Jurnal Info Kesehatan
Vol. 22, No. 4, December 2024, pp. 724-734
P-ISSN 0216-504X, E-ISSN 2620-536X
DOI: *10.31965/infokes.Vol22.Iss4.1738*
Journal homepage: *https://jurnal.poltekkeskupang.ac.id/index.php/infokes*

RESEARCH Open Access

Energy Intake, Protein Intake, and Toddler Hygiene with the Incidence of Stunting in 24-59 Months Toddlers in Mentawai Islands

Fatia Ilmiati[1a], Ahmad Syauqy[2b*], Etika Ratna Noer[2c], Ani Margawati[2d], Apoina Kartini[3e]

[1] Postgraduate of Nutrition Science Program, Faculty of Medicine, Diponegoro University, Central Java, Indonesia
[2] Department of Nutrition Science, Faculty of Medicine, Diponegoro University, Central Java, Indonesia
[3] Department of Nutrition Science, Faculty of Public Health, Diponegoro University, Central Java, Indonesia

[a] Email address: fatiailmiati18@gmail.com
[b] Email address: syauqy@fk.undip.ac.id
[c] Email address: etikaratna@fk.undip.ac.id
[d] Email address: amargawati@lecturer.undip.ac.id
[e] Email address: apoinakartini@lecturer.undip.ac.id

Received: 12 October 2024 Revised: 22 October 2024 Accepted: 16 December 2024

Abstract
Toddlerhood is an important period in human growth and development; during that period, if the nutrition is not adequate, they risk stunting. Some factors that cause this are energy intake, protein intake, parenting, and food security. In 2022, the prevalence of stunting is around 148 million (22.3%), most coming from Asia and Africa; according to WHO, in Indonesia, the prevalence of stunting is 21.6%. The incidence of stunting in Mentawai Islands Regency is 32%, the second highest rate below the national rate. According to the author's knowledge, this research is the first study to analyze the relationship between independent and dependent variables as well as the determinants of stunting in toddlers in the Sarereiket Health Centre using questionnaire data, direct observation, and interviews that have gone through a validation and reliability process from experts through the laboratory. The research aims to analyze the relationship between energy intake, protein intake, and hygiene of toddlers and the incidence of stunting in toddlers aged 24-59 months in South Siberut District, Mentawai Islands Regency. The method used the observational method. The subjects of analysis were 393 toddlers aged 24-59 months in the Sarereiket Health Centre who were involved in this study. Multivariate regression was performed to identify the relationship between dependent and independent variables. The results indicate that toddlers' energy intake, protein intake, and hygiene are associated with stunting. The results of the multivariate analysis in this study indicate that protein intake and toddler hygiene influence stunting and contribute to increasing the incidence of stunting in toddlers. The conclusion is there is a significant relationship between energy intake, protein intake, and hygiene of toddlers and the incidence of stunting in the Sarereiket Community Health Centre, Mentawai Islands.

Keywords: Energy Intake, Protein Intake, Toddler Hygiene.

Corresponding Author:

Ahmad Syauqy
Department of Nutrition Science, Faculty of Medicine, Diponegoro University, Central Java, Indonesia
Email: syauqy@fk.undip.ac.id

1. INTRODUCTION

Stunting is a condition of chronic or prolonged malnutrition that leads to impaired growth characterized by inappropriate or substandard height for age. Toddlers with diverse food consumption have better nutritional status (Hadi et al., 2022). However, the level of food consumption among toddlers in Indonesia is still not diverse. This affects the quality of nutrients consumed by toddlers and can result in a lack of nutrient intake. Lack of nutrient intake will inhibit growth and lead to undernutrition, which will increase the chance of stunting (Raiten & Bremer, 2020a).

Globally, the prevalence of stunted children under five in 2022 will be around 148 million (22.3%) (UNICEF/WHO/World Bank Group, 2022). Most of the stunting problems come from Asia and Africa. The prevalence of stunting in Asia has decreased from 81.7 million (54.8%) in 2020 to 76.6 million (22.3%) in 2022 (UNICEF/WHO/World Bank Group, 2022). While the prevalence of stunting in Indonesia, according to WHO (2022), is (21.6%) (UNICEF/WHO/World Bank Group, 2022). The incidence of stunting in Mentawai Islands Regency is 32%, which is the second highest rate below the national rate (Fitriani & Oktobriariani, 2017).

