

The Relationship Between Protein Adequacy Levels and a History of Exclusive Breastfeeding with The Incidence of Stunting among Toddlers In Sumbang Village Banyumas

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ABSTRACT

Sumbang Village in Sumbang Subdistrict is designated as one of the villages prone to stunting in Banyumas Regency with a prevalence of 14.4%. Factors contributing to stunting in toddlers include protein adequacy and exclusive breastfeeding. The study was designed to investigate the relationship between protein adequacy, exclusive breastfeeding history, and stunting in toddlers aged 24-59 months in the village. The study used a case-control design with a sample of 37 stunted infants and 37 non-stunted infants in Sumbang Village. Respondents were selected using cluster sampling with matching based on age (± 2 months) and posyandu (integrated health service post) area. Data collection used the SQ-FFQ questionnaire and the SKI exclusive breastfeeding history questionnaire. Bivariate analysis was conducted using a 2x2 Chi-square test with IBM SPSS version 25. The results of bivariate analysis of protein adequacy were significantly associated with stunting in children aged 24–59 months ($p=0.000$; $OR=6.781$; $95\%CI=2.1-20.1$), whereas a history of exclusive breastfeeding showed no significant association with stunting in children aged 24–59 months ($p=0.163$). There is a significant association between protein sufficiency levels and stunting in children aged 24–59 months. Children with insufficient protein sufficiency levels are 6.781 times more likely to experience stunting than children with adequate protein sufficiency levels.

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INTRODUCTION

Stunting, one of the chronic nutritional problem affecting toddlers and a current focus of global attention, is defined as a height-for-age z-score (TB/U) of < -2 SD (Kemenkes RI, 2020; Kemenkes RI, 2023c). Indonesia ranks third in terms of the highest prevalence of stunting in the Southeast Asian region (Kemenkes RI, 2018). In 2023, the prevalence of stunting in toddlers in Indonesia was 21.5%, reflecting a decrease from previous years (Kemenkes RI, 2023). Although there has been a decrease, this progress has not yet met the 2020-2024 RPJM target of 14% (Bappenas, 2019). The stunting rate in Central Java Province ranks 20th nationally with a prevalence of 20.7% (Kemenkes RI, 2023). Furthermore, in Banyumas District, the stunting rate among toddlers is recorded at 20.9% (Kemenkes RI, 2023).

Stunted toddlers tend to have weak immune systems and impaired cognitive and motor

development. They may also experience impaired brain and organ function and are more susceptible to disease and infection (Asiah et al., 2020; Latifah et al., 2020). Conversely, non-stunted infants can develop normally and have a lower risk of health problems as long as their nutritional needs are met (Asiah et al., 2020; Sundari & Nuryanto, 2016).

Stunting in toddlers aged 24-59 months is irreversible and poses a risk of growth retardation if not accompanied by catch-up growth (Utami et al., 2021). Conversely, the 24-59 month age group has been identified as a vulnerable period for toddlers, with the potential for deficiencies in key nutrients. At this stage of development, the practice of breastfeeding is no longer commonplace, and thus, the primary source of nutrients for toddlers is their dietary intake (Damayanti et al., 2016).

According to Haryani et al (2023) stunted toddlers generally have a lower protein intake in terms of quality and/or quantity than toddlers who

are not stunted. Low protein consumption can inhibit bone mineral mass formation through Insulin-like Growth Factor 1 (IGF-1) synthesis, which in turn disrupts osteoblast function and causes bone growth disorders (Rachmawati et al, 2022). Therefore, long-term protein deficiency has a negative impact on the nutritional status of toddlers.

Exclusive breastfeeding is also an important factor in preventing stunting related to infant nutrition intake. Only about 55.5% of infants in Indonesia are breastfed for the first 6 months (Kemenkes RI, 2023). Failure to exclusively breastfeed for a full 6 months, including an unbalanced intake pattern and inadequate levels of nutrients during infancy, carries a greater risk of stunting (Fitri 2018, Damayanti 2016).

