Environmental Factors Associated with Incidence of Stunting in Toddlers: Literature Review

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Abstract
Stunting is a public health problem that receives special attention because it is related to human resources in the future. Many studies state that stunting is related to nutritional problems in toddlers, only a few studies show that environmental factors are an indirect cause of stunting in toddlers. The purpose of this systematic study was to describe the relationship between environmental factors and the incidence of stunting in toddlers. This literature study used a scoping review method by searching through several search engines such as Scopus and nature and science direct databases supported by Diponegoro University. The articles selected for review are articles that contain the results of observational studies (cross-sectional, cohort and case control) that analyze environmental factors with the incidence of stunting in toddlers. From 7 articles, only 1 study stated that environmental factors did not affect the incidence of stunting, 6 other articles stated that environmental factors were an indirect cause of stunting in toddlers. Environmental factors related to stunting are the source of drinking water, the practice of haphazard defecation, the presence of animal waste in the living environment, environmental enteric dysfunction, the availability of proper toilet, the practice of washing hands with soap when feeding children, exposure to cigarette smoke, exposure to PM 2.5, household waste and clean and healthy living behavior.

Keywords: environmental factors, stunting, behavior, sanitation, toddlers

1. Introduction
Stunting is a chronic condition that describes stunted growth characterized by low height or the body is shorter than other children in his age.[1] Toddlers are categorized as short if the calculation of the Z score for the height-for-age index (H/A) is less than -2 standard deviations (SD) based on the World Health Organization (WHO) standards [2].

Stunting is a child health major problem in worldwide, especially in middle- and low-income countries [3][4]. According to the United Nations International Children's Emergency Fund (UNICEF), one in three children under five years’ experience stunting problems and 40% of children under five who experience stunting problems are in rural areas [5]. Based on this statement, the World Health Organization (WHO) has set several targets for health problems globally, including reducing stunting cases as much 40% in 2030, especially for children under five years old (toddlers) [6].
The incidence of stunting is closely related to neurodevelopment and poor health from childhood to adult. Linear growth disorders (stunting) that occur in children under five can increase the risk of stagnant height in their teens, and continue causing health problems in adulthood. According to research, when a child is stunted at the age of five, they have 27 times the risk of having stagnant height before entering puberty [7]. Toddlers who experience stunting are at risk of decreasing intellectual abilities, productivity and an increased risk of having disease in the future. This is because children with stunting problems also tend to be more susceptible to get infectious diseases [8]. Stunting can increase the risk of obesity because people with short stature also have low ideal body weight, gain a few kilograms can make a person's Body Mass Index (BMI) increase beyond normal limits. A condition of overweight and obesity that last long will increase the risk of degenerative disease in the future [9].

The efforts to increase children's growth are long-term investments that are very important, for this reason various studies on stunting are focused on intervention to increase food intake with assumption that slow growth in child is caused by children not eating enough and lacking good nutrition, many research is focused on efforts to identify nutritional improvements as a solution. The results of research on effect of improving food intake on children's growth resulted in a conclusion that strong nutrition is very important, but in fact it is not enough to guarantee optimal linear growth [10]. The results of a recent study found implications for the influence of the environment, the research states that environmental factors are indirect factors in the incidence of stunting. The environmental factors that influence stunting are the availability and sources of water, availability of toilet, haphazard defecation behavior, environmental sanitation. Stunting is closely related to infectious diseases caused by environment; this is the beginning of environmental factors that cause stunting in toddlers.

2. Material and Method

This study uses a systematic review method to summarize the results of research in the last 5 years. The data source comes from journals subscribed by Universitas Diponegoro (Undip) using the keywords “stunting and environmental and health”. Journal searches were carried out through databases: Scopus, Nature and Science Direct. The selection of articles is also based on the observational research design.

The data or information obtained from the article presented into the form of a synthesis matrix table as:

![Figure 1. Screening Process articles](image-url)
3. Result and Discussion

Based on Table 1, from 7 journals that fulfill the requirements there are 9 variables from environmental factors are the causes of stunting.

