

Dietary adequacy and parenting practices associated with toddler stunting in UPT Puskesmas Koppe

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ABSTRACT

Stunting is a chronic nutritional problem that remains a serious concern in Indonesia, including Bone Regency. This condition is associated with long-term undernutrition, maternal knowledge of nutrition, and suboptimal caregiving practices and affects physical growth, cognitive development, productivity, and the risk of disease later in life. This study aimed to analyze the relationship between dietary adequacy, maternal nutrition knowledge, and caregiving practices with stunting among toddlers in the service area of UPT Puskesmas Koppe and to identify the dominant factors influencing it. An analytic quantitative study with a cross-sectional design was conducted in the UPT Puskesmas Koppe service area. A total of 43 respondents were selected using purposive sampling based on inclusion and exclusion criteria. Data were collected through interviews using questionnaires and a Food Frequency Questionnaire (FFQ) to measure dietary adequacy, maternal knowledge, and caregiving practices. Data analysis included univariate, bivariate (chi-square test), and multivariate (logistic regression) analyses. The prevalence of stunting in toddlers was 39.5%. There was a significant association between dietary adequacy and stunting ($p=0.000$), in which all toddlers with inadequate nutrition were stunted. Caregiving practices were also significantly associated with stunting ($p=0.024$), with a 6.75-times higher risk among toddlers receiving suboptimal care. Maternal knowledge was not significantly associated with stunting ($P =0.783$). Logistic regression confirmed that dietary adequacy was the most important factor influencing stunting. Adequate nutrition and optimal care are crucial for preventing stunting. Interventions should prioritize improving access to and the quality of nutrition, as well as strengthening caregiving practices at the household level through support from health workers.

Keywords: Dietary adequacy; maternal knowledge; caregiving practices; toddlers; stunting; UPT Puskesmas Koppe.

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1. INTRODUCTION

Malnutrition in toddlers is a serious condition that can affect a child's growth and development. It occurs when toddlers do not receive sufficient or balanced nutrition. This problem may manifest as undernutrition, short stature (stunting), thinness (wasting), or marasmus, all of which can impair immune and brain functions. Overnutrition (obesity) is another major concern. In Indonesia, malnutrition has serious consequences for the quality of human resources. One of the main problems is the high rate of stunting in toddlers (Rahayu et al., 2023). Stunting is a health problem that reflects the failure of a child's growth and development owing to chronic undernutrition. It affects not only physical growth but also the cognitive development and future productivity of the child. If undernutrition occurs during the Golden Period, a child's brain cells do not develop optimally, and growth and development during this critical stage are not maximized (Probosiwi, 2017; Layli & Indarjo, 2023).

Stunting has significant short- and long-term effects on the health of children. The most common effects are shorter height compared to peers and a greater susceptibility to illness. The causes of stunting are complex and interrelated. One major factor is the adequacy of nutrient intake. Insufficient intake, especially during the first 1,000 days of life, can hinder linear growth and increase the risk of stunting in children. Maternal nutritional knowledge also plays an important role. Mothers with good nutritional knowledge tend to provide higher quality food for their children (Setiawati et al., 2024).

Stunting remains a major global problem that must be addressed and has therefore become a key focus of global nutrition improvement targets through 2025 (Asri, 2022; Setiawati et al., 2024). In 2021, the WHO reported that global stunting reached 22% (149.2 million) in 2020. Indonesia has the second-highest burden of stunting in Southeast Asia, after that of Timor-Leste. According to the 2023 Indonesian Nutrition Status Survey (SSGI), the prevalence of stunting in Indonesia decreased from 24.4% in 2021 to 21.6%, but it is still above the WHO target of 20%.

According to the SSGI 2023 report by the Indonesian Ministry of Health, the prevalence of stunting in South Sulawesi is 26.3%. Stunting data for Bone Regency, based on the South Sulawesi Provincial Health Office (2024), reached 4.15%, while the Koppe Community Health Center area reported 0.9% (Bone Health Office, 2024). A study by Sanin et al. (2018) in slum areas of Bangladesh found that nutrient adequacy measured by the Mean Adequacy Ratio (MAR) reached only 0.48 at 24 months, with low intake of micronutrients such as vitamins A, E, and B-complex, calcium, iron, and zinc. Colo et al. (2024) showed that nutrient adequacy and dietary patterns significantly influenced stunting among children aged 12–36 months in Usttasae Village, Timor-Leste. The findings indicated that protein deficiency was the dominant factor, with an 11.5-times higher risk of stunting, followed by inadequate zinc intake and low dietary diversity, which contributed to a stunting prevalence of 64.8%.