Therefore, adequate energy intake and protein intake patterns are needed to prevent the increase of stunting in Indonesia. Adequate energy intake is needed to support body activities and child growth, while protein plays an important role in body tissue formation, cell growth, and brain development (Fikawati et al., 2021). Lack of energy and protein intake can cause delays in children's physical growth and cognitive development, impacting their future quality of life (Fikawati et al., 2020). In Mentawai, socioeconomic conditions that do not support access to nutritious food, as well as limited nutrition knowledge, exacerbate the problem of stunting (Raiten & Bremer, 2020). Therefore, proper nutrition intervention, including the provision of nutritious food with adequate energy and protein sources such as fish, meat, and beans, is needed to break the stunting cycle (Simamora et al., 2019).

The Mentawai people have a traditional speciality food known as sago. Carbohydrate sources that the Mentawai people often consume include taro, sago, sweet potato, and banana. Protein sources such as sago worms, eggs, fish, tempeh and tofu are available because the location of the market is far away and the purchasing power is quite expensive, so only people who have a middle to upper economy can afford it. A diverse and age-appropriate intake is needed to fulfill various nutrients. At the age of 0-6 months, babies only need intake from breast milk; after 6 months, they are given complementary foods (MP-ASI) (Aritonang, et. al., 2021; Anggraeni, et al, 2022; Tyas, Sa'danoer, & Silvia, 2024). Inadequate intake risks malnutrition, making them susceptible to diseases, especially infectious diseases.

In addition, under-five hygiene also plays an important role in preventing stunting in Mentawai communities. Unhygienic environments, such as limited access to clean water and poor sanitation, increase the risk of infectious diseases such as diarrhea and parasitic infections, which can undermine the nutritional status of under-fives (Aisyah & Yunianto, 2021). Toddlers who are often sick will have difficulty absorbing nutrients properly, thus hindering their growth. Then, maintaining hygiene, such as washing hands with soap, maintaining environmental sanitation, and ensuring access to clean water, can prevent infections that interfere with the growth process (Endrinikapoulos et al., 2023). In Mentawai, geographical challenges increase the problem of access to hygiene, so education to the community and improvement of sanitation infrastructure are key (Sari et al., 2020).

South Siberut sub-district is located at an altitude of 2,000 meters above sea level. The area of the South Siberut sub-district is 328 km^2. The majority of livelihoods are as farmers. South Siberut sub-district still needs a place to accommodate garbage and waste management, so people often throw garbage into the river or the garden. The population lives in hilly areas where there are still houses that do not have bathrooms, so they dispose of feces carelessly or go into the river. In addition, it is also known that children under five years old have a habit of

not wearing footwear and not washing their hands after playing. This can increase the risk of infection transmission. Based on the description above, the researcher aims to analyze toddler hygiene, energy intake, and protein intake about the incidence of stunting.

2. RESEARCH METHOD

This cross-sectional study was conducted at the Sarereiket Community Health Centre in South Siberut and focused on children aged 24-59 months within the health center's area, with a total population of 393 toddlers. A sample of 130 toddlers was selected using purposive sampling. Data was collected through questionnaire interviews covering parent and toddler demographics, dietary diversity, hygiene, environmental sanitation, food intake, exclusive breastfeeding history, complementary feeding, family size, health service utilization, and low birth weight (LBW) data. Soil-transmitted helminth (STH) infections were identified by collecting fecal samples and analyzing them at the Faculty of Medicine Laboratory, Andalas University, using the Kato Katz method. Anthropometric measurements of weight and height were also taken to confirm the toddlers' nutritional status. The data was univariately analyzed using frequency distribution and bivariate analysis with the Fisher Exact test at a 95% significance level to understand the relationship between independent and dependent variables. Additionally, multivariate analysis, specifically multiple logistic regression, was employed to examine the relationship between several independent variables and stunting, determining which independent variable had the greatest influence on the dependent variable. This study was approved by the Ethical Committee with Approval No. 037/EC/KEPK/FK-UNDIP/II/2024.

