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Research Article

Nutrition Intake and Stunting of Under-Five Children in Bogor West Java, Indonesia

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Abstract

Stunting is a growth and development disorder experienced by children due to poor nutrition, recurrent infections, and inadequate psychosocial stimulation. As much as 22.2% of children under five in the world or around 150.8 million under five are stunted. The average prevalence of stunting under five in Indonesia from 2005 to 2017 is 36.4%. One of the main factors causing stunting is inadequate nutritional intake. This study aims to see the relationship between nutrient intake, both macronutrients and micronutrients to the incidence of stunting in children aged 6-59 months in Bogor. The design of this study used a cross sectional. This research is a quantitative study using secondary data "Determinant Factors of Stunting Incidence in Babakan Madang Subdistrict, Bogor 2019". The research instruments included a questionnaire as a means of obtaining data, 1x24 hours food recall form, measurement of length or height, and weight of children under five. The results showed that the percentage of children under five with stunting was 43.0%. Iron intake had a significant relationship with the incidence of stunting under five (p=0.018; OR=1.784; 95% CI: 1.106-2.278) after controlling variables of gender, energy intake, protein intake, fat intake, carbohydrate intake, and vitamin an intake. The risk of stunting in under-five can be reduced by providing variety of macro and micro nutrients specialy iron and vitamin A in their diets.

Keywords: Macronutrients; Micronutrients; Stunting; Toddler

Introduction

Stunting is still a global problem that is of concern to the world so that it is ranked first in the indicator of the success of the Sustainable Development Goals (SDGs). Stunting is a growth and development disorder experienced by children due to poor nutrition, repeated infections, and inadequate psychosocial stimulation [1]. Stunting is also defined as the condition of children under five with a Z-Score less than -2SD (stunted) and less than -3SD (severely stunted) [2]. As much as 22.2% of children under five in the world or around 150.8 million children under five are stunted even though this figure shows a decrease in the stunting rate, which was previously 24.4% in 2013 and 23.8% in 2016 but has not met WHO standards [3]. The limit of nutritional problems set by WHO is not more than 20%, so that stunting in toddlers is a nutritional problem experienced by toddlers in the world. Sustainable Development Goals (SDGs) is a sustainable development program that has 17 goals with the second goal being the 2030 target to end all forms of malnutrition, including achieving the international target of 2025 for reducing stunting in children under five [4].

Stunting is directly influenced by two main factors, namely food consumption and a history of infectious diseases [5]. Stunting is indirectly influenced by parenting styles, food availability, socio-economic, cultural, and political factors [6]. Stunting can also be caused by Low Birth Weight (LBW), non-exclusive breastfeeding, too early complementary breastfeeding, and low economic factors [7]. Other factors were low maternal education, maternal occupation, number of family members, maternal Body Mass Index (BMI) <18.5, and incomplete immunization [8]. Moreover, inadequate access to clean water, poor sanitation and hygiene had detrimental effects on children's growth and development [9]. According to Loya and Nurtanto's research, the factors that can influence the occurrence of stunting in toddlers are food diversity and parenting styles. Parenting patterns, including dietary care adopted by mothers, can affect the growth and development of toddlers [10]. Malnutrition during toddlerhood will be irreversible so that during toddlerhood it requires a diverse and nutritionally balanced food intake [11]. Stunting is also caused by the health and nutritional conditions of the mother before pregnancy, during pregnancy, after childbirth, the mother's short posture, the pregnancy is too close, and the mother is still a teenager or the mother's gestational age is too young [2].

Based on the stunting prevalence data collected by WHO, Indonesia is one of the third countries with the highest prevalence in the Southeast Asia region or South-East Asia Regional (SEARO). The average prevalence of stunting under five in Indonesia from 2005 to 2017 is 36.4%. Stunting has devastating effects both in the short and long term. According to WHO 2018, the short-term impact of stunting is an increase in morbidity and mortality, suboptimal cognitive, motor, and verbal development in children, and an increase in health costs. The long-term effects of stunting include posture that is not optimal as an adult (shorter than usual), it can increase the risk of obesity and other diseases, and decrease reproductive health. Stunting also causes less than optimal learning capacity and performance during school years as well as sub-optimal productivity and work capacity [2].