Poor nutrition-related health conditions, such as stunting, lead to developmental deficits from early to middle childhood, increasing the risk of illness and death and slowing motor and mental development (Rahmawati, 2018; Laily & Indarjo, 2023). Toddlers with stunting are at risk of reduced intellectual ability, lower productivity, and a higher risk of degenerative diseases later in life. Stunting is also associated with speech and language disorders and poorer cognitive abilities in children (Probosiwi, 2017; Laily & Indarjo, 2023).

In addition to nutrition and maternal knowledge, parental care for their children is crucial for preventing stunting. Good care means breastfeeding only, providing the right extra food, and proper health care. Poor care, such as poor hygiene and unbalanced feeding, can lead to stunting in young children. This can happen if mothers do not know enough about nutrition during pregnancy and how to prepare food to help with breastfeeding (Ariyanti, 2015; Noorhasanah & Tauhidah, 2021). The environment also affects stunting. Stunting can occur if children do not eat enough food or become sick often. These problems are linked to the way mothers care for their children. Getting enough food, especially in the first 1,000 days—from pregnancy to age two—is crucial for a child's nutrition. Therefore, good care that provides sufficient food and maintains a clean environment is essential to prevent stunting (Dayuningsih et al., 2020).

In addition to prenatal nutrition, ineffective child-rearing significantly contributes to stunting. Ineffective caregiving includes suboptimal feeding behaviors and practices. Many factors can influence caregiving, such as limited knowledge and understanding of balanced nutrition, irregular eating patterns, and difficulty in accessing nutritious foods (Noorhasanah & Tauhidah, 2021). Additionally, maternal undernutrition during adolescence and pregnancy can negatively affect a child's nutritional status at birth. During lactation, an inadequate maternal diet and nutrition can affect the quality and quantity of breast milk provided to the infant. These factors can hinder a child's growth and development, thereby increasing the risk of stunting.

Fallo et al. (2023) showed that maternal education, knowledge, and caregiving practices are associated with toddler stunting. Mothers with lower education and nutrition knowledge have less optimal caregiving, which increases the risk of stunting in their children. Silaban et al. (2022) found a significant relationship between micronutrient adequacy (vitamin A, iron, and zinc) and stunting among children aged 13–23 months in the Banyuasin Regency. Stunted toddlers had lower intakes of vitamin A, iron, and zinc than non-stunted toddlers did. Vitamin A deficiency affects protein synthesis and cell growth, whereas iron deficiency causes anemia and immune impairment, which inhibit growth of the fetus. Zinc is essential for bone metabolism and cell differentiation and influences the physical development of toddlers.

In the Koppe Community Health Center area, 2024 data show toddler nutrition problems of stunting (15%), wasting (3.7%), and underweight (6.2%). The Koppe Health Center in Libureng Village, Bengo District, South Sulawesi, has an uneven population distribution. Settlements vary from dense areas near the village center to remote inland areas with limited access to resources. While population concentration near the village center indicates better health coverage, the area faces economic limitations and low health awareness. This creates gaps in stunting management, with children in remote areas facing a higher risk of growth disorders due to geographic, social, and economic factors.

Factors such as nutrient adequacy, maternal knowledge, and caregiving practices are suspected to influence stunting incidence. However, few studies have analyzed the relationships between these factors. This study aimed to analyze the relationship between nutrient adequacy, maternal knowledge, and caregiving practices and stunting among toddlers in the service area of UPT Puskesmas Koppe. Based on this background, the author will conduct a study on "The relationship between nutrient adequacy, maternal knowledge, and caregiving practices with stunting among toddlers in the service area of UPT Puskesmas Koppe."

2. LITERATURE REVIEW

2.1 Stunting

Stunting is a chronic growth and developmental disorder caused by long-term undernutrition (in the mother and/or child), recurrent infection, and environmental/psychosocial factors. According to the WHO, a child is classified as stunted if height-for-age (HFA) is < -2 SD. Its effects can be irreversible if not addressed during the critical period of the first 1,000 days of life (Setiyaningrum et al., 2024; Silaban et al., 2022).

The impacts of stunting include increased morbidity, delayed cognitive and motor development, poorer school performance, a higher risk of degenerative diseases (e.g., diabetes, obesity, heart disease, and stroke), and reduced productivity and income in adulthood (Leroy et al., 2019; Shodikin et al., 2023; Dai et al., 2024).

