



## Zinc Supplementation on Stunting Child: Literature Review

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### ABSTRACT

Zinc (Zn) deficiency in children causes growth disorders, increasing the possibility of getting an infection, and reducing the child's development ability, whereas those problems are related to stunting. Zinc supplementation in several countries is used in efforts to prevent stunting and improve nutrition to reduce stunting prevalence. Unfortunately, zinc intervention revealed some contradictive findings and needed further study. The aim of this study is to analyze zinc supplementation in stunted toddlers. The method used is a literature review with identification, filtration, eligibility determination, and inclusion steps. The article was obtained from search engines: Science Direct, Scopus, Proquest, and Google Scholar within the year 2012-2021. 6 articles were obtained through the process. The analysis result shows that the intervention of zinc implementation gives a significant effect in increasing a child's height/age (TB/U). However, a significant change towards the status of a child's biochemistry and another variable was not found. We suggest that zinc supplementation is continuously used in managing stunting by considering the adequacy of other micronutrients nutrition.

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#### *Kata kunci:*

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### ABSTRAK

Defisiensi zinc (Zn) pada anak menyebabkan gangguan pertumbuhan, peningkatan kemungkinan terkena infeksi, dan menurunkan kemampuan perkembangan anak, dimana masalah-masalah tersebut berkaitan dengan kejadian stunting. Suplementasi zinc di beberapa negara digunakan dalam upaya pencegahan stunting dan perbaikan gizi dengan harapan dapat menurunkan prevalensi stunting. Sayangnya, intervensi zinc mengungkapkan beberapa temuan kontradiktif dan memerlukan kajian lebih lanjut. Studi ini bertujuan untuk menganalisis suplementasi zinc pada kejadian balita stunting. Metode yang digunakan adalah literatur review dengan tahap identifikasi, filtrasi, penentuan kelayakan, dan inklusi. Artikel diperoleh dari mesin pencari Science Direct, Scopus, Proquest, dan Google Scholar dengan batasan tahun 2012-2021. Sejumlah 6 artikel diperoleh dari proses tersebut. Hasil analisis menunjukkan bahwa intervensi suplementasi zinc memberikan dampak yang signifikan dalam peningkatan tinggi badan/umur (TB/U) anak, meskipun tidak ditemukan perubahan yang signifikan pada status biokimia anak dan variabel-variabel lain. Kami menyarankan agar suplementasi zinc tetap digunakan dalam penatalaksanaan stunting dengan memperhatikan kecukupan gizi mikronutrien lainnya.

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## INTRODUCTION

Micronutrients have the main function in human metabolism and physiology in maintenance, optimization of health, and disease prevention. The adequacy of nutrition intake is very important in maintaining homeostasis of the body, its physiology function and for child's normal growth and development. World Health Organization (WHO) predicted that more than 2 billion people suffers from important micronutrients; they are vitamin A, iodine, iron and zinc (Shergill-Bonner, 2017). Zinc (Zn) become one of micronutrients that is important in human metabolism because it is involved in all main biochemistry process and roles in maintaining gene materials, including DNA transcription, RNA translation and cellular division (Gupta et al., 2021).

Zn deficiency is related to the obstruction linier growth and the decrease of immune function (Rahman et al., 2016). Low zinc level mostly found in low development countries which is related to the economy condition, the ability on nutrition in take as well as child growth and development disorder (Gupta et al., 2020). This condition is generally found in children who live in a certain environment with low variety of food and limited source of animal protein consumption (Wessells & Brown, 2012). Incidence and seriousness of diarrhea and the risk of stunting increase in children with low zinc level (Evan Mayo-Wilson et al., 2014). The increase of child's mortality and morbidity caused by lower respiratory tract infection and malaria was also found in children with zinc deficiency. Those problems influence and obstruct child's growth (Gregory et al., 2017).

