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Submission date: 10-Apr-2023 01:31PM (UTC+0700)

Submission ID: 2060343613

File name: STUNTING_IN_CHILDREN_AGED_12-59_MONTHS_IN_OGAN_ILIR_REGENCY.pdf (834.67K)

Word count: 8117

Character count: 41994

ENVIRONMENTAL SANITATION AND INCIDENCE OF STUNTING IN CHILDREN AGED 12-59 MONTHS IN OGAN ILIR REGENCY

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Article Info

Submitted : 18 May 2020
In reviewed : 12 June 2020
Accepted : 21 July 2020
Available Online : 31 July 2020

Keywords : *Incidence of stunting, age 12-59 months, physical quality of clean water, quality of sewerage , quality of latrines*

Published by *Fakultas Kesehatan Masyarakat Universitas Airlangga*

Abstract

Introduction: *Ogan Ilir is one of the three regency with the highest stunting incidence in South Sumatera. Environment factor is indirect causes of stunting in toddlers. The objective of this study therefore was to analyze the correlation between environmental sanitation with the incidence of stunting on toddler in Ogan Ilir Regency. Method: An observational analytical with a Cross sectional approach was conducted to determine incidence of stunting and associated environmental sanitation factors among toddler. Samples were toddler aged 12-59 months around 152 which selected by Multi Stage Cluster Sampling. Data was collected through interviews using questionnaires and observation was using checklist. The data was analyzed using Analysis of covariance test at ($\alpha=0.05$). Result and Discussion: There was significant association between physical quality of clean water with incidence of stunting ($p=0.036$). Also, quality of sewerage significantly correlated to incidence of stunting ($p=0.011$). Significantly association also found between quality of latrines with incidence of stunting ($p=0.005$). On the other hand, history of infectious disease ($p=0.100$), personal hygiene ($p=0.347$), pesticide exposure ($p=0.06$), and cigarette smoke exposure ($p=0.077$) were not associated with incidence of stunting. Conclusion: Indirectly, the incidence of toddlers stunting is determined by environmental sanitation.*

INTRODUCTION

Henry L. Blum in his theory explains that health status is determined by 4 (four) main factors including environmental, behavioral, health services and genetic. A good health status will be achieved if all four components are in optimal condition. The environment became the largest contributor among the four factors in influencing health status (1). The environment consists of physical, biological, chemical and social components where each of these components can affect the occurrence of a disease or health disorder.

Basic sanitation conditions that include the quality of drinking water, quality of clean water, the way of disposal of feces, disposal of waste water, the way of handling bad waste is the main cause of infectious diseases such as diarrhea and helminthiasis. Infectious diseases cause impaired nutrient absorption in the digestive process. Infection of the baby can cause the infant weight to fall, if this condition lasts for a long time without adequate intake for the healing process, then it can lead to stunting (2-3).

The environment is an indirect factor of the cause of stunting in children (2). Poor quality of clean water, sanitation and hygiene of individuals is clearly recognized as a contributing factor to stunting (4). While the direct factor causes stunting is the health status and nutritional status of mothers before and during pregnancy and after childbirth, maternal posture (short), the distance of pregnancy is too close, mothers who are still young, and the intake of nutrients that are lacking in pregnancy (2).

Previous research results found a meaningful correlation between environmental sanitation and child stunting (5). A significant household wastewater is associated with stunting (6-7). Clean water sources, surface water use and access to clean water are associated with stunting in children (6, 8-9). The use of latrines in quality is not good to be a risk factor for the children to be stunted and there are differences in children's body of 6-35 months based on the cleanliness of the latrines (6,10).

Exposure to chemicals in the environment is also an indirect cause of children's stunting incident. There are several pesticide groups known as *Thyroid Disrupting Chemicals* (TDCs) which result in hypothyroidism. Hypothyroidism experienced by expectant mothers resulted in impaired growth and development of fetal birth. Women of childbearing age and expectant mothers with a history of exposure to pesticides at risk for childbirth stunting the research in Brebes mentions pesticide exposure in children to be the highest risk factors of stunting (11).

The harmful chemicals from cigarette smoke such as carbon monoxide and nicotine have a bad impact on the expectant mothers and fetuses they contain. Nicotine stimulates the catecholamine hormone so that the heart is encouraged to raise blood pressure resulting in changes in heart rate and blood flow in the umbilical and inducing hypoxia against the fetus so that the onset and fetal development becomes impaired. Children with a history of 2.686 times larger cigarette smoke exposure will become stunting than the unexposed cigarette smoke (9).