Sumbang Subdistrict, Banyumas Regency, is one of the areas with public health and nutrition problems, as evidenced by the prevalence of stunting in the working area of the Sumbang I Community Health Centre, which was 14.4% in 2023 (BPS Banyumas, 2023). Regent Decree No. 50 of 2023 designates Sumbang Village as a priority village for integrated stunting acceleration in Sumbang Subdistrict. The stunting rate in Sumbang Village has been determined to be moderate in accordance with the classification system established by the World Health Organization (WHO), as evidenced by the most recent data on infant weight. These data reveal a prevalence of 19% among toddlers. Therefore, this study aimed to analyze the level of protein adequacy and exclusive breastfeeding history in stunted and non-stunted toddlers aged 24-59 months in Sumbang Village, Sumbang District, Banyumas Regency.

METHOD

This study employed a case-control design with a quantitative approach. Data collection was conducted in Sumbang Village, Sumbang Subdistrict, which is a village with a high prevalence of stunting, from November to December 2024. The study population comprised children aged 24-59 months residing in Sumbang Village, Sumbang Subdistrict, Banyumas Regency. The sampling technique employed in this study was cluster sampling, which was based on posyandu (integrated health service post) areas. This study used matching based on age and posyandu area variables. The control group was selected from the same age group as the case sample, with a tolerance limit of ± 2 months. A total of 74 respondents were selected as samples (meeting the minimum criteria of 68 respondents). The case group was determined based on the latest posyandu measurement data.

The data collected included primary and secondary data. Anthropometric measurements were conducted concurrently with posyandu activities. Respondents who met the specified criteria were then interviewed. Data were collected through interviews using a sociodemographic questionnaire, a questionnaire pertaining to the history of exclusive

breastfeeding Survei Kesehatan Indonesia (SKI) in 2023 and a Semiquantitative Food Frequency Questionnaire (SQ-FFQ) form.

Individual protein requirements were determined based on the Acceptable Macronutrient Distribution Ranges (AMDR), which are equivalent to 15% of the total daily energy requirements (Fikri et al., 2024; Hardinsyah et al., 2013). As indicated by the RDA (IDAI, 2018), individual energy requirements are to be determined on a case-by-case basis. For the age range of 1-3 years, energy requirement was set at 100 kcal/kg body weight/day, and for ages 4-6 years, it was 90 kcal/kg body weight/day. The classification of protein adequacy levels is determined in accordance with the WNPG (2012) criteria, which categories levels as follows: severe deficiency (<70% of requirements), moderate deficiency (70-79%), mild deficiency (80-89%), normal (90-119%), and excess ($\geq 120\%$). For the purpose of bivariate analysis, these categories were regrouped into two categories, resulting in the following protein adequacy classification: inadequate (<90% of requirements) and adequate ($\geq 90\%$ of requirements) (Maharani et al., 2022).

The present study analyzed the relationship between protein adequacy and history of exclusive breastfeeding with stunting in toddlers. The analysis was conducted using a 2 x 2 Chi-square test, as the data is ordinal. The statistical analysis process used IBM SPSS Statistics for Windows version 27. The study was approved by the Health Research Ethics Committee (KEPK) of the Faculty of Health Sciences, Jendral Soedirman University, with the reference number 1612/EC/KEPK/X/2024.

RESULTS

Characteristics of Toddlers

The characteristics of toddlers in this study can be seen in Table 1.

Table 1. Characteristics of Toddlers

Variable	Cases (n=37)		Control (n=37)	
	n	%	n	%
Gender				
Male	22	59,5	14	37,8
Female	15	40,5	23	62,2
Usia Balita				
24-36 months (toddler)	12	32,4	12	32,4
37-59 months (preschool)	25	67,6	25	67,6
Birth Weight				
BBLR (<2500 g)	3	8,1	3	8,1
Normal (≥ 2500 g)	34	91,9	34	91,9
Birth Length				
< 48 cm	13	35,1	11	29,7
≥ 48 cm	24	64,9	26	67,6

Based on Table 1, it is known that most toddlers in both groups were aged between 37 and 59 months (67.6%). In the case group, most infants were male (59.5%), had normal birth weight (≥ 2500 g) (91.9%) and normal birth length (≥ 48 cm) (64.9%). The majority of infants in the control group were female (62.2%), had a normal birth weight (≥ 2500

g) (91.9%) and normal birth length (≥ 48 cm) (67.6%).

The Relationship Between Protein Adequacy Levels and The Incidence of Stunting in Toddlers

The results of the bivariate analysis of the relationship between protein adequacy level and stunting in toddlers can be seen in Table 2.

