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Article

Protein And Calcium Adequacy Levels As Dominant Factors In The Incidence Of Stunted Primary School Students In Coastal Areas

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Abstract

Background: Stunting does not only occur in toddlers but also affects children of primary school age. The 2018 Basic Health Research (RISKESDAS) reported that the prevalence of stunting among children aged 5–12 years was 23.6%, indicating that it remains a public health problem. **Objective**s: This study aimed to analyze stunting among primary school students in coastal areas in relation to nutritional adequacy for growth. **Method**: A cross-sectional study was conducted among primary school students in coastal areas. Data were collected on the adequacy levels of energy, protein, vitamin C, calcium, phosphorus, zinc, and iron intake. Data were analyzed using chi-square tests and logistic regression to identify dominant risk factors. **Results**: The prevalence of stunting among primary school students in coastal areas was 12.5%, with a higher proportion among females (8.3%). Risk factors associated with stunting included inadequate energy intake (PR = 4.4; 95% CI: 1.3–15.2), protein (PR = 29.3; 95% CI: 7.1–119.8), calcium (PR = 8.1; 95% CI: 2.4–37.5), phosphorus (PR = 7.9; 95% CI: 1.1–58.4), and zinc (PR = 23.2; 95% CI: 5.6–96.5). Multivariate analysis showed that inadequate protein and calcium intake were the dominant factors associated with stunting. **Conclusion**: Inadequate protein and calcium consumption are the dominant determinants of stunting among primary school students in coastal areas. Nutritional interventions focusing on improving protein- and calcium-rich food intake are strongly recommended.

Keywords: *Stunting, primary school students, protein and calcium adequacy*

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1. Introduction

Learner health is an effort that must be made through personal health guidance such as physical, mental and social health, so that students can grow and develop properly (Ministry of Education, 2012). The results of the Basic Health Research (RISKESDAS) in 2018 showed that the prevalence of shortness in preschool and primary school age children (5-12 years) was 23.6%. When compared to the results of Riskesdas in 2013 where the prevalence of stunting was 30.7%, it means that there has been a decrease of 7.1% within five years. Although the prevalence of stunting has decreased, it is still categorized as a public health problem (Ministry of Health, 2018; Ministry of Health, 2013; WHO).

The prevalence of stunting among children aged 5-12 years in West Java according to Riskesdas 2018 is 23%. The results of research conducted in Lemahabang District in

2018 showed that 32.4% of stunted children aged 0-23 months experienced growth disorders at primary school age and as many as 14.0% of children who did not have a history of stunting at the age of 0-23 months experienced growth disorders at primary school age (Riskesdas, 2018; Samuel, 2018). The purpose of this study is to analyze the problem of stunting that occurs in primary school students in terms of meeting nutritional adequacy for growth.

Some of the risk factors that lead to stunted primary school children include socioeconomic factors in low-income families who often show poorer growth than children in affluent families (Georgiadis et al., 2017). Economic factors cause low purchasing power which has an impact on nutrient consumption that does not meet the needs. The results of research on elementary school students show that there is a relationship between the level of energy consumption and the nutritional status of school children (Purmasari, 2016). Research conducted in Bengkulu showed a relationship between energy consumption and nutritional status. In addition, research in Bengkulu on elementary school children showed that there were differences in protein and calcium consumption between stunted and non-stunted children (Yuristi M et al., 2018). The results of a study conducted in the coastal area of Semarang showed a significant difference in the average serum zinc and the risk of insufficient zinc intake in stunted children (Pranomo A et al., 2016). Based on the high prevalence of stunting in elementary school students and insufficient nutrient consumption, we want to examine the results of this study.

2. Materials and Methods

2.1 Study Design and Setting

The type of research used was experimental research in the form of making spinach-based pastry products that are known to be rich in iron, then iron content and acceptability testing was carried out in pregnant women suffering from iron nutritional anemia as panelists. Sensory studies, which use a variety of approaches and are based on the sensory organs, provide details about the nature of a product and the level of acceptance of that product by consumers.[11]

Organoleptic assessment with the hedonic method is a testing method based on the level of preference of the panelists for the product presented. In this test, the panelists expressed personal responses whether they liked it or not, besides also stating their level of likability. The level of preference is also called the hedonic scale. The hedonic scale is transformed into a numerical scale with an ascending number according to the level of preference. With this numerical data, statistical analysis can be carried out.[12] The test with the hedonic method used five scales, namely 5 (very like), 4 (like), 3 (somewhat like), 2 (dislike) and 1 (very dislike). This test is carried out on the parameters of the aroma, taste and texture color of the product produced.[13] By using the Hedonic Scale Test, namely by providing samples to the panelists to be assessed and poured in the form of a hedonic test, where from different treatments it can be known which final product has the best formula reviewed from the level of preference according to organoleptic properties (color, taste, aroma and texture). The Hedonic Test in this study was carried out twice.