Stunting is a state aged 0-59 months in which the length or height based on age is at the <-2 SD of the median World Health Organization (WHO) standard (3). The WHO notes 150.8 million (22.2%) Stunting children in the world in 2017. Children who have more than half of stunting in Asia (55%) and more than a third (39%) In Africa. Children stunting in Asia is 83.6 million where most (58.7%) from South Asia while the fewest ones are in Central Asia (0.9%) (3). One of the countries in South Asia with high stunting in children in the year 2011 is Bangladesh which reaches 41% (12).

Indonesia is facing a problem of stunting toddlers as a major nutritional problem today than underweight, wasting and overweight. Nutritional Status Monitoring data in the last three years explains the prevalence of stunting children tend to be higher than underweight, wasting and overweight. The percentage of toddlers was stunted in 2015 (29%), year 2016 (27.5%), and year 2017 (29.6%). Infants with underweight year 2015 (10%), year 2016 (17.8%) and in 2017 (17.8%). The percentage of toddlers who experienced wasting in years 2015 (11.9%), year 2016 (11.1%), year 2017 (9.5%). While the overweight toddlers year 2015 (5.3%), the year 2016 (4.3%), and the year 2017 (4.6%) (3). Basic Health Research result in 2018 noted toddler nutritional problem where 11.5% severe stunting and 19.3% stunting, severe underweight 3.85%, underweight 11.4%, severe wasting 4.2% and wasting 7.2% (13).

According to WHO the result of stunting in short term is increased morbidity and mortality and untimely development of children later. The long-term impact on the next life is not optimal posture when adult, the risk of obesity increases, more susceptible to degenerative diseases, the occurrence of intellectual decline and decreased reproductive health and decreased productivity (3).

The result of Nutritional Status Assessment in South Sumatera Province in 2017 indicates that the stunting prevalence is at 22.8%. The highest prevalence is in 3 (three) districts including the North Musi Rawas, Banyuasin 32.8% and Ogan Ilir by 29.5% (14). While

the results of Basic Health Research year 2018 reported that in South Sumatera Province there is a toddler with severe stunting 14.4% and stunting 17.2% (13)

The quality of basic sanitation of residential environment in several sub-districts in Ogan Ilir Regency is relatively low, especially settlements located on the riverbank, swamps, and peatlands. Clean water sources some people still use river water for the purpose of each day as raw water for drinking water, cooking food, eating groceries, washing tableware, and for personal hygiene purposes. The habits of some people who still defecation in rivers, as well as dispose of household wastewater and garbage to the river caused the worse the water quality of the river. In addition to river water, well water is also the main source of clean water for residents in Ogan Ilir regency, especially those residing in areas other than wetlands. Well sourced water pollution from discarded household waste water without a qualifying sewer. In addition to environmental sanitation conditions that are generally still relatively bad, the risk of exposure to households such as antimosquito relatively high. The use of antimosquito in households in Indralaya Ogan Ilir District reached 72% (15). Behavior handling of antimosquito majority is still poor (62.67%) (16). Source of livelihood of some people in Ogan Ilir is from agriculture sector so it is possible to be exposed to pesticides both when the application of pesticides in the garden as well as exposure that may be received because of pesticide storage in the house or around the house.

Starting from the condition of environmental factors and the figures of stunting in children in Ogan Ilir Regency, need to be analyzed by the environmental sanitation correlation with stunting incidence aged 12-59 months.

METHOD

This research was an analytical type of observational with cross sectional study approach, conducted in Ogan Ilir Regency. a cross sectional study was conducted with the aim of analyzing the basic sanitation correlation of the environment with stunting, which measured the measurement of exposure and its effects and analysis at the same time.

The population was all children aged 12-59 months who reside in Ogan Ilir Regency. Samples were some toddlers aged 12-59 months residing in Ogan Ilir selected Multi Stage Cluster Sampling. The first chosen 3 (three) sub-districts were randomly in Ogan Ilir District where the chosen was Indralaya Sub-district, Tanjung Batu Sub-district and West Pemulutan Sub-district. Then, each elected sub-district was taken randomly, namely Muara Penimbung Ulu Village and Tanjung Seteko

Village for Indralaya Sub-district, Tanjung Batu Village and Tanjung Batu Timur Village for Tanjung Batu Sub-district and Talang Pangeran Village for West Pemulutan Sub-district. This process was done as an effort to obtain a representative sample, given that the subject spread widely within one district.

