Amerta Nutrition
e-ISSN: 2580-1163 (Online)
p-ISSN: 2580-9776 (Print)
Haryani et al. | Amerta Nutrition Vol. 7 Issue 2SP (December 2023). 139-146

RESEARCH STUDY
English Version
OPEN ACCESS

Animal-Based Protein Intake is Associated with Stunting in Children in Primary Health Care of Minggir

Asupan Protein Hewani Berhubungan dengan Stunting *pada Balita di Wilayah Kerja Puskesmas Minggir*

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ARTICLE INFO

Received: *14-09-2023*
Accepted: *15-12-2023*
Published online: *31-12-2023*

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DOI:
10.20473/amnt.v7i2SP.2023.139-146

Available online at:
https://e-journal.unair.ac.id/AMNT

Keywords:
Animal-Based Protein, Under-Fives Children, Stunting

ABSTRACT

Background: Stunting in children under fives years of age still become crucial problem. One of the factors that influenced directly to stunting is lack of nutritional intake especially protein. Most of protein consumed by under-fives children must be in high quality such as animal-based protein because it has more complete composition of essential amino acids than plant-based protein.
Objectives: The study aimed to analyzed the association between animal-based protein and stunting in children in Primary Health Care of Minggir.
Methods: This study was analytical observational with cross-sectional design. A total of 50 mothers that have 24–59 months old children were involve in this study and taken by using purposive sampling. Data of animal-based protein intake were collected by SQ-FFQ for the last three months. Height-for-age in z-score was used to determine stunting that were obtained from the last measurement and recorded in Maternal and Child Book. The association between stunting and the animal-based protein intake was analyzed descriptively through cross-tabulation.
Results: More than half of under-five children were stunting (56%). Inadequate animal-based protein intake was observed in 46% of under-fives children. Sources of animal-based protein were eggs, chicken, catfish, ice cream and UHT milk. Children who have adequate animal-based protein intake were not stunted (67%), however children who have inadequate animal-based protein intake were stunted (83%). The prevalence of stunting in children who consume inadequate animal-based protein is 2 times greater than in children who consume adequate animal-based protein (PR: 2.478).
Conclusions: Based on this study, animal-based protein intake is associated with stunting in under-fives children in Primary Health Care of Minggir. Mothers should improve their children's animal-based protein intake by local food sources supplied from side dishes to prevent stunting.

INTRODUCTION

Stunting is a crucial child nutrition problem because it is associated with a greater risk of morbidity and mortality, the risk of non-communicable diseases in the future due to metabolic disorders, poor cognitive development, and decreased quality of human resources[1]. Stunting in children under five years of age contribute to 1.5 million under-five deaths worldwide and cause 55 million Disability-Adjusted Life Years (DALYs), namely the loss of healthy life every year[2]. Globally, there were 22% of children experiencing stunting in 2020. As many as 53% of these children came from Asia and more than 11% of cases occured in Southeast Asia[3].

Based on the results of Indonesian Nutritional Status Survey (SSGI) in 2022, the prevalence of stunting in Indonesia was 21.6% and has not yet reached the 2024 National Medium-Term Development Plan of Indonesia's target (14%)[4]. The prevalence of stunting under five in the Special Region of Yogyakarta was 16.4%, while in Sleman Regency it was 15%[5]. The first sub-district in Sleman Regency with the highest prevalence of stunting is Minggir District; in 2021, it was 15.8%, and in 2022, it was 13.48%. Minggir District has the top three villages with the highest prevalence of stunting, including Sendangmulyo (15.19%), Sendangarum (14.48%), and Sendangagung (14.54%). According to the criteria for national stunting focus locations, these villages have been identified as stunting-prone villages[6].

Stunting is a failure condition to thrive in children under five years of age due to chronic malnutrition, frequent infections, and limited psychosocial stimulation, so that children are shorter for their age[7]. One of the factors that directly influences stunting is nutrient intake, specifically a lack of energy, protein, and zinc[8]. Protein needs in children are higher than other age groups.

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Children's growth rate can be slowed down by a lack of protein since it can harm the production of the hormone Insulin-like Growth Factor (IGF)-1, which influences bone growth[9].

Protein can be adequate if it includes all types of essential amino acids in appropriate quantities and is easily digested and absorbed by the body. Under-fives children require the amino acids lysine, leucine, isoleucine, valine, threonine, phenylalanine, tyrosine, methionine, cysteine, tryptophan, histidine, and arginine; the majority of which are essential[10]. Therefore, most of the protein consumed by children must be of high quality such as animal-based protein because it has better digestibility and a more complete composition of essential amino acids compared to plant-based protein[11].