The need for macro and micronutrients per kilogram of body weight in infants is higher than for other ages. This is needed to accelerate cell division and DNA synthesis during growth, especially energy and protein. Infants aged 0-6 months can meet their nutritional needs only with breast milk, which is 6-8 times a day or more in the

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early days, while babies more than six months can begin to be introduced to solid foods as complementary foods to help meet nutritionalneeds [12]. Malnutrition occurs since the baby is in the womb and in the early days after the baby is born, but the condition of stunting only appears after the baby is two years old. Therefore, the researcher intends to conduct research related to nutrient intake on the incidence of stunting in children aged 6-59 months in Bogor.

Methods

This research is a quantitative study using secondary data from the 2019 PITTA B umbrella research from the Universitas Indonesia "Determinant Factors for Stunting Incidence in Babakan Madang Subdistrict, Bogor 2019". The research design used a cross-sectional. Amount of 612 toddlers aged 6-59 months paired with mothers who live in Babakan Madang Subdistrict were taken as samples. The sample size used a 95% confidence interval and significance (alpha) 0.05. The sample was taken by using the cluster random sampling method. Babakan Madang subdistrict was chosen as the research area because it has a high prevalence of stunting.Furthermore, six villages were taken, namely Babakan Madang, Karang Tengah, Citaringgul, Kadungmangu, Cijayanti Village, and Kadungmangu. Each selected village is taken from 2 to 6 Integrated Healthcare Center. The sample inclusion criteria were children aged 6-59 months and who lived at least one year in the study area. The study was conducted from March to November 2019 in Bogor Regency. This research has been approved by The Research and Community Engagement Ethical Committee of the Faculty of Public Health, Universitas Indonesia Number: Ket-612/UN2.F10/PPM.00.02/2019.

As a research instrument, a questionnaire was used as a tool to obtain data, a 1x24 hours food recall form, a measurement of length or height and weight of children. The data used in this study are the characteristics of children under five (age and gender), family characteristics of children (number of family members, family income, risk of maternal age at pregnancy, maternal nutritional status, maternal education, maternal occupation, and father's occupation), toddler nutrition (energy intake, protein, fat, carbohydrates, vitamin A, vitamin C, calcium, magnesium, iron, and zinc).Toddler height data is needed to determine the nutritional status of toddlers so that the incidence of stunting is obtained by plotting it in the WHO H/A z-score table. Meanwhile, data on energy intake, protein, fat, carbohydrates, vitamin A, vitamin C, calcium, magnesium, iron, and zinc are available in units of kilocalories, grams and milligrams. The data was converted into a percentage of intake based on the Recommended Dietary Allowances (RDA) Indonesian for 2019. The energy and macronutrient intake data used in the study were obtained through the 24-hours food recall method.

All data obtained were then entered into the SPSS for Windows version 25.0 program and univariate, bivariate, and multivariate analyzes were performed. Univariate analysis or also known as the descriptive analysis was carried out to determine the description of each of the variables studied in the form of toddler stunting status, toddler characteristics, family characteristics, and toddler nutritional intake. Furthermore, all variables in the form of categories were tested using the Chi-square to determine the relationship between independent and dependent variables.Then a multivariate analysis was performed using multiple logistic regression tests to assume the Odds Ratio (OR) and determine the factors that contributed to the incidence of stunting. All variables of toddler characteristics, family characteristics, and nutritional intake of children under five that had a p-value of <0.25 and which had a substantial relationship were selected as predictor candidates included in the multiple logistic regression model.

Results

Table 1 shows that 43.0% of toddlers aged 6-59 months were stunted. A total 47.8% subjects aged 6-23 months and aged 24-59 months were 52.2%. The number of male toodlers was 49.4%. As much as 73.9% of respondents' families have ≥4 family members. The Regional Minimum Wage limit (RMW) in 2019 for Bogor Regency, West Java Province, is Rp. 3,760,000, - so that the category of family income is <Rp. 3,760,000,- and ≥Rp. 3,760,000,-. Based on the analysis, most of the children under five came from families with an income below the RMW (66.7%). Mothers who have an age at risk during pregnancy are 23.5% with gestational age <20-35 years. The proportion of mothers with abnormal nutritional status was 53.0% with a thin nutritional status of 5.8% and fat as much as 47.2%. Most of the mothers had a low level of education (graduated from elementary school or graduated form junior high school) (78.5%). Most of the mothers were housewife (84.1%) and almost all fathers work (99.8%).

