Research Article

Normal Plasma Zinc Level In Correlation With Length Velocity In Stunting Children Aged Between 1 And 2 Years Old In Surakarta

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ABSTRACT

Background: Stunting is a chronic malnutrition caused by prolonged insufficient nutritional intake due to feeding inappropriate to nutritional needs. Malnutrition in children increases the mortality in infants and children, causing susceptibility to illness and non-optimal posture in adulthood. Malnutrition problem, other than macronutrient deficiency, can also be caused by micronutrient deficiency. One of the micronutrients that have benefits and vital to the growth and development of human is zinc (Zn).

Objective: To analyze the correlation between normal plasma zinc level and length velocity in stunting children.

Methods: Observational analytical study with cross-sectional approach was conducted in 35 stunting children, aged between 1 and 2 years old in several community health centers in Surakarta from January 2019 to June 2019. The subjects underwent blood laboratory examination for plasma zinc level. All participants data was processed and statistical analyzed.

Results: Our study found a correlation (rk) value of 0.554, meaning there was a positive correlation between zinc level and length velocity, with moderate correlation power. The p-value was 0.001 ($p < 0.05$), which means that there was a significant correlation between normal plasma zinc level and length velocity in 1-2 years old stunting children.

Conclusion: There is a significant correlation between normal plasma zinc level and length velocity in 1-2 years old stunting children. Zinc supplementation and consumption of zinc-containing foods could increase growth in children with abnormal growth pattern without other abnormalities.

Keywords: Zinc, supplement, stunting, length velocity, micronutrient.

INTRODUCTION

The nutritional status of children under 5 years old is highly influential in producing high quality human resource in the future. Nutritional status is associated with intelligence. Intelligence development in early years depends on nutrition consumption. The lower the nutrition consumed, the lower the nutritional status and children health. Nutritional disorder in infants and children, especially below five years old can cause problems in physical growth and intelligence. The growth of brain cells occur rapidly and will arrest or complete at the age of 4-5 years old. Rapid brain growth can only be achieved with good nutrition.[1,2] Stunting children are more vulnerable to infectious disease, which contributes to the risk of decreased school learning quality and more absence from school.[3] Stunting also increases the risk of obesity because people with short height have lower ideal body weight. Body weight increase of several kilograms can result in an increase of body mass index (BMI) over the normal limit. Prolonged duration of overweight and obesity can increase the risk of degenerative disease.[4]

According to WHO (2008), the number of stunting children in the world reached 21% and the condition of short stature children is the cause of 2.2 million children death throughout the world. Malnutrition in children can also be found in developing countries, including Indonesia.[5]

The growth phenomenon in adolescence demands high nutrition to achieve maximum growth because nutrition and growth have an integral relationship. Thus, inefficient nutrition during this period can lead to delayed sexual maturity and linear growth inhibition.[6]

According to UNICEF (2015), in 2014, there were 159 million out of 667 million children under 5 years old experienced stunting.[7] The Basic Health Research (*Riset Kesehatan Dasar*; Riskesdas) divided the height-for-age indicator classification cited from the WHO into 3, i.e. very short (Z-score < -3.0), short (-3.0 ≤ Z-score < -2.0), and normal (Z-score ≥ -2.0). According to the data of Riskesdas 2013, the rate of stunting in children under 5 years old in Indonesia was 37.2% (18% very short and 19.2% short), 5-12 years old had 30.7% (12.3% very short and 18.4% short), 13-15 years old 35.1% (13.8% very short and 21.3% short) and 15-18 years old 31.4% (7.5% very short and 23.9% short). North Sumatera is one out of 15 provinces with higher very short prevalence in 5 – 12 years old children above the national prevalence, with the incidence of short stature of 18% and very short 19%.[1]

Nutritional problems can also be caused by micronutrient deficiency, other than macronutrient deficiency. The types of micronutrients that have benefits and are very vital in the growth and development of human are zinc and iron. Zinc is an essential micronutrient for human. This nutrient is the second most common after iron in the human body. Zinc is contained in several types of enzyme, and almost 100 enzymes in the body contained zinc.[7] Zinc is especially needed for the process of growth acceleration, which not only caused by cell replication and nucleic acid metabolism, immune function, but also as a mediator of growth hormone activity. Zn supplementation has significant positive response on body weight and height increase and can increase linear growth in adolescence and stunted children.[8,9]

METHODS

Cross-sectional observational analytical study was conducted in several community health centers in Surakarta from January 2019 to June 2019. The target population was children aged 1 to 2 years old. The parents of the children agreed for blood analysis. The samples of all subjects that fulfilled the inclusion and exclusion criteria using cluster random sampling were obtained for investigation if the parents consented to it until the desired number of samples was reached. Sampling was performed and analyzed in Prodia laboratory. The inclusion criteria were children aged 1 to 2 years old, stunting, not consuming zinc within a week and whose parents were willing to participate in this study by signing informed consent. Children with chronic disease, congenital abnormalities, and zinc level below normal excluded from the study. The target number of research subjects were 35 peoples.

This study was conducted after receiving ethical clearance recommendation from the Ethical Committee of public health office of Surakarta. The data obtained were analyzed, and the results were presented in narration, table, and graph. The main characteristics of the subjects consisted of: height and zinc level in the plasma. The analysis was performed on two variables which presumably correlated. All subjects who met our inclusion criteria underwent blood examination for zinc in plasma level and the blood samples were sent to laboratory. Hypothesis testing used the Pearson product moment test if the data normally distributed and the Spearman Rank test was used if the data is not normally distributed and the statistical analysis was conducted using SPSS program version 22.