Several studies have shown that intake of animal-based protein can affect the stunting in children[12–14]. According to a study done in seven Southeast Asian nations, including Indonesia found that the quality and quantity of food consumed by under-fives children is a serious concern. This is because children under five years of age still consume relatively low food, particularly in the form of animal-based protein, vegetables, and fruits[15]. In line with this, the results of the 2014 Total Diet Survey (SDT) shown that the types of foodstuffs most consumed by under-fives children in Indonesia are cereals, roots and tubers[16]. However, research on the risk factors for animal-based protein intake and the stunting in national stunting focus areas is still rarely conducted. Therefore, this study aimed to analyzed the association between animal-based protein and stunting in children in Primary Health Care of Minggir.

METHODS

This research was analytic observational with a cross-sectional design which was conducted from February to July 2023. Population in this study were all mothers with children aged 24–59 months in Primary Health Care of Minggir. The sampling technique used was purposive sampling. A total of 50 mothers who have under-five years old children were selected as research subjects spread over 10 posyandu from 5 villages in the Primary Health Care of Minggir's working area. The inclusion criteria included mothers who had children aged 24–59 months old, domiciled in Primary Health Care of Minggir's working area, have willingness to be the respondents, can communicate well, have Maternal and Child Book, and measuring children anthropometric in the Integral Health Care (IHC) based on latest measurement. The exclusion criteria were children who had a history of co-morbidities (tuberculosis, heart, kidney, and cancer disease) or genetic disorders (down's syndrome, klinefelter's syndrome, and autism), allergies to animal-based protein sources, and/or still consuming breast milk. This research was approved by the Research Ethics Commission of the Universitas 'Aisyiyah Yogyakarta with number 1713/KEP-UNISA/VI/2023.

Data characteristics of subject was collected by filling out the questionnaire directly. Data of animal based protein intake were obtained by interviews using the SQ-FFQ for the last three months. Data were processed using the Nutrisurvey program and converted in grams per day with 2 categories, adequate (≥ mean) and inadequate (< mean)[17]. Recommended Daily Allowance (RDA) for protein shows the average need for overall protein (animal-based protein and plant-based protein) in a day. Therefore, the RDA was not used as a cut off of animal-based protein intake in this study because this study only assessed animal-based protein intake. Meanwhile, data on the stunting was obtained through secondary data from measuring the height of children at the IHC in the last month and copied from the Maternal and Child Book. Stunting was determined using height-for-age based on WHO Anthro software and presented as a z-score with 2 categories, stunted (< -2 SD) and not stunted (-2 to +3 SD)[18].

The normality test using the Komogorov Smirnov test was carried out before the data was analyzed. Univariate data analysis showed the characteristics of the subjects which included the characteristics of children (stunting, age of children, sex, birth length, history of exclusive breastfeeding, and animal based protein intake), animal-based protein sources that are often consumed by children, and mother's characteristics (mother's education, mother's occupation, and family income). The association between stunting and the animal protein intake was analyzed descriptively through cross-tabulation.

RESULTS AND DISCUSSION

This research was conducted on five villages in the Primary Health Care of Minggir's working area in February to July 2023 with a total sample of 50 mothers who have under-five years old children. The characteristics of the subjects in this study were divided into children and mother characteristics. The research results obtained are as follows:

Table 1. The Mean and Median Values are based on the Stunting, Age of Children, Birth Length, and Animal-based Protein Intake

Variables	Mean ± SD or Median	Min	Max
Stunting (z-score)	-2.15**	-7.4	1.92
Age of children (month)	38.34 ± 8.4867*	24	59
Birth length (cm)	47.66 ± 2.0663*	41	53
Animal-based protein intake (g)	21.05 ± 6.2258*	10	32.1

*Mean
**Median

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Table 2. Frequency Distribution of Children and Mother Characteristics

Characteristics	N = 50	
	Frequency (n)	Percentage (%)
Children Characteristics		
Stunting		
Stunted	28	56
Not Stunted	22	44
Age of Children		
24 – 35 months	17	34
36 – 47 months	24	48
48 – 59 months	9	18
Sex		
Boys	28	56
Girls	22	44
Birth Length		
Normal (≥ 48 cm)	31	62
Short (< 48 cm)	19	38
History of Exclusive Breastfeeding		
Yes	36	72
No	14	28
Animal-Based Protein Intake		
Adequate (≥ mean)	27	54
Inadequate (< mean)	23	46
Mother Characteristics		
Mother's Education		
No school	-	-
Low (elementary or junior high school)	7	14
Intermediate (senior high school)	31	62
High (diploma or bachelor)	12	24
Mother's Occupation		
Not working / housewives	34	68
Laborer	2	4
Self-employed	1	2
Private employees	11	22
Civil servants	2	4
Family Income		
High (≥ Rp 2.159.519,22)	22	44
Low (< Rp 2.159.519,22)	28	56