Characteristics	Frequency	Percentage (%)
Stunting Status		
Stunting	214	43.0
Normal	284	57.0
Toddler Age		
<24 Months	238	47.8
≥24 Months	260	52.2
Gender		
Boy	246	49.4
Girl	252	50.6
Number of Family Member		
<4 people	130	25.1
≥4 people	368	73.9
Total Income per months		
<IDR 3,760,000	332	66.7
≥IDR 3,760,000	166	33.3
The Risk Status of Maternal Age		
Risky	117	23.5
Not Risky	381	76.5
Mother's Nutritional Status		
Abnormal (thin and fat)	264	53.0
Normal	234	47.0
Mother's Education Status Low	391	78.5
High	107	21.5
Mother's Job Status		
Housewife	419	84.1
Work	79	15.9
Father's Education Status		
Doesn't Work	1	0.20
Work	497	99.8
Energy Intake		
Deficit (<90%RDA)	359	72.1
Adequate (≥90% RDA)	139	27.9

Characteristics	Frequency	Percentage (%)
Protein Intake		
Deficit (<90% RDA)	156	31.3
Adequate (≥90% RDA)	342	68.7
Fat Intake		
Deficit (<90% RDA)	322	64.7
Adequate (≥90% RDA)	176	35.3
Carbohydrate Intake		
Deficit (<90% RDA)	399	80.1
Adequate (≥90% RDA	99	19.9
Intake of Vitamin A		
Deficit (<77% RDA)	167	33.5
Adequate (≥77% RDA)	331	66.5
Intake of Vitamin C		
Deficit (<77% RDA)	327	65.7
Adequate (≥77% RDA)	171	34.3
Calcium Intake		
Deficit (<77% RDA	365	73.3
Adequate (≥77% RDA)	133	26.7
Magnesium Intake		
Deficit (<77% RDA)	253	50.8
Adequate (≥77% RDA)	245	49.2
Phosphorus Intake		
Deficit (<77%RDA)	358	71.9
Adequate (≥77% RDA)	140	28.1
Iron Intake		
Deficit (<77% RDA)	368	77.5
Adequate (≥77% RDA)	112	22.5
Zinc Intake		
Deficit (<77%RDA)	261	52.4
Adequate (≥77% RDA)	237	47.6

Table 1: Distribution of characteristics toddler age 6-59 months.

Toddlers who experienced a deficit energy intake were 72.1%. More than half of children under five had sufficient protein intake, namely 68.7%. As much as 64.7% of children under five are classified as deficit in fat intake and 80.1% deficit in carbohydrate intake. There were 33.5% of children under five had a deficit in vitamin A, while 66.5% and more than half of under-five who had a deficit in vitamin C intake (65.7%). Most of the children under five had a deficit in calcium intake (73.3%) and 49.2% in magnesium intake. The analysis showed that the deficit of phosphorus and iron intake in children under five was quite high, 71.9% and 77.5%, respectively. There are 52.4% of children under five are classified as a deficit in zinc intake.

Table 2 shows the variables that have a p-value ≤0.05 are carbohydrate intake (p=0.012), vitamin A intake (p=0.040), calcium intake (p=0.048), and iron intake (p=0.012). There is a significant relationship between carbohydrate intake and the incidence of toddler stunting. The result obtained OR 1.858, meaning that children who have a deficit in carbohydrate intake have a chance of experiencing stunting 1.858 times greater than toddlers with sufficient carbohydrate intake. Furthermore, there is also a significant relationship between vitamin A intake and the incidence of toddler stunting.Children who have a deficit in vitamin A intake have a 1.509 times greater chance of experiencing stunting than toddlers who have sufficient intake of vitamin A.Another result significant relationship between calcium intake and the incidence of toddler stunting. Toddlers who have a deficit in calcium intake have a 1.543 times greater chance of experiencing stunting than toddlers who have sufficient calcium intake. Apart from carbohydrates, vitamin A, and calcium, the results of the analysis also showed that there was a significant relationship between iron intake and the incidence of toddler stunting.Children who have a deficit in iron intake have a chance of experiencing stunting 1.807 times greater than toddlers who have sufficient iron intake.Another variables as characteristics of the children and the characteristic of family of the children under five not significant relationship with the incidence of stunting (p>0.05).

