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The association between protein intake and feeding practice with stunting in children aged 24-59 months

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ABSTRACT

Introduction: Stunting is a growth disorder caused by prolonged malnutrition, particularly during the first 1,000 days of life. It is diagnosed by assessing a child's height for age. This study aims to analyze respondent characteristics and examine the association between family income, feeding practices, protein intake, and stunting in toddlers aged 24-59 months.

Method: This cross-sectional study involved 171 toddlers aged 24-59 months in the Koto Mudik IV Health Center area, Pesisir Selatan Regency. Participants were selected using proportional random sampling. Family expenditure data were gathered using the *Home Observation for Measurement of Environment* (HOME) questionnaire, while feeding practices were assessed with the *Semi-Quantitative Food Frequency Questionnaire* (SQ-FFQ). Protein intake was calculated based on daily consumption and compared to Recommended Dietary Allowances (RDA). Stunting was determined using height-for-age Z-scores (HAZ) according to WHO standards, with a HAZ score below -2 Standard Deviations (SD) classified as stunting. Statistical analysis was conducted using the chi-square test, significant ($p < 0.05$).

Results: The study found that 34.5% of toddlers were stunted, 59.1% had families earning below the Provincial Minimum Wage, 56.1% had poor feeding practices, and 31.6% had insufficient protein intake. Additionally, 56.1% of fathers and 53.2% of mothers had completed secondary education, while most fathers (66.7%) were farmers and mothers (79.5%) were homemakers. Significant associations were observed between stunting and family income ($p=0.017$), feeding practices ($p=0.007$), and protein intake ($p=0.002$).

Conclusion: Family income, feeding practices, and protein intake significantly influence stunting. Increasing animal protein consumption may help reduce stunting prevalence.

KEYWORDS

Anthropometric assessment, growth; malnutrition, pediatric nutrition, socioeconomic factors.

INTRODUCTION

Stunting is a condition where children face hindered growth as a result of long-term nutritional deficiencies, especially during the critical first 1,000 days of life, which spans from pregnancy to the age of two. It is assessed by evaluating a child's height to their age[1].

Data from the Indonesian Nutrition Status Study (SSGI) in 2022 reveals that the prevalence of stunting in Indonesia has decreased from 24.4% in 2021 to 21.6% in 2022. However, this decrease remains below the National Medium-Term Development Plan (RPJMN) target of 14%. Furthermore, data from the Ministry of Health in 2023 show that stunting prevalence in 2021 and 2022 in Western Sumatra has increased from 23.3% to 25.2%, while in Bali it has declined from 10.9% to 8% [2]. The West Sumatra report on the accelerated reduction of stunting in 2023 showed SSGI results in 2022 showing that the prevalence of stunting in the Pesisir Selatan Regency was (29.8%), Sawah Lunto City was (13.7%), and Bukit Tinggi City was (16.8%) [3].

According to the causal framework of undernutrition developed by UNICEF, the causes of undernutrition according to UNICEF reports from 2013 and 2019, the causes of malnutrition (including undernutrition) can be categorized into three primary levels: immediate, underlying, and basic causes.

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Immediate causes include insufficient dietary intake and the presence of infectious diseases. Underlying causes encompass factors such as household food insecurity, inadequate caregiving practices, an unhealthy living environment, and limited access to healthcare services. At the most fundamental level, basic causes are driven by poverty, governance systems and policies, as well as access to education[1,4].

The impacts of stunting on children's lives can be in the short and long term. Short-term impacts include increased mortality, morbidity, impaired cognitive, motor, and language development, and health expenditure. Long-term impacts include short stature, increased risk of obesity and related diseases, poor reproductive health, decreased achievement, and learning ability, and lack of ability to engage in physical or cognitive activities at optimal levels and work capacity. The impacts of stunting on children can persist until children become adults. In the absence of effective prevention, management, or intervention strategies, stunting can expose children to numerous long-term health challenges. These include an increased likelihood of developing conditions such as obesity, osteoporosis, diabetes mellitus, and other degenerative illnesses. To address and minimize the effects of stunting, it is crucial to adopt a comprehensive approach that incorporates better dietary practices, improved access to healthcare services, and enhanced nutritional education[5,6].

