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Stunting and Dietary Diversity in Children 24-59 Months in Indonesia (Analysis of Indonesian Family Life Survey 2014-2015)

Stunting *dan Keragaman Pangan pada Balita Usia 24-59 Bulan di Indonesia (Analisis Data* Indonesian Family Life Survey *Tahun 2014-2015)*

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ABSTRACT

Background: Stunting is impaired growth and cognitive development that could decrease learning ability and productivity and increase morbidity and mortality. In 2018, 30.8% of children under the age of five in Indonesia were stunting. Chronic lack of nutrition as a cause of stunting is well known. However, the type of food that causes differences in the conditions between stunting and non-stunting children still needs further investigation. Dietary diversity is an indicator to identify the type and quality of food consumed.
Objectives: Analyzing the relationship between dietary diversity and stunting and determinants of stunting in children aged 24-59 months in Indonesia.
Methods: This was an observational study using a cross-sectional design. Secondary data from the (IFLS) 5 was used. Bivariate analysis was conducted using the chi-square test. Multivariate analysis used the logistic regression test. The subjects in this study were 2421 children aged 24-59 months.
Results: Bivariate analysis showed a significant relationship between dietary diversity and stunting. Significant relationships were found between meat, eggs, milk and its products, and vitamin A-rich vegetables and stunting. Multivariate analysis showed LBW, economic status, area of residence, and maternal education are predictors of stunting.
Conclusions: Dietary diversity, especially consumption of animal protein such as eggs, meat, fish, and milk could improve the quality of children's diets. Improving the quality of diets could potentially reduce the risk of stunting. Therefore, efforts and strategies are needed to increase accessibility to various foods and increase nutritional knowledge.

INTRODUCTION

Stunting is a disorder of linear growth and cognitive development which can result in degraded learning ability and productivity, as well as an increased risk of disease and mortality in the future[1]. Stunting can increase the risk of mortality and disease, decreased cognitive development, increased risk of obesity as an adult, decreased learning ability, and decreased productivity[2]. Based on data from the 2023 *Survey Kesehatan Indonesia* (Indonesian Health Survey), 20.5% of toddlers in Indonesia still suffered from stunting[3]. Stunting is defined as a child whose nutritional status is based on body length or height according to age compared to the 2005 World Health Organization Multicenter Growth Reference Study (WHO-MGRS) standard. It is said to be stunted if the z-score value is <-2 SD. Stunting in children is the result of malnutrition in mothers and inadequate intake of babies and children[1].

Chronic deficiency of nutritional intake as a cause of stunting is well known. However, the type of food that causes differences in conditions between stunted and non-stunting children still needs further researches. Dietary Diversity Score (DDS) for individuals is a tool that can be used to describe the quality of the diet consumed[4]. DDS assesses the diversity of food consumed, observed from several food groups, so that it can be seen which food groups are less consumed by stunted children. Researches on children under five in several small and middle-income countries show a significant relationship between food diversity scores and Weight-for-Age (WFA), Height-for-Age (HFA), and Weight-for-Length/Height (WFH). The more food diversity increases, the more children's nutritional status will grow[5–7].

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It can be said that food diversity in Indonesia has not reached an optimal point. Based on the National Food Agency data in 2020, the highest proportion of spending by the Indonesian population on food is to purchase ready-to-eat food and drinks. This indicates that the majority of people still prefer to buy food and drinks from the food stall. Apart from that, spending on grains still dominates, followed by tobacco and betel. This proportion is still greater than the spending allocated for the consumption of vegetables, fruit and animal protein dishes, so it can be said that the proportion of spending on carbohydrates is still more dominant, and the population's food consumption is still not diverse and balanced. Meanwhile, protein consumption is still dominated by vegetable protein compared to animal protein[8]. By considering the proportions based on the 2018 National Expected Food Pattern, all food group components are within the %RDA (Recommended Daily Allowance) range of the Food and Agriculture Organization-Regional Office for Asia and Pacific (FAO-RAPA) as a reference for ideal food composition. However, improvements can still be made, especially in the animal protein food group, considering that the %RDA for animal protein food is still 12% compared to the %RDA (FAO-RAPA) of 5.0-20.0%[9]. It is expected that an analysis of the quality of diet in stunted children can sharpen the intervention strategies to reduce and eradicate stunting. Considering that the problem of stunting is an urgent problem and must be resolved immediately, intervention and problem-solving strategies must be effective and right on target. Therefore, an analysis of food diversity in stunted children is considered necessary as an effort to find the most appropriate strategy in decreasing stunting.