Linier growth restriction causes child's height below normal or stunting. A child is called stunting if the height is  $\leq 1$  SD in WHO growth curve. Stunting child grow slower than another children (IDAI, 2017). There are many cases of stunting in toddlers found in Africa and Asia with the greater percentage in Asia (87 million of toddlers). In 2016 mostly 151 million of toddlers suffer from stunting (FAO et al., 2018). The chronic malnutrition reflects the failure in the adequacy of nutrition intake in long period because of bad dietary habit, recurrent infection, and chronic disease. The long term effect from stunting includes cognitive and physical decline in growth; the decrease of productivity; and

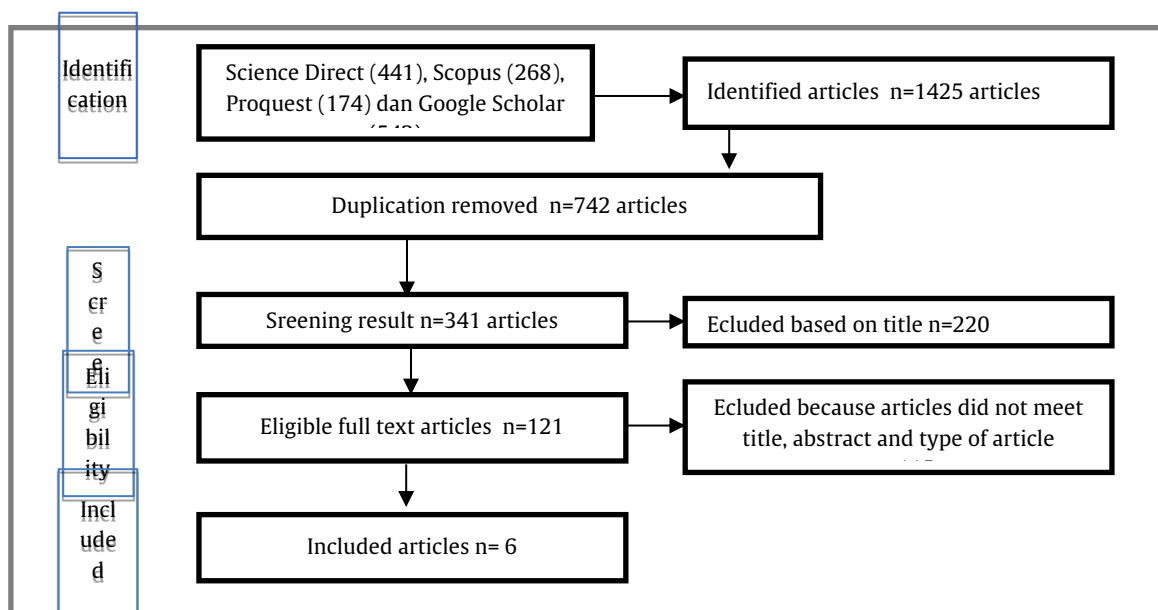
the increase of the risk of degenerative disease, such as diabetes (Geberselassie et al., 2018). Moreover, children with obstructive growth has fast weight gain and has the risk of obesity in the future (Gowele et al., 2021).

Administration of zinc for toddlers as preventive or curative action for growth improvement and decrease stunting prevalence has been done in various countries. In Indonesia zinc syrup is given as preventive or curative action (Purnamaningrum & Margono, 2019). In another countries, zinc supplementation is also given whether in a single form as well as in combination with other micronutrients as an effort to solve malnutrition problem (Hill, 2017)..

Some findings showed contradiction of zinc in the case of stunting. In a national study in Iran, it was found that there was no significant correlation between zinc level and the case of stunting (Sharif et al., 2020). Casualty relation between zinc and stunting was also could not be proved in the research in Calvinia (van Stuijvenberg et al., 2015). Considering other findings, literature review is needed in order to get clear view in determining a policy regarding zinc administration in the case of stunting. The aim of this study is to analyze zinc supplementation in stunting according to the previous research and findings. The result can be used as the input and consideration in using a single micronutrient supplementation in stunting administration.

## METHOD

The method used in this study is literature review. Data were collected from various researches about the effect of Zinc towards stunting by search engine: Science Direct, Scopus, Proquest, and Google Scholar. The key word of the search was Zinc/Zn supplementation, and stunting. The articles in inclusion criteria were full text article which were published in 2012-2021, whereas the articles in exclusive criteria were articles which were not in full text and articles without clear sources. The collected articles were identified and filtered according to the suitability towards the topic. The proper article would be chosen and selected, so that those articles were included in the analyzed articles.



