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Mother's Height and Calcium Intake Against Stunting among Children Aged 3-5 Years and The Impact on Child Development

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ABSTRACT

The purpose of this study was to identify the impacts of the mother's height and calcium intake on the incidence of stunting and the implications for child development. It was a cross-sectional study and involved about 78 children aged 3-5 years old from three early childhood education programs in Darul Imarah Sub-district, Aceh Besar District, Indonesia. Chi-square was performed to determine the correlation of the mother's height and calcium intake against the incidence of stunting, and impact of stunting on child development. The results showed that the height of mother (OR=4.0; 95% CI: 1.05 – 15.12) and calcium intake (OR=4.6; 95% CI: 1.37 – 15.69) had a significant correlation to the incidence of stunting, while to the child's development (OR=2.5; 95% CI: 0.82 – 8.11) had no significant impacts. This study could be one of the fundamental basic about the importance of nutritional intake in each life cycle so that the mother's height could be maximized.

Keywords: Body height, calcium intake, development, stunting

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INTRODUCTION

The low level of human resources is a result of not optimized integrated efforts to solve the problems of poverty, nutrition, and health (A. Das, 2015). Those problems are the main factors sustainably influencing the mutual nutritional problems in infants (Wicaksono and Harsanti, 2020). Therefore, a holistic and multi-sectoral approach is required to solve nutritional problems in realizing a high-quality human resource, i.e., healthy, smart, and productive.

An Attempt to improve the quality of human resources should be carried out since the initial cycle of a human's life because it may determine the quality of human resources in the future. One very essential life cycle is the toddler period. Toddlerhood or infancy is also often referred to as the golden period of rapid growth and development so that nutrition problems during this period will contribute a significant impact on the next life period. Chronic malnutrition in children under five can inhibit the growth and development of the brain in children (Soetjiningsih, 2013).

Stunting is one of several nutritional problems that occurred in children under five. Stunting is defined as a failure to achieve a linear growth. It indicates the cumulative effect of a lack or inadequate intake of energy, macronutrients, or micronutrients in the long term or maybe as the result of chronic or recurrent infections (Umeta et al., 2003). Stunting is presenting chronic malnutrition according to height for age index (height Body/age) and more common in children under five, particularly in developing countries.

Specifically, in Indonesia, according to the results of Indonesia Basic Health Research in 2012, it was known that there was a decrease in the prevalence of stunting in infants from 2013 by 37.2% to 30.8% in 2018. However, the decline remained at a high prevalence rate because the range was 30-39% (Kemenkes RI, 2019, 2014a). The results of those basic health research in 2018, Aceh was one province with the prevalence of stunting above the national rate of 37.5%. The World Health Organization (WHO) limits stunting in each country, province, and district/city to only 20% of the total number of children under five in the area (World Health Organization, 2000). Means, the problem of stunting due to chronic malnutrition in some areas in Indonesia was still far from the target set.

Food consumption is a prominent factor in determining the nutrients intake for children under five that may affect the height growth and development of children. The results of monitoring nutrition consumption of children under five carried out in Aceh Province (2017), found that the average consumption of energy and protein was in the category of deficit/very lack, i.e., 72.4% in energy consumption, and 47.5% in protein consumption (Aceh, 2017) .

In Indonesia, stunting in children under five occurred due to lack of animal food (meat, fish, eggs, and milk) consumption as a primary source of protein and

calcium, the growth could be hampered if the child has a protein deficiency although sufficient energy intake (Faisal A, 2012; RS, 2005). Calcium deficiency known will affect linear growth if the calcium content in the bones less than 50% of normal, while other studies have shown zinc deficiency to linear growth.

Besides nutrition aspects, genetic factors also influence the child's height. One of the genetic factors is the height of the mother during pregnancy, known as maternal height (Kesehatan, 2010). Short mothers, even if fathers are normal, lead to stunting children. Babies born to malnourished or stunted mothers are likely suffering from malnutrition and stunting too. Thus, lack of nutrition passes from one generation to the next (Bank, 2006). Mothers who classified as stunting may increase the adverse risk of outcome fetuses, newborns, and children. Women with height less than 145 cm or called as stunting is at risk of having stunting children (Brief, 2010). While the research of Zottarelli et al. 2007, showed that mother's height <150 cm tends to have stunting children (Zottarelli et al., 2007).