Various entities, such as government bodies, global organizations, non-governmental organizations, and community groups, have been addressing the issue of stunting with the goal of lowering the stunting rate to below 14% by 2024. Currently, much of the attention given to addressing stunting focuses on increasing the intake of animal protein. This is because animal-based foods are rich in high-quality protein and essential micronutrients such as iron, zinc, and vitamin B12, which are critical for child growth and development. Previous studies have demonstrated that adequate consumption of these nutrients can improve children's growth outcomes and reduce the risk of stunting, particularly during the first 1000 days of life, a critical period for preventing nutritional deficiencies. Headey *et al* indicate that higher consumption of animal-derived foods is strongly associated with lower stunting rates in children. The provision of high-quality protein from animal products, coupled with vital micronutrients like iron and vitamin B12, has been proven to promote children's growth and help mitigate the nutritional deficiencies that lead to stunting[7].

The percentage of total caloric intake from protein in Pesisir Selatan Regency (54.40%) is lower than in Pasaman Barat (67.14%). Solok Selatan (59.44%), and Sijunjung (55.07%). According to the Decree of the Minister of National Development Planning/Head of Bappenas No. KEP.42/M.PPN/HK/04/2020, Pesisir Selatan Regency has been designated as one of the regions for coordinated efforts to reduce the stunting rate in 2021. The Pesisir Selatan Regency government is dedicated to reducing stunting rates in the area by implementing the 'pasan mandeh' innovation, a comprehensive community-based approach with ten actionable steps aimed at preventing stunting. These steps focus on enhancing child nutrition, improving the health of infants and toddlers, promoting the intake of a variety of nutritious and balanced foods, and encouraging family participation in health insurance programs. The 'pasan mandeh' method blends local knowledge with focused interventions across multiple sectors to involve families and communities in combating stunting, making it a distinctive model that meets the region's specific needs. The concept of "pasan mandeh" highlights a community-driven, localized intervention that integrates both health and nutrition aspects[8]. With this in mind, Pesisir Selatan was considered a suitable location for this study to identify the characteristics of respondents as well as the correlation between feeding practice, family income, and protein intake and the nutritional status of toddlers aged 24-59 months in the working area of the Koto Mudik Health Centre IV in Pesisir Selatan Regency.

METHOD

This study, employing a cross-sectional design, was conducted from March 2023 to January 2024 in the working area of the Koto Mudik Health Centre IV, Pesisir Selatan Regency. Concentrating on children aged 24-59 months allows for a clearer and more pertinent understanding of the lasting effects of nutritional problems, while also providing valuable insights into child development during this crucial stage of growth.

The total population amounted to 415 children aged 24-59 months. The technique of proportional random sampling was undertaken by fulfilling the inclusion criteria, i.e., parents were willing to participate in the study, could communicate well, had toddlers aged 24-59 months. The sample size of 171 toddlers was obtained by the following formula:

$$n = \frac{z^2 1 - \alpha/2 \; P \; (1-P) N}{d^2 (N-1) + Z^2 - \alpha/2 \; P(1-P)}$$

n: Minimum sample size required

N: Total population

$z^2 1-\alpha/2$: Z value at the significance level (95% = 1.96)

P: Proportion of the subject group with low family income

d: Degree of deviation from the desired population

This study used informed consent. The research data consisted of primary and secondary data. Primary data included data on nutritional status, family income, parental feeding style, and protein intake. Data on Nutritional Status related to Stunting is derived from assessments of toddlers using

the height-for-age z-score, using a Microtoice stature meter, with classifications set at below -2 standard deviations (SD). The categories for nutritional status include Stunting (defined as < -2 SD) and Normal (defined as ≥ -2 SD)[9].

Family Income is defined as the total monetary earnings a family receives each month, which is then compared against the provincial minimum wage standard (UMP) using the HOME questionnaire. Income considered below the UMP is categorized as less than Rp. 2.742.476 per month, while income above this threshold is classified as equal to or greater than Rp. 2.742.476 per month[10].