Stunting is primarily triggered by prolonged inadequate nutrient intake, especially during the first 1,000 days of life, and is worsened by recurrent infections (diarrhea, acute respiratory infections, and helminth infections) that hinder nutrient absorption. Other contributing factors include suboptimal caregiving practices (lack of exclusive breastfeeding and inappropriate complementary feeding), poor sanitation and limited access to clean water, low economic status, limited access to nutritious food, inadequate health services, and birth-related factors such as low birth weight (Kresna et al., 2023; Ismawati et al., 2020; Shodikin et al., 2023). Pertiwi and Hendrati (2023) emphasized caregiving, socioeconomic

conditions, birth history, poor clean and healthy living practices (PHBS), and maternal pregnancy conditions (low ANC visits, chronic energy deficiency, and anemia) as key risk factors.

2.2 Maternal Knowledge Aspect

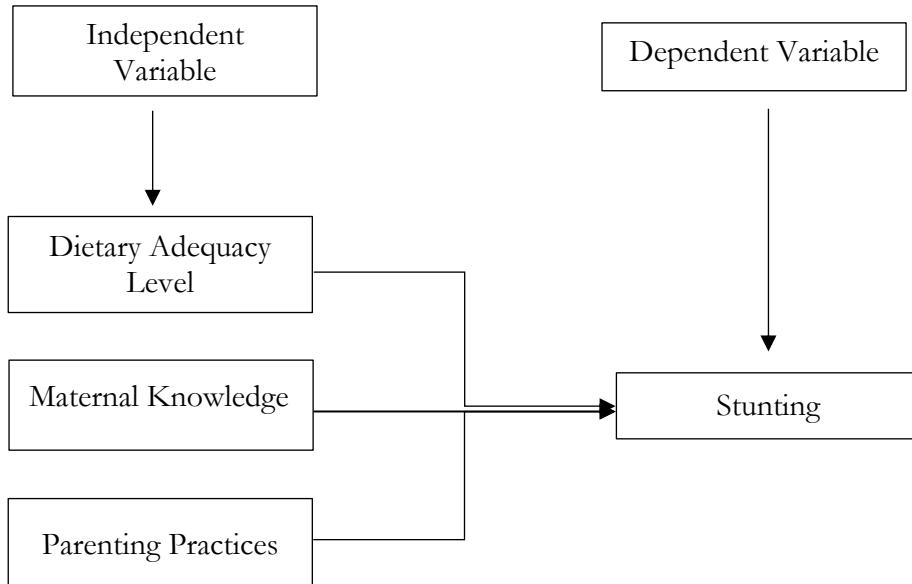
Maternal knowledge is an important factor in stunting prevention because a mother's role is not limited to pregnancy; it begins in the pre-pregnancy period and continues through breastfeeding and feeding practices for toddlers up to 36 months of age. Mothers with good nutritional knowledge are more likely to plan balanced diets, practice exclusive breastfeeding, provide appropriate complementary feeding (MPASI), and choose foods rich in protein, vitamins, and minerals according to a child's needs, thereby preventing nutritional problems such as stunting, wasting, and underweight. In contrast, limited nutritional knowledge can lead to inappropriate feeding practices, nutrient imbalance, or inadequate quality of complementary foods, which negatively affects a child's growth and development (Shodikin et al., 2023; Rahayu et al., 2023). Knowledge of toddler nutrition also includes understanding key nutrient requirements (protein, carbohydrates, healthy fats, vitamins, and minerals), dietary diversity, and the ability to recognize signs of malnutrition to enable early detection and prompt intervention (Olii et al., 2024; Mirin et al., 2024).

Several studies have shown that maternal knowledge influences toddlers' nutritional status: mothers with better nutrition knowledge tend to have children with better nutritional status, whereas low knowledge is an indirect factor contributing to stunting (Arfenda et al., 2023). Maternal knowledge is shaped by education, economic conditions, culture, the social environment, family support, and access to health services and nutrition education through *posyandu/puskesmas*, including supplementary feeding programs (PMT) (Hagos et al., 2017; Apriluana & Fikawati, 2018; Aini et al., 2022; Agustina et al., 2025). Low maternal knowledge may also result in suboptimal feeding-related caregiving, micronutrient deficiencies, greater susceptibility to infections, and delays in cognitive and motor development, which can ultimately reduce a child's productivity (Harnawati & Agustin, 2022; Harnawati Zulfiana, 2024; Sampouw, 2021).