Flow Chart

RESULTS AND DISCUSSION

Table 1  
 Data and Information Extraction from Article Study

No	Author & Year	Title	Design	Variable	Result
1	Adriani & Wirjatmadi, (2014)	The effect of adding zinc to vitamin A on IGF-1, bone age and linear growth in stunted children	Design Experiment with <i>Randomized Controlled Trial</i> , <i>double-blind</i> in the toddlers aged 48-60 months	Supplementation of vitamin A and zinc, the rate of retinol serum, the rate of zinc serum, IGF-1 hormone, the rate of C-reactive protein (CRP), the rate of gamma globulin, Bone age and index TB/U	There was the significant increase of the rate of retinol serum, zinc, IGF-1 hormone, gamma globulin and height index in intervention group and there was the significant decrease in infection/inflammation measured CRP level. There was significant correlation between CRP level and TB/U, and gamma rate and height for certain ages. Supplementation of vitamin A and zinc decrease the risk of infection and child's linear growth and control infection and stunting towards toddlers.
2	Kusudaryati et al.(2017)	The effect of Zn supplementation towards the change of stunted toddlers' TB/U index aged 24-36 months	Design experiment <i>pre test post test</i> with randomized controlled group	Zn supplementation, Z TB/U score, term of diarrhea, morbidity	The change of Z TB/U score of controlled group significantly higher than compared group (p=0,006). Energy in take, protein, and Zn of controlled group is higher than compared group (p=0,009, p<0,001, p<0,001, successively). The term of diarrhea (p=0,045) and morbidity (p=0,019) of treatment group is lower than controlled group.
3	Abdollahi et al. (2019)	Zinc supplementation is an effective and feasible strategy to prevent growth retardation in 6 to 24 month children: a pragmatic double blind, randomized trial	Experiment with multi-central randomization <i>double-blind</i> and parallel group in toddlers aged 6-24 months	Zinc supplementation, height growth, concentration of zinc serum and ferritin	There was a significant difference in the increase of average height. There was not any significant difference in the concentration of zinc serum and ferritin. Prevalence of Zinc deficiency is significantly in intervention group compared to placebo group. There was not any complication and side effect reported and well obedience (7 of 344 toddlers did not take the syrup properly).
4	Barffour et al. (2019)	Effects of daily zinc, daily multiple micronutrient powder, or therapeutic zinc supplementation for diarrhea prevention on physical growth, anemia, and micronutrient status in rural laotian children: a randomized controlled trial	Experiment with <i>Randomized Controlled Trial</i> in the toddlers aged 6-23 months in Khammouane Province, Lao PDR	Anthropometry, the status of hemoglobin, the status of zinc, and the status of iron	Although increasing the status of zinc, the administration of zinc and micronutrient powder as the preventive action did not give significant effect towards the growth. Micronutrient powder increases the status of iron and decrease anemia in previous anemia group.
5	Hendrayati et al. (2020)	The effectiveness of zinc supplementation toward bio-chemistry status and nutrition intake towards toddler after the administration of high doze vitamin A	Experiment, <i>pretest post test design</i> , with <i>double blind</i> method in 45 <i>stunted</i> toddlers aged 2-4 years	Zinc supplementation, energy intake, carbohydrate intake, protein intake, fat intake, bio-chemistry status	The administration of zinc supplementation after high doze vitamin A towards stunting toddlers was effective enough in bio-chemistry status and it was not effective in energy intake and macro nutrients
6	Hayman et al. (2021)	Zinc supplementation with or without additional micronutrients does not affect peripheral	Random controlled experiment towards 388 toddlers aged 9-11 months in	Zinc supplementation, peripheral blood gene expression, and cytokines level	One of the effects of zinc intervention was undetected in peripheral blood gene expression in the end of intervention. The effect of intervention towards the concentration of cytokines was undetected as well. From the

blood gene Dhaka,  
expression or serum Bangladesh  
cytokine level in  
Bangladeshi Children

exploration analysis, there was no correlation between malnutrition (identified as stunting, underweight or wasting) with peripheral blood gene expression. Zinc intervention towards the toddlers did not produce gene expression or cytokines sign in peripheral blood.