3. RESULTS AND DISCUSSION

Table 1. Subject Characteristics (N=130)

Variables	**N**	**%**
Nutritional status		
Stunting	76	58,5
Normal	54	41,5
Gender		
Women	64	49,2
Male	66	50,8
Age		
24-36	52	40
37-59	78	60
Birth Weight (g)		
No LBW	110	84,6
LBW	20	15,4
Energy Intake (kcal)		
Less	75	57,7
Simply	55	42,3
Protein Intake (g)		
Less	77	59,2
Simply	53	40,8
Food Diversity (IDDS)		
Not Diverse	108	83,1
Various	22	16,9
Exclusive breastfeeding		
No	100	76,9
Yes	30	23,1

Variables	N	%
Complementary Foods		
Not good	113	86,9
Good	17	13,1
STH infection		
Positive	57	48,3
Negative	73	56,2
Toddler Hygiene		
Not good	73	56,2
Good	57	43,6
Maternal Hygiene		
Not good	20	15,4
Good	110	84,6
Mother's education		
Low	89	86,5
High	41	31,5
Father's education		
Low	80	61,5
High	50	38,5
Number of Family Members		
A little	13	10,0
Many	117	90,0
Food Diversity (HDDS)		
Not Diverse	105	80,8
Various	25	19,2
Environmental Sanitation		
Not good	11	8,5
Good	119	91,5
Health Services		
Home	49	37,7
Fakes	81	62,3
Parents' Income		
Low	120	92,3
High	10	7,7

Table 1 shows that 130 children aged 24-59 months were involved in this study. Most children were identified as having stunted (58,5%). A slight difference according to gender, where slightly higher males than females with 60% aged 37-59 months. Children who were LBW or born normal (15.4%) and not LBW (84.6%). Children with low energy (57.7%) and low protein (59.2%) had a high probability of stunting. IDDS (83.1%) and HDDS (80.8%) food conditions that were not diverse had a higher percentage. In addition, children who did not receive exclusive breastfeeding (86.9%) and did not receive complementary feeding (13.1%) had a high probability of stunting. Then toddlers with a level of hygiene are not good (56.2%) and good (43.6%). There are toddlers infected with STH (48.3%) who have a high percentage of stunting in toddlers. Regarding households, about (91.5%) had good environmental sanitation. Low mother's education (86.5%) and low father's education (61.5%) have a higher probability of stunting. A high percentage of stunting was also found in large families (90.0%) and low parental income (92.3%). Table 1 summarizes the results of the frequency of subjects' characteristics.

Table 2. Logistic Analysis of Stunted Children 24-59 Months of Age

Characteristics	Bivariate		Multivariate	
	OR (95% CI)	p-value	OR (CI95%)	p-value
Gender				
Women	1	-	-	-
Male	1,26 (0,62-2.53	0,515	-	-
Age				
37-59	1	-	-	-
24-36	1,85 (0,89-3,85)	0,416	-	-
IDDS				
Various	1	-	1	-
Not Diverse	1,88 (0,74-4,75)	0,179	0,37 (0,01-8,16)	0,535
HDDS				
Various	1	-	-	-
Not Diverse	1,38 (0,57-3,32)	0,467	-	-
Environmental Sanitation				
Good	1	-	1	-
Not good	3,49 (0,73-16,86)	0,119	8,97 (0,10-776,52)	0,335
Toddler Hygiene				
Good	1	-	1	-
Not good	17,31 (7,17-41,74	0,000	14,98(2,17-103,04)	0,006
Maternal Hygiene				
Good	1	-	1	-
Not good	2,41(0,81-7,09)	0,110	0,27 (0,10-7,79)	0,447
STH				
Negative	1	-	1	-
Positive	0,46 (0,22-0,978)	0,043	1,36 (0,78-23,95)	0,830
Energy Intake				
Simply	1	-	1	-
Less	78,85 (24,94-249,28)	0,000	105(10,01-1113,59)	0,000
Protein Intake				
Simply	1	-	1	-
Less	113,60 (32,80-393,36)	0,000	94 (9,79-920,56)	0,000
Exclusive breastfeeding history				
Exclusive breastfeeding	1	-	-	-
Not exclusively breastfed	0,92 (0,40-2,11)	0,845	-	-
Complementary Foods				
Good	1	-	-	-
Not good	1,70 (0,61-4,734)	0,310	-	-
Birth Weight				
LBW	1	-	1	-
Not LBW	0,41 (0,14-1,22)	0,110	1,64 (0,07-36,56	0,754
Number of Family Members				
Many	1	-	-	-
A little	0,81 (0,25-2,56)	0,722	-	-
Parents' Income				
High	1	-	1	-

Characteristics	Bivariate		Multivariate	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Low	2,25 (0,60-8,39)	0,227	0,239 (0,01-5,20)	0,363
Health Services				
Fakes	1	-	-	-
Shamans	0,70 (0,34-1,43)	0,332	-	-
Father's education				
High	1	-	-	-
Low	1,33 (0,63-2,81)	0,451	-	-
Mother's education				
High	1	-	1	-
Low	1,53 (0,75-3,14)	0,238	0,37 (0,01-8,16)	0,700

Table 2 presents bivariate and multivariate analyses of stunting in children aged 24-59 months. Bivariate analysis showed that children with poor hygiene (p=0,000), infected by STH (p= 0,043), lack of energy (p=0,000), and protein intake (p=0,000) are more likely to be stunted children. The results of multivariate analysis strengthen that poor toddler hygiene variable (OR = 14.98; 95% CI = 2.17-103.04), lack of energy intake (OR =105; 95% CI =10.01-1113.59), and lack of protein intake (OR =94; 95% CI =9.79-920.56) influence the incidence of stunting.