Table 2. Bivariate Analysis of Protein Adequacy Levels and Stunting Incidence in Toddlers

Protein Adequacy Level	Cases		Control		P Value	Odd Ratio
	n	%	n	%		
Inadequate	21	56,8	6	16,2	0,000	6,781
Adequate	16	43,2	31	83,8		

As shown in Table 2, the p-value was 0.000 ($p < 0.05$). This finding indicates a significant association between protein adequacy and the incidence of stunting in children aged 24-59 months. It has been demonstrated that children with insufficient protein adequacy ($<90\%$ of requirements) are 6.781 times more likely to experience stunting than children with adequate protein adequacy ($\geq 90\%$ of requirements) (OR: 6.781; 95% CI: 2.1-20.1). Data on protein intake and fulfilment are presented in Table 3.

Table 3. Infant Protein Data

Protein	Cases	Control
	Mean \pm SD	Mean \pm SD
Protein Intake (g)	39,89 \pm 7,3	48,13 \pm 6,5
Protein Fulfilment (%)	89,87 \pm 16,5	99,66 \pm 14,03

Table 3 shows that toddlers in the case group had an average protein intake of 39.89 g per day. Toddlers in the control group had an average daily protein intake of 48.13 g. Toddlers in the case group had a protein fulfilment rate of 89.87%. The control group had an average daily protein fulfilment of 99.66%. The average intake and daily protein fulfilment percentage in the case group was lower than in the control group. The following list of protein-contributing foods and protein consumption frequency in both groups is presented in Table 4.

Table 4. List of Protein-Rich Foods and Frequency of Consumption

Protein Consumption	Cases	Control
Protein Intake in Food (g/day)		
Tempe	6,27	8,80
Chicken eggs	5,38	5,96
Chicken meat	4,18	5,22
Tofu	3,89	5,13
White rice	5,18	5,12
Frequency of Animal Product Consumption Based on Number of Respondents (n (%))		
≤ 2 time/week	15 (40,5%)	7 (18,9%)
> 2 time/week	22 (59,5%)	30 (81,1%)

Table 4 shows a list of the five foods highest in protein content. The case group and control group had the same types of protein-rich foods with the highest frequency of consumption. Tempeh ranked first with the highest consumption levels in both the case group (6.27 g/day) and the control group (8.80 g/day). In terms of consumption frequency, some toddlers in both groups consumed animal protein ≤ 2 times/week, with a higher percentage in the case group.

The Relationship between a History of Exclusive Breastfeeding and Stunting in Toddlers

The results of the bivariate analysis of the relationship between a history of exclusive breastfeeding and stunting in toddlers can be seen in Table 5.

Table 5. Bivariate Analysis of a History of Exclusive Breastfeeding and Stunting in Toddlers

Breastfeeding History	Cases		Control		P Value
	n	%	n	%	
Non exclusive	22	59,5	16	43,2	0,163
Exclusive	15	40,5	21	56,8	

Based on Table 5, the results of the statistical analysis using the chi-square test yielded a p-value of 0.163 ($p > 0.05$). This suggests that a history of exclusive breastfeeding is not significantly associated with stunting in children aged 24-59 months in Sumbang Village. The distribution of responses to the Breastfeeding History questionnaire in the case and control groups is shown in Table 6.

Table 6. Overview of Exclusive Breastfeeding History and Protein Adequacy Levels in Toddlers

Protein Adequacy Level	Non Exclusive (n=38)		Exclusive (n=36)	
	n	%	n	%
Inadequate	16	42,1	11	30,6
Adequate	22	57,9	25	69,4

A higher proportion of infants in the exclusive breastfeeding group (69.4%) had adequate/normal protein levels than in the non-exclusive breastfeeding group (57.9%). Nevertheless, over half of the infants in both groups had achieved adequate/normal protein levels.

DISCUSSION

Characteristics of toddlers

The results of the study show that 67.6% of children are aged between 37 and 59 months. The toddler period marks the optimal acceleration phase in a child's growth and development. As they begin to have control over themselves, toddlers over the age of two will become more active and show increased mobility (Afrida & Aryani, 2022). Therefore, toddlers require an adequate nutritional intake to support optimal growth.

In the case group, the gender of the toddlers was dominated by males at 59.5%, while in the

control group, it was dominated by females at 62.2%. Boys generally have a faster growth rate than girls, but they are also more prone to health problems (Moore, 2024). Physiologically, testosterone in males increases the need for energy and protein to support muscle growth. Meanwhile, females tend to allocate more energy to fat reserves (Thompson et al., 2024). The rapid growth rate and high metabolic needs of boys cause an increase in basal metabolism. Consequently, when nutrient intake is reduced, their energy reserves are depleted quickly.