Feeding Practices encompass the methods that mothers use in nurturing toddlers, particularly regarding the preparation and provision of food. The questionnaire used for this assessment contains 15 questions. Feeding practices are categorized as Poor (when the score is ≤80% of the Total Score) and Good (when the score is >80% of the Total Score)[11].

Protein Intake refers to the daily average of protein-rich foods consumed by toddlers, which is then compared to the recommendations outlined in the Adequate Nutritional Intake (RDA) guidelines. Data collection was done using the Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ). The classification of intake is categorized as Deficient (when <90% of RDA) and Normal (when ≥90% of RDA)[12].

Meanwhile, secondary data included data on the profile of Pesisir Selatan Regency and the total population obtained from the report. The data was subjected to further analysis through the Chi-Square test to examine the relationships among categorical variables, particularly focusing on family income levels, maternal feeding practices, and the nutritional status (stunting vs. normal) of toddlers. The statistical analyses were carried out using SPSS version 25, with significance established at $p < 0.05$.

RESULTS

This study demonstrated that the majority of the children were identified as male. The respondents were mostly at the age of 36-47 months. Most of the respondents' fathers' education was at the high school level, and most of them worked as farmers. Meanwhile, the education of the respondents' mothers was mostly at the senior secondary school level, and most of them were housewives. The number of stunting respondents was smaller than normal. The family income of more than half of the respondents was below UMP. The parental feeding practices of more than half were categorized as poor. In addition, most of the respondents' protein intake was in the normal category (Table 1).

This study presents the ten kinds of food most consumed by respondents, including rice as a source of carbohydrates.

Table 1. Frequency distribution of respondents' characteristics in the working area of the Koto Mudik Health Centre IV in Pesisir Selatan Regency year 2024

Respondent Characteristics	f	%
Characteristics of Toddlers		
Sex		
Male	93	54.4
Female	78	45.6
Age		
24-35 months	56	32.7
36-47 months	58	33.9
48-59 months	57	33.3
Case of Stunting (TB/U)		
Stunting (Z-Score <-2 SD)	59	34.5
Normal (Z-Score ≥-2 SD)	112	65.5
Family Income		
Below UMP (<Rp2,742,476/month)	101	59.1
Above UMP (≥Rp2,742,476/month)	70	40.9
Parental Feeding Style		
Poor (≤80% of total score)	96	56.1
Good (>80% of total score)	75	43.9
Protein Intake		
Deficit (<90% RDA)	54	31.6
Normal (≥90% RDA)	117	68.4
Characteristics of Fathers		
Education		
Dropout from primary school	2	1.2
Primary school	16	9.4
Junior secondary school	36	21.1
Senior secondary school	97	56.7
Higher education	20	11,7

Table 1 continuation. Frequency distribution of respondents' characteristics in the working area of the Koto Mudik Health Centre IV in Pesisir Selatan Regency year 2024

Respondent Characteristics	f	%
Characteristics of Fathers		
Occupation		
Unemployed	114	6.0
Farmer		66.7
Merchant	9	5.3
Peasant	2	1.2
Entrepreneur	10	5.8
Civil servant	7	4.1
Characteristics of Mothers		
Education		
Dropout from primary school	4	2.3
Primary school	15	8.8
Junior secondary school	31	18.1
Senior secondary school	91	53.2
Higher education	30	17.5
Occupation		
Farmer	4	2.3
Merchant	6	3.5
Entrepreneur	4	2.3
Civil servant	5	2.9
Housewife	136	79.5
Others	16	9.4
Total	171	100.0

Meanwhile, the average daily intake of animal protein most consumed by respondents was that of chicken meat.

Table 3 illustrated that 42.7% more stunting was found among the group with income below UMP. The statistical test results depicted that there was a significant association between family income and the case of stunting in respondents ($p < 0.05$).

43,8% stunting was more common among children with poor feeding practice. The statistical test result showed that there was a significant association between parental feeding style and stunting ($p < 0.05$). Stunting was more prevalent among children with protein intake in the deficit category. There was a significant association between protein intake and stunting in toddlers aged 24-59 months in the working area of the Koto Mudik Health Centre IV in Pesisir Selatan Regency Year 2024 ($p < 0.05$).