Stunting due to chronic malnutrition indicates a public health problem since the association with an increased risk of morbidity and mortality. Various adverse effects have been found in stunting children. Research by Mendez et al. (1999) conducted in the Philippines proved it significantly, cognitive test scores in stunting children aged 24 months were lower than in normal one. They also have lower scores on language and math test scores (Mendez and Adair, 1999). Also, stunting causes a significant decrease in the development of motor and mental function later reduces physical capacity.(World Health Organization, 2000) Long-term effects of stunting include short body size, reduced working capacity, and an increased risk of poor reproductive performance. Stunting contributes up to 14.5% of deaths annually and 12.6% of disability-adjusted life-years (DALYs) in children under five years (The Lancet, 2013).

METHODOLOGY

Study Design and Sampling

The study was a descriptive-analytic using a cross-sectional study design. The study located in Darul Imarah Subdistrict, Aceh Besar District, in three early childhood education programs (called PAUDs), namely AL-Yaqin, AT-Taqwa, and AL-Bariq. This research was conducted in August-September 2019. The population was households that have toddlers, while respondents were mothers who have toddlers aged 3-5 years. One District in Aceh Province would be chosen according to the high prevalence of stunting. By using the same sampling method, 1-2 villages in a chosen sub-district were selected. Furthermore, toddlers were obtained through those 2-3 early childhood education programs. The number of samples in this study was the total population that met the sample candidates, a total of about 78 samples. Primary data collection executed by interviews using questionnaires and direct measurement. Before data collection, an informed consent form was distributed through selected early schools to be filled out and signed by the families of the chosen children. Furthermore, the parents of the sample who were willing to participate in the study would be involved in the collecting data in each early childhood school at the school delivery or pick up time.

Socio-Demographic Characteristics

Data on socio-demographic characteristics consisted of the mother and toddler characteristics. Data on the characteristics of children under five were including sex and age, while data on the mother's characteristics were determined from education and occupation.

Calcium Intake

The data of calcium intake was collected using a 1x24 hour food recall method for two days, and Food Frequency Questionnaires (FFQ) were performed to measure the quality of food consumption data used to assess the consumption frequency of calcium sources food. Calcium adequacy calculated by directly comparing the adequacy rate. Furthermore, the level of nutrient adequacy obtained by comparing the amount of these nutrients consumption with their adequacy.(Kemenkes RI, 2014b) Here is the formula for the nutrients adequacy:

$$AdLNi = (CNi/RDANi) \times 100\%$$

Note:
AdLNi = The adequacy level of nutrient i
CNi = Consumption of nutrients i
RDANi = RDA of nutrient i

Child Development

Measuring toddler development was by using the Pre Development Screening Questionnaire, which was according to the age of the child, regarding the toddler's development achieved. This questionnaire contains ten questions with "yes" or "no" answer choices. Calculate the answer "Yes" then categorized according to the child's development, classified as normal/appropriate if the score was 9-10, and classified as suspected or suspicious having problems if the score achieved was less than 9 (Dhamayanti, 2006).

Anthropometric Characteristics of the Participants

Anthropometric variables were defined according to the WHO Growth Child standards 2006(Onis M, 2006) and calculated using the World Health Organization WHO Anthro software (version 3.2.2, January 2011). The following variables were calculated: height-for-age z-score (HAZ), Weight-for-age z-score (WAZ), BMI-for-age z-score (zBMI), Weight-for-height z-score. The following cut-offs as defined by the WHO were used: stunted: <-2 HAZ (moderately stunted: -3≤ HAZ <-2; severely stunted: HAZ<-3); acute malnutrition based on WHZ score: <-2 WHZ (acute malnutrition: -3≤ WHZ <-2; severe acute malnutrition: WHZ <-3). Data of the mother's height collected by Anthropometric measurements were the measurement of height by using microtoice with a capacity of 200 cm and accuracy level 0.1 cm.