2.3 Definition of Parenting (Practices)

Parenting refers to a set of parental practices that involve caring for, feeding, maintaining children's health, and ensuring a clean environment so that toddlers can grow and develop optimally. Good parenting, especially nutrition-related caregiving, is reflected in breastfeeding practices, appropriate complementary feeding (MPASI), the selection of quality foods, appropriate portion sizes and feeding schedules, and attentive, affectionate care. These practices are important for preventing stunting (Izhar, 2017; Shodikin, 2023). Parenting also includes health-related practices such as growth monitoring, complete immunization, hygienic behaviors (e.g., handwashing), and prompt responses when a child is ill to prevent recurrent infections that may disrupt nutrient absorption (Mardhiah et al., 2024; Nurkholizah et al., 2025).

Several studies have indicated that suboptimal parenting is associated with a higher risk of stunting because children's nutritional and care needs are not consistently met over time, and this condition is often influenced by maternal nutritional knowledge (Colo & Manongga, 2021; Olsa et al., 2018; Fallo 2023). Parenting practices are shaped by parents' education and knowledge, socioeconomic conditions, culture/beliefs, social support, parents' psychological conditions, access to health services, and government policies. Economic constraints and limited support can hinder the implementation of ideal caregiving (Mukhlis, 2024; Furwati et al., 2025; Fitriyani, 2022). Suboptimal parenting can lead to nutritional problems (stunting, wasting, and obesity), increased vulnerability to infections due to inadequate immunization and hygiene, and delays in social and academic development that may persist into adulthood, highlighting the need for support from families, health workers, and the government to improve caregiving practices (Pratiwi, 2016; Fatonah & Damayanti, 2023; Mukhlis, 2024; Purwati et al., 2025). See Figure 1

**Figure 1. Conceptual Framework**

The conceptual framework of this study illustrates the relationships between several factors that influence children's nutritional status, particularly stunting. The independent variables (factors examined) included dietary adequacy, maternal nutritional knowledge, and caregiving practices. These three factors are interrelated and presumed to affect the occurrence of stunting in children. Dietary adequacy refers to a child's daily nutrient intake, including energy, protein, vitamins, and minerals required for optimal growth and development. If nutrient intake is insufficient, the child is at risk of growth impairment, including stunting. Dietary adequacy is an indicator that measures the extent to which a child's daily nutrient intake meets basic requirements, and it is influenced by various factors, including household economic conditions, food availability, and understanding of a balanced diet.

3. METHOD

This study used a quantitative design with a cross-sectional approach to analyze the relationship between dietary adequacy level, maternal knowledge, and parenting practices with the occurrence of stunting among toddlers in the service area of UPT Puskesmas Koppe. This approach was selected because it allows data to be collected simultaneously at a single point in time, making it efficient for identifying relationships among variables without observing changes over time. This was an observational analytic study, with independent variables consisting of dietary adequacy level, maternal nutrition knowledge, and parenting practices, while the dependent variable was stunting among toddlers. Variables were measured objectively using standard instruments, such as a Food Frequency Questionnaire (FFQ), maternal knowledge questionnaire, parenting practices questionnaire, NutriSurvey to calculate nutrient intake, and anthropometric measurements. The study design also considered potential confounding variables, such as the toddler's age, household economic status, and history of infectious diseases, which were controlled in the analysis using logistic regression.

The study was conducted in the service area of UPT Puskesmas Koppe, Bone Regency, South Sulawesi, which was selected because of the high prevalence of stunting in the area. The research activities were conducted from July 14, 2025, to July 31, 2025, covering preparation, data collection, data analysis, and final report writing. The research schedule was adjusted to the respondents' availability and coordination with the health center to ensure smooth data collection. The study population consisted of all toddlers aged 6–59 months and their mothers or primary caregivers registered in the UPT Puskesmas Koppe service area, totaling 1,319 toddlers. The sample size was determined using the Slovin formula with a 15% margin of error, resulting in 43 respondents being selected. The sampling technique was purposive

sampling, selecting participants based on specific criteria: toddlers aged 6–59 months, registered residents in the UPT Puskesmas Koppe service area, having a mother/primary caregiver willing to participate, and no special medical conditions affecting linear growth. Sample selection involved verifying the population list from health center records, screening respondent eligibility, approaching participants to obtain informed consent, and excluding subjects who did not meet the criteria during data collection. Purposive sampling was chosen for efficiency, given the limited research timeframe, easier access through *posyandu* cadres, and alignment with the schedules of the health center and *posyandu* activities.