RESULTS

There were 35 stunting children aged between 1 and 2 years old who participated in our study comprising 18 boys (51.4%) and 17 girls (48.6%) with the mean age of 18.23 $\pm$ 3.30 months old and the mean height of 74.60 $\pm$ 3.31 cm (Table 1). The characteristic were categorical and presented in distribution frequency (%). Meanwhile, numerical data were presented in means and ± SD. The normality test was carried out by The Saphiro-Wilk test because the subjects were less than 50.

Table 1. Baseline Characteristics of the Subjects

Characteristics	Results (n = 35)
Gender	
Male	18 (51.4%)
Female	17 (48.6%)
Age (Months)	18.23 ± 3.30
Height (cm)	74.60 ± 3.31

Table 2. Data Description and Normality Test

Variable	Mean ± SD	p-value (Shapiro-Wilk test)	Description
Zinc level	74.29 ± 13.24	0.001	Abnormal
Length velocity	0.66 v 0.24	0.001	Abnormal

The mean zinc level in our subjects was 74.29 ± 13.24. Shapiro-Wilk test obtained p value of 0.001 ($p < 0.05$), demonstrating abnormal zinc level data distribution.

Length velocity of our subjects had mean value of 0.66 ± 0.24. Shapiro-Wilk test showed p value of 0.001 ($p < 0.05$), which means that the data distribution of length velocity was abnormal (Table 2).

Hypothesis test

The hypothesis in this study was to determine the correlation between plasma zinc and length velocity in stunting children aged 1 – 2 years old. Therefore, the correlation test used was Spearman Rank test because the data were not normally distributed.

Table 3. The correlation between normal plasma zinc level and length velocity in stunting children aged 1 – 2 years old

Variable	Length velocity	
	rk	p-value
Zinc level	0.554	0.001

Spearman rank test

The Spearman Rank test obtained a correlation value (r_k) of 0.554, which means that there was a positive correlation between zinc level and length velocity, with moderate correlation power. This means the higher the zinc level, the better the length velocity. The p-value of 0.001 ($P < 0.05$), represented a significant correlation between normal plasma zinc level and length velocity (Table 3.)

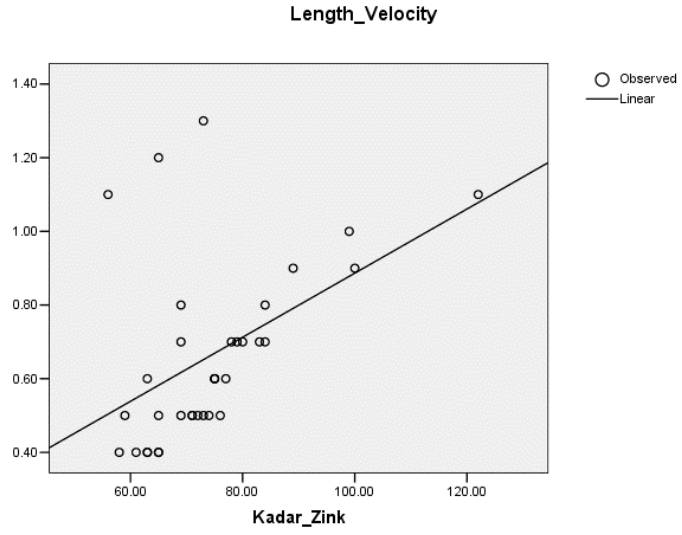

Figure 1. The plot chart of the correlation between zinc level and length velocity.

DISCUSSION

Linear growth failure in children or stunting is defined as height-per-age less than -2 SD under the median of reference population.[10] Stunting is the most common form of malnutrition, along with wasting (weight-per-height less than 2 SD under the median of reference population, intrauterine growth restriction, vitamin A and zinc deficiency, and suboptimal breastfeeding, cause the death of 3.1 million children each year, or 45% of all children death. Stunting is probably caused by a deficit in the essential protein and micronutrients in cell level and chronic infection, which reduce the concentration of growth factors such as insulin 1 needed for linear growth[11]. Other than that, stunting is also a clinical syndrome from various pathological process marked by linear growth retardation, increased morbidity and mortality, and reduced physical ability, development and neurological disorder, reduced economic ability, and increased risk of metabolic disease in adult.[12] The nutrition impact model estimated that 1.2 million deaths per year or 17% of all deaths in children between 0 to 59 months old were caused only by stunting.[5]

Zn deficiency can inhibit the metabolism of thyroid hormone, androgen, and growth hormone (GH).[13] It can be caused by inadequate diet, absorption disorder, excessive excitation, or congenital disorder in zinc metabolism. In Turkey, except for middle to high income families, the daily zinc intake was much lower than the recommended value of 15 mg/day. Zinc has an important role in the synthesis of protein and IGF-1, which can be inhibited by zinc deficiency. Reduced circulation of IGF-1 concentration has been suggested as a potential mechanism for growth retardation caused by zinc deficiency. However, IGF-1 level was difficult to assess.[14] In the last several years, efforts had been conducted to reduce a more appropriate and reliable zinc deficiency indicator using direct measurement of zin status.[15]

Zinc supplementation could increase the growth in patients with abnormal growth pattern without other disorders, except with low zinc levels. Twenty children with GH deficiency who received hGH, were given 50 mg of oral zinc supplementation every day and showed improved growth rate from 5.1 to 7.3 cm/year.[14]

Our hypothesis that stated "There was a significant correlation between normal plasma zinc level and length velocity in 1-2 years old stunting children" was proven.

CONCLUSION

Consumption of nutritional foods such as those containing substantial amount of zinc, or consumption of zinc supplementation could improve the growth of children with stunting. Our study demonstrates a significant correlation of normal plasma zinc level with length velocity in 1-2 years old stunting children. This correlation is positive with moderate correlation power showing the higher the zinc level, the better the length velocity.

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Conflicts of interest

None declared

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