Variable	Stunting Status				p-Value	OR (95% CI)
	Stunting		Normal			
	n	%	n	%		
Toddler Age						
<24 months	91	38.2	147	61.8	0.051	0.690
≥24 months	123	47.3	137	52.7		0.482 – 0.986
Gender						
Boy	113	45.9	133	54.1	0.219	1.270
Girl	101	40.1	151	59.9		0.890 – 1.812
Number of Family Members						
<4 people	55	42.3	75	57.7	0.940	0.964
≥4 people	159	43.2	209	56.8		0.643 – 1.444
Total Income						
<IDR 3.760.000	142	42.8	190	57.2	0.974	0.976
≥IDR 3.760.000	72	43.4	94	56.2		0.670-1.421
The Risk Status of Maternal Age						
Risky	47	40.2	70	59.8	0.553	0.860
Not Risky	167	43.8	214	56.2		0.565-1311
Mother's Nutritional Status						
Abnormal (Thin and fat)	105	39.8	159	60.2	0.304	1.320
Normal	109	46.6	125	53.4		0.925-1.885
Mother's Education Status						
Low	171	43.7	220	56.3	0.585	1.157
High	43	40.2	64	59.8		0.749-1.787
Mother's Job Status						
Housewife	182	43.4	237	56.6	0.720	1.128
Work	32	40.5	47	59.5		0.692-1.839
Father's Job Status						
Doesn't Work	0	0.0	1	100.0	1.000	1.756
Work	214	43.1	283	56.9		1.627-1.896
Energy Intake						
Deficit (<90% RDA)	163	45.4	196	54.6	0.097	1.435
Adequate (≥90% RDA)	51	36.7	88	63.3		0.959-2.146
Protein Intake						
Deficit (<90% RDA)	68	43.6	88	56.4	0.928	1.037
Adequate (≥90% RDA)	146	42.7	196	57.3		0.708-1.520
Fat Intake						
Deficit (<90% RDA)	137	42.5	185	57.5	0.869	0.952
Adequate (≥90% RDA)	77	43.8	99	56.3		0.657-1.380
Carbohydrate Intake						
Deficit (<90% RDA)	183	45.9	216	54.1	**0.012****	1.858

Variable	Stunting Status				p-Value	OR (95% CI)
	Stunting		Normal			
	n	%	n	%		
Adequate (≥90% RDA)	31	31.3	68	68.7		1.164-2.968
Intake of Vitamin A						
Deficit (<77% RDA)	83	49.7	84	50.3	**0.040****	1.509
Adequate (≥77% RDA)	131	39.6	200	60.4		1.037-2.195
Intake of Vitamin C						
Deficit (<77% RDA)	147	45.0	180	55.0	0.254	1.268
Adequate (≥77% RDA)	67	39.2	104	60.8		0.870-1.847
Calcium Intake						
Deficit (<77% RDA)	167	45.8	198	54.2	**0.048****	1.543
Adequate (≥77% RDA)	47	35.3	86	64.7		1.023-2.327
Magnesium Intake						
Deficit (<77% RDA)	118	46.6	135	53.4	0.112	1.357
Adequate (≥77% RDA)	96	39.2	149	60.8		0.950-1.937
Phosphorus Intake						
Deficit (<77% RDA)	158	44.1	200	55.9	0.461	1.185
Adequate (≥77% RDA)	56	40.0	84	60.0		0.796-1.763
Iron Intake						
Deficit (<77% RDA)	178	46.1	208	53.9	**0.012****	1.807
Adequate (≥77% RDA)	36	32.1	76	67.9		1.159-2.817
Zinc Intake						
Deficit (<77% RDA)	119	45.6	142	54.4	0.250	1.253
Adequate (≥77% RDA)	95	40.1	142	59.9		0.877-1.788

Table 2: Relationship characteristics of children and nutrient intake with stunting.