Children aged 12-59 months later were randomized from each selected village to serve as a sample of research. If inside a household there were more than one toddler aged 12-59 months then that was taken was the last child of the toddler. Children with a history of congenital illness were not included in this study to avoid bias (17). Respondents were the mothers of infants elected to research samples.

Based on the calculation of obtained a large sample of 152 toddlers who were determined according to the formula of the hypothesis test two different population proportions from Lemeshow as follows:

$$n = \frac{\{Z_{1-\alpha/2}\sqrt{2P(1-P)} + Z_{1-\beta}\sqrt{P_1(1-P_1) + P_2(1-P_2)}\}^2}{(P_1 - P_2)^2} \times D_{eff}$$

The minimum required number of samples expressed with N, the level of significance (for $\alpha = 0.05$ is 1.96) declared $Z_{1-\alpha/2}$, the power of test (for $1-\beta = 80\%$ is 0.842) declared $Z_{1-\beta}$, the proportion of the stunting incident in the exposed group risk factor was P_1 , while P_2 was the proportion of stunting incident in groups not exposed to risk factors, P was averaging P_1 and P_2 . Because sampling techniques were clusters, then large samples were calculated by the design of the effect (times two) (18). The minimum sample calculation result was 68. Then a large minimal sample was multiplied by 2 (the design effect value) so that it became 136 and then coupled with a large 10% sample of the result was being 150 and completed into 152.

Dependent variable was a stunting occurrence divided into 2 (two) categories that were stunting when Height-for-Age z score (HAZ) < -2 SD and normal when Height-for-Age z score (HAZ) \geq -2 SD. Independent variables consisted of personal hygiene, history of infectious diseases, physical qualities of clean water, sewerage quality, latrines quality, pesticide exposure and cigarette smoke exposure.

Primary data collection through a questionnaire interview was variable age of toddlers, personal hygiene, history of infectious diseases, pesticide exposure and cigarette smoke exposure. Observation by using a checklist was done to collect data on physical quality of clean water, quality of sewerage, and quality of latrines. Data to determine the stunting incidence was collected by measuring the length of the child's body use infantometer

for children aged 12-24 months and for toddlers aged > 24-59 months using microtoise. The physical quality of clean water checks included colour, smell and taste. The data processing started from the editing step then coding the numbers to facilitate the processing of the data on each of the variables. Determination of the measuring result of each independent variables (personal hygiene, physical quality of clean water, quality of sewerage, quality of latrines, pesticide exposure, and cigarette smoke exposure) was carried out by the method of scoring then made into a measurement result in the form of categories. The next step was data entry using SPSS software then analyzed and presented in the form of a table univariate and bivariate table.

The data analysis stages began with a univariate analysis of all independent variables as well as the dependent variables. Next up was bivariate analysis to test the significance of a independent variable correlation with a dependent variable using the covariance analysis on alpha ($\alpha = 0.05$). The covariance analysis was done by controlling other variables that can affect the stunting incidence so it can be ensured that the sanitation factors are the environment affecting the stunting incident.

This research had been declared ethical by the Ethics Committee of Health Research Public Health Faculty of Sriwijaya University based on certificate of Certification of Information No: 386/UN 9.1.10/KKE/2019. The collection of research data in the field was done after obtaining the research permit. The licensing process was initiated from the Dean of Public Health Faculty Sriwijaya University by giving a cover letter to permit research permits to the Directorate General of the Unity of Nations and Politics of Ministry of Interior (Kesbangpol) of Ogan Ilir, then the Directorate General of the Unity of Nations and politics of Ministry of Interior (Kesbangpol) Ogan Ilir issued a letter to the District Health Office of Ogan Ilir and the third district where research in Ogan Ilir regency to be granted research permits. Data collection was done after the respondent was first given explanation of the purpose and benefit of the research and sign informed consent.