DISCUSSION

Relationship between Energy Intake and Incidence of Stunting. The results of the bivariate analysis in Table 2 show that the energy intake variable has a p-value of 0.000, which has a value smaller than 0.05. This can be interpreted that there is an association between energy intake and the incidence of stunting, with an OR value (OR = 78.85; 95% CI = 24.94-249.28). The results of this study are in line with research conducted by (Aisyah & Yunianto, 2021), which states that the lack of ideal energy intake can increase the incidence of stunting in toddlers. Stunting in toddlers is a chronic condition caused by a lack of nutritional intake in the long term, especially in the first 1,000 days of life. One of the main factors affecting the incidence of stunting is insufficient energy intake (Morales et al., 2024). Energy obtained from daily food is very important for the growth and development of toddlers. When energy intake is inadequate, a child's body does not have enough fuel to support vital functions and optimal growth processes (Djuardi et al., 2021). This leads to impaired physical development, including age-inappropriate length or height. In addition, energy deficiency also affects the immune system, increasing the risk of infections that can worsen nutritional conditions and accelerate stunting (Sari et al., 2020).

The relationship between energy intake and the incidence of stunting is also influenced by other factors such as diet quality, meal frequency, and family socioeconomic conditions. Toddlers from families with low economic status tend to have limited access to nutritious food, resulting in low intake of energy and other nutrients (Pitoyo et al., 2022). In addition, inappropriate feeding practices, such as inadequate complementary feeding, can lead to deficiencies in energy and other essential nutrients. Overall, stunting is the result of complex interactions between inadequate energy intake, poor diet quality, and environmental and social factors that affect the ability of families to provide adequate and quality food for their children (Pitoyo et al., 2022).

Relationship between protein intake and the incidence of stunting. The results of the bivariate analysis in Table 2 show that the protein intake variable has a p-value of 0.000, which has a value smaller than 0.05. This can be interpreted that there is an association between protein intake and the incidence of stunting, with an OR value (OR =113.60; 95% CI =32.80-393.36). The results of this study are in line with research conducted by (Fikawati et al., 2021), who stated that the lack of protein intake needed in toddlers can increase the incidence of

stunting in toddlers. Protein is one of the important components in child growth and development, especially during toddlerhood. Adequate protein intake is needed to build and repair body tissues, including muscles and bones (Fikawati et al., 2021). Protein also plays an important role in the synthesis of enzymes and hormones that regulate metabolic processes and growth. When protein intake is inadequate, a child's linear growth can be disrupted, leading to a decrease in growth rate and, ultimately, a risk of stunting (Endrinikapoulos et al., 2023). In addition, high-quality protein containing essential amino acids is required to support brain development and cognitive function, which can also be affected when children experience long-term protein deficiency.

The relationship between protein intake and stunting is influenced by the quality and quantity of protein consumed. Children who consume protein from animal sources, such as meat, fish, eggs, and milk, tend to have better growth compared to those who rely on plant-based proteins with lower biological value. However, adequate protein intake must be balanced with calorie and other nutrient intake, as energy-protein malnutrition often occurs together (Komang et al., 2023). In addition, other factors such as recurrent infections, poor sanitation, and socioeconomic conditions can also exacerbate the impact of protein deficiency on stunting. Therefore, a holistic approach is needed to ensure adequate protein intake as part of efforts to prevent stunting in children under the age of five.