METHODS

This was a quantitative research with a cross-sectional design using secondary data from the 2014-2015 of IFLS 5. IFLS 5 data collection was carried out in 13 provinces spreading across Indonesia, including West Nusa Tenggara, Special Region of Yogyakarta, East Java, Special Capital Region of Jakarta, South Sulawesi, North Sumatra, West Java, Lampung, South Sumatra, South Kalimantan, West Sumatra, Central Java, and Bali from September 2014 to April 2015. The populations in the study were children aged 24-59 months in Indonesia while the research subjects were children aged 24-59 months who met the inclusion criteria, namely registered as IFLS 5 participants aged 24-59 months. The exclusion criteria for research subjects showed that there was missing data in the sample related to data for the variables studied. The number of samples in this study was 2421 children. The research had received a letter of ethical clearance from the Research Ethics Commission of the Faculty of Medicine, Public Health and Nursing, Gadjah Mada University, Yogyakarta on March 11, 2020 with reference number KE/FK/0304/EC/2020.

The subject's nutritional status was observed based on body length or height according to age compared with the 2005 WHO-MGRS standard. Children are categorized as stunting if they have a z score <-2 SD[10]. The diversity of food consumption of research subjects was measured using the dietary diversity score. The interpretation performed by the Dietary Diversity Score (DDS) questionnaire with 10 food components, namely (1) cereals, (2) tubers, (3) meat (beef, chicken, pork, etc.), (4) eggs (5) fish, (6) milk and its processed products (cheese, butter, etc.), (7) vegetables rich in vitamin A (carrots), (8) green leafy vegetables, (9) fruits rich in vitamin A (papaya, mango), and (10) other fruits (bananas)[4]. Each food component is given a score of 1 if consumed in the last week, and 0 if not consumed in the last week. The food diversity category is low if the score is 0-5, while high if the score is 6-10[11]. The subject's birth weight was categorized as normal when the weight was ≥2500 g and low birth weight (LBW) <2500 g. Infectious diseases was seen based on the presence of infectious diseases suffered by the subjects in the last 1 month, including ARI (Acute Respiratory Infection) (characterized by symptoms of headache, runny nose, cough, shortness of breath, and fever) and diarrhea (characterized by symptoms of stomach ache and loose stools). The mother's education as the subject was divided into 2 categories, namely low (no education, completed elementary school/Islamic Elementary School (*MI*), completed junior high school/Islamic Junior High School (*MTS*); and high (completed high school or college).

Analysis to see the relationship between variables was performed by the chi-square test. The α value <0.05 was used to determine whether there was a significant relationship or not. The Odds Ratio (OR) score was used to interpret the magnitude of the relationship or risk between the independent and dependent variables. Multivariate analysis with a logistic regression test was carried out to jointly test variables that had a significant relationship in the bivariate test with a p-value<0.25 to determine which model was best in predicting the incidence of stunting.

RESULTS AND DISCUSSIONS

Based on descriptive analysis, the prevalence of stunting was found to be 31.72% in children aged 24-59 months. The majority of respondents met the criteria for food diversity, namely 90.95%. The cereal component was the most widely consumed with 99.22% meeting the criteria. Based on protein sources, 61.17% of respondents met the criteria for consuming meat, 89.84% consumed eggs, 77.45% consumed fish, and 76.62% consumed milk and its products. In the LBW variable, the majority of respondents were born with normal weight, namely 91.90%, while the percentage of respondents who had a history of infectious diseases was only 4.92% of the total respondents. There was 42.42% of respondents living in rural areas, while 57.58% living in urban areas. There are no major differences in the variables of economic status and the mother's education level, in which the percentages of both are close to 50% in each category.