Data Analysis

The information gathered from questionnaires filled into the primary sheet using the Statistical Package for Social Sciences (SPSS) version 22. After data entry, data transformation, and data analysis. Chi-square test was performing to analyze the correlation among the effect mother's height, calcium intake to stunting, and effect stunting to child development. Descriptive characteristics such as mean, median, frequency, and percentage were calculated. All results were considered significant if $P < 0.05$.

Ethical Approval

The Ethics Committee approved this health research study through the Polytechnic of Health Ministry Aceh before the survey was executed. Information of the respondent gathered by the questionnaires was confidentially kept. Signed informed consent for the

respondent participation was obtained before included in this study.

RESULTS AND DISCUSSION

This study involved samples that early childhood students aged 3-5 years of some early childhood programs, namely, Alyakin, At-Taqwa, and Al-Yasin, located in Darul Imarah subdistrict, Aceh, Indonesia. The total number of samples was 78 children consisting of 67.9% children aged 36-48 months and 32.1% of children aged 48-59 months. Most of the samples were female, about 60.3%, and males, about 39.7% (Table 1).

The result of the study revealed that most children were categorized as normal nutritional status under the height index according to age (body height/age) (78.2%). Still, there were several stunting children (21.8%). Following the results of the Indonesia Basic Health Research (Riskesdas 2018), the stunting prevalence n this study was lower than the national stunting prevalence rate by age 36-47 months old, that was equal to 40.7%, very short category was about 10.7% and short category was approximately 20.9%. While the age 48-59 months old group was found about 26.9%, with a very short category was 7.7%, and a short category was 19.2%.

The development of children in this study was measured using the Development Pre-Screening Questionnaire instrument with two categorizations, namely suspect and normal. Table 1 shows that most samples had normal development (73.1%). However, it also found children with suspicious development (26.9%).

The characteristics of the mother consisted of occupation and education. Table 2 shows that mostly sample mothers' occupations were housewives (70.9%), followed by entrepreneurs such as trade (12.8%) and civil servants (10.2%). The majority sample had mothers with a senior high school education level (64.1%), and the lowest percentage was elementary school education level (6.4%).

The mother's height measurement was aimed to determine the status of maternal stunting. The stunting categorization in this parameter used mother's height ≤150 cm, while not stunting if the mother's height >150 cm. The results showed that the majority mother's sample was with height >150 cm or categorized as not stunting (78.2%). However, it also found the percentage of mothers who ≤150 cm in height or classified as stunting, approximately 21.8%

Table 1 Distribution of sample according to the characteristics

Characteristics	n	%
Age (months old)		
36-47	25	32.1
47-59	53	67.9
Total	78	100
Sex		
Male	31	39.7
Female	47	60.3
Total	78	100
Development Category		
Suspicious development (suspected having a developmental problem)	21	26.9
Normal	57	73.1
Total	73	100
Stunting Categories		
Stunting	17	21.8
Normal	61	78.2
Total	73	100
Mother's Occupation		
Housewife	60	70.9
Civil servants	8	10.2
Entrepreneur	10	12.8
Total	78	100
Mother's Education		
Elementary school	5	6.4
Junior High School	11	14.1
Senior High School	50	64.1
College	12	15.4
Total	78	100
Mother's Height Categories		
Short (height ≤150 cm)	17	21.8
Not short (height >150 cm)	61	78.2
Total	73	100
($\bar{x}$ ± sd) (max-min)	(153±4,54) (165±135)	

Table 2 Distribution of samples according to the adequacy level of energy and other nutrients

Nutrient Consumption	N	%
Energy adequacy level		
Severe deficit (<70% RDA)	33	42.3
Moderate deficit (70-79% RDA)	14	17.9