Relationship Between Toddler Hygiene and the Incidence of Stunting. The results of the bivariate analysis in Table 2 show that the toddler hygiene variable has a p-value of 0.000, which has a value smaller than 0.05. This can be interpreted that there is a relationship between toddler hygiene and the incidence of stunting, with an OR value (OR =17.31; 95% CI =7.17-41.74). The results of this study are in line with research conducted by (Adani & Nindya, 2017), which found that a low level of hygiene habit formation in toddlers can result in an increased likelihood of stunting in toddlers. Toddler hygiene has an important role in preventing stunting, which is a condition of growth failure in children due to a lack of nutritional intake and repeated infections (Silva et al., 2023). When hygiene standards are not met, children under five are more susceptible to infectious diseases, especially gastrointestinal infections such as diarrhea. Recurrent diarrhea causes malabsorption of nutrients, so the child's body cannot utilize the food consumed optimally (Raiten & Bremer, 2020). This results in insufficient intake of nutrients necessary for growth, which contributes to stunting (Ahmed et al., 2022; Raiten & Bremer, 2020). In addition, unsanitary environments increase the risk of exposure to pathogens, which can trigger chronic inflammation and inhibit the growth process (Manalu et al., 2023).

Other contributing hygiene factors are unhygienic feeding practices and lack of access to clean water and sanitation (Das et al., 2021). For example, using contaminated water to prepare food or formula can be a source of infection. In addition, a lack of personal hygiene, such as not washing hands with soap before touching food or breastfeeding, can also increase the risk of disease transmission. As a result, toddlers living in poor sanitation conditions have a higher risk of developing recurrent infections, which negatively impacts their nutritional status and increases the likelihood of stunting (Manalu et al., 2023). Therefore, improving the environmental hygiene of under-fives through public health interventions and health education is an important step in stunting prevention efforts (Nuzhat et al., 2020).

Effect of Energy Intake on the Incidence of Stunting. The results of multivariate analysis in Table 2 show that the energy intake variable has a p-value of 0.000, which has a value smaller than 0.05 with an OR value (OR =105; 95% CI =10.01-1113.59). This means that energy intake can influence the incidence of stunting. The results of this study are in line with research conducted by (Fikawati et al., 2021), who stated that inadequate energy intake is one of the main causes of stunting in toddlers. Energy obtained from food is the main source for the body to carry out various metabolic functions that support the growth and development of children (Fikawati et al., 2021). When energy intake is insufficient, the body will prioritise the use of energy to maintain vital functions such as brain and heart activity, while growth functions will

be neglected. As a result, children who experience chronic energy deficits cannot reach their optimal growth potential, resulting in stunting. In addition, lack of energy intake is also often associated with deficiencies in other nutrients, such as protein and micronutrients, that are important for bone and tissue development (Kwami et al., 2019).

Inadequate energy intake can also worsen the risk of infection, which in turn worsens the nutritional status of children under five. Children who lack energy have weaker immune systems, making them more susceptible to infections, especially gastrointestinal infections such as diarrhoea. These infections interfere with the absorption of essential nutrients needed for growth (Kwami et al., 2019). In addition, children who experience frequent illnesses tend to have decreased appetite, which further decreases energy intake and creates a continuous cycle that increases the risk of stunting. Therefore, ensuring adequate energy intake is crucial in preventing stunting in children under five.

Effect of Protein Intake on the Incidence of Stunting. The results of multivariate analysis in Table 2 show that the protein intake variable has a p-value of 0.000, which has a value smaller than 0.05 with an OR value (OR =94; 95% CI =9.79 -920.56). The results of this study are in line with research conducted by (Endrinikapoulos et al., 2023), which states that lack of protein intake in toddlers is one of the factors that can increase the likelihood of stunting in toddlers. Lack of protein intake is one of the main factors that can increase the likelihood of stunting in toddlers. Protein is an essential nutrient that plays an important role in various biological processes, including body tissue growth, brain development, and immune system function (Endrinikapoulos et al., 2023). Protein deficiency results in the disruption of enzyme synthesis, hormones, and body structure, which directly impacts a child's linear growth. When protein intake is insufficient, the body is unable to build and repair tissues optimally, resulting in stunted height growth (Xiong et al., 2023). Protein deficiency can also weaken the immune system, making children more susceptible to infections. Recurrent infections, especially in the digestive tract, can result in malabsorption of nutrients, which further worsens the stunting condition (Nuzhat et al., 2020).

In addition, the quality of the protein consumed also plays an important role. Animal proteins usually contain all the essential amino acids the body needs, while plant proteins often lack one or more essential amino acids (Fikawati et al., 2020). Toddlers who eat a diet low in high-quality protein, especially from animal sources, are at higher risk of protein deficiency. Furthermore, protein deficiency often occurs alongside energy and other micronutrient deficiencies, synergistically increasing the risk of stunting. Ensuring adequate intake of high-quality protein is therefore key in stunting prevention, especially in under-five populations in developing countries where access to animal protein may be limited (Xiong et al., 2023).