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Table 1. The characteristics of children aged 24-59 months in Indonesia (N=2421)

Variables	Frequency (n)	Percentage (%)
Stunting		
Stunting	768	31.72
Not Stunting	1653	68.28
Food Diversity		
Low	219	9.05
High	2202	90.95
Cereals		
Do not consume	19	0.78
Consume	2402	99.22
Tubers		
Do not consume	1762	72.78
Consume	659	27.22
Meat		
Do not consume	940	38.83
Consume	1481	61.17
Egg		
Do not consume	246	10.16
Consume	2175	89.84
Fish		
Do not consume	546	22.55
Consume	1875	77.45
Milk and Dairy Products		
Do not consume	566	23.38
Consume	1855	76.62
Vitamin A Rich Vegetables		
Do not consume	1510	62.37
Consume	911	37.63
Green Leafy Vegetables		
Do not consume	603	24.91
Consume	1818	75.09
Vitamin A Rich Fruits		
Do not consume	507	20.94
Consume	1914	79.06
Other Fruits		
Do not consume	1199	49.52
Consume	1222	50.48
Low Birth Weight		
LBW	196	8.10
Not LBW	2225	91.90
Infectious Diseases		
Yes	119	4.92
No	2302	95.08
Residence Area		
Rural	1027	42.42
Urban	1394	57.58
Economic Status		
Low	1215	50.19
High	1206	49.81
Mother's Education		
Low	1211	50.02
High	1210	49.98

Bivariate analysis was carried out to understand the relationship among dietary diversity, components of dietary diversity (cereals, tubers, meat, eggs, fish, milk and dairy products, vitamin A vegetables, green vegetables, vitamin A fruits, and other fruit) and the incidence of stunting. Table 2 shows that there was a significant relationship between dietary diversity and stunting (p-value=0.005), in which the chance of the prevalence of stunted toddler who has low dietary diversity is 1.5 times greater (CI 95%=1.12-2.02) compared to toddlers who are not stunted. By analyzing each component contained in dietary diversity, there are several components that are significantly related to the incidence of stunting, namely meat (p-value=0.041, OR=1.2; 95% CI=1.00-1.43), eggs (p-value<0.001, OR=1.67; 95% CI=1.26-2.20), milk and its processed products (p-value=0.0004, OR=1.43; CI 95%=1.16-1.74), as well as vegetables as sources of vitamin A (p-

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value<0.001, OR=1.54; CI 95%=1.28-1.86). Other researches also state that achieving minimum food diversity contributes to the consumption of animal protein foods[12]. There was no significant relationship among the components of cereals (p-value=0.630), tubers (p-value=0.841), fish (p-value=0.545), green vegetables (p-value=0.708), vitamin A fruits (p-value=0.083), and other fruits (p-value=0.579). Previous similar researches also show that toddlers who are stunted have a higher tendency to not meet the minimum limit for dietary diversity compared to toddlers who are not stunted[13,14].

Dietary diversity is a qualitative measure of food consumption that reflects a household's ability to access various types of food[4]. If it is related to stunting in children which is the impact of malnutrition in mothers and providing inadequate intake to babies and children, then dietary diversity can provide an overview of diet quality as one of the factors that can contribute to stunting. In the process of fulfilling dietary diversity, there are two internal factors that can hinder the creation of diverse food consumption, namely economic factors and knowledge. In the relationship between economic status and food diversity, a significant relationship is found in which respondents who have high economic status have the opportunity to have a diet that meet food diversity. Meanwhile, regarding mother's education and food diversity, a significant relationship is found in which respondents who have mothers with higher education are more likely to have a diet that meet dietary diversity[15–17].