Birth weight in both groups was predominantly in the normal category (≥ 2500 g), at 91.9% in both the case and control groups. A similar pattern was observed for birth length: 64.9% of cases and 67.6% of controls fell within the normal category (≥ 48 cm). Clinically, low birth weight and length are risk factors for child health and are associated with immaturity of the immune system and several organ systems (Mayesti et al., 2024). However, toddlers with a history of low birth weight (LBW) and low birth length can still grow and develop normally if they receive adequate nutrition and are not affected by chronic infections (Handayani, 2024).

The Relationship Between Protein Adequacy Levels and Stunting in Toddlers

The findings of the bivariate analysis demonstrate a significant relationship between protein adequacy levels and stunting in toddlers aged 24–59 months ($p < 0.05$; OR: 6.781, 95% CI: 2.1–20.1). These findings are consistent with the study by Nurmalasari, Sjariani and Sanjaya (2019) which stated that toddlers with insufficient protein adequacy have a 15,145 times greater risk of stunting compared to toddlers with adequate protein adequacy. Protein plays an integral role in growth, tissue formation and antibody production. Infants who consume adequate protein intake can reduce the risk of stunting (Nurmalasari et al., 2019).

From the analysis results, the average protein intake of respondents in the case group was 39.89 g/day (meeting 89.87% of requirements), while the control group reached 48.14 g/day (meeting 99.67% of requirements). The observed protein intake in most respondents, particularly in the case group, may be attributed to the ongoing Supplementary Food Programme (PMT) that ran concurrently with the study. Stunted toddlers received regular PMT in the form of complete meals (rice, animal side dishes, vegetables and fruit) that were prepared and delivered by cadres. This programme most likely influenced their protein intake during the last month. However, protein intake in the stunted group was lower than in the non-stunted group.

In this study, tempeh and chicken eggs were the most consumed sources of protein. Tempeh, as a source of plant-based protein, was widely consumed due to its affordability and availability. In the case group, 40.5% of toddlers consumed animal

protein other than eggs, namely meat and fish, with a frequency of ≤ 2 times per week. Iswara and Syafiq (2024) revealed that toddlers who consumed animal protein less than twice a week were at greater risk of stunting. This finding is also in line with the research by Ernawati et al. (2016), which revealed that toddlers with nutritional problems, including stunting, had a history of lower animal protein intake compared to children with normal nutritional status.

From a biological perspective, animal protein is more bioavailable, meaning it is digested more quickly by the body than plant protein (Fufa, 2022). Animal protein sources contain a more diverse range of essential amino acids than plant protein sources. Furthermore, animal protein is high in energy and micronutrients, which support toddler growth (Sari et al., 2016). It contains vitamins A, D, B12 and C, as well as minerals such as calcium and zinc, which are easily absorbed by the body (Ernawati et al., 2016).

Protein, as a macronutrient, plays an important role in children's growth through the formation and repair of body tissues, the provision of amino acids for the synthesis of digestive enzymes, and the stimulation of bone growth through the activation of Insulin-like Growth Factor-1 (IGF-1) and growth hormone (GH) (Alam et al., 2025; Syagata et al., 2024). The process of bone growth is primarily influenced by the hormone insulin-like growth factor-1 (IGF-1), which triggers the growth of new bone cells in the epiphysis. The levels of IGF-1 in the epiphysis are highly dependent on adequate protein intake. Long-term protein deficiency risks inhibiting height growth even if energy intake is sufficient (Syagata et al., 2024). In order to prevent stunting, public education efforts are vital on the necessity of increasing not only plant-based protein consumption but also that of animal protein. It has been established that an increase in the diversity of protein sources consumed by infants is indicative of a lower likelihood of stunting (Iswara & Syafiq, 2024).

The Relationship between Exclusive Breastfeeding History and Stunting in Toddlers

The results of bivariate analysis showed no statistically significant relationship between exclusive breastfeeding history and stunting in toddlers aged 24–59 months in Sumbang Village ($p > 0.05$). This study contradicts the research by Handayani, Wiwin and Eka (2019) in Gunungkidul District, which stated that there was a relationship between exclusive breastfeeding and stunting in children aged 24–36 months ($p = 0.000$). Research by Pramulya et al. (2021) also reported that toddlers who were not exclusively breastfed had a 4.682 times higher risk of stunting compared to toddlers who were exclusively breastfed.