2.2 Population and Sampling

A population is all objects that are the object of research or observation and have the same properties. Samples are part of the population that are taken to be used as objects of direct observation and used as a basis for drawing conclusions. In other words, a population is a set of whole objects being studied, while a sample is a part taken from the population.[13] This study involved students of the Nutrition Study Program DIII Cirebon, Health Polytechnic, Ministry of Health, Tasikmalaya as panelists in the acceptability test of spinach and red bean cookies. The students involved numbered 30 people and were randomly selected. Panelists are panel members or people involved in

organoleptic assessments based on various subjective impressions of the products presented. Panelists are instruments or tools to assess the quality and analyze the sensory properties of a product.[12]

2.3 Data Analysis

The making of red spinach cookies is carried out in the laboratory of the DIII Cirebon Nutrition Study Program, starting from pre-research to making cookies for organoleptic tests. The purchase of research materials was carried out at one of the supermarkets in Cirebon City, while the purchase of red bean flour was carried out through an online store. The organoleptic test was carried out at the Organoleptic Laboratory of the Nutrition Study Program DIII Cirebon, Health Polytechnic, Ministry of Health, Tasikmalaya.

The data obtained came from the results of the panelists' organoleptic research on variation using diversity fingerprints. Furthermore, if there is a significant difference in results between treatments, the Duncan's Multiple Range Test (DMRT) is performed with a confidence level of 95% (α 0.05)[15]

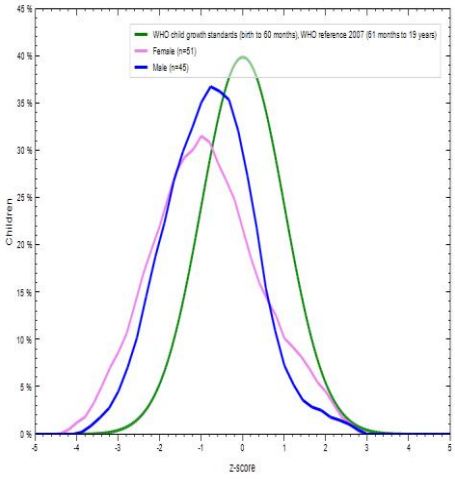
3. Results

Table 1 shows the characteristics of the respondents, the parents of the respondents are generally educated, the father has a high school education and the mother generally has a junior high school education. Although they live in coastal areas only 11.5% work as fishermen and generally as private employees. The gender proportion of respondents was generally female 53.1% and most were aged 11 years 40.6%.

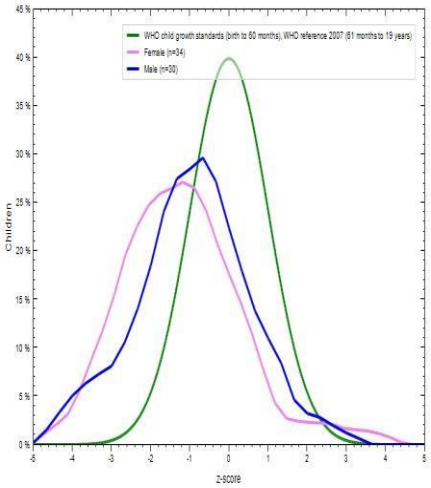
Table 1. Respondent Characteristics

Variables	n	%
Father's Education Level		
Not in school	4	4.2
Compulsory education	36	37.5
High school education	55	57.3
Higher Education	1	1.0
Mother's Education Level		
Not in school	4	4.2
Compulsory education	50	52.1
High school education	42	43.8
Father's occupation		
Not working	4	4.2
Pedicab driver	1	1.0
Fisherman	11	11.5
Labor	23	24.0
Private Employee	39	40.6
Self-employed	13	13.5
PNS/TNI/Polri	3	3.1
Gender of respondent		
Male	45	46.9
Women	51	53.1
Age of respondent		
8 years	1	1.0
9 years	18	18.8
10 years	38	39.6
11 years	39	40.6

Figure 1, growth curves of primary school students based on Height-for-Age and Weight-for-Age indices. The results showed that for TB/U index, there was a shift towards minus z- score. The female student group shifted more towards the minus z-score than the male. For BB/U, both male and female students also shifted the z-score towards minus, especially the female student group, there was a positive shift of the z-score. This indicates that there are two nutritional problems, namely very underweight and the risk of overweight.



Height-for-age index



Weight-for-age index

Figure 1. Growth curve of elementary school students in coastal areas

Table 2, shows that the prevalence of stunted primary school students in the coastal area of the city was only 12.5%, and most of them were female at 8.3%. In line with the results of research in Kupang which showed that female students were more stunted (58.6%) than malel (41.4%) (Zogara, A. U., 2020).