Data collection used both primary and secondary data sources. Primary data were obtained through structured interviews, anthropometric measurements, and document review using instruments such as a maternal nutrition knowledge questionnaire, a 24-hour dietary recall form to assess nutrient intake, and a parenting practices questionnaire that described daily caregiving behaviors. Anthropometric measurements were taken using an infantometer for toddlers under 2 years old, a stadiometer for toddlers over 2 years old, and calibrated weighing scales for all toddlers. Secondary data were obtained from toddlers' health records at the UPT Puskesmas Koppe. The collected data were then processed, including editing, coding, tabulating, and data entry using Microsoft Excel and SPSS. The questionnaire and measurement data were checked for completeness and assigned numerical codes to facilitate analysis. Statistical analysis was conducted to examine the relationship between risk factors and stunting using logistic regression, which describes the association between a categorical dependent variable and one or more categorical and/or continuous independent variables. The results are presented in the form of respondent distribution tables, group comparison charts, and narrative explanations of key findings relevant to the research objectives.

4. RESULT AND DISCUSSION

4.1 Result

4.1.1 Characteristics of Respondents

4.1.1.1 Age

Table 1. Frequency Distribution of Respondents' Characteristics by Age in the Working Area of UPT Puskesmas Koppe

No	Age (months)	Frequency (n)	Percentage (%)
1	6–11	1	2.33
2	12–35	25	58.14
3	36–59	17	39.53
Total		43	100.0

Based on the frequency distribution in Table 1 of respondents by age group in the service area of UPT Puskesmas Koppe, most respondents were in the 12–35 months age group, totaling 25 children (58.14%). The 36–59 months group consisted of 17 children (39.53%), while the 6–11 months group had the fewest respondents, with only one child (2.33%). These results indicate that the majority of respondents were toddlers aged 1–3 years, whereas children under 1 year were relatively few.

4.1.1.2 Gender

Table 2. Frequency Distribution of Respondents' Characteristics by Gender in the Working Area of UPT Puskesmas Koppe

No	Gender	Frequency (n)	Percentage (%)
1	Male	24	55.81
2	Female	19	44.19
	Total	43	100.0

Source: Processed Primary Data, 2025

Based on the frequency distribution table of respondents by sex, most respondents were boys (24 children, 55.81%), while girls accounted for 19 children (44.19%). This indicates that the proportion of male toddlers in this study was slightly higher than that of female toddlers, although the difference was not significant.

4.1.2 Univariate Analysis

4.1.2.1 Nutrient Adequacy Level

Table 3. Frequency Distribution of Respondent Characteristics Based on Nutrient Adequacy Level in the Service Area of UPT Puskesmas Koppe

No	Level of Nutrient Adequacy	Frequency (n)	Percentage (%)
1	Inadequate	26	60.47
2	Adequate	17	39.53
	Total	43	100.0

Source: Processed Primary Data, 2025

Based on the frequency distribution in Table 3 of respondents by nutrient adequacy level, most toddlers were classified as having inadequate nutrient intake, totaling 26 children (60.47%). Meanwhile, 17 children (39.53%) had an adequate nutrient intake. This indicates that a substantial proportion of toddlers still experience insufficient intake, which may lead to health problems, including an increased risk of stunted growth.

4.1.2.2 Maternal Knowledge

Table 5. Frequency Distribution of Respondent Characteristics Based on Maternal Knowledge in the Service Area of UPT Puskesmas Koppe

No	Mother's Knowledge	Frequency (n)	Percentage (%)
1	Poor	3	7.0
2	Fair	21	48.8
3	Good	19	44.2
	Total	43	100.0

Source: Processed Primary Data, 2025

Based on the frequency distribution in Table 5 of respondents by maternal knowledge, most mothers had moderate knowledge, totaling 21 mothers (48.8%), followed by good knowledge in 19 mothers (44.2%), while only 3 mothers (7.0%) had poor knowledge. This indicates that most mothers

have an adequate understanding of child health, although a small proportion still requires additional attention through health education and counseling.

4.1.2.3 Caregiving Practices

Table 6. Frequency Distribution of Respondent Characteristics Based on Caregiving Practices in the Service Area of UPT Puskesmas Koppe

No	Parenting Pattern	Frequency (n)	Percentage (%)
1	Not optimal	25	58.1
2	Optimal	18	41.9
Total		43	100.0

Source: Processed Primary Data, 2025

Based on the frequency distribution in Table 6 of respondents by caregiving practices, most mothers were classified as having suboptimal caregiving, totaling 25 mothers (58.1%). Meanwhile, 18 mothers (41.9%) were classified as having an optimal caregiving. These findings indicate that a considerable proportion of mothers still need to improve their caregiving practices to better support children's growth and reduce the risk of health problems, including stunting.