Nutrient Consumption	N	%
Mild deficit (80-89% RDA)	6	7.7
Normal (90-119% RDA)	22	28.2
Over (≥120% RDA)	3	3.8
Total	78	100.0
($\bar{x}$ ± sd) kcal	78.2 ± 22.0	
Protein adequacy level		
Severe deficit (<70% RDA)	20	17.6
Moderate deficit (70-79% RDA)	25	11.8
Mild deficit (80-89 % RDA)	6	7.7
Normal (90-119% RDA)	15	19.2
Over (≥120% RDA)	4	5.1
Total	78	100.0
($\bar{x}$ ± sd) g	99.5 ± 33.5	
Fat adequacy level		
Severe deficit (<70% RDA)	24	30.8
Moderate deficit (70-79% RDA)	3	3.8
Mild deficit (80-89% RDA)	12	15.4
Total		
($\bar{x}$ ± sd) g		
Calcium adequacy level		
Defficient (<77% RDA)	29	37.2
Sufficient (≥77% RDA)	49	62.8
Total	78	100.0
($\bar{x}$ ± sd) µg	92.4 ± 40.9	
Zinc adequacy level		
Defficient (<77% RDA)	13	16.7
Sufficient (≥77% RDA)	65	83.2
Total	78	100.0
($\bar{x}$ ± sd) mg	30.1 ± 27.6	

Table 3 Analysis of mothers' height against stunting

Characteristics of mother and children	**Stunting**						p	OR
	Stunting		Normal		Total			
	N	%	n	%	n	%		
Mothers' height categories								
Short	5	31.3	11	68.8	16	100	0.047	4.0 (1.05 – 15.12)
Not short	12	19.4	50	80.6	62	100		
Calcium intake								
Deficient	7	46.7	8	53.3	17	100	0.016	4.6 (1.37 – 15.69)
Sufficient	10	15.9	53	84.1	61	100		

Chi-square test, significant α<5%

Table 4 Analysis of Stunting against Child Development

Incident of stunting	Development				Totals		P.value	OR
	Suspects		Normals					
	N	%	n	%	N	%		
Stunting	7	41.1	10	58.9	17	100	0.121	2.5 (0.82 – 8.11)
Normal	14	21.3	48	78.7	62	100		

Chi-square test, significant α<5%

Table 3 shows that most of the stunting children came from mothers with a height of less than 150 cm or stunting (31.4%), compared to non-stunting mothers (19.4%). Furthermore, the majority of normal children

come from mothers with height more than 150 cm or not stunting (80.6%), compared to stunting mothers (68.8%). The results of the chi-square analysis showed a significant correlation of maternal height against the stunting status of the sample in children aged 3-5 years (p <0.047) and OR = 4.0 at 95% CI (1.05-15.12). These results indicated that children aged 3-5 years whose mother height ≤150 cm or stunting have a 4.0 times chance of experiencing stunting compared to children whose mother height <150 cm. This fact was consistent with the research of Addo et al. (2013), which found that maternal height influenced the linear growth during the growth period. These effects are likely involved both genetic and non-genetic factors, including intergenerational effects related to nutrition on child growth.

There is a theory that adult women with small bodies will be more likely to give birth of low birth weight baby, partly due to the size of pregnancy has an essential impact on a baby's weight. Children born with low weight will tend to experience a growth disorder during childhood. Thus, women born with low weight will tend to be a small adult woman (Kemenkes RI, 2014a). Babies born to mothers suffering from malnutrition or stunting, more likely to suffer from malnutrition and stunting as well. Thus, malnutrition pass one generation to the next (Bank, 2006).

Short mothers, even fathers are normal, may still have stunting children. Mothers who classified as stunting can increase the adverse risk to the fetus, newborns, and children (Kesehatan, 2010). Women whose height less than 145 cm or stunting are more at risk of having stunting children (Brief, 2010). while several studies(Zottarelli et al., 2007), indicates that the mother's height <150 cm tends to have stunting children. The average maternal height in this study was 153 cm, minimum height was 135 cm, and the maximum height was 165 cm. Stunting mothers had more chance to have stunting children (31.3%), compared to mothers who were not stunting (19.4%). According to Indonesia Basic Health Research (Riskesdas) report, Indonesian women had an average height below 150 cm of 36.1% in 2007, and 35.1% in 2010 (Walker et al, 2007). The impact of genetic factors on the incidence of stunting about 20-30%, but the rest are environmental factors such as parenting, food, and nutritional intake (Setiawan, 2018).