Table 2. Bivariate analysis of dietary diversity variables and types of food with stunting in children aged 24-59 months in Indonesia

Variables	Status				OR	CI 95%	p-value
	Stunting **(n)**	**%**	**Not *Stunting* (n)**	**%**			
Dietary Diversity							
Low	88	11.46	131	7.92	1.50	1.12-2.02	0.005**
High	680	88.54	1522	92.08			
Components of Dietary Diversity							
Cereals							
Do not consume	7	0.91	12	0.73	1.26	0.42-3.5	0.630
Consume	761	99.09	1641	99.27			
Tubers							
Do not consume	561	73.05	1201	72.66	1.01	0.84-1.24	0.841
Consume	207	26.95	452	27.34			
Meat							
Do not consume	321	41.80	619	37.45	1.2	1.00-1.43	0.041*
Consume	447	58.20	1034	62.55			
Egg							
Do not consume	104	13.54	142	8.59	1.67	1.26-2.20	<0.001***
Consume	664	86.46	1511	91.41			
Fish							
Do not consume	179	23.31	367	22.20	1.06	0.86-1.31	0.545
Consume	589	76.69	1286	77.80			
Milk and Dairy Products							
Do not consume	214	27.86	352	21.29	1.43	1.16-1.74	<0.001***
Consume	554	72.14	1301	78.71			
Vitamin A Vegetables							
Do not consume	531	69.14	979	59.23	1.54	1.28-1.86	<0.001***
Consume	237	30.86	674	40.77			
Green Vegetables							
Do not consume	195	25.39	408	24.68	1.04	0.85-1.27	0.708
Consume	573	74.61	1245	75.32			
Vitamin A Fruits							
Do not consume	177	23.05	330	19.96	1.20	0.97-1.48	0.083
Consume	591	76.95	1323	80.04			
Other Fruits							
Do not consume	374	48.70	825	49.91	0.95	0.80-1.13	0.579
Consume	394	51.30	828	50.09			

OR: Odds Ratio, CI 95%: Confidence Interval 95%, *) p-value<0.05; **) p-value<0.01; ***) p-value<0.001**,** Bivariate analysis was carried out using the Chi-Square test.

In the meat component, the chance of prevalence of a stunted children who has inadequate meat intake is 1.2 times greater with a CI (1.00-1.43) compared to children who are not stunted. In eggs, this chance

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increases to 1.67 times (CI 95%=1.26-2.20); in milk components and other dairy products; the chance increases to 1.43 times (CI 95%=1.16-1.74). Meanwhile, for vitamin A vegetables, the chance of prevalence of stunted toddlers who have insufficient intake of it is 1.54 times greater (CI 95%=1.28-1.86) compared to toddlers who do not stunting. Food sources of animal protein have a significant relationship to the incidence of stunting, namely meat, eggs, milk and other its processed products; but not fish. Animal protein sources are sources of protein that contain a lot of nutrients that can meet toddlers' nutritional needs during the growth period, such as energy, protein, zinc, iron, vitamins and other micronutrients which are foods that have a density of nutrients that are beneficial for growth[18, 19]. Fish is a source of protein that comes from animals which is good for children's growth. Research shows that the quantity of fish consumed by children is significantly associated with stunting[20]. The possible reason that there was no significant relationship found between fish and stunting in this study was due to external factors that could influence the incidence of stunting. Research by Arthatiani et al. (2021), found that there is a negative correlation between consumption of preserved fish and the upper economic class groups in society on the Java island[21], so it can be concluded that consumption of preserved fish is higher in lower economic class groups. This shows that even though fish consumption is part of the diet component, there are other factors that can contribute to stunting, in this case low economic status.

Based on the analysis, a significant relationship was found between consumption of vitamin A vegetables and the incidence of stunting. In this research, the type of vegetable categorized as vitamin A vegetable is carrot; this is an adjustment from the toddlers' food frequency form referred to IFLS-5. Carrots are vegetables that contain carotenoids, flavonoids, vitamins, and minerals[22]. The total intake of vitamin A is known to have a significant association with the increasing body length as an effort to recover from stunting[23]. Another research also found that there is a correlation between the secretion of nocturnal growth hormone and vitamin A in toddlers who experience slow growth[24].