4.1.2.4 Stunting

Table 7. Frequency Distribution of Respondent Characteristics Based on Stunting Status in the Service Area of UPT Puskesmas Koppe

No	Nutritional Status	Frequency (n)	Percentage (%)
1	Stunted	17	39.53
2	Not stunted	26	60.47
Total		43	100.0

Source: Processed Primary Data, 2025

Based on the frequency distribution in Table 7 of respondents by nutritional status, most toddlers were not stunted, totaling 26 children (60.47%). Meanwhile, 17 children (39.53%) were also stunted. These results indicate that, although most toddlers had a normal growth status, the proportion experiencing stunting remains relatively high, suggesting that stunting is still a health concern that requires serious attention in the service area of UPT Puskesmas Koppe.

4.1.3 Bivariate Analysis

4.1.3.1 Relationship Between Nutrient Adequacy and Stunting Among Toddlers in The Service of UPT Puskesmas Koppe

Table 8. Relationship between nutrient adequacy and stunting among toddlers in the service area of UPT Puskesmas Koppe

Level of Nutrient Adequacy	Not Stunted n (%)	Stunted n (%)	Total n (%)	p-value	α
Inadequate	12 (27.9)	14 (32.6)	26 (60.5)	0.018	0.05
Adequate	14 (32.6)	3 (7.0)	17 (39.5)		
Total	26 (60.5)	17 (39.5)	43 (100)		

Source: Chi-Square Test Analysis (SPSS)

Based on Table 8, there is a significant relationship between nutrient adequacy and stunting among toddlers in the service area of UPT Puskesmas Koppe. Of the 26 toddlers with inadequate nutrient intake, 14 (32.6%) were stunted and 12 (27.9%) were not. In contrast, among the 17 toddlers with adequate nutrient intake, 14 (32.6%) were not stunted, and only 3 (7.0%) were stunted. The statistical test showed a p-value of 0.018, which is smaller than $\alpha = 0.05$, indicating a significant association. This suggests that toddlers with lower nutrient adequacy have a higher risk of stunting than those with adequate intake.

4.1.3.2 Relationship Between Maternal Knowledge and Stunting Among Toddlers in The Service of UPT Puskesmas Koppe

Table 9. Relationship between maternal knowledge and stunting among toddlers in the service area of UPT Puskesmas Koppe

Mother's Knowledge	Not Stunted n (%)	Stunted n (%)	Total n (%)	p-Value	α
Poor	1 (2.3)	2 (4.6)	3 (7.0)	0,236	0,05
Fair	11 (25.0)	10 (23.0)	21 (49.0)		
Good	14 (32.0)	5 (12.0)	19 (44.0)		
Total	26 (60.0)	17 (39.0)	43 (100)		

Source: Chi-Square Test Analysis (SPSS)

As shown in Table 9, maternal knowledge was not significantly associated with stunting among toddlers in the service area of UPT Puskesmas Koppe. Among mothers with good knowledge, 14 toddlers (32%) were not stunted, and 5 toddlers (12%) were stunted. In the moderate knowledge group, 11 toddlers (25%) were not stunted and 10 toddlers (23%) were stunted. In the poor knowledge group, one toddler (2.3%) was not stunted and two toddlers (4.6%) were stunted. The chi-square test produced a p-value of 0.236, which is greater than $\alpha = 0.05$, indicating no significant relationship between maternal knowledge and child stunting. This suggests that good maternal knowledge does not necessarily translate into lower stunting rates, as other factors, such as caregiving practices and nutrient adequacy, also play important roles.