The Effect of Toddler Hygiene on the Incidence of Stunting. The results of multivariate analysis in Table 2 show that the toddler hygiene variable has a p-value of 0.006, which has a value smaller than 0.05 with an OR value (OR = 14.98; 95% CI = 2.17-103.04). This means that toddler hygiene can influence the incidence of stunting. The results of this study are in line with research conducted by (Krisnana et al., 2020), who stated that toddler hygiene, such as poor toddler care, is one of the factors that can increase the likelihood of stunting in toddlers. Low hygiene in toddlers is one of the main factors that increase the likelihood of stunting. When hygiene standards are not maintained, toddlers become more vulnerable to various infections, especially gastrointestinal infections such as diarrhea (Nuzhat et al., 2020). Recurrent diarrhea causes nutrient malabsorption, where the nutrients consumed cannot be absorbed properly by the body. As a result, the child's body lacks the nutrients necessary for optimal growth and development, which directly contributes to stunting. In addition, dirty environments and poor sanitation increase a child's exposure to pathogens, which can trigger chronic inflammation in the gut and inhibit nutrient absorption, thus worsening a child's nutritional status (Fikawati et al., 2021).

In addition, poor hygiene is often associated with a lack of access to clean water and proper sanitation (Emerson et al., 2020; Mock et al., 2017). This increases the risk of contamination of food and water consumed by under-fives, which can lead to intestinal infections and other illnesses. Unhygienic feeding practices, such as not washing hands before preparing food or breastfeeding, can also increase the risk of disease transmission (Silva et al., 2023). In addition, the risk of transmitting infectious diseases may increase when toddlers do not wear sandals. Toddlers who do not wear footwear are more susceptible to cuts or injuries to the feet, which can be an entry point for various pathogens, including bacteria and parasites (Wang et al., 2023). All these factors cumulatively lead to an increased risk of stunting, as a toddler's body that is constantly fighting infection cannot focus on the growth process. Therefore, improving hygiene through education and the provision of adequate sanitation facilities is crucial in the effort to prevent stunting in children under five (Das et al., 2021).

From the results of this study, several factors contribute to insurgency in Indonesia, so various strategies are needed to solve the problem. The government should prioritize equitable health and nutrition policies to achieve the country's medium-term development goals. This study stands out for being the first to assess the prevalence and causes of non-adherence in Indonesian children. The study used a representative sample and data collected by trained interviewers. However, the cross-sectional research design limits its ability to establish causality. Factors such as location and age group may influence the results and should be considered. It is also important to recognize potential biases, such as recollection or negative news, that may affect the study findings.

4. CONCLUSION

Judging from the results of the research and discussion of this study, it can be concluded that several variables can increase the likelihood of stunting, namely low IDDS and HDDS scores, poor environmental sanitation, low toddler and maternal hygiene, STH infection, minimal energy and protein intake, absence of exclusive breastfeeding and lack of complementary foods, inappropriate LBW methods and minimal health facilities, as well as low parental income and low parental education. When viewed from bivariate analysis, the results of this study can be concluded that energy intake, protein intake and toddler hygiene have a relationship with the incidence of stunting in toddlers. The results of multivariate analysis in this study indicate that energy intake, protein intake and toddler hygiene have an influence on the incidence of stunting in toddlers and are contributing factors to the increase in the incidence of stunting in toddlers in the Mentawai Islands.

REFERENCES

Adani, F. Y., & Nindya, T. S. (2017). Perbedaan Asupan Energi, Protein, Zink, dan Perkembangan pada Balita Stunting dan non Stunting. *Amerta Nutrition*, *1*(2), 46–51. https://doi.org/10.20473/amnt.v1i2.6225

Ahmed, M. H., Vasas, D., Hassan, A., & Molnár, J. (2022). The impact of functional food in prevention of malnutrition. *PharmaNutrition*, 19, 100288. https://doi.org/10.1016/j.phanu.2022.100288

Aisyah, I. S., & Yunianto, A. E. (2021). Hubungan Asupan Energi dan Asupan Protein dengan Kejadian Stunting pada Balita (24-59 Bulan) Di Kelurahan Karanganyar Kecamatan Kawalu Kota Tasikmalaya. *Jurnal Kesehatan Komunitas Indonesia*, *17*(1), 240–246. https://doi.org/10.37058/jkki.v17i1.3603

