Multilevel Analysis Factors of Air Exposure in the Neighborhood of Residence to the Risk of Pneumonia in Toddler

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ABSTRACT

Background: Toddler is prone to malnutrition and disease. The highest cause of the death is infectious diseases in toddler, called pneumonia (WHO, 2010). There are an estimated 1.6 million or 14% of deaths caused pneumonia every year, surpassing deaths from AIDS 2%, