of Study Variables

According to univariate analysis, 48.5% of moms had good care habits and 51.5% had bad ones. In terms of family income, 22.3% of households had a high income, 38.5% had a normal income, and 39.2% had a low income. In terms of food availability, 27.7% of homes were categorized as stable, 31.5% as sufficient, and 40.8% as insufficient. In children between the ages of 24 and 59 months, 86.9% (113/130) showed normal linear growth, whereas 13.1% (17/130) exhibited stunting.

Table 2. Distribution of maternal caregiving, family income, household food availability, and stunting status (N = 130)

Variable / Category	n	%
Maternal caregiving		
Poor	67	51.5
Good	63	48.5
Family income		
Low	51	39.2
Normal	50	38.5
High	29	22.3
Household food availability		
Insufficient	53	40.8
Sufficient	41	31.5
Stable	36	27.7
Stunting status		
Stunted (HAZ < −2 SD)	17	13.1
Normal (HAZ ≥ −2 SD)	113	86.9

Source: Primary data, Centro Saúde Ainaro-Villa, 2026.

Bivariate Analysis

A statistically significant correlation between the three independent factors and stunting status was revealed by chi-square analysis. Compared to 6.3% of children of mothers with good care practices, 19.4% of children of mothers with poor care practices were stunted (χ^2 = 4.867, p =

0.027). There were no occurrences of stunting in the high-income group (χ^2 = 6.314, p = 0.043), and the prevalence of stunting gradually declined as family income grew, from 19.6% in low-income households to 14.0% in normal-income households. In a similar vein, the prevalence of stunting dropped from 20.8% in homes with inadequate food to 12.2% in those with enough food and 2.8% in those with stable food (χ2 = 6.136, p = 0.047).

Table 3. Association between maternal caregiving, family income, household food availability, and stunting status

Variable	Stunted n (%)	Normal n (%)	Total	χ^2	p-value
Maternal caregiving					
Poor	13 (19.4)	54 (80.6)	67	4.867	0.027*
Good	4 (6.3)	59 (93.7)	63		
Family income					
Low	10 (19.6)	41 (80.4)	51		
Normal	7 (14.0)	43 (86.0)	50	6.314	0.043*
High	0 (0.0)	29 (100.0)	29		
Household food availability					
Insufficient	11 (20.8)	42 (79.2)	53		
Sufficient	5 (12.2)	36 (87.8)	41	6.136	0.047*
Stable	1 (2.8)	35 (97.2)	36		

**Statistically significant at p < 0.05 (Pearson chi-square test). Source: Primary data, Centro Saúde Ainaro-Villa, 2026.*

Magnitude of Risk (Odds Rasio Analysis)

A 2x2 contingency table split into two groups was used to compute crude odds ratios for each variable in order to gage the level of risk. In comparison to adequate care, poor maternal care was linked to 3.55 times greater chances of stunting (OR = 3.55; a = 13, b = 54, c = 4, d = 59). The odds of stunting were 2.51 times greater for low family income than for normal/high income combined (OR = 2.51; a = 10, b = 41, c = 7, d = 72). When compared to sufficient/stable availability combined, inadequate food availability was linked to 3.10 times higher odds of stunting (OR = 3.10; a = 11, b = 42, c = 6, d = 71). Maternal care was the most strongly associated factor with stunting out of the three, followed by family income and the availability of food in the home.

Table 4. Odds ratio (OR) of stunting for maternal caregiving, family income, and household food availability

Risk Factor	Comparison	a, b, c, d	OR	p-value
Maternal caregiving	Poor vs. Good	13, 54, 4, 59	3.55	0.027
Family income	Low vs. Normal/High combined	10, 41, 7, 72	2.51	0.043
Household food availability	Insufficient vs. Sufficient/Stable combined	11, 42, 6, 71	3.10	0.047

a, b, c, d correspond to the cells of the 2×2 contingency table (exposed–stunted, exposed–normal, unexposed–stunted, unexposed–normal, respectively).
OR = (a×d)/(b×c).
Source: Primary data, Centro Saúde Ainaro-Villa, 2026.

B. Discussion

Maternal Care and Stunting

Maternal care and stunting were found to be statistically significantly correlated in this study (χ^2 = 4.867, p = 0.027; OR = 3.55). Accordingly, children of mothers who practice poor care are more likely to have stunting than children of moms who practice good care. This outcome is in line with a cross-sectional study conducted in the Indonesian service area of Puskesmas Cipadung, which found a significant correlation between stunting and maternal care, with a prevalence odds ratio of 2.9 (p = 0.045) (Wibowo et al., 2023). When the reference category was altered, the study in Cipelang Village, Cijeruk, likewise indicated an OR of 0.179 (95% CI: 0.081–0.394; p = 0.000) for good care practices, indicating a protective effect that was in the same direction as the risk seen in the current study (Karo et al., 2022).

Complementary feeding techniques, nutritional diversity, food hygiene habits,

and health monitoring procedures are all aspects of maternal care that directly affect a child's nutrient intake and risk of infection. While insufficient care raises the risk of chronic nutrient shortages, mothers who offer responsive care and have enough nourishment are more likely to maintain healthy linear growth. This finding is consistent with data from Tanzania about inadequate child feeding habits, which are significantly linked to stunting in children under two (Mandara et al., 2024), coupled with an Indonesian study that found that Central Javanese children's stunting was linked to traditional feeding methods 6–59 (Astuti et al., 2024). The danger of inadequate care practices in this setting may be increased by Ainaro Municipality's remote location and restricted access to nutrition education services.

Family Income and Stunting

Stunting was also shown to be significantly correlated with family income ($\chi 2$ = 6.314, p = 0.043; OR = 2.51), with children from low-income households being more at risk than those from normal or high-income families. This outcome is in line with research from Indonesia that found poor family income to be a major risk factor for stunting (Agustin & Rahmawati, 2021), It is in line with a study conducted in Kelurahan Naioni, Kupang, which found a greater correlation between household income and stunting (OR = 5.50, p = 0.00) (Arinya D. Rambadeta et al., 2024).

Child development outcomes are impacted by family income, which also influences the ability to maintain proper sanitation, access health services, and buy nutrient-rich diets. Economic vulnerability seems to be a significant structural factor for child malnutrition in Ainaro, where subsistence farming is still a major source of income and household income is frequently erratic.

Household Food Availability and Stunting

Stunting was substantially correlated with household food supply (χ^2 = 6.136, p = 0.047; OR = 3.10). Compared to children from households with adequate or stable food availability, children from households reporting inadequate food availability are more vulnerable. This outcome is in line with a study conducted in Kelurahan Naioni, Kupang, which found a strong correlation between household food security and stunting (OR = 5.67, p = 0.004) (Arinya D. Rambadeta et al., 2024), Coupled with the systematic review and meta-analysis that demonstrated a robust correlation between family food insecurity and stunting in children aged 0–59 from several cohort studies (Patriota et al., 2024).

Continuous access to the energy, protein, and micronutrients needed for linear growth is made possible by having enough food in the home. However, nutritional diversity and quantity are frequently reduced in households experiencing food hardship. Households in Ainaro Municipality may be more susceptible to fluctuations in food availability due to the region's mountainous terrain and seasonal disruptions to the food distribution infrastructure.

Synthesis and Program Implications

Maternal care had the highest correlation with stunting among the three factors examined: family income (OR = 2.51), household food availability (OR = 3.10), and maternal care (OR = 3.55). These factors are theoretically and causally related to one another: poor family income restricts the amount of food available in the home, which in turn restricts the mother's ability to use the best feeding and care techniques.

This standard supports the need for multisectoral interventions in Timor-Leste that collectively strengthen maternal nutrition education, household economic

resilience, and food security rather than treating each determinant independently. It is also consistent with the UNICEF conceptual framework on the immediate, underlying, and basic determinants of child malnutrition (Has et al., 2024).

Strengths and Limitations

Using WHO-standardized anthropometric measurements and a systematic analytical methodology, this study is one of the first to concurrently examine maternal care, family income, and food availability in connection to stunting in Timor-Leste. But there are certain restrictions that must be taken into account. The cross-sectional design makes it impossible to draw conclusions about causality, and the relatively small sample size (n = 130) combined with the low number of stunting cases in some subgroups for example, there are no stunting cases in the high-income category may make the estimates less accurate and result in wide, though unreported, confidence intervals for some odds ratios.

Additionally, non-probability (random) sampling methods may restrict how broadly the findings can be applied outside of the study area. It is advised that future research use probability-based sampling, bigger sample sizes, and multivariate analyzes to account for confounding variables and produce adjusted odds ratios.

CONCLUSION

In the care area of the Ainaro-Villa Health Center, Ainaro Municipality, Timor-Leste, stunting was found to be significantly correlated with maternal care (χ^2 = 4.867, p = 0.027, OR = 3.55), family income (χ^2 = 6.314, p = 0.043, OR = 2.51), and household food availability (χ^2 = 6.06, p = 0.47, OR = 3.10).

Of the three factors examined, maternal care exhibited the strongest correlation. These findings highlight the necessity of an integrated, multisectoral approach to preventing stunting in Timor-Leste that takes into account the socioeconomic and geographic realities of rural municipalities like Ainaro, strengthens household food security and economic capacity, and integrates maternal care and nutrition education.

ACKNOWLEDGEMENT

The authors thank the staff of the Ainaro-Villa Health Center and all the mothers who participated in this study, their time and cooperation.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

FUNDING

This research received no specific financial support from governmental, commercial, or nonprofit funding agencies.

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