Anggraeni, R., Aljaberi, M. A. A., Nisha Nambiar, N., Sansuwito, T. B., & Wati, N. L. (2022). The Relationship of Supplementary Feeding, Breast Milk (MP-ASI) to Infants with The Event of Diarrhea. *International Journal of Nursing Information*, 1(1), 1–9. https://doi.org/10.58418/ijni.v1i1.9

Aritonang, T. R., Wa Ode Ida Fitriani, Riyen Sari Manulang, & Farida Mentalina Simanjuntak. (2021). Relationship of MP ASI Processing with Infant 6 to 12 Months Old Baby Growth and Development (Study at Umi Rahma Maternity Clinic in 2019). *Science Midwifery*, 9(2), 377-382. Retrieved from: https://midwifery.iocspublisher.org/index.php/midwifery/article/view/116

Das, S., Fahim, S. M., Alam, M. A., Mahfuz, M., Bessong, P., Mduma, E., Kosek, M., Shrestha, S. K., & Ahmed, T. (2021). Not water, sanitation and hygiene practice, but timing of stunting is associated with recovery from stunting at 24 months: results from a multi-country birth cohort study. *Public Health Nutrition*, *24*(6), 1428–1437. https://doi.org/10.1017/S136898002000004X

Djuardi, Y., Lazarus, G., Stefanie, D., Fahmida, U., Ariawan, I., & Supali, T. (2021). Soil-transmitted helminth infection, anemia, and malnutrition among preschool-age children in nangapanda subdistrict, indonesia. *PLoS Neglected Tropical Diseases*, *15*(6), 1–16. https://doi.org/10.1371/journal.pntd.0009506

Emerson, L. E., Anantharam, P., Yehuala, F. M., Bilcha, K. D., Tesfaye, A. B., & Fairley, J. K. (2020). Poor wash (Water, sanitation, and hygiene) conditions are associated with leprosy in North Gondar, Ethiopia. *International Journal of Environmental Research and Public Health*, *17*(17), 1–10. https://doi.org/10.3390/ijerph17176061

Endrinikapoulos, A., Afifah, D. N., Mexitalia, M., Andoyo, R., Hatimah, I., & Nuryanto, N. (2023). Study of the importance of protein needs for catch-up growth in Indonesian stunted children: a narrative review. *SAGE Open Medicine*, *11*. https://doi.org/10.1177/20503121231165562

Fikawati, S., Moh Anshori, L., & Sutrisna, B. (2020). Relationship Energy and Protein Intake with the Incidence of Stunting among Toddler Aged (25-60 Months) in Mangkung Village, District of Central Lombok. *Indian Journal of Public Health Research & Development*, *11*(03), 1593-1598. https://doi.org/10.37506/ijphrd.v11i3.1858

Fikawati, S., Syafiq, A., Ririyanti, R. K., & Gemily, S. C. (2021). Energy and protein intakes are associated with stunting among preschool children in Central Jakarta, Indonesia: a case-control study. *Malaysian Journal of Nutrition*, *27*(1), 81–91. https://doi.org/10.31246/MJN-2020-0074

Fitriani, I., & Oktobriariani, R. R. (2017). Stimulasi, Deteksi dan Intervensi Dini Orang Tua terhadap Pencegahan Penyimpangan Pertumbuhan dan Perkembangan Anak Balita. *Indonesian Journal for Health Sciences*, *1*(1), 1. https://doi.org/10.24269/ijhs.v1i1.383

Hadi, A. J., Riman, E. Y., Sudarman, S., Manggabarani, S., Ahmad, H., Ritonga, N., Antoni, A., Ishak, S., Rate, S., Simamora, F. A., Hidayah, A., Napitupulu, M., & Sani, H. A. (2022). Socio-Family Culture Against Stunting Risk: A Cross-Sectional Population-Based Study. *Natural Volatiles & Essential Oils Journal*, *9*(1), 1301–1311.

Komang, I. Y., Ashar, K., & Syafitri, W. (2023). The Effect of Food Ingredients Containing Protein on Stunting Cases in East Java. *Journal of International Conference Proceedings*, *6*(1), 368–375. https://doi.org/10.32535/jicp.v6i1.2312

Krisnana, I., Pratiwi, I. N., & Cahyadi, A. (2020). The relationship between socio-economic factors and parenting styles with the incidence of stunting in children. *Systematic Reviews in Pharmacy*, *11*(5), 738–743. https://doi.org/10.31838/srp.2020.5.106