RESULT

Univariate Analysis of Personal Hygiene, Environmental Sanitation, and Stunting Incidence

Results of analysis of the univariate data on the measurement of toddler nutrition status according to *Height-for-Age* z score (HAZ), obtained by children with stunting 14.5%, short 20.4%, and normal 65.1%. Proportion of male toddlers (55.3%) higher than women, the level of education of most of the toddler mother is still relatively low (Elementary School and Junior

High School), the majority of the mother of toddlers only as housewives (56.65%). The Personal hygiene of the toddler is mostly good (63.2%). The majority of respondents were exposed to pesticides in the household (77.6%) and the presence of cigarette smoke in the house (65.1%).

Table 1. Univariate Analysis of Personal Hygiene, Environmental Sanitation and Stunting Incidents in Toddler in Ogan Ilir District

Variable	n	%
Stunting incidents		
Severe stunting	22	14.5
Stunting	31	20.4
Normal	99	65.1
Toddler's gender		
Male	84	55.3
Woman	68	44.7
Mother's Education		
No School	1	0.7
Elementary	51	33.6
Junior high school	47	30.9
Senior High School	41	27.0
Collage	12	7.9
Maternal work		
Housewives	86	56.6
Civil servant/state-owned enterprises	4	2.6
Private officers	5	3.3
Self employed	43	28.3
Farmer/Worker	14	9.2
Pesticide exposure		
Have	118	77.6
No	34	22.4
Cigarette smoke exposure		
Have	99	65.1
No	53	34.0
Personal hygiene		
Not good	56	36.8
Good	96	63.2
Main sources of drinking water		
Rechargeable water	74	48.7
Well water	63	41.4
River water	15	9.9
Water source for cooking		
Well water	72	47.4
River water	80	52.6
Physical quality of clean water		
Not good	70	46.1
Good	82	53.9
Quality of latrines		
Not using latrines	15	9.9
Not good	54	35.5
Good	83	54.6
Quality of sewerage		
Not using sewerage	78	51.3
Not good	32	21.1
Good	42	27.6

The source of household drinking water is mostly refill water (48.7%) and well water (41.4%) While water to cook the majority using river water (52.6%) The physical quality of the eligible (good) clean water (53.9%). Not using latrines (open defecation on a river) by 9.9% of respondents, using latrines that does not good 35.5%, and 54.6% use a good latrines. People are still many

who do not have sewerage (51.3%) So that household wastewater is disposed of recklessly in the yard or directly flowing into the river, using sewerage that good 21.1%, and only 27.6% are good, as described in Table 1.

Environmental Sanitation Correlation Analysis with Stunting Incidence

Table 2 informs that the results of a covariance analysis show a history of infectious diseases controlled by personal hygiene not related to stunting in infants ($p = 0.100$) as well as personal hygiene as covariate (controller) does not significantly correlate with stunting incident ($p = 0.133$). The personal correlation of hygiene and the simultaneous history of infectious diseases of the stunting incidence is also insignificant ($p = 0.107$).

Table 2. Covariance Analysis of Infectious Disease History Correlation with Stunting Incidents in the Toddler in Ogan Ilir District

Source	Type III Sum of Squares	df	Mean Square	F	Sig
Corrected model	8.040 ^a	2	4.020	2.269	0.107
Intercept	49.969	1	49.969	28.205	0.000
Personal hygiene	4.047	1	4.047	2.284	0.133
Infectious disease history	4.839	1	4.839	2.732	0.100
Error	263.977	149	1.772		
Total	664.074	152			
Corrected Total	272.017	151			

^aR Squared = 0.030 (Adjusted R Squared = 0.017)
Dependent variable : Height-for-Age z score (HAZ)

The quality of sewerage relates to stunting incidence in children without being influenced by personal hygiene ($p = 0.011$). While personal hygiene is not related to the stunting incident ($p = 0.347$). But if simultaneously, the quality of sewerage and personal hygiene can be correlated with the stunting incident ($p = 0.013$), as seen in table 3.

Table 3. Covariance Analysis of Quality of Sewerage Correlation with Stunting Incidents on Toddlers in Ogan Ilir District

Source	Type III Sum of Squares	df	Mean Square	F	Sig
Corrected model	19.87 ^a	3	3.362	3.723	0.013
Intercept	44.461	1	44.461	26.016	0.000
Personal hygiene	1.519	1	1.519	0.889	0.347
Quality of sewerage	15.886	2	7.943	4.468	0.011
Error	252.931	148	1.709		
Total	664.074	152			
Corrected Total	272.017	151			

^aR Squared = 0.070 (Adjusted R Squared = 0.051)
Dependent variable : Height-for-Age z score (HAZ)

The physical quality of clean water is related to incidence of stunting children without the influence of personal hygiene toddlers ($p = 0.036$). Personal hygiene is not related to the stunting incident ($p = 0.257$) but if

simultaneously with the physical quality of clean water, it can be correlated with the occurrence of children stunting ($p = 0.046$), as shown in table 4.