Note: ** significant (p<0.05)

The results of the multivariate analysis showed that the variables that were significantly related to the incidence of under-five stunting were vitamin A and iron intake, while the variables of gender, energy intake, protein intake, fat intake, and carbohydrate intake were the controllers. The results of the analysis showed that the Odds Ratio of the iron intake variable was 1.784 (95% CI: 1.106-2.878), meaning that children with deficit iron intake had a risk of stunting by 1.784 times greater than children who had sufficient iron intake after controlling for gender variables, intake of energy,protein, fat, carbohydrate and vitamin A. The most dominant variable against the incidence of stunting based on the analysis was iron intake (Table 3).

Variabel	B	Pvalue	OR	95% CI
Gender	0.226	0.224	1.253	0.871-1.804
Energy Intake	0.134	0.675	1.143	0.611-2.140
Protein Intake	-0.171	0.459	0.842	0.535-1.327
Fat Intake	-0.306	0.219	0.736	0.452-1.200
Carbohydrate Intake	0.541	0.093	1.717	0.913-3.230
Intake of Vitamin A	0.459	0.021*	1.582	1.073-2.333
Iron Intake	0.579	**0.018***	1.784	1.106-2.878

Table 3: 1 Logistic regression modeling results.

Note: *Significant (p<0.05)

Discussion

Stunting is still a problem in Indonesia, indicated by the prevalence of stunting of 27.7% in 2019, even though it has decreased from 30.8% in 2018, but this figure is still far from the target of reducing stunting to 14% based on the 2020-2024 National Medium Development Plant of Indonesia. As many as 43% of toddlers aged 6-59 months in Babakan Madang Subdistrict, Bogor were stuntedwith 24.5% of children stunted and 18.5% severely stunted. The proportion of children under five with stunting in Babakan Madang Subdistrictas a whole exceeds the national figure of 27.7% [2]. Stunting is a form of growth failure due to the accumulation of long-lasting nutritional insufficiency from pregnancy to 24 months of age [13]. This is also stated by Achadi, toddlers who experience stunting are known to be a failure to develop and develop since they are in the womb during the golden period of the first 1000 days of life [14]. Inadequate nutritional intake can result in stunted growth [2]. Based on the results of the analysis, it was found that the variables related to the incidence of stunting in children under five were the variable intake of vitamin A and iron intake with gender, energy intake, protein intake, fat intake, and carbohydrate intake as the controlling variable.

Fulfilling the energy needs of infants or toddlers (infants under five years old) has the objective of physical and psychomotor growth and development, carrying out physical activity, and providing adequate nutrition for life's needs, namely for maintenance and/or restoration and improvement of health. Research in Egypt states that there is a significant difference in energy intake in the stunting and non-stunting groups of children under five [15]. This can cause achronic lack of energy and if over a long periodit can cause disrupted linear growth. A negative energy balance can also cause plasma insulin to decrease so that it can reduce the synthesis of Liver Insulin Growth Factor (IGF-1), affect the performance of IGF binding protein-1, thyroid hormone, and other systemic factors involved in fibroblast Growth Factor (FGF-21) which all play a role in linear growth [16].

Protein functions as a builder of new tissue during the growth and development of the body, maintaining, repairing, and replacing damaged tissue. Children who experience a long-lasting deficiency of protein intake even though their energy intake is sufficient will experience stunted growth in height [17]. Fat intake during toddlerhood is recommended to be more in foods with sources of essential fatty acids such as nuts, vegetable oils, whole grains, and brown rice. Breast milk contains a large amount of essential fatty acids such as linoleic acid, arachidonic acid and decosahexanoic acid which support the growth of the brain and retina. The recommended linoleic acid intake is 4.4g/day, omega-3 0.5g/day, and omega-6 4.6g/day [18].

