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PROCEEDINGS OF THE 2ND INTERNATIONAL
SYMPOSIUM OF PUBLIC HEALTH

Achieving SDGs in South East Asia: Challenging and Tackling of Tropical Health Problems

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Editor on Board: Febi Dwirahmadi

Organized by
Faculty of Public Health, Universitas Airlangga



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FOREWORD

The point of Sustainable Development Goals (SDGs) has been determined in the consistent meeting in all countries. The health sector position is one of the key components in achieving the indicators. Special attention to the health sector focuses on community nutrition, national health systems, access to reproductive health and family planning and sanitation and clean water.

Based on that, Southeast Asian countries are seen as important part in formulating strategic and policy efforts to improve the effectiveness and efficiency of achieving the various goals of the SDGs. Therefore, the Doctoral Program of Health Science, Faculty of Public Health, Universitas Airlangga held The 2nd International Symposium of Public Health. This remarkable event is in collaboration with Faculty of Medicine, Widya Mandala Catholic University Surabaya and Magister Program of Public Health, Jember University. It's an honour to present **“Achieving SDGs in South East Asia: Challenging and Tackling of Tropical Health Problems”**.

We have tried to give our best contributing of our knowledge in the field of public health especially our contribution to help the problems on tropical health, health equity and quality of health care, clinical and community relationship to enhance public health, emerging and re-emerging diseases, nutrition-enhancing as strategic investment, global strategy framework for food security and nutrition, environmental and occupational health and mental health for achieving SDGs in South East Asia.

The aim of this symposium is to disseminate knowledge and share it to the public, especially in the scientific community, such as academics and practitioners in the field of health. The symposium focusing on formulation of policy recommendations for related parties to accelerate the achievement of the target of SDGs in the field of health. The results of this symposium are also expected to be an input for policy makers, from various levels in formulating programs to accelerate the SDGs goals' achievement. This international symposium will help us, to grasp and share more knowledge especially in public health science.

At last, we would like to acknowledge for all parties which are provide the valuable materials as well as financial support for the successful symposium. As chair of organizing committee, I would also like to say deep thank you for all committees; my colleagues, and also students in faculty of Public Health Universitas Airlangga, who have been working to be part of a solid team and amazing committee.

I am looking forward to seeing you at ISoPH in the near future.

Rachmad Suhanda
Chairman of the Committee



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Zinc Status and Cadmium Exposure in Stunted Children Aged from 24 to 59 Months: A Cross Sectional Study

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Abstract: Stunting prevalence in Indonesia was increasing year by year. Zinc plays an important role in the growth, development and functioning of all living cells. Cadmium is a heavy toxic heavy metal that can interact with an essential element such as zinc at different stages of absorption, distribution and excretion as well as its biological function. We analyzed correlation between zinc status and cadmium exposure with Z-Score Height by Age (HA) in stunted children. This study was observational analytic research with a cross sectional design. 35 stunted children aged from 24 to 59 months (HA < -2SD) were taken as a sample by simple random sampling of family and children collected by questionnaire including smoking exposure in family. Zinc concentration was measured in hair, and cadmium exposure was measured in urine by spectrophotometry method. The data was analyzed by linear regression. The result showed that the most stunted child was a boy with a mean of Z-score HA equal to -2.9; 17% were born with low birth (<2500gr). The average zinc concentration in their hair showed 82.84 ppm and the cadmium concentration in urine was 2.6 µg/L. A significant correlation was found between zinc and cadmium concentration with Z-Score HA (p=0.000).

1 INTRODUCTION

Stunting, or a short body, is a linear growth retardation as a picture of the state of the past (chronic), due to obstacles or disorders of height growth or linear growth which takes a long time, in months or even years (Sudiman, 2008). WHO reported stunting prevalence decreased from 47% in 1980 to 33% in 2000 and is expected to continue to decline to 21% by 2020. However, this decline did not occur in some developing countries located in the African continent and parts of Asia including Indonesia. The range of stunting prevalence variations in some countries in the world is still wide, between 5% and 65%. The prevalence of stunting in Indonesia is categorized as severe endemic (> 40%).