Table 4. Covariance Analysis of the Physical Quality of Clean Water With A Stunting Incident to Toddlers in Ogan Ilir District

Source	Type III Sum of Squares	df	Mean Square	F	Sig
Corrected model	11.021 ^a	2	5.510	3.146	0.046
Intercept	51.552	1	51.552	29.430	0.000
Personal hygiene	2.264	1	2.264	1.293	0.257
Physical quality of clean water	7.820	1	7.820	4.464	0.036
Error	260.997	149	1.752		
Total	664.074	152			
Corrected Total	272.017	151			

^aR Squared = 0.041 (Adjusted R Squared = 0.028)
Dependent variable : Height-for-Age z score (HAZ)

Table 5. Covariance Analysis of Quality of Latrines Correlation With Stunting Incidents in Toddlers in Ogan Ilir District

Source	Type III Sum of Squares	df	Mean Square	F	Sig
Corrected model	21.940 ^a	3	7.313	4.328	0.006
Intercept	57.517	1	57.517	34.039	0.000
Personal hygiene	1.045	1	1.045	0.618	0.433
Quality of latrines	18.739	2	9.370	5.545	0.005
Error	250.077	148	1.690		
Total	664.074	152			
Corrected Total	272.017	151			

^aR Squared = 0.081 (Adjusted R Squared = 0.0620)
Dependent variable : Height-for-Age z score (HAZ)

Table 5 explains that the quality of the latrines is associated with the stunting incidence in infants without the influence of personal hygiene variables ($p = 0.005$) and personal hygiene itself is not related to the stunting incident ($p = 0.433$). Simultaneously between the quality of the latrines with personal hygiene correlated to the stunting incidence of toddlers ($p = 0.006$).

Table 6. Covariance Analysis of Pesticide Exposure Correlation with Stunting Incident in Toddler in Ogan Ilir District

Source	Type III Sum of Squares	df	Mean Square	F	Sig
Corrected model	9.506 ^a	2	4.753	2.698	0.071
Intercept	44.824	1	44.824	25.442	0.000
Personal hygiene	2.945	1	2.945	1.672	0.198
Pesticide exposure	6.306	1	6.306	3.579	0.060
Error	262.511	149	1.762		
Total	664.074	152			
Corrected Total	272.017	151			

^aR Squared = 0.035 (Adjusted R Squared = 0.022)
Dependent variable : Height-for-Age z score (HAZ)

Shown in table 6 that the pesticide exposure in the household with controlled by the personal hygiene variables, does not relate significantly with the stunting toddler cases ($p = 0.060$). Simultaneously between the

exposure of pesticides and personal hygiene also does not show a significant correlation with stunting in infants ($p=0.071$).

Table 7. Covariance Analysis of Cigarette Smoke Exposure Correlation with Stunting Incidents in Toddlers in Ogan Ilir District

Source	Type III Sum of Squares	df	Mean Square	F	Sig
Corrected model	8.816 ^a	2	4.408	2.496	0.086
Intercept	44.683	1	44.683	25.259	0.000
Personal hygiene	2.062	1	2.062	1.167	0.282
Cigarette smoke exposure	5.616	1	5.516	3.179	0.077
Error	263.201	149	1.766		
Total	664.074	152			
Corrected Total	272.017	151			

^aR Squared = 0.032 (Adjusted R Squared = 0.019)

Dependent Variable: Height-for-Age z score (HAZ)

Cigarette smoke exposure in the home does not relate significantly to stunting incident in children ($p=0.077$). In-house cigarette smoke exposure with personal hygiene is not simultaneously related to the stunting of toddler ($p=0.086$), as seen in table 7.