<table>
<thead>
<tr>
<th>No.</th>
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</table>
| 1.  | Nurjazi,
Budiyono,
Mursyid
Raharjo and Nur
Endah
Wahyuningsih. [11] | The aim of this study was to determine the environmental factors associated with stunting in Salatiga, Indonesia. | Methods in this study is observational analytic research using cross sectional research design. | The sample in this study were 251 stunted toddlers. | Toddler age, toddler health history, household environmental conditions, coliform detection from drinking water, exclusive breastfeeding. | Research states that environmental factors do not contribute to stunting, but boiled water is believed as a risk factor for stunting. Research shows that exclusive breastfeeding has correlation with stunting and provides a protective factor for stunting in toddlers. |
| 2.  | Zemichael
Gizaw,
Alemayehu
Worku Yalew,
Bikes Destaw
Bitew, Jiyong
Lee & Michael
Bisesi. [12] | This study was conducted to assess the relationship between stunting and sanitation, enteric infections, and EED in children aged 24–59 months in rural north western Ethiopia. | Methods in this study is observational analytic research using cross sectional research design. | The sample in this study was 224 children aged 24–59 months in rural areas in the eastern Dembiya district that randomly selected | The variables in this study were poor food intake, poor hygiene and sanitation, haphazard defecation, animal feces in the environment, e-coi contamination in drinking water, incidence of diarrheal disease, intestinal parasites in children and environmental enteric dysfunction disease | Research shows that poor food intake, the practice of haphazard defecation, animal waste in living environment, sources of drinking water, and environmental enteric dysfunction are the causes of stunting in toddlers. |
| 3.  | Biruk
Woldesenbet,
Alemu Tolcha,
and Berhan
Tsegaye. [13] | The aims of this study is to assess the prevalence and factors associated with stunting in children aged 24-59 months in Lemo district, southern | Methods in this study is observationa l analytic research using cross sectional research design. | The sample in this study were 415 toddlers who were randomly selected. | Variables in this study were the age of toddler, mother's education, availability of proper toilet, haphazard defecation, the incident mothers not | Research shows that there is a significant relationship between the education level of mothers, the availability of proper toilet, children feces that disposed unsafely, and... |
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<td>4.</td>
<td>Suzhen Cao, Muxing Xie, Chunrong Jia, Yawei Zhang, Jicheng Gong, Beibei Wang, Ning Qin, Liyun Zhao, Dongmei Yu, and Xiaoli Duan. [14]</td>
<td>The aims of this study is to find out the relationship between the height of school-age children and the exposure of cigarette smoke after birth at home</td>
<td>Method in this study is observationa l analytic research using a cohort research design</td>
<td>The sample in this study was 41,439 children aged 6-17 years who were recruited from 30 provinces in China using a multi-stage stratified random sampling approach.</td>
<td>The variables in this study were age, smoking behavior, and duration of exposure to cigarettes</td>
<td>This study shows that exposure to second-hand smoke in the household inhibits the growth of school-age children, and this finding prove the need to promote smoking-free home.</td>
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<td>5.</td>
<td>Priyanka N. deSouza, Melanie Hammer, Peter Anthamatten, Patrick L. Kinney, Rockli Kim, S. V. Subramanian, Michelle L. Bell &amp; Kevin M. Mwenda. [15]</td>
<td>The aim of this study was to evaluate the relationship of prenatal and early life exposure to PM2.5 and child malnutrition as captured by high-for-age z-scores (HAZ), and stunting in 32 countries in Africa.</td>
<td>Methods in this study is observationa l analytic research using a cohort research design</td>
<td>The sample in this study was 264,207 toddlers</td>
<td>Variables in this study are gender, child nutrition, exposure during childhood in gestational age, wealth quintile, and urban/rural</td>
<td>There is a relationship between in utero and early life exposure to PM 2.5 as an important sign of malnutrition in childhood.</td>
</tr>
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<td>6.</td>
<td>Lefebo, Berhanu Kibemo, Kassa, Dejene Hailu, Tarekegn, and Baye Gelaw. [16]</td>
<td>The purpose of this study was to determine the relationship between intestinal inflammation and stunting in toddlers</td>
<td>Methods in this study is observationa l analytic research using cross sectional research design.</td>
<td>The sample in this study were 82 toddlers</td>
<td>The variables in this study were place to stay, history of diarrheal disease, duration of breastfeeding, and number of family members</td>
<td>There is a relationship between intestinal inflammation due to diarrheal infectious diseases caused by environmental enteric dysfunction and the incidence of stunting in toddlers.</td>
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<td>7.</td>
<td>Muhammad Anis Muslim et al [17]</td>
<td>The aims of this study is to analyze the effect of spatially correlated sanitation risk</td>
<td>Method in this study is observationa l analytic research using a cohort</td>
<td>The sample in this research is 3000 respondents.</td>
<td>The variables in this study are Environmental drainage (greywater), Solid Waste, Environmental Engineering</td>
<td>Research states that environmental factors related to stunting, namely environmental drainage</td>
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on the incidence of stunting in toddlers in Malang, Indonesia.