As demonstrated in Table 5, the data indicates that the proportion of toddlers with a history of non-exclusive breastfeeding was comparable in both the case group and the control group. The Ministry of Health's Balanced Nutrition

Guidelines (PGS) assert that breast milk fulfils all the nutritional requirements of infants up to six months of age. However, after this age (6-24 months), breast milk alone is no longer sufficient, and for toddlers >24 months who have been weaned, nutritional needs depend entirely on food. Consequently, children who have been fed exclusively on breast milk are still at risk of stunting between the ages of 24 and 59 months if their food intake, particularly protein, is inadequate (Handayani et al., 2019).

In this study, a history of exclusive breastfeeding was not identified as a risk factor for stunting. This finding is consistent with research in the Balen Bojonegoro subdistrict, which also found no significant association between a history of exclusive breastfeeding and stunting in toddlers (Vernanda & Ruhana, 2023). Despite the findings of Bunga et al. (2015) that exclusive breastfeeding offers a degree of protection against stunting, it is not a significant contributing factor to the issue. Stunting is a multifactorial condition; other factors such as nutritional intake and a history of recurrent infectious diseases can also influence stunting (Wahyuningsih et al., 2021).

As illustrated in Table 6, it is evident that the majority of children who were not given exclusive breastfeeding in both the case and control groups exhibited adequate protein levels. Protein has been demonstrated to play a significant role in the linear growth of toddlers (Sari et al., 2016). This finding further supports the assertion by Vernanda and Ruhana (2023) that toddlers with a history of non-exclusive breastfeeding, when aged >6 months, can potentially regain lost height growth if they receive adequate nutritional intake. Adequate intake has the potential to support the improvement and prevention of linear growth disorders even if the child is not exclusively breastfed (Handayani et al., 2019).

The interview results revealed several reasons why children were not exclusively breastfed, including breast milk not coming out, children not wanting to breastfeed, and separate care. The types of drinks and food given to toddlers were formula milk and water. Additionally, some mothers started complementary feeding before the child was 6 months old, which also caused the toddler to not meet the criteria for exclusive breastfeeding. These findings suggest that achieving exclusive breastfeeding is closely linked to breastfeeding practices and is influenced by various factors, particularly relating to mothers' understanding of the criteria and importance of exclusive breastfeeding (Hadi et al., 2021).

During the crucial first 1,000 days of a child's life, exclusive breastfeeding plays a key role in laying the foundations for optimal growth and development, and in preventing stunting, as breast milk provides all the essential nutrients required (Maila Putri & Andarini, 2024). Research by Maila Putri and Andarini (2024) reveals that breast milk significantly supports cognitive and neurological

development. The main components for the formation of brain nerve cells are the lactose, arachidonic acid (AA), docosahexaenoic acid (DHA), iron, zinc, selenium and iodine content in breast milk (Setyowati et al., 2022). Stunting itself is related to a decline in children's cognitive abilities (Utami et al., 2021). Therefore, exclusive breastfeeding is a vital step in improving children's health.

CONCLUSION

The study revealed a significant correlation between protein adequacy levels and stunting in children aged 24–59 months in Sumbang Village, with a p-value of 0.000 and an odds ratio (OR) of 6.781. However, no significant relationship was found between a history of exclusive breastfeeding and stunting in this age group, with a p-value of 0.163. These findings provide a valuable evidence base for further research and policy development. Protein intake should be balanced between animal and plant sources in accordance with nutritional recommendations for each age group. Relevant institutions can optimize community collaboration by prioritizing exclusive breastfeeding education and ensuring adequate daily protein intake. Other researchers may wish to use more diverse matching to obtain stronger findings and control for external interventions, such as the PMT programme, which has the potential to influence research results.

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AUTHOR CONTRIBUTION AND COMPETING INTEREST

DFO: Field Coordinator, Data management and analysis, writing–original draft; TJP: conceptualization, investigation, methodology; supervision, writing–review and editing; HAR: methodology, Data Analysis, writing–original draft, formal analysis, resources.; INK: Methodology, writing–review and editing, supervision; KAS: Data curation, writing–review and editing. The author declares that there are no conflicts of interest in the writing and preparation of this article.

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