The determinant of stunting is quite complex, as is the case of less weight or better known as malnutrition. One of the direct causal factors is the

problem of zinc intake as an essential nutrient that has a wide effect in the body's metabolism (formation of enzymes, growth hormone (GH) and antioxidants. Zinc deficiency will affect certain tissues at the time of growth. However, the process of absorbing zinc in the body is strongly influenced by some nonessential nutrients, one of which is Cadmium (Cd). Cadmium and zinc (Zn) have very similar physical and chemical properties, and these two metals lie in Group 12 (or IIb) in the periodic table.

The process of bone growth restriction due to Cd can be explained by 2 mechanisms: direct and indirect. Directly, Cd causes metabolism of mineral disorders and one of them is Zn. Indirectly, bone damage is caused as a secondary response to Cd disorders against vitamin D and mineral metabolism resulting from kidney and gastrointestinal damage by Cd. Brozka, through his research on bone metabolism in male rats exposed to Cd, proved that

exposure to Cd even in low doses (1 mg / l) may cause skeletal disorders.

Stunting prevalence in Jember district remains higher than the national prevalence. It is suggested that there was cadmium exposure in stunted children besides a low intake of zinc. Cadmium exposure was suggested from exposure to smoking and agricultural activity that results in phosphate residue in the water, land and local food product. A pre-elementary study showed that cadmium urine of 5 stunted children remains high, with an average of 2.69 µg/L.

2 METHOD

This study was an analytic research with a cross sectional design. 35 stunted children from 24 to 59 months' old (HA<-2SD) were taken as a sample by simple random sampling. Family and children characteristics were collected by questionnaire including exposure to smoking in the family.

To assess nutrient intake used 24 hours' food recall method. Based on recall, the nutrient intake was measured by using NutriSurvey, then the status of consumption was assessed by comparing nutrient intake with Indonesian RDA 2013 and classified into 5 categories for macronutrient intake, including:

- overnutrition (>120%);
- normal (100-120%);
- moderate (80-99%)

There are also 2 categories for micronutrient intake:

- normal (>77%)
- deficit (<77%).

To assess cadmium exposure, 10 ml of urine was collected from children and 0.5 mg of hair to measure zinc deposits. Zinc concentration and cadmium exposure were measured by spectrophotometry method. The data was analyzed by linear regression.

3 RESULTS

3.1 Children and Family Characteristics

The average age of stunted children who were the subjects of this research was 45 months and ranged from 24 to 57 months. The average family income is

Rp 1,058,571, and this value is still below the minimum wage of Rp 300,000 per person. Furthermore, the average amount of family food expenditure is Rp 688,571 (65% of income), with a minimum family expenditure of Rp 300,000 and a maximum of Rp 1,500,000.

Parents' education levels are mostly in the basic education category (graduated/not elementary school), 91.4% of fathers and 91.4% of mothers, only 8.6% are junior or senior high school. Most mothers are housewives (80%).

Table 1: Family characteristic.

No	Variable	Mean	SD	Min	Max
1	Age (months)	45	9.914	24	57
2	Salary (thousand Rp)	1.059	524	300	3.000
3	Food Spend (thousand Rp)	689	308	300	1.500
4	Number of family relative who smoke	1.28	0.46	1	2

3.2 Daily Nutrition Intake

Measuring the level of stunting consumption of toddlers was obtained by using the 24 hours' food recall method. The result of measurement of energy consumption level, protein, fat, carbohydrate, iron, zinc and calcium can be seen in Table 2.

Nutrient	RDA	Consumption	% RDA	Category
Energy (cal)	1600	807.11	50.44%	Deficit
Protein (gr)	35	34.92	99.77%	Normal
Fat (gr)	62	30.45	49.11%	Deficit
Carbo (gr)	155	101.02	65.17%	Deficit
Fe (mg)	5	5.2	104%	Normal
Zn (mg)	9	4.64	51%	Deficit
Ca (mg)	1000	150.53	15.05%	Deficit

Table 2: Daily nutrition intake of stunted children.