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<td></td>
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<td>research design.</td>
<td>and Domestic Waste water (greywater), solid waste, and domestic waste water (black water), according to researchers of a clean and healthy lifestyle and water sources have a smaller influence on sanitation risks. This study explain that sanitation has an important influence on the incidence of stunting.</td>
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All variables related to statistics are factors that influence the incidence of stunting based on the similarity of results between researchers. These factors are the source of drinking water (articles 1, 2 and 7), the practice of haphazard defecation (articles 2 and 3), the presence of animal waste in living environment (article 2), environmental enteric dysfunction (articles 2 and 6), availability of proper toilet (article 3), practice of washing hands with soap when feeding children (article 3), exposure to cigarette smoke (article 4), exposure to PM 2.5 (article 5), household waste (article 7), and clean and healthy living behavior (article 7).

3.1 Relationship between stunting and drinking water sources

Drinking water is a basic human need that must be fulfilled every day, but not all people get proper drinking water. Several studies, especially research in Indonesia, state that improper drinking water treatment can increase the incidence of stunting in toddlers, most of the stunted toddlers who live in rural areas have trouble with getting a proper source of drinking water. The requirements for proper water are drinking water that is not murky (clear), has no aroma, and not contaminated with chemicals that can cause children to stunting.[11] Research states that there are 81% of E-coly bacteria found in drinking water sources, inadequate drinking water sources are a risk factor of stunting (OR = 4.2)[12]

3.2 Relationship between Stunting Incidents and Open Defecation Practices

The results showed that 69% of households defecated in open areas. Research states that the practice of haphazard defecation in open area is associated with the incidence of stunting in toddlers. Haphazard defecation behavior can cause environmental pollution due to the spread of pathogenic germs from the anus, if these germs are touched by a child in growth period that has behavior putting his finger in his mouth can cause the child to consuming a number of bacteria which can infect the intestines. Intestinal infection conditions can be diarrhea and Environmental Enteric Dysfunction (EED) that can affect the nutritional status of children by reducing appetite, interfering with nutrient absorption which causes children to experience malnutrition and growth disorders. The results of the study stated that the practice of haphazard defecation is a risk factor for stunting (OR=3.0)[12].

3.3 Relationship between Stunting Incidents and the Presence of Animal Feces in the Environment Stay

Sanitation and environmental factors affect the health of pregnant mother and also the growth and development of children because children under 2 years are very vulnerable to exposure to various diseases. Exposure to animal feces that enter the mouth of a toddler while playing if it occurs continuously can increase bacterial infections which make it difficult for the body to absorb nutrients. The growth of brain cells which should be growth very rapid in the first two years of birth is hampered, the impact is that the child is at risk of suffering from stunting which results in impaired mental and physical growth so that the child's potential cannot develop optimally. Research states that there is 76% of animal waste in residents' homes, and research concludes that there is a significant relationship between the presence of animals in the neighborhood and the incidence of stunting [OR = 3.4].[12]
3.4 Relationship between Stunting and Environmental Enteric Dysfunction (EED)

Environmental Enteric Dysfunction (EED) is a syndrome of inflammation that incompletely defined, reduced absorptive capacity, and decreased barrier function in the small intestine. It is widespread among children and adults in low- and middle-income countries. Current understanding of EED and its health consequences is still limited.[18]

Poor environmental sanitation factors contribute to an increase in infectious diseases such as diarrhea, Environmental Enteric Dysfunction (EED), and helminthiasis. These conditions can inhibit growth resulting in stunting and can increase mortality in toddlers, infectious diseases can also disturb the process of absorption of nutrients and it will inhibit the growth of toddlers.[19]

Research states that statistically stunting in children is 3.4 times higher happen in children who have diarrhea compared to children who do not have diarrhea [12].