Carbohydrates are needed in infant feeding because they function in several important ways, including supplying energy for growth, bodily functions, and activities; forming new body tissues with protein; building blocks for essential body components; and as the main source of energy for activities. The type of carbohydrate that is most suitable for babies is lactose found in breast milk and formula milk. In infants aged more than six months, additional carbohydrates are needed to be given in the form of complementary foods such as cereals, products from flour, fruits, and vegetables [12].

According to Solihin et al., in preschool children in West Java, it is known that every 1% addition of the toddler's energy sufficiency level will increase the Z-score of toddler's H/A by 0.032 units and every 1% addition of the toddler's protein adequacy level will increase the H/A z-score toddler is 0.024 units [19]. Research Wahdah et al., stunted children have a poor diet. In general, they eat two times a day and mostly consume only two types of food, namely rice with vegetables

or rice with side dishes [20]. According to Esfarjani et al., first graders in Teheran, Iran, showed that adherence to a diet high in protein (e.gmilk, nuts, and meat products) and carbohydrates (e.g.fruit, candy, and desserts) may be associated with reduced stunting in children [21].

The results of the analysis showed that children with deficit vitamin A intake were at risk of stunting by 1.582 times greater than toddlers who had sufficient vitamin A intake. Vitamin A deficiency is one of the factors that can affect the incidence of stunting in toddlers [22]. The fulfillment of micronutrients, such as vitamins and minerals, is also important even though the amounts needed are not large. Inadequate intake of micronutrients can occur due to the low intake of micro-nutrient sources in the daily consumption of toddlers and the low bioavailability factor [15]. Vitamin A plays a role in physiological functions such as vision in the retina, regulation of gene expression and cell differentiation, and antioxidants (β-carotene) [23]. Orange vegetables contain more vitamin A [24]. However, stunting toddlers do not eat vegetables and only like vegetable sauce [22]. High-dose vitamin A supplementation is still a mandatory program of the Ministry of Health Republic Indonesia. Adequacyof vitamin A can also be fulfilled by consuming vegetables and fruits rich in vitamin A, reporting that carrots are the main contributor to β-carotene (25%). Other major contributors to β-carotene are cantaloupe, broccoli, pumpkin, peas, and spinach.

The results of the analysis showed that children with deficient iron intake had a risk of stunting 1.784 times greater than toddlers with adequate iron intake. Lack of zinc and iron can affect the incidence of stunting in children under five [22]. The results of research by Damayanti et al., show that there is a significant difference in the level of iron intake in stunting and non-stunting toddlers [25]. In addition, research by Hidayati et al., showed that inadequate iron intake increased the risk of stunting in children under 3.46 times greater than with adequate iron intake [26]. Early in life, babies experience rapid muscle and skeletal development. Ninety-five percent of the brain develops in the first three years of life. Essential nutrients such as amino acids and iron are needed in the formation of synapses and neurotransmitters that affect thinking speed. Stunting syndrome in the short term has an impact on developmental barriers, cognitive decline and immunity. The best sources of iron are red meat, chicken liver, and beef liver. Red spinach is rich in iron, butlow absorption only 3-8%, while animal food 23%. When food aseptabilitysource of iron for toodleris low, the next step is iron fortified foods. If there are clinical symptoms of micronutrient deficiency or there is evidence of laboratory tests to overcome them, nutritional supplements in the form of drugs can be given [27]. Minerals that are very important to prevent stunting are zinc, iron, and iodine. Calcium and phosphorus are also very important roles in children's linear growth [28].

Conclusion

This study concluded that the percentage of children under five with stunting in Babakan Madang Sub-District, Bogor was 43.0%. Iron intake as the dominant factor was related to the incidence of stunting in under-five children in Bogor Regency after controlling for variables of gender, intake of energy, protein, fat, carbohydrate, and vitamin A. The risk of stunting in under-five can be reduced by providing variety of macro and micro nutrients specialy iron and vitamin A in their diets.This study has several limitations, including bias in data collection, because the data comes from secondary data so that researchers do not take data directly.Besides that, the results of the study are difficult to generalize for all stunting children in Indonesia because it only describes one sub-district in Indonesia. However, these data provide some useful information to facilitate the design of intervention strategies to prevent children from stunting based on the problem of toddler food intake and their characteristics.

Conflicts of Interest

The authors declare no conflicts of interest.

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