Tables 1 and 2 showed the characteristics of children and mother. The stunting is identified by looking at the z-score for height-for-age. A child can be categorized as stunted if he has a height-for-age in z-score value of less than -2 Standard Deviations (SD). The median z-score in this study was -2.15 SD (Table 1), which it was stunted category[18]. The results of the study showed that more than half of the under-fives children were stunted (56%) (Table 2). The prevalence of stunting in under-fives children was higher in this study compared to the national and Sleman Regency prevalence of stunting (21.6% and 15%, respectively)[5]. Based on the public health significance cut-off values for stunting specified by the World Health Organization (WHO), the results of this study is deemed to have a very high prevalence of stunting (≥30%)[19]. This was maybe related to the method of data collection method, which it was more directed at stunting children. Nonetheless, higher stunting prevalence (56%) in this study could be an indication of child nutrition issues in Primary Health Care of Minggir's working area.

Stunting could happen while a fetus is still in the womb and in the first few days after birth, although it is not often visible until a child is 24 months old[20]. In this study, the mean age of 50 children were 38.34 ± 8.5 months years old (Table 1). Most of the children were aged 36–47 months old (48%) followed by ages 24–35 months old (34%) and 48–59 months old (18%) (Table 2). A study in Ghana found a significant relationship between children age and stunting. Children who aged 36–47 months were 10.4 times more likely to be stunted than children who aged less than six months[21].

Based on this study, most of the children were boys (56%) (Table 2). Boys are more susceptible to stunting because they played a lot in the environment. This condition makes under-five children often forget to eat, and it is exacerbated by poor parenting so the food intake was inadequate[22]. Boys tend to have larger body proportions and were more active in gross motor skills than girls. This makes the nutritional needs also higher. If the intake was inadequate for a long time, it would affect child growth[23].

The mean of body length at birth was 47.66 ± 2.0663 cm (Table 1). There were 31 children (62%) who had a history of normal birth length and the remaining 19 children (38%) who had short birth length (Table 2).

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Children who have a history of short birth length have an indication of a deficiency in the fulfillment of maternal nutrition during pregnancy. The problem of malnutrition begins with a slowdown or retardation of fetal growth known as Intra Uterine Growth Retardation (IUGR) which causes linear growth to not be optimal[24]. Babies who experienced malnutrition during pregnancy could still be improved with good intake so that they could catch up growth. However, if the intervention was too late, the child may experience failure to thrive[25].

Based on the history of exclusive breastfeeding for 0-6 months, it is known that the majority of under-fives children was had a history of exclusive breastfeeding (72%) (Table 2). In Indonesian's Balanced Nutrition Guidelines, breast milk can provide all the nutrients a baby needs until the age of 6 months[26]. At the age of 6-24 months, the need for various nutrients increased so that breast milk alone would not be enough. Meanwhile, children who are 24 months and older stopped to consume breast milk and rely entirely on the nutrients found in food[10]. Therefore, children who have a history of exclusive breastfeeding may experience stunting at the age of 24–59 months due to inadequate food intake, one of which is protein intake such as animal-based protein sources[27].

The protein intake based on Indonesian's RDA in children who aged 2–3 years old is 20 g/day dan who aged 4–5 years old is 25 g/day[28]. Therefore, the mean of protein intake for children aged 24–59 months old (2–5 years old) is 22.5 g/day. The animal-based protein intake in this study ranged from 10 to 32.1 g/day (Table 1) and the mean was of 21.05 ± 6.2 g/day (Table 2). In general, this mean is adequate based on Indonesian's RDA of protein intake. This may be influenced by the maximum value of animal protein intake for under-fives children (32.1 g) which looks quite high when compared to the RDA for total protein (22.5 g). Based on the results of interviews with mothers, this can be caused by some under-fives children have a habit of consuming milk products such as UHT milk and formula milk in large quantities, around 3–4 servings a day.

However, the average animal-based protein intake in this study was lower than the results of further analysis of the Indonesia's Basic Health Research data in 2013 and the Indonesia's Individual Food Consumption Survey in 2014, which showed the median animal-based protein intake for stunted toddlers was 22.39 g/day and normal toddlers 22.91 g/day[29]. The results in this study were also lower compared to research in Pontianak City, that found the consumption of animal-based protein in stunted children was significantly lower than non-stunted children with an average consumption of 28.31 g/day in stunted children and 39.31 g/day in children are not stunted[9]. Furthermore, the results of the study based on Table 2, showed that almost half of under-fives children (46%) had inadequate animal-based protein intake.