The average energy consumption of toddlers stunting amounted to 807.11 kcal /day with a minimum value of 209.9 kcal and a maximum of

1541 kcal / day. Based on Indonesia RDA 2013, the average energy consumption of stunting in deficit category is 50.44%. Furthermore, protein consumption showed an average consumption of 3492 gr / day with a minimum value of 6.5 grams and a maximum value of 75.7 gr / day. The average protein consumption of stunting children is included in the good category (99.77%).

Fat consumption shows an average consumption of 30.45 g / day with a minimum value of 1.4 g / day and a maximum value of 67.1 g / day. The average stunting fat consumption included a category of deficit (49.11%). The average carbohydrate consumption shows a value of 101.02 grams with a minimum value of 28.77 gr/day and a maximum value of 248.5 gr / day. The average carbohydrate consumption of toddlers is included in the category of deficit (65.17%).

3.3 Relationship between Z-Score Value Height/ Age with Consumption Level, Hair Zinc Level and Urine Cd level

The statistical results show the relationship between some independent variables (energy consumption level, protein, fat, carbohydrate, iron, zinc and calcium and hair Zn level and initial urinary Cd level) with dependent variable, in this case z score, with significance value 0.000. In addition, the Pearson correlation score indicates that there is a bivariate correlation between each independent variable and the dependent variable.

Regression test results showed that, of the independent variables that correlated with the z score, there are 2 variables that have significant effect to z score value that is energy consumption and zinc consumption with $p = 0.004$ and $p = 0.002$. Meanwhile, other variables have no significant effect.

The magnitude of influence is shown by the value of EXP (B) or also called Odds Ratio (OR). The test result shows a constant value = 4.237 and value B (energy consumption) = 0.003 and B (consumption zinc) = -0.107. The model of regression equation obtained is:

$$Z \text{ score Height / Age} = 4.237 + 0.003 (\text{energy consumption}) - 0.107 (\text{zinc consumption}). \quad (1)$$

4 DISCUSSION

Stunting is a community nutritional problem with a complex and comprehensive factor. The low level of education will affect the level of knowledge of parents, especially the mother's ability in keeping to a feeding pattern. In addition, education also has a correlation with the ability to access jobs that will ultimately affect the ability of a family's economic status (family income). A low income will affect the purchasing power of the family on food and also access to health services when there are family members who are sick.

Children aged from 24 to 59 months are at an age which has a high risk to infectious diseases. They were having low immunity and not supported by a good intake or good personal hygiene behavior and sanitation. The responsive action of the parents when the child is sick is crucial to the success of growth. Often parents consider child sickness to be reasonable for some reason that is strongly influenced by local cultural views, as sick children are perceived as a sign that their toddlers will grow for the better. This can be seen from the results of interviews that showed most of the actions of parents when the child is sick is to treat themselves first and if the pain is continued then the child will be taken to health services 51.4% and even 8% were still self-treated and not taken to health services. This condition will affect the occurrence of growth failure (growth faltering), one of which is stunting.

Macro nutrients intake is instrumental in maintaining the availability of energy for the body to run the activities and metabolism of nutrients in the body. Carbohydrates are a source of energy, protein is a building agent and the formation of hormones and enzymes that function in metabolizing nutrients, especially micronutrients and fat, serve as the largest energy reserves. An average level of consumption of macro nutrition of stunting children is a deficit category, that is energy, carbohydrates and fat. Only proteins are in both categories. However, a low input of energy can cause a negative energy balance, which means that, eventually, the protein cannot function properly. This condition is worsened if toddlers regularly suffer from infectious diseases, resulting from a low immune system that often accompanies the condition of stunting. Zinc works for cell growth and division, antioxidants, sexual development, cellular and humoral immunity, dark adaptation, tasting and appetite. Zinc is especially needed for growth acceleration, not only because of the effects of cell replication and nucleic acid

metabolism, but also as a mediator of growth hormone activity.