Types of food that do not have significant association with the incidence of stunting are cereals, tubers, green vegetables, high vitamin A fruit, and other fruits. Cereals are a staple food that is the main source of food for Indonesian people. Based on the results of this research analysis, it was found that 99.22% of toddlers consume cereals. This is likely to cause no difference in nutritional status between toddlers who consume cereals and those who do not consume cereals. In the fruit and vegetable ingredient group, the absence of a significant relationship with stunting could possibly be related to the ingredients contained in this food group. Based on the Food Consumption Score by the World Food Program (WFP), compared to other food groups, the vegetable and fruit group has a fairly low weight with the justification of low energy and protein content, and does not contain fat[25].

Table 3. The relationship between the incidence of stunting and external variables in children aged 24-59 months in Indonesia

Variable	Status				OR	CI 95%	p-value
	Stunting (n)	%	Not *Stunting* (n)	%			
LBW							
LBW	101	13.15	95	5.75	2.48	1.82-3.37	<0.001***
Not LBW	667	86.85	1558	94.25			
Infectious Disease							
Yes	37	4.82	82	4.96	1	0.63-1.46	0.880
No	731	95.18	1571	95.04			
Residence Area							
Rural	383	49.87	644	38.96	1.56	1.31-1.86	<0.001***
Urban	385	50.13	1009	61.04			
Economic Status							
Low	458	59.64	757	45.80	1.75	1.46-2.09	<0.001***
High	310	40.36	896	54.20			
Mother's Education							
Low	468	60.94	743	44.95	1.91	1.60-2.28	<0.001***
High	300	39.06	910	55.05			

OR: Odds Ratio, CI 95%: Confidence Interval 95%, *) p-value<0.05; **) p-value<0.01; ***) p-value<0.001, Bivariate analysis was carried out using the Chi-Square test.

Based on the analysis between external variables and the dependent variable, namely stunting, there were several variables that were significantly related to stunting, including history of LBW (p-value<0.001), area of residence (p-value<0.001), economic status (p-value<0.001), and mother's education (p-value <0.001). Meanwhile, infectious disease was not found to be significantly related to stunting (p-value=0.880). LBW is defined as a condition when a baby is born weighing <2500 g. According to the World Health Organization (WHO) (2013), LBW is one of the factors that directly leads to stunting[1]. LBW is also a vulnerable aspect of achieving growth in babies after birth. The presence of LBW in babies is associated with premature birth, or Intrauterine Growth Restriction (IUGR), or both[26]. Babies born with IUGR, apart from having problems in catching up with low growth, also tend to experience various developmental problems, so that babies born with LBW

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have the risk of becoming underweight or stunted in the first years of their life[27]. Factors that can cause LBW include incomplete antenatal care and passive exposure to cigarette smoke[28].

Based on several studies, stunting is closely related to economic status in which the increasing economic status can reduce the prevalence of stunting[26,29]. Other researches show that women who are in a higher socio-economic status have better nutritional awareness than women with a lower socio-economic status, as well as in providing food from parents to their children[30,31]. Another influencing factor is parent's education. The longer the formal education of the parents, the smaller the risk of stunting in children[32]. Higher education is related to parenting and child care behavior, including receiving vitamin A, giving children complete immunizations, better sanitation, and the use of iodized salt[33]. Based on the area of residence, several studies show that children who live in rural areas are at greater risk of experiencing stunting than children who live in urban areas[34,35]. Several reasons why children living in rural areas are at greater risk of stunting than children living in urban areas include lower levels of education, lower socio-economic status, scarcity of clean water sources, prevalence of infectious diseases, and lower knowledge of nutrition in the rural areas compared to urban areas[34].

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Table 4. Analysis of Determinants of Stunting Incidence