Another factor that contributes to the stunting was the characteristics of the mother. In Table 2, it could be seen that the highest proportion of mother's education level was intermediate education (senior high school graduation or equivalent) (62%). The mother's knowledge of nutrition would be influenced by her educational background because a higher education makes it easy to receive and assimilate information[30]. Then, mother's knowledge would influenced the behavior in providing food for her under-fives children. Mothers with good knowledge of nutrition could prepare, procure, and select nutritious food based on the right type and amount so that children could grow and develop optimally[31].

However, most of mothers are known as housewives or do not work (68%) with lower family income levels based on Sleman Regency's minimal salary (56%) (Table 2). Mothers who were not working, they could not contribute to boosting the family's financial situation[32]. The level of family income could reflect the ability of a family to obtain daily food to consume[27]. Families with low income preferred to buy more types of food sources of carbohydrates than food sources of protein because the price was relatively cheaper[33].

Table 3. Frequency Distribution of Animal-based Protein Sources

Animal-based Protein Sources	Stunted n (%)	Not Stunted n (%)	Total N (%)
Eggs	25 (89)	22 (100)	47 (94)
Chicken	26 (93)	21 (95)	47 (94)
Catfish	25 (89)	22 (100)	47 (94)
Ice cream	27 (96)	20 (91)	47 (94)
UHT milk	25 (89)	21 (95)	46 (92)
Meatball	15 (54)	20 (91)	45 (90)
Sausage	23 (82)	19 (86)	42 (84)
Formula milk	18 (64)	16 (73)	34 (68)
Quail eggs	10 (36)	13 (59)	23 (46)
Yogurt	7 (25)	14 (64)	21 (42)
Milkfish	12 (43)	9 (41)	21 (42)

Table 3 showed some food source of animal-based protein intake that were usually consumed by children. The top five most frequently consumed of the animal-based protein sources were eggs, chicken, catfish, and ice cream for 47 children (94% each) and UHT milk for 46 children (92%). Based on the results of an interview with one of nutritionists at Primary Health Care of Minggir, it was known that catfish was a local food source of animal-based protein in Primary Health Care of Minggir's working area. This was consistent with the results of this study, which it found that catfish was included in the top list of animal-based protein sources

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that most often consumed by children (47 out of 50 under-fives children). Meanwhile, one out of five villages in the Primary Health Care of Minggir's working area was a shrimp farming location. However, this study did not show that under-fives children often consume shrimp as a source of animal-based protein.

The findings of this study were in line with research in East Flores Regency and Semarang City, which found that mostly the food sources of animal-based protein consumed by under-fives children were eggs, meat and fish[13,34]. Fish accounts for 99.2% of the animal-based protein consumed by children 1 to 5 years old in the Nagi Health Care, East Flores Regency, with eggs coming in second with 90.3% and chicken coming in third with 83.9%[34]. Similar findings were found in Primary Health Care of Rowosari, Semarang City, which showed that a total of 106 subjects aged 2–4 years old, 61 children ate eggs most frequently, and the meat consumed 28 children more frequently; 13 children ate fish, milk for 2 children, and seafood for 2 children[13].

Table 4. Association of Animal-based Protein Intake with Stunting

Animal-based Protein Intake	Stunting		PR
	Stunted	Not Stunted	
Inadequate	19 (83%)	4 (17%)	2.478
Adequate	9 (33%)	18 (67%)	

According to Table 4, the percentage of under-fives years old children who stunted were highest among children with inadequate animal-based protein intake (83%). Apart from that, the under-fives years old children who are not stunted were found in children with adequate animal-based protein intake (67%). Meanwhile, children who are not stunted with inadequate animal-based protein intake were 17% and children who are stunted with adequate animal-based protein intake were 33%. Based on these results, it could be known that there was a association between animal-based protein intake and stunting in under-fives children in Primary Health Care of Minggir. The prevalence of under-fives years old children who have inadequate animal-based protein intake have 2 times higher stunted risk compared to children who have adequate animal-based protein intake (PR: 2.478).

The similar results were found in a study on pre-school children aged 2–4 years old, that showed a significant relationship between total animal-based protein intake and its role as an element causing failure to grow or stunting. Stunting was 6.1 times more likely to occur in children who consume less animal-based protein than in children who consume enough animal-based protein[13]. In agreement with these findings, a study in Cambodia found that consumption of animal source foods can reduce the risk of stunting by 31% in children under five of age[35].