3.5 The Relationship between Stunting Incidents and Availability of Adequate Latrines

The availability of a toilet cannot be separated from the environmental conditions where human waste is disposed of, the availability of proper toilet is a human effort to maintain health by making the environment healthy [24]. Research states that the availability of proper toilet is a risk factor for stunting. Children who do not have proper toilet has a high probability to be stunted than their peers (OR = 3.6).[13].

3.6 The Relationship between the incident of Stunting and the Practice of Handwashing Using Soap when feeding the Children

Research states that the possibility of stunting among children whose mothers do not wash their hands with water and soap before eating or feeding their children is 1.7 times higher than their peers. This is related to food security, which is the adequacy of food supply for households in quantity, quality, nutrition are also determines the guarantee of security, equitable distribution and ability to buy, and have enough a healthy and active life.[13]

3.7 Relationship between Stunting and Exposure to Cigarette Smoke

The high prevalence of smoking fathers can cause risk factors for children as passive smokers, cigarette smoke is very dangerous for passive smokers. The cigarette smoke from active smokers inhaled by passive smokers will contain 5 times more carbon monoxide gas and 4 times more tar and nicotine. The infections of Lower respiratory tract and asthma also have potential to contribute to the growth and development of children. Cigarette smoke can affect thyroid disorders. Tobacco smoke contains several poisons such as thiocyanate which can cause goitre and 2,3 – hydroxyypidine which can cause thyroxine deiodinase by limiting the activity of iodothyronine deiodinase, this effect may not be significant but will greatly increase the serum thyroxine level. Infants whose parents smoke have higher serum concentrations of thyroglobulin and thiocyanate at birth and at the age of 1 year than infants whose parents do not smoke, this indicates a passive transfer effect of smoking (thiocyanate) stimulates thyroglobulin secretion, smoking during pregnancy is also reported causing neonatal thyroid dilatation. Research states that there is a significant relationship between the incidence of stunting and exposure to cigarette smoke (OR = 2.89).[14]

3.8 Relationship between Stunting and PM 2.5 Exposure

Particulate Matter (PM 2.5) are air particles smaller than or equal to 2.5 µm (micrometer). PM 2.5 concentration was measured using the Beta Attenuation Monitoring method with units of micrograms per cubic meter (µm/m3). Exposure to PM 2.5 in Africa is relatively high, research states that PM 2.5 is a risk factor for stunting in Africa [15]

3.9 Relationship between stunting and household waste

Household waste protection is carrying out waste management activities in the household by prioritizing the principles of reducing, reusing, and recycling. The review of household waste protection is to avoid unsafe waste storage, which is the collection, transportation, processing, recycling or disposal of waste material in a way that endangers public health and environment. Research has found that there is a significant relationship between household waste and the incidence of stunting.[16]

3.10 Relationship between the incident Stunting and Clean and Healthy Behavior

Clean and healthy behavior is health behavior that is carried out because of personal awareness that the family and all the members are able to help themselves in the health sector and have an active role in community activities. Clean and healthy behavior is basically an effort to pass on experiences regarding healthy behaviors through individuals, groups or the wider community with communication line as a medium for sharing information. There is a variety of information that can be shared such as educational materials to increase knowledge and improve attitudes and behavior related to a clean and healthy life. [17]

Clean and healthy behavior is a social engineering to make as many members of the community as agents of change so that they are able to improve the quality of daily behavior to have a clean and healthy behavior.
life. Research states that there is a significant relationship between clean and healthy behavior and the incidence of stunting in toddlers.[17]

4. Conclusion
The results of this review study stated that environmental factors associated with the incidence of stunting were sources of drinking water, the practice of haphazard defecation, the presence of animal feces in living environment, environmental enteric dysfunction, the availability of proper toilet and the practice of washing hands with soap when feeding children. Exposure to cigarette smoke, exposure to PM 2.5, household waste and clean and healthy behavior. From this systematic review, it was found that the most dominant factor was the source of drinking water.

5. Suggestions
Researchers initiate suggestions to the government, not only giving adequate nutrition for toddlers but also pay attention to environmental aspects which are an indirect cause 6.

6. Acknowledgments
Thanks to Onny Setiani as the main supervisor and Yusniar Hanani Darundati, S. as the second supervisor, who have provided advice and guidance in preparation of this literature review article. Thank you to the Department of Environmental Health Masters, Faculty of Public Health, Diponegoro University, for supporting us during the process of writing this article. Hopefully this article can be useful for many people and can be used as a reference in making a literature review of stunting.

7. References