The results of chi-square analysis showed a statistically significant effect on calcium intake against the stunting in children aged 3-5 years (p <0.009) and OR = 4.6 at 95% CI (1.37-15.69). These results also revealed that children aged 3-5 years who less calcium intake had 4.6 times the chance to experience stunting compared to children who consumed sufficient calcium. Linear growth disorders occur mainly in the first 2 to 3 years of a child's life, which reflects the interaction among some factors, such as the lack of energy and nutrient intake, and infection.(R Martorell, L K Khan, 1994) Calcium has an essential role in the body, i.e., the formation of bones and teeth, and regulation of cell function in extracellular and intracellular fluids such as for nerve transmission, muscle contraction, blood clotting, and maintaining cell membrane permeability. Besides, calcium also regulates the work of hormones and known as a growth factor (Sunita, 2006).

Following the results of the correlation test between consumption of calcium food sources (milk, meat, fish, and nuts, or processed products) within a week showed that only milk food sources had a significant correlation with the incidence of stunting in children aged 3-5 years. While other food sources, such as meat, fish, and nuts, did not show a significant relationship (p> 0.05).(Esfarjani et al., 2013) Many dairy components potentially affect linear growth in children are protein, calcium milk, and insulin-like growth factor-1 (IGF-1). IGF-1 understand well to involved in calcium and phosphate metabolism and contributes to osteoblast proliferation, differentiation, and matrix formation (Kelly et al., 2003). Micronutrient intake, particularly calcium, is one factor that influenced the incident of stunting in children under five years (Roberts and Stein, 2017; Stuijvenberg et al., 2015).

Failure of linear growth serves as a marker of various pathological abnormalities associated with decreased nerve development and cognitive function (Alam et al., 2020). Severe irreversible physical and neurocognitive damage that follows stunting poses a significant threat to human development (de Onis and Branca, 2016; Sokolovic et al., 2014). Stunting children have a low cognitive level until the age of eight, seen from the Peabody Picture Vocabulary Test and Cognitive Development Assessment quantitative tests (Tassew Woldehanna, Jere R. Behrman, 2017). Table 4 shows that the stunting affects suspicious trading was less than half (41.1%), while stunting with normal development conditions was more than half (58.9%). The condition of normal height children with suspected development was found lower (21.3%) compared to normal development (78.7%). The results of the analysis using the chi-square test did not reveal a significant impact on the incidence of stunting against the development of children aged 3-5 years (p <0.05). It means that the prevalence of stunting in children aged 3-5 years in this study did not influence the children's development. This study differs from the findings of Suryana et al. (2019) that found a correlation between the incidence of stunting with the development of pre-school children. The fact that there was no influence between the rate of stunting on the development of children aged 3-5 years in this study allegedly caused by other factors contributed effect to the development such as stimulation of parenting patterns provided by the family or neighborhood where the child lives. However, this factor was not examined in this study

CONCLUSION

According to the results and discussion, it can be concluded that the prevalence of stunting in children of early childhood education program, aged 3-5 years was 21.7%. There was an impact between mothers' height and calcium intake against stunting in 3-5 years old children in early childhood education programs in Darul Imarah Sub-District, Aceh Besar District, Indonesia. Furthermore, the incidence of stunting in 3-5 years old children did not affect the child's development.

This study was limited by the cross-sectional design and the instruments used for child developmental measurement were not able to measure the development of children in early childhood education programs, take place in the research location. A good questionnaire should be developed according to the child's age development as a more valid and reliable tool.

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CONFLICT OF INTEREST

All authors declare that there is no conflict of interest in this study.

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