Stunting conditions accompanied by chronic or acute recurrent infections will lead to weight loss, and will eventually create a chronic acute malnutrition condition called stunted-wasted (short and thin). This has consequences for multiple handling related to macro and micro nutrient deficiencies.

Descriptions of micronutrient intake such as iron, zinc and calcium show a variety of consumption categories; some are good and some are lacking. The average iron consumption of stunting children is 5.2 mg / day, with a minimum value of 0.7 mg / day and a maximum of 26.5 mg / day. The average iron consumption of toddlers stunting is included in either category (104%). Average zinc stunting for toddlers is 4.64 mg / day, with a minimum value of 0.6 mg / day and a maximum of 12.9 mg / day. The average consumption of zinc toddler stunting included in the category of less (51%). Lastly, the average calcium consumption of toddlers stunting is 150.53 mg / day, with a minimum value of 20.6 mg / day and a maximum of 720.2 mg / day. The average of stunting iron consumption is included in the category of less (15.5%).

The consequences of micronutrient deficiency during childhood are very dangerous. Iron deficiency can interfere with the mental and motoric development of children and also lead to anemia. Zinc deficiency may also lead to late growth, dermatosis, hypogonadism, oligospermia, decreased dark adaptation, impaired immunity, hair loss, and decreased appetite. Almatsier mentions that deficiency of calcium minerals during growth can cause growth disorders, bones growth, bones becoming easily bent and brittle.

Zinc is an essential nutrient that has an important role in growth and development. Zinc plays a role in the activity of 300 enzymes through the formation of structures and catalytic activity and enzyme regulation. Zinc also interacts with hormones that play a role in bone growth such as somatomedin-c, oestocalcin, testosterone, thyroid hormone and insulin. Zinc is strongly associated with bone metabolism; therefore, zinc has a positive impact on growth and development. Zinc is also an essential component of calcified matrix and vitamin D effect enhancer factor to bone metabolism through the stimulation of DNA synthesis in bone cells.

Nakamura reported that zinc supplementation had a positive role in growth in stunted Japanese in the absence of endocrine disorders. Zinc mediates growth by affecting the Insulin-like growth factor-I

(IGF-1) activity in plasma. Zinc supplementation can stimulate the acceleration of growth by increasing the concentration of IGF-1.

Nasoetion studied the effect of zinc supplementation (20 mg) once daily for 3 months in stunting (short) children aged from 6 to 24 months, where the results showed an increase in the body length (Height for Age Z-score) of 30 %. Another similar study conducted by Adriani and Salmun mentioned that there was significant weight gain and height before and after supplementation of zinc in elementary school students aged from 7 to 9 years for 8 weeks, and can decrease the incidence of disease by 67.7%.

Zinc and Cadmium are both classified in Group 12 (or IIB) of post-transition in the periodic table, so they have many similarities. In biological systems, Zn and Cd are linked to macromolecules, primarily through Sulphur (S), Oxygen (O) and Nitrogen (N). They bind preferentially to the same protein, with Albumin, in the blood stream, Metallothionein (Mt) in tissue. Thus, Cd^{2+} and Zn^{2+} ions can compete for uptake in various cells and binding to intracellular sites and Cd may displace Zn in a number of biological processes. The result showed that there was correlation between zinc concentration with linear growth and cadmium exposure with linear growth. By displacing Zn, Cd interferes with Zn absorption, distribution into tissue and cells, and may inhibit Zn biological functions such as its important role in growth, development and functioning of living cells.

5 CONCLUSIONS

Stunted children with high cadmium concentration will have a low zinc concentration, and it correlates with z-score HA. Therefore, it is suggested to minimalized the exposure to cadmium, especially from cigarette smoke.

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