DISCUSSION

Respondent Characteristics (stunting, family income, feeding Practice, and protein intake)

This research found that 34.5 % were stunted. This is in line with a study conducted by Vasera and Kurniawan showed 20.9% of the proportion of stunted[14]. In the present study, 40.9% of children with family income above UMP. This is in line with a study by Nurmalasari *et al* which found that 41.4 % children from families with high income[15]. UNICEF in 2013 suggested that the economic crisis is one of the root causes of inhibited growth and development of toddlers. Families with high income levels manage to fulfill all primary and secondary needs of children[4].

This research also illustrates that the number of toddlers with good feeding practice amounted to 75 children (43.9%). This is in line with a study by Widyaningsih *et al*., in 2018 which found that 51.2% of stunting exhibit fewer breastfeeding patterns[12]. Feeding habits have an impact on food consumption quality, which eventually raises nutritional adequacy[16].

This study showed that 31.6 % of children with a protein intake deficit. This is in line with a study by Ranti *et al* showed that 11.6 % of children with protein intake deficits[18]. Protein intake plays a role in various metabolic processes of other nutrients, especially contributing to the absorption of micronutrients that support the growth and physical development of toddlers. Protein is a macronutrient and the basic building block of the body's cell structure. The main function of protein is to form new tissues and repair damaged body tissues[19,20].

Association between Family Income and Stunting

This researched showed that stunting is more common in families whose income is below UMP compared to family income above UMP. The result of the statistical test showed that there was a significant association between family income and stunting in toddlers aged 24-59 months in the working area of the Koto Mudik Health Centre IV, Pesisir Selatan Regency. This result is in line with a study by Saadong *et al* which stated that there was a significant association between family income and stunting (p-value = 0.044)[21].

Table 2. Frequency distribution and average intake of food ingredients that are often consumed by toddlers aged 24-59 months of the Koto Mudik Health Centre IV in Pesisir Selatan Regency Year 2024

No.	Food	N	%	Average protein intake per day (g)	Intake per day%
1	White Rice	171	100	4.4	16.0
2	ChickenMeat	161	94.1	2.9	10.6
3	ChickenEggs	160	93.5	3.4	12.4
4	Tofu	157	91.8	0.9	3.2
5	Potatoes	143	83.6	0.2	0.7
6	Tempeh	140	81.8	2.0	7.2
7	Biscuits	128	74.8	0.7	2.7
8	*Bakwan*	117	68.4	0.3	1.3
9	Doughnuts	115	67.2	0.3	1.0
10	Chicken Satay	114	66.6	1.9	7.1

Table 3. Association between family income, feeding practice, and protein intake and stunting in toddlers aged 24-59 months in the working area of the Koto Mudik Health Centre IV in Pesisir Selatan Year 2024

Independent Variable	Stunting in Toddlers						*P-Value
	Stunting		Normal		Total		
	f	%	f	%	f	%	
Family Income							
Below UMP (<Rp2,742,476)	41	42.7	55	57.3	96	100	0.017
Above UMP (≥Rp2,742,476)	18	24	57	76	75	100	
Feeding Practice							
Poor (≤80% of total score)	42	43.8	54	56.3	96	100	0.007
Good (>80% of total score)	17	22.7	58	77.3	75	100	
Protein Intake							
Deficit (<90% RDA)	28	51.9	26	48.1	54	100	0.002
Normal (≥90% RDA)	31	26.5	86	73.5	117	100	

* the chi-square test is significant with p<0.05, UMP (provincial minimum wage).

Family income refers to the household's ability to fulfil its needs. Families with low incomes will have limitations in meeting their needs and less variety in food ingredients. They also commonly spend most of their income on food. Family income determines the kind of food that will be consumed. Lack of food consumption and variety can increase the risk of nutrient deficiencies. Although a family spends most of its income to fulfil its consumption, it does not necessarily mean that the food consumed has adequate nutrition. In addition, the family's ability to purchase food is not only influenced by the amount of income but also by the price of food. Some food with high prices are not purchased, causing some families to rarely serve them and further resulting in reduced fulfilment of nutritional needs by Nurmalasari *et al*[15].