4.1.3.3 Relationship Between Caregiving Practices and Stunting Among Toddlers in The Service Area of UPT Puskesmas Koppe

Table 10. Relationship between caregiving practices and stunting among toddlers in the service area of UPT Puskesmas Koppe

Parenting Pattern	Not Stunted n (%)	Stunted n (%)	Total n (%)	p-Value	α
Optimal	12 (28.0)	13 (30.0)	25 (58.0)	0,049	0,05
Not optimal	14 (33.0)	4 (9.3)	18 (42.0)		
Total	26 (60.5)	17 (39.5)	43 (100)		

Source: Chi-Square Test Analysis (SPSS)

Based on Table 10, there is a significant association between caregiving practices and stunting in toddlers in the service area of UPT Puskesmas Koppe. Among mothers with suboptimal caregiving, 12 toddlers (28%) were not stunted and 13 toddlers (30%) were stunted. In contrast, among mothers with optimal caregiving, 14 toddlers (33%) were not stunted, while 4 toddlers (9.4%) were stunted. The chi-square test yielded a p-value of 0.049, which is lower than $\alpha = 0.05$, indicating a significant relationship. This suggests that toddlers who receive optimal caregiving are more likely to grow normally, whereas suboptimal caregiving increases the risk of stunting.

4.1.4 Multivariate Analysis

Identifying the dominant factor influencing stunting among toddlers in the service area of UPT Puskesmas Koppe

Table 11. The most dominant factors influencing stunting among toddlers in the service area of UPT Puskesmas Koppe

Variable	B	S.E.	Wald	df	Sig.	Exp(B)
Nutrient Adequacy Level	-3.564	1.268	7.897	1	0.004	0.028
Maternal Knowledge	-0.156	0.711	0.048	1	0.826	0.856
Caregiving Practices	-3.299	1.212	7.426	1	0.004	0.037
Constant	-9.514	3.305	8.039	1	0.005	13144.026

Source: Logistic Regression Test Analysis (SPSS)

Based on the logistic regression results in Table 11 examining the relationship between nutrient adequacy level, maternal knowledge, caregiving practices, and stunting among toddlers in the service area of UPT Puskesmas Koppe, the findings indicate that the most influential variable is nutrient adequacy level. The analysis shows that nutrient adequacy has a significance value of 0.004, which is lower than $\alpha = 0.05$, meaning it is significantly associated with stunting. The Exp(B) value of 0.028 suggests that nutrient adequacy status can clearly differentiate between stunted toddlers and those who are not. Therefore, nutrient adequacy is the dominant factor affecting stunting in this area.

Meanwhile, the significance value for maternal knowledge was 0.826, which is much higher than $\alpha = 0.05$. This indicates that maternal knowledge in this study is not significantly associated with stunting. Although knowledge is theoretically important, the results suggest that it does not directly determine whether a toddler is stunted.

The caregiving practices variable has a significance value of 0.004, which is lower than $\alpha = 0.05$, indicating a significant association with stunting. The Exp(B) value of 0.037 indicates that toddlers receiving suboptimal caregiving have a higher risk of stunting compared with those receiving optimal caregiving.

4.2 Discussion

4.2.1 Relationship Between Nutrient Adequacy and Stunting Among Toddlers in The Service Area of UPT Puskesmas Koppe

Nutrient adequacy reflects how well a toddler's nutrient intake meets daily requirements based on the Recommended Dietary Allowance (RDA) and plays an important role in supporting growth and preventing stunting. In this study, toddlers' food intake was assessed using a Food Frequency Questionnaire (FFQ) and processed with NutriSurvey to convert portion sizes into grams and to calculate energy, macronutrients, and micronutrients. Daily intake was then compared with the RDA for toddlers aged 6–59 months to obtain the nutrient adequacy percentage, which was classified as adequate ($\geq 80\%$ of the RDA) or inadequate ($< 80\%$ of the RDA).

The results showed that 60.5% of toddlers had adequate nutrient intake, while 39.5% had inadequate intake. Bivariate analysis indicated a significant association between nutrient adequacy and stunting ($p = 0.018$; $p < 0.05$), where all toddlers with inadequate intake experienced stunting. This aligns with field findings of suboptimal feeding patterns (limited portions, eating only 1–2 times per day, low dietary diversity, and carbohydrate-dominant meals), which increase the risk of deficits in energy, protein, and key micronutrients (e.g., iron, zinc, and vitamin A) that impair linear growth, especially during the first 1,000 days of life. These findings are consistent with studies by Haryanto et al. (2025), Wulandari et al.

(2020), and Rahmatika et al. (2024), suggesting that improving nutrient adequacy through better feeding practices, dietary diversity, and parental nutrition education is a key strategy for stunting prevention.

4.2.2 Relationship Between Maternal Knowledge and Stunting Among Toddlers in The Service of UPT Puskesmas Koppe

This study found no association between maternal knowledge and stunting among toddlers in the service area of UPT Puskesmas Koppe. Statistical testing produced a p-value of 0.236 ($p > 0.05$), indicating that maternal knowledge did not significantly affect the stunting status of children. Although many mothers had good knowledge, stunting was still observed, suggesting that knowledge is not always reflected in practice.