Table 2. Prevalence of Stunted by Gender

Variables	n	%
Prevalence of stunting		
Stunting	12	12.5
Normal	84	87.5
Prevalence of stunting by gender		
Male	4	4.2
Female	8	8.3

Table 3, generally stunted students have an insufficient level of energy adequacy whichis 23.1% the results of the chi square test show a difference in proportion, this illustrates a significant relationship between the incidence of stunted with the level of energy adequacy. The value of RP = 4.4 with 95% CI = 1.3-15.2, this can be interpreted that a lack of energy adequacy is a risk factor for stunted incidence in students or students with a lack of energy adequacy have a risk of being stunted 4.4 times greater than children who have a good levelof energy adequacy.

Table 3. Nutrient adequacy level as a risk factor for stunted incidence in primaryschool students

Nutrient Adequacy Level	Incidence of Stunting		RP	P-value
	Yes (%)	No (%)	(95% CI)	
Energy sufficiency level				
Deficient (<70% RDA)	9 (23.1)	30 (76.9)	4,4	0.013*
Adequate (≥ 70% AKG)	3(5.3)	54 (94.7)	1.3-15.2	
Protein sufficiency level				
Deficient (<70% RDA)	10 (71.4)	4 (28.6)	29.3	0.000*
Adequate (≥ 70% AKG)	2 (2.4)	80 (97.6)	7.1-119.8	
Vitamin C sufficiency level				
Deficient (<70% RDA)	8 (13.8)	50 (86.2)	1.3	0.758
Adequate (≥ 70% AKG)	4 (10.5)	34 (89.5)	0.4-4.1	
Calcium sufficiency level				
Deficient (<70% RDA)	10 (66.7)	5 (33.3)	8.1	0.000*

Nutrient Adequacy Level	Incidence of Stunting		RP	P-value
	Yes (%)	No (%)	(95% CI)	
Adequate (≥ 70% AKG)	2 (2.5)	79 (97.5)	2.4-37.5	
Phosphorus sufficiency level				
Deficient (<70% RDA)	11 (19.6)	45 (80.4)	7.9	0.012
Adequate (≥ 70% RDA)	1 (2.5)	39 (95.5)	1.1-58.4	
Zinc sufficiency level				
Deficient (<70% RDA)	10 (58.8)	7 (41.2)	23.2	0.000*
Adequate (≥ 70% RDA)	2 (2.5)	77 (97.5)	5.6-96.5	
Fe sufficiency level				
Deficient (<70% RDA)	6 (14.6)	35 (85.4)	1.3	0.585
Adequate (≥ 70% RDA)	6 (10.9)	49 (89.1)	0.5-3.8	

**) Chi square test, Significant p<0.05*

The proportion of stunted children with protein adequacy levels <70% RDA (71.4%) was greater than the proportion of stunted children with good protein adequacy levels (2.4%).The chi-square test showed a significant association between the two groups, illustrating the relationship between the incidence of stunting and the level of protein adequacy. The value ofRP = 29.3 with 95% CI = 7.1-119.8 can be interpreted that the level of protein adequacy that is less than the RDA is a risk factor for stunted incidence in students or students with insufficient protein adequacy have a risk of stunted 29.3 times greater than students who havea good level of protein adequacy. In addition to energy and protein adequacy levels, several vitamins also play a role in growth. As with vitamin C, the results of this study showed that the proportion of stunted incidents with vitamin C adequacy levels, <70% RDA showed no relationship between Vitamin C intake and the incidence of stunted in students.

Mineral sufficiency level showed that the proportion of stunted students with calcium sufficiency level <70% was greater than the proportion of stunted students with good calcium sufficiency level. The chi square test showed that there was a significant relationship between the level of calcium sufficiency and the incidence of stunted primary school students. The value of RP = 8.1 with 95% CI = 2.4-37.5 means that the level of calcium adequacy that is less than the RDA is a risk factor for the incidence of stunted students or students with calcium adequacy levels <70% have a risk of being stunted 8.1 times compared to children who have a good level of calcium adequacy.

This study showed that the proportion of stunted students with a phosphorus sufficiency level <70% (19.9%) was greater than the proportion of stunted students with a good phosphorus sufficiency level (2.5%). The chi- square test showed a significant association between the level of phosphorus sufficiency and the incidence of stunting. The RP value = 7.9 with 95% CI = 1.1-58.4 indicates that a phosphorus sufficiency level <70% has a risk of being stunted 7.9 times compared to children who have a good phosphorus sufficiency level.