Kwami, C. S., Godfrey, S., Gavilan, H., Lakhanpaul, M., & Parikh, P. (2019). Water, sanitation, and hygiene: Linkages with stunting in rural Ethiopia. *International Journal of Environmental Research and Public Health*, 16(20), 3793. https://doi.org/10.3390/ijerph16203793

Manalu, S. M. H., Syaputri, D., Bambang S, Th. T., Tanjung, N., Tanjung, R., & Damanik, A. P. (2023). The Effect of Clean Water Facilities and Household Food Sanitation Hygiene on Stunting in Toddlers. *Contagion: Scientific Periodical Journal of Public Health and Coastal Health*, *5*(3), 969. https://doi.org/10.30829/contagion.v5i3.17239

Mock, C. N., Nugent, R., Kobusingye, O., & Smith, K. R. (2017). Injury prevention and environmental health. World Bank Group. https://doi.org/10.1596/978-1-4648-0522-6

Morales, F., Montserrat-de la Paz, S., Leon, M. J., & Rivero-Pino, F. (2024). Effects of Malnutrition on the Immune System and Infection and the Role of Nutritional Strategies Regarding Improvements in Children's Health Status: A Literature Review. *Nutrients*, 16(1), 1. https://doi.org/10.3390/nu16010001

Nuzhat, S., Shahunja, K. M., Shahid, A. S. M. S. B., Khan, S. H., Islam, S. Bin, Islam, Md. R., Ahmed, T., Chisti, M. J., Hossain, M. I., & Faruque, A. S. G. (2020). Diarrhoeal children with concurrent severe wasting and stunting compared to severe wasting or severe stunting. *Tropical Medicine & International Health*, *25*(8), 928–935. https://doi.org/https://doi.org/10.1111/tmi.13446

Pitoyo, A. J., Saputri, A., Agustina, R. E., & Handayani, T. (2022). Analysis of Determinan of Stunting Prevalence among Stunted Toddlers in Indonesia. *Populasi*, *30*(1), 36. https://doi.org/10.22146/jp.75796

Raiten, D. J., & Bremer, A. A. (2020a). Exploring the nutritional ecology of stunting: New approaches to an old problem. *Nutrients*, *12*(2), 371. https://doi.org/10.3390/nu12020371

Sari, M. P., Nathasaria, T., Majawati, E. S., & Pangaribuan, H. U. (2020). Soil-Transmitted Helminth Infections, Anemia, and Undernutrition Among School-Children in An Elementary School in North Jakarta, Indonesia. *Majalah Kedokteran Bandung*, *52*(4), 205–212. https://doi.org/10.15395/mkb.v52n4.2137

Silva, J. M., Vieira, L. L., Abreu, A. M., de Souza Fernandes, E., Moreira, T. R., da Costa, G. D., & Cotta, R. M. (2023). Water, sanitation, and hygiene vulnerability in child stunting in developing countries: a systematic review with meta-analysis. Public Health, 219, 117-123. https://doi.org/10.1016/j.puhe.2023.03.024

Simamora, V., Santoso, S., & Setiyawati, N. (2019). Stunting and development of behavior. *International Journal of Public Health Science*, *8*(4), 427–431. https://doi.org/10.11591/ijphs.v8i4.20363

Tyas, D., Sa'danoer, I., & Silvia, E. (2024). The Relationship between Family Attitudes and Complementary Feeding (MP-ASI) for Infants at Lubuk Alung Health Center in 2023. *Journal of Midwifery and Nursing*, 6(1), 372-378. Retrieved from: https://iocscience.org/ejournal/index.php/JMN/article/view/4735

UNICEF/WHO/World Bank Group. (2022). *Levels and trends in child malnutrition.* UNICEF/WHO/World Bank Group. Retrieved from: https://iris.who.int/bitstream/handle/10665/368038/9789240073791-eng.pdf?sequence=1

Wang, Y., Jiang, H., Yu, L., Gao, Z., Liu, W., Mei, Q., & Gu, Y. (2023). Understanding the Role of Children's Footwear on Children's Feet and Gait Development: A Systematic Scoping Review. *Healthcare (Basel, Switzerland)*, 11(10), 1418. https://doi.org/10.3390/healthcare11101418

Xiong, T., Wu, Y., Hu, J., Xu, S., Li, Y., Kong, B., Zhang, Z., Chen, L., Tang, Y., Yao, P., Xiong, J., & Li, Y. (2023). Associations between High Protein Intake, Linear Growth, and Stunting in Children and Adolescents: A Cross-Sectional Study. *Nutrients*, *15*(22), 1–15. https://doi.org/10.3390/nu15224821