DISCUSSION

Correlation of Personal Hygiene with Stunting Incidence

Statistical results of the covariance analysis concluded that personal hygiene is not related to the stunting cases on toddlers. Toddlers who have a good personal hygiene that is measured by observation of body hygiene, nails, teeth and mouth, in fact the proportions have been higher (63.2%) than toddlers with poor personal hygiene. Nevertheless, there are toddlers with poor hygiene practices. The practice of maternal hygiene/caregivers is also still a lot less good when caring for toddlers. Like not to wash your hands with soap before feeding up toddler. Another example for poor personal hygiene of toddler is toddler play in a dirty environment and does not use footwear, then does not wash hands using soap before eating, and or after playing. Invisible nails of toddler that not cut regularly result in sticky dirt on the child's nails.

Based on personal hygiene theory, poor personal hygiene can increased risk of infectious disease transmission. The frequency of diarrhea and other infectious diseases such as Acute Upper Respiratory Infections (AURI) and helminthiasis which often occur in toddlers have an impact on the growth of toddler body. Long-term effects of diarrhea on toddler may result in the occurrence of growth deficits in height. This is because of the loss of zinc mineral in many quantities (19).

Previous studies have explained that there is a meaningful correlation between hygiene practices with

stunting incident in children, where children who grew up with poor hygiene practice care has the risk of being stunting more than children who grew up with good hygiene practice care. The behavior of hand washing with soap in children is one of stunting determinants, where children who does not wash their hands using soap have stunting risk, if compared with children who wash their hands with soap, the habit of washing mother's hand with soap is also related to stunting children (20-23).

The unproven significance of the analysis of the personal hygiene correlation to the stunting incident of this study, might due to the fact that the basic sanitation effect of the environment is generally still poor. The proportion of the ineligible disposal of fecal matter is high especially in the riverbank settlement because the final disposal of the household latrines flows into the river or immediately defecate in the river. The way the majority of household waste water is ineligible because households do not generally have waste water drains, or have sewerage but are not qualified (table 1). Ineligible disposal of wastewater and feces also cause underground water, especially water well polluted. Thus with poor basic sanitation conditions even if the personal hygiene of the toddler is good, then it is possible to experience high infection disease that eventually affects the onset of growth disorder so that the toddler has a short body or stunting.

Correlation History of Infectious Diseases with Stunting Incidence

The results of covariance analysis with personal hygiene as controller variables, did not found a significant influence of the history of infectious diseases of the stunting incidence. The history of infectious diseases in this case is diarrhea and helminthiasis as well as Acute Upper Respiratory Infections (AURI). The theory of infection and lack of nutritional diseases are two things that affect each other, where the disease causes less nutrition, otherwise nutrients are less causing infection. If this condition occurs for a long time it will cause decreased intake and the disruption of absorption of nutrients that results in the occurrence of stunting (24).

Earlier research also explains the frequency of diarrhea pain not correlated with stunting incidence. The frequency of acute respiratory infections is not associated with stunting, diarrhea in the children of Indonesia in the last two weeks when the research carried out, was not correlated with stunting (25-26). However, different results are found in the previous research results explaining the relationship of infection history with the stunting incidence in infants, the average duration of AURI pain or diarrhea relates to stunting (20, 27-29).

The insignificance of historical relations of infectious diseases with stunting incidents in this study, could be due to the influence of the duration or the length of infex disease or the status of the intake of nutrients at all times the occurrence of infectious diseases (29). Children with short periods of time pain or good intake of nutrient during illness may reduce the risk of stunting children. But the limitation of this study, not until analyzing the duration of the toddler had an infectious disease and also did not ask for information about the intake of nutrient during sick toddlers at the time.

Correlation between Quality of Sewerage with Stunting Incidence

The covariance analysis reveals that there is a quality of sewerage correlated to the stunting incident in infants, controlled by a personal hygiene variable. Observations in Indralaya Sub-district in two elected villages namely Tanjung Seteko village and Muara Penimbung Ulu village, it is known that most of the population does not have sewerage so the household wastewater is discarded in the yard. The same thing in Talang Pangeran Village Sub-district West Pemulutan in general the population threw waste water into the yard or into the river. Unlike the two villages where research in Tanjung Batu District, most households already have sewerage, but among households who already have sewerage still use a lot of sewerage that is not qualified.

Wastewater should meet the criteria such as made from water-resistant, closed material, does not cause a puddle of water, no odor, no vector nest, does not cause a clot, connected to the got or wells of recation (30). Some previous studies mention the quality of wastewater disposal associated with stunting incidence. Children with poor household wastewater are more at risk of stunting than children with good household waste water disposal (6-7).