Stunting reflected the inability to achieve optimal growth[36]. A literature review explained that consuming animal-based protein could increase growth according to age, including height-for-age (HAZ), body length-for-age (LAZ), and weight-for-age (WHZ)[37]. This study was supported by the results of research in Samarinda City that intake of animal-based protein in a week was protective against stunting. The number of toddlers who did not consume animal protein was nine times more at risk of stunted compared to toddlers who consume animal-based protein[12]. According to empirical findings from a study, treatments that increased animal protein diet by merely 1 gram per day could enhance height for age by about 0.02 SD in a month and perhaps eliminate stunting[38].

Protein is needed to build, maintain, and repair body tissues[10]. Protein deficiency could cause growth retardation and bone maturity. Adequate energy intake but inadequate protein would still increase a risk of stunted growth in under-fives children[39]. Bone growth was influenced by Insulin-like Growth Factor-1 (IGF-1) by stimulating the proliferation and differentiation of chondrocytes in the epithelial growth plate by directly acting on osteoblasts. Inadequate protein intake can inhibit the production and effects of IGF-1 due to disruption of mineral absorption in bone mass[9]. In this regard, animal-based protein has aromatic amino acids including phenylalanine, tyrosine and tryptophan which have been proven to increase serum IGF-1 levels higher than non-aromatic amino acids in plant-based protein[34]. Additionally, animal-based protein also contained of micronutrients that were related to growth, such as heme iron, zinc, selenium, calcium and vitamin B12. So it would have a greater influence on the stunting when compared to plant-based protein[9].

In terms of quality, animal-based protein was known to be superior to plant-based protein. Animal-based protein had more complete essential amino acids than plant-based protein. This essential amino acid (EAA) played a role in synthesizing several growth hormones, such as thyroid hormone and Human Growth Hormone (HGH)[40]. Low levels of essential amino acids are one of the common characteristics found in stunted children. According to a study, children with stunting had lower serum levels of certain amino acids than children without stunting[41]. In accordance with that, research in North Lombok Regency found that the intake of EAA, especially isoleucine, in stunted under-fives children was lower than in non-stunting under-fives children because they rarely consumed food sources of animal-based protein[42]. Plant-based proteins usually experience deficiencies in several essential amino acids, such as lysine, threonine, tryptophan and methionine[43].

Another advantage of animal-based protein had better bioavailability than plant-based protein. This could happen because anti-nutrient substances were more commonly found in plant-based protein. For example, the tannins found in legumes, a source of plant-based protein, For example, tannins found in legumes, a plant protein source, can interfere with protein digestion and cause a reduction in essential amino acids through the formation of tannin-protein complexes[44]. The Digestible Indispensable Amino Acid Score (DIAAS) was a method used to assess the bioavailability of amino acids which is

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determined most accurately at the end of the small intestine (ileum). DIAAS scores were categorized into three (<75, no claim of good quality protein; 75–99, claim of good quality protein; and ≥100, claim of very good quality protein)[45]. In general, animal-based protein (dairy, egg, and meat) was considered "very good" quality protein with a DIAAS value of greater than 100. In contrast, plant-based protein generally has a DIAAS value of less than 75 with soy protein typically having a DIAAS value of between 75 and 100[46].

This study still had limitations that future researchers can consider to achieve better research results. These limitations include the design of this study using a cross-sectional design with a purposive sampling technique that focuses more on under-fives children who stunted. In addition, the stunting variable still used secondary data from IHC measurements so the results would not be as accurate as primary data. However, in this study IHC cadres have received training in anthropometric measurements of under-fives children.

CONCLUSIONS

According to the study's findings, it can be concluded that animal-based protein intake is associated with stunting in under-fives children in Primary Health Care of Minggir. Children who have adequate animal-based protein intake were not stunted, however children who have inadequate animal-based protein intake were stunted. Mothers should boost their children's consumption of animal-based protein by using local food supplied from side dishes to prevent stunting. Mothers are also expected not to give excessive milk products to children. Future researchers can use case-control research design with a sampling technique in the form of proportional sampling and then analyze the stunting using primary data. Additionally, other researchers can also explore why protein intake has decreased so that real solutions can be provided.

ACKNOWLEDGMENTS

We would like to thank the head of Primary Health Care of Minggir for the opportunity to do this research study, cadeers and enumerators for their help in this research study.

Conflict of Interest and Funding Disclosure

There is not any conflict of interest. Financial support for this research came from researcher's funds.

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