### ***Zinc Supplementation and Stunting***

Zinc is called as micronutrients because it is needed by the body in a small amount. Zinc absorption is about 10-40% from the total absorption per day; that is 4-14 mg/day. Zinc is absorbed by the stomach, colon, and jejunum. The process of zinc absorption can be disturbed by the bond of the agents which change unabsorbed mineral (Rahfiludin & Ginandjar, 2013). The lack of micronutrients chronically, in this case zinc, can cause malnutrition condition in toddlers, one of them is stunting, therefore zinc deficiency correlates with stunting (Wellina et al., 2016)..

Based on the analysis of the result of the experiment which has been collected, the administration of zinc gives positive effect towards child's linear growth. The combination of zinc with another micronutrient can lower the rate of morbidity and the possibility of infections towards the child. Zinc supplementation as a therapy is used to decrease the duration of diarrhea towards the child (Dhingra et al, 2020) and as a part of Guidelines of Integrated Management of Sick Toddlers about diarrhea medication (World Health Organization, 2014). Zinc supplementation as prevention is available in independent dispersion tablets; or through fortification given in the household in form of micronutrients powder and has been considered as a potential strategy to prevent zinc deficiency in low development countries. This approach is beneficial in reducing diarrhea, increasing child development and lower mortality rate (Hayman et al., 2021). Zinc as an important element in cell metabolism, plays important role in transcription factors and involved in the activity of many enzymes and cellular function (Kambe et al., 2015). The experiment on lymphocyte cell line exposure in zinc supplementation shows thousands genes that support the growth. The lack of zinc increase the risk of inflammation, therefore it should be modified with zinc supplementation (Wessels et al 2017). The administration of systemic zinc has been considered increasing the function of child's immune. It mediates the metabolism and give beneficial effect toward clinical child health and immune (Uwiringiyimana et al., 2019)..

In this study, zinc supplementation did not show significance towards the possibility of being effected by exposure of metal pollution such as lead (Pb). Child with high concentration of lead has the rate of low zinc serum or other reasons. Lead is found in several fish products which may be consumed daily by the children (Pramono, Panunggal, Rahfiludin, et al., 2016). The contradiction of the result is found, but zinc supplementation showed the increase of growth and the average of child's height (Kusudaryati et al., 2017; Abdollahi et al., 2019), although the status of child's bio-chemistry remains the same. The lack of zinc intake has less contribution towards zinc deficiency in child population where stunted child has low zinc serum rate compared to normal (Pramono, Panunggal, Anggraeni, et al., 2016). Because of that, the strategy of Zinc administration can be considered to prevent growth inhibition and nutrition

improvement in order to restore the nutritional status of children.

### ***Zinc and other micronutrients in fulfillment nutrition in stunting management***

The lack of nutrition is affected by various aspects including the lack of access towards healthy food, poverty, variation of extreme climate, and natural disaster (FAO et al., 2018). The condition of macronutrient and micronutrient deficiency affects child growth, moreover, if it is happen in long period. Complex micronutrient deficiency related to stunting (Nugraheni et al., 2020).

Micronutrient sufficiency is affected by the low of energy which often reported from the complementary food is Southeast Asia. Feeding practice for toddler is affected by economy, culture, neglectful parenting causes nutrition inadequacy and imparity of micronutrient rate in toddler's body (Arsenault et al., 2013; Diana et al., 2017).

Perhaps single micronutrient administration is not related to linier growth, considering complex link in the metabolism process. The combination of micronutrient in complementary food correlated in growth (Cespedes & Hu, 2015), because of that, it is difficult to distinguish independent contribution of single micronutrient towards child growth (Haszard et al., 2019).

### **LIMITATION OF THE STUDY**

This research does not apply meta-analysis which is more specific. Therefore the analysis of data collected from the articles is not detail.

### **CONCLUSIONS AND SUGGESTIONS**

Zinc supplementation has been proved giving positive significant result towards toddler's linier growth. However, the adequacy of other micronutrient must be noticed in giving nutrition for toddlers. We still suggest stunting treatment using zinc supplementation considering other micronutrients to maintain homeostasis of the growth and recovery in the case of stunting.

### **ETHICAL CONSIDERATIONS**

#### **Funding Statement**

The writer does not receive any financial supports from any organization for the submitted work.

#### **Conflict of Interest Statement**

There is no conflict of interest in writing this article. In the last 3 years, the writer interest is the topic of child and maternal health, especially child health and stunting.

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