Generally, stunted students have a level of zinc adequacy that is less than 58.8% with the results of the chi square test showing a difference in proportions, this illustrates a significant relationship between the incidence of stunted with the level of zinc adequacy. Thevalue of RP = 23.2 with 95% CI = 5.6-96.5 can be interpreted that the level of zinc sufficiency that is less than the RDA is a risk factor for stunted incidence in students or students with insufficient zinc sufficiency have a risk of stunted 23.2 times greater than children who have a good level of zinc sufficiency. Fe intake from the results of this study showed that the proportion of stunted children with Fe sufficiency levels <70% was 14.6%, not too much different from the proportion of stunted children with vitamin C sufficiency levels ≥ 70% RDA (10.9%). Chi square test results showed no association between Fe intake and the incidence of stunted students.

Table 4. shows the logistic regression results of 6 variables that are candidates as the most dominant factors of the risk of stunted incidence in primary school students in urban areas. The significant and most dominant variables were protein and calcium intake.

Table 4. Results of logistic regression analysis of five variables associated with the incidenceof stunted primary school students in coastal areas

Variables	B	POR (Exp. B)	95% CI		P-value
			Lower	Upper	
Constant	-5.81				
Energy sufficiency level	1.92	6.84		0.5-97.2	0.156
Protein sufficiency level	4.29	7.02		4.5-11.9	0.003*
Calcium sufficiency level	3.81	4.06		3.3-5.9	0.004*

**) Logistic regression test, significant p <0.0; POR = Prevalence Odds Ratio*

4. Discussion

The two most dominant variables for the incidence of stunted primary school students in coastal areas of Cirebon city are low protein and calcium consumption. The results of this study showed that protein consumption <70% RDA was the dominant factor in the incidence of stunted primary school students (p = 0.003; PR = 7.02, CI = 4.5-11.9). In line with research conducted in Labuan Beach District, based on the results of the logistic regression test showed that low protein consumption was associated with the incidence of stunted (Simorangkir E. A et al., 2020). In addition, research in Saudi Arabia on school children, also showed differences in protein consumption. Stunted children consumed lower protein (37.3 ± 2.3g) compared to normal children and adolescents (45.6 ± 4.5g) (Alshammari E, 2017). It is evident that there is a relationship between the level of protein adequacy and growth disorders (Yuliana at.al, 2014). Stunted children with consumption of protein sources such as meat, poultry, and fish, and milk are lower than non-stunted children (Angeles-Agdeppa I, et al., 2020).

Nutrient consumption plays an important role in the growth process of children, however, several studies have found genetic contributions in calcium absorption, will affect growth. The results of the study showed a significant relationship between energy and protein consumption and children's weight for age (Lee, C et al.,2021). Protein consumption from food is essential for optimal bone maintenance et all stages of life. Consumption in accordance with the needs will benefit bone health (Wallace, Frankenfeld, 2017). In addition, adequate protein consumption will fulfill the availability of amino acids used in building and maintaining bone tissue, as well as stimulating growth hormone, and promoting bone growth and increasing calcium absorption (Darling, A. L et al., 2021). Adequate consumption of dietary protein is the basis for the maintenance of muscle mass and overall health. Animal protein sources, such as beef, lamb, poultry, fish, eggs, and milk are generally considered to be high-quality dietary protein sources because they meet all the indispensable amino acid requirements for humans (Churchward-Venne, et al., 2017). Protein and zinc play an important role in linear growth, through insulin-like growth hormone-1 (IGF-1). Protein as a binder, triiodothyronine, amino acids and Zn2+ to stimulate growth. Animal source foods, such as milk, have specifically been shown to influence linear growth in children (Millward, D. J, 2017).

The results of this study indicate that calcium intake that is less than the RDA is a dominant factor in the incidence of stunted primary school students (p = 0.004; PR = 4.06, CI = 3.3-5.9). In line with this study there is an association between insufficient calcium consumption and the incidence of stunted (Ramadhani, A. T et al., 2019). Boys with calcium consumption below (327 mg / day) will have a shorter stature as adults. and children who consume calcium more than 566 mg / day have better height growth (Fang A et al., 2017). Calcium is an essential element in the growth and maintenance of bones and teeth. Calcium is required for linear growth in height for both males and females (Mendes, M. M et al., 2019). Calcium metabolism is closely related to phosphorus, a good

ratio of calcium and phosphorus composition is 1: 1 to 1: 3, if the ratio is greater it will inhibit calcium absorption (Sediaoetama A. D, 2012). Calcium and magnesium consumption in stunted children was found to be below the average requirement. Food sources of calcium such as milk and dairy products contribute the most to calcium adequacy. Other sources of calcium are cereals and vegetables (Cuadrado-Soto E et al., 2020).

5. Conclusions

Low consumption of energy, protein, calcium, phosphorus and zinc are risk factors for stunted primary school students in coastal areas. Protein and calcium are the most dominant nutrients for the incidence of stunted primary school students in urban coastal areas.

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7. Conflicts of Interest

"The authors declare no conflict of interest."

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