The quality of sewerage that is not well causes the contaminants to permeated into the water well carried away to the river water so that the water is polluted and a source of infection of infectious diseases. Ineligible sewage drains are the place where vector diseases such as roaches and flies move the seedlings into the water and food environment, causing infectious diseases.

So, the difficult access to the means of wastewater disposal is one of the indirect causes of stunting. Improving the quality of sewerage is a choice of sensitive interventions in preventing stunting in infants.

Correlation between Physical Quality of Clean Water with Stunting Incidence

The covariance analysis shows the physical quality of clean water related to the stunting incident. The availability of clean water will determine the quality of other environmental sanitation, such as the latrines will be used well if there is always adequate clean water and qualified quality. Limited access to clean water is often a barrier for toddlers or mothers in good hygiene practices and in preparing food safely for toddlers.

A good use of latrines will prevent the occurrence of environmental pollution and avoid transmission of disease. The use of clean water that is eligible for household needs such as raw water for the needs of drinking water, washing tableware, washing groceries, raw water for cooking, as well as for hygiene purposes as gargle or brush teeth, beneficial to reduce the risk of gastrointestinal infections.

Previous studies have stated that the physical qualities of clean water are not significantly related to the stunting incident in Toddler (0-2 year old), but the source of clean water used to have a meaningful relationship with the stunting incident where the Toddler (0-2 year old) using water from a source that is not well at risk 1.8 times becomes stunting than the Toddler (0-2 year old) that uses water from a good source (6). The use of surface water, clean water access is associated with stunting in children (8-9).

Based on the observation of two villages in the district of Indralaya namely Muara Penimbung Ulu and Tanjung Seteko village have different characteristics in the source of clean water where Muara Penimbung Ulu that is close to the river flow, use the river as the main water source. Meanwhile, Tanjung Seteko Village uses Wells as a source of clean water but still many of its physical qualities are not eligible. The two villages in Tanjung Batu subdistrict also rely on the well as a source of clean water and in general, the physical quality is qualified. The physical quality of river water in the village of Talang Pangeran subdistrict of Pemulutan is generally ineligible.

Based on the results of cross trabulation it is seen that stunting toddlers tend to be exposed to water whose quality is not eligible compared to infants who are exposed to qualified water. So in this case the quality of clean water affects the stunting incidence

The poor quality condition of clean water is now more clearly recognized as a contributing factor in the occurrence of stunting in children. Improved quality of

clean water to focus the target of interventions aimed at improving public health and child growth (4). So the ability of the community to access qualified clean water is expected to prevent stunting in children.

Correlation Between Quality of Latrines with Stunting Incidence

Significant quality of latrine is associated with stunting incidents based on analysis of covariance, after the variable-controlled personal hygiene. Some households in Muara Penimbung Ulu village and Talang Pangeran village are still defecating in the river even though there is actually a public latrines available in both villages. The reason is because it does not have private latrines and closer and comfortable bowel movements in the river.

Healthy latrines means disposal of dirt that can break chains of infectious disease transmission. Latrines with qualified quality will prevent the vector from spreading the disease for those who use latrines also surrounding environment (30). The unhealthy latrines also creates pollution to the groundwater such as wells and surface water pollution such as rivers that allow for the transmission of infectious diseases.

The use of healthy latrines related to the incidence of diarrhea considering diarrhea is one of the diseases of stunting causes in children (31-32). The study in Ethiopia proved a meaningful correlation between the latrines facility with stunting (33). Toddler (0-2 year old) with an unwell facility is at risk of 1.33 times greater than the toddler (0-2 year old) with good latrines facilities to experience stunting. Research in 10 villages in the district Purwojati Banyumas describes sanitation correlated with the height of children aged 6-35 months, where there are differences in the child's height based on the cleanliness of the latrines (6, 10).

The observation shows that the latrines used still many do not qualify as it does not have a septic tank that is qualified, still there are latrines that are from clean water source less than 10 meters, the floor of the bridge is not tightly so that insects and other vectors can be nested, not waterproof, not easy to clean. Tendencies on the two villages that are not close to the river are defecation in the latrines but still many latrines used are not eligible.

Higher stunting incidents in infants with latinals are not eligible than infants with qualified latrines. So in this case it is apparent that indirectly the use of latrines can affected stunting.