Association between Feeding Practice and Stunting

The results of this study indicated that there was a significant association between parental feeding style and stunting in toddlers aged 24- 59 months in the working area of the Koto Mudik Health Centre IV in Pesisir

Selatan Regency. This result is in line with a study by Mastila *et al* which showed that there was an association between child feeding and stunting ($p < 0.05$) [22].

The act of feeding infants and young children directly impacts children's nutritional status and has a significant impact on child survival. One of the indirect variables influencing children's nutritional health, including stunting, is the feeding habits of the parents, according to the United Nations Children's Fund (UNICEF)[4]. Parenting is the mother's ability to provide good care for children through feeding practices, personal hygiene practices, and the environment so as to support the achievement of good nutritional intake for child growth and development. Feeding practices are parents' behavior in providing food intake to meet children's nutritional needs. Good feeding practices include three main meals and two snacks as sources of energy, carbohydrates, protein, fat, vitamins, and minerals[24,25].

Association between Protein Intake and Stunting

The findings in this study show that there was a significant relationship between protein intake and stunting in toddlers aged 24-59 months in the working area of Koto Mudik Health Centre IV in Pesisir Selatan Regency also shows that the source of protein most consumed by respondents was animal protein derived from chicken eggs and chicken meat. The results of this study are in line with Sari and Hidayati indicating that the intake of chicken protein has a beneficial effect on children's growth and helps lower the risk of stunting[26]. Furthermore, Widyastuti and Rahmawati found a notable connection between the consumption of animal protein, such as chicken, and the occurrence of stunting in children. These research findings emphasize the crucial role of sufficient protein intake in supporting the healthy growth and development of children[27]. Likewise, The study by Pratiwi and Setiawan suggests that regularly eating chicken meat is linked to better nutritional health in children and a lower likelihood of stunting[28]. Different from Diana *et al* the result also indicated that the chocolate flavor biscuits prepared with 20 g Bilih fish flour significantly increased the tail lengths, Y-Maze score, and the number of hippocampus neuron cells (CA4, DG) in experimental Rats[29,30]. Another study by Kaimila *et al* also reported a linear correlation between animal protein consumption and increased height in children[31]. Fikri *et al* reviewed and compiled existing knowledge on the role of protein in managing stunting, highlighting the significance of adequate protein intake in supporting optimal growth while minimizing potential risks[32].

The nutritional content of animal protein is higher than that of vegetable protein sources. Animal protein is easier to digest and contains more essential amino acids necessary for growth. Protein (high-protein foods such as meat, fish, eggs, milk, and other dairy products) can stimulate IGF-1 production in the body. Protein is the main fuel for the process of growth and repair of body tissues. IGF-1 is produced naturally in the human body and is influenced by factors such as growth hormone and nutrient intake (protein, omega-3 fatty acids, complex carbohydrates, vitamin D, and zinc). Although some foods can potentially increase IGF-1 production or activity in the body, it is important to note that a balanced diet and a healthy lifestyle are keys to ensuring optimal IGF-1 levels and healthy growth[19,20].

IGF-1 balance is vital because IGF-1 is a hormone that plays a pivotal role in growth, development, bone growth, cartilage growth, and muscle growth, as well as stimulates the production of growth hormone in the pituitary gland, which in turn stimulates the growth of body cells. IGF-1 works in the body by stimulating the growth of cells (including bone and muscle cells). When IGF-1 is present in sufficient amounts, the process of bone growth runs properly, helping children achieve optimal height and then stimulating muscle growth, which can prevent stunting. IGF-1 also affects the body's overall metabolism and ensures the body gets the nutrients it needs for optimal growth. IGF-1 deficiency leads to stunted bone growth, thus contributing to stunting. As such, IGF-1 helps to ensure that a child's growth process runs smoothly and reduces the risk of stunting[19,20].

CONCLUSION AND SUGGESTION

The results show that there is a significant association between family income and stunting, parental feeding style, and protein intake and stunting in toddlers aged 24-59 months in the working area of the Koto Mudik Health

Centre IV in Pesisir Selatan Regency in 2024**.** Mothers of toddlers are encouraged to constantly provide protein-rich foods, especially animal protein, to support the growth and development of toddlers.

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