Variable	Model 1		Model 2		Model 3		Model 4		Model 5	
	OR (CI 95%)	p-value	OR (CI 95%)	p-value	OR (CI 95%)	p-value	OR (CI 95%)	p-value	OR (CI 95%)	p-value
Dietary Diversity										
Low	1.504** (1.131-1.999)	0.005	1.490* (1.118-1.986)	0.007	1.361* (1.018-1.819)	0.038	1.305 (0.974-1.748)	0.075	1.192 (0.887-1.600)	0.244
High	1				1		1		1	
LBW										
LBW			2.473*** (1.841-3.321)	<0.001	2.353*** (1.748-3.168)	<0.001	2.383*** (1.768-3.213)	<0.001	2.342*** (1.743-3.163)	<0.001
Not LBW			1		1		1		1	
Economic Status										
Low					1.669*** (1.400-1.990)	<0.001	1.585*** (1.326-1.894)	<0.001	1.461*** (1.219-1.752)	<0.001
High					1		1		1	
Residence Area										
Rural							1.445*** (1.211-1.726)	<0.001	1.329** (1.109-1.593)	0.002
Urban							1		1	
Mother's Education										
Low									1.616*** (1.344-1.943)	<0.001
High									1	
R^2	0.003		0.014		0.025		0.031		0.039	
AIC	3021.4		2987.8		2957.0		2942.4		2918.2	
N	2421		2421		2421		2421		2421	

OR: Odds Ratio, CI 95%: Confidence Interval 95%, AIC: Akaike's Information Criterion, *) p-value<0.05; **) p-value<0.01; ***) p-value<0.001

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Multivariate analysis was carried out to determine the impact of dietary diversity on stunting by considering other variables. The analysis model in this research was logistic regression. Based on multivariate analysis, the results showed that the best model for predicting the incidence of stunting in children aged 24-59 months was model 5, namely there were four variables that still had a significant influence on the incidence of stunting, namely LBW, area of residence, economic status, and mother's education. These results are in accordance with several studies in which LBW is a predictor of stunting[36–39]. LBW is also a vulnerability factor for achieving growth in babies after birth. LBW in babies is associated with premature birth, or IUGR, or both[40,41]. LBW is one aspect that can directly lead to stunting. Based on the OR after logistic regression analysis, LBW is the variable that has the largest odds ratio.

Similar things are also found in the variables of area of residence, economic status and maternal education, which states that these variables can be predictors of the incidence of stunting[29,32–34]. Several reasons why children living in rural areas have a greater risk of stunting than children living in urban areas include the lower levels of formal education, lower socio-economic status, scarcity of clean water sources, prevalence of infectious diseases, and lower nutritional knowledge of rural areas compared to urban areas[34]. Based on several studies, stunting is closely related to economic status, as the increasing economic status can reduce the prevalence of stunting[26,29]. Other researches show that women who are in a higher socio-economic status have better nutritional awareness compared to those in a lower socio-economic status, as well as in providing food from parents to their children[30,31]. Therefore, it can be concluded that the variables that can be the predictors of stunting in children aged 24-59 months in Indonesia based on analysis of 2014 IFLS-5 data are LBW, economic status, area of residence, and mother's education.

It is expected that the results of research regarding the relationship between dietary diversity and stunting can increase efforts to improve people's quality consumption patterns. The results of the analysis regarding food groups related to stunting can also be taken into consideration in designing more targeted interventions in handling stunting in Indonesia. Multivariate analysis regarding factors related to stunting can be useful as a reference in preparing a more comprehensive stunting management program. However, this research has not assessed the quantity of diet consumed. Thus, further researches need to be carried out to determine the quantity needed to achieve a qualified diet as an effort to prevent and treat stunting in children in Indonesia.

CONCLUSIONS

Dietary diversity has been proven to have a significant relationship with the incidence of stunting, in which the chance of the prevalence of a stunted toddler who has low food diversity is 1.5 times greater than that of a toddler who is not stunted. There are 90.95% of respondents in this study having a high food diversity score, while the other 9.05% have a low food diversity score. Based on bivariate analysis between components of food diversity and stunting, there are several food ingredients that have a significant relationship with the incidence of stunting, namely meat; egg; milk and its products; and vegetables as sources of vitamin A. Meanwhile, food ingredients that do not have a significant association with the incidence of stunting are cereals, tubers, fish, green vegetables, vitamin A fruit, and other fruit. Several variables that can be used as predictors of stunting based on multivariate analysis in toddlers aged 24-59 months in Indonesia are history of low birth weight, area of residence, economic status, and mother's education.

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AUTHOR CONTRIBUTIONS

MHH: conceptualization, investigation, methodology, formal analysis, writing, editing; MH: conceptualization, methodology, supervision, review; TA: conceptualization, formal analysis, supervision, review.

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