Correlation of Pesticide Exposure with Stunting Incidence

Results of the analysis of covariance explain that the pesticide exposure is not related to the stunting incident but it looks almost significant probability value ($P = 0.060$). Based on the results of interviews and observations most of the respondents used pesticides in his household and are generally anti-mosquito. In addition there are agricultural pesticides stored in the house or around the home environment. Respondents who use agricultural pesticides are located in the village of Tanjung Seteko and Talang Pangeran village, because these two villages are mostly rice and vegetable farmers.

Pesticide exposure is an indirect cause of stunting in children. Some pesticides are *Thyroid Disrupting Chemicals* (TDCs) which cause interference with the structure and function of the thyroid gland, synthesis, secretion, transport, binding and elimination of thyroid hormones so hypothyroidism occurs. Hypothyroidism that occurs causes the fetus to be born with growth disorder, thus risking stunting. The results of research at the Brebes Agricultural Center explained the existence of pesticide exposure with stunting incident, mentioned that the pesticide exposure becomes the most risk factor in the occurrence of stunting among several other variables studied (11).

The lack of the exercise of pesticide exposure to stunting in this study could be due to the intensity of pesticide exposure in children not like in adults who perform agricultural activities such as pesticide spraying. The exposure received is more sourced from household insecticides such as mosquito repellent only. Agricultural activities that allow the exposure of mothers to pesticides are also not very large because of the activities of spraying pesticides or other agricultural activities that potentially cause pesticide exposure is generally done by husbands or male farmers. This insignificant relationship can also be caused by a more dominant environmental base sanitation condition affecting the stunting incident.

Correlation of Cigarette Smoke Exposure with Stunting Incidence

Results of analysis of covariance showed the exposure of cigarette smoke not related to the stunting incident in infants. The toddler's father or other members in the house who have smoking habit become a large source of cigarette smoke exposure for toddlers. The existence of the members who smoke in the house is

quite high proportion in the three sub-districts where research. The number of family members who smoke inside the house can be more than one person, causing the intensity of cigarette smoke to get higher.

The chemical hazard of cigarette smoke is not experienced by active smokers but even greater danger for passive smokers like toddlers let alone toddlers have not been able to avoid exposure to cigarette smoke. Most children receive daily cigarette smoke exposure at home (table 1) and most children with a short and stunting status are exposed to cigarette smoke at home.

Cigarette smoke contains many types of chemicals that are harmful to the human body. Carbon monoxide and nicotine are substances contained in cigarette smoke that are harmful to pregnant women and the fetus they contain. Nicotine stimulates the catecholamine hormone so that the heart is encouraged to raise blood pressure. Increased blood pressure resulted in heart rate changes as well as blood flow in the umbilical, as well as inducing hypoxia to the fetus so that the growth and development of the fetus becomes impaired. Children who have exposure to cigarette smoke at risk 2.686 times larger to be stunting than the unexposed cigarette Smoke (9).

The results of the research in Palembang mention the exposure of cigarette smoke related to the length of the toddler body. Infants who are exposed to cigarette smoke in the house will be 1.4 times larger to experience abnormal body length compared to non-smoking infants in the house (34), instead the research in Bontoramba and Yogyakarta mentions the exposure of children to cigarette smoke is not correlated with stunting (21, 35). These results can be caused by elementary school children who tend to avoid exposure to cigarette smoke compared to toddlers.

The unproven significance of cigarette smoke exposure with stunting incidents is likely due to other factors more influential to the stunting incident, such as the physical quality of clean water, the way of feces disposal and the way of sewage removal.

ACKNOWLEDGEMENT

Researchers thanked the Institute for Research and community service (LPPM) of Sriwijaya University for its support especially in assisting the funding of this research on the scheme of Science of Technology and Arts (Sateks) fiscal year 2019. For village midwives and cadres also thank you for the participation in accompanying enumerator when collecting data in the field.

CONCLUSION

Environmental basic sanitation factors include the physical quality of clean water, quality of sewerage and quality of latrines is the cause of the stunting incident in children aged 12-59 months in Ogan Ilir South Sumatera. It is necessary to actively monitor *Height-for-Age* z score (HAZ) of toddlers by health related agencies, especially in settlements with poor basic sanitation status, so that can be immediately done countermeasures and prevention in the future. There is a need for active participation of the community in mutual assistance to create health-qualified sewerage and perform clean water treatment with easy and inexpensive methods such as simple water treatment installations, as well as using economical healthy latrines.

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