Stunting appears to be more strongly influenced by other factors such as food availability, household dietary patterns, socioeconomic conditions, caregiving practices, the home environment, and access to health services. Several studies (Fitriani & Darmawi, 2023; Forh et al., 2022; Saputra et al., 2022) have suggested that knowledge alone is insufficient without supportive practices and household conditions. Therefore, improving maternal knowledge should be accompanied by practical interventions (nutrition education, support for feeding/complementary feeding practices, and strengthened access to nutritious foods and health services) to make stunting prevention more effective.

4.2.3 Relationship Between Caregiving Practices and Stunting Among Toddlers in The Service of UPT Puskesmas Koppe

The study found a significant association between caregiving practices and stunting among toddlers in the service area of UPT Puskesmas Koppe, Indonesia. Toddlers who received optimal caregiving were less likely to be stunted, whereas those who received suboptimal caregiving were more likely to experience stunting. The statistical test showed a p-value of 0.049 ($p < 0.05$), indicating a significant relationship.

Caregiving practices may influence stunting through daily behaviors related to feeding, health care, hygiene, and emotional support, as these factors affect nutrient adequacy and reduce the infection risk that can hinder growth. This finding is consistent with studies by Putri et al. (2024), Megasari et al. (2024), Purwati et al. (2025), Abdullah et al. (2025), and George et al. (2024), which emphasize that good caregiving—such as appropriate breastfeeding/complementary feeding, use of health services, personal hygiene, sanitation, and consistent caregiving practices—plays an important role in reducing the risk of stunting. Therefore, stunting prevention should be supported by education and practical guidance for caregivers at the household level in Indonesia.

4.2.4 The Dominant Factor Influencing Stunting Among Toddlers in The Service of UPT Puskesmas Koppe

Logistic regression results showed that among the three variables examined (nutrient adequacy, maternal knowledge, and caregiving practices), the most dominant factor influencing stunting was nutrient adequacy, with a significance value of 0.004. This indicates a strong association between insufficient nutrient intake and impaired linear growth, particularly when it persists over time, during the first 1,000 days of life. This finding is consistent with Wisudariani et al. (2023), who emphasized the importance of meeting children's nutritional needs for stunting prevention.

In addition, caregiving practices were significantly associated with stunting ($p = 0.024$), where suboptimal caregiving increases the risk of stunting through feeding practices, hygiene, sanitation, and use of health services (Ewi Lestari et al., 2022). Meanwhile, maternal knowledge was not significantly associated with stunting ($p = 0.826$), suggesting a gap between knowledge and practice that may also be shaped by economic conditions and food access. Therefore, interventions should prioritize improving

toddlers' nutrient adequacy and strengthening caregiving practices, supported by practical education that can be applied in daily life settings.

5. CONCLUSION

Based on the study on factors associated with stunting among toddlers in the service area of UPT Puskesmas Koppe, the following conclusions can be drawn: (a) There is an association between nutrient adequacy level and stunting among toddlers. Toddlers with adequate nutrient intake did not experience stunting, whereas those with inadequate nutrient intake all experienced stunting (p -value = 0.000). This indicates that nutrient adequacy is an important factor in stunting prevention; (b) There is no significant relationship between mothers' nutritional knowledge and stunting among toddlers (p -value = 0.783). Although most mothers had good knowledge, this was not always followed by practical implementation in stunting prevention; (c) There is an association between caregiving practices and stunting among toddlers (p -value = 0.024). Toddlers who received optimal caregiving tended to have normal growth, while suboptimal caregiving increased the risk of stunting; (d) The most dominant factor influencing stunting is nutrient adequacy level, with a significance value of 0.000 and a very high odds ratio ($Exp(B)$), followed by caregiving practices, while maternal knowledge does not directly influence stunting.

Ethical Approval

Not Applicable

Informed Consent Statement

Not Applicable

Authors' Contributions

AAV led the conceptualization of the study, developed the research framework, coordinated data collection, and prepared the initial manuscript draft. AN participated in refining the theoretical foundation, validating measurement instruments, and reviewing the analysis to ensure methodological rigor. I contributed to the literature review, strengthened the discussion by integrating relevant empirical studies, and revised the manuscript for academic coherence.

Disclosure Statement

The Authors declare that they have no conflict of interest

Data Availability Statement

The data presented in this study are available upon request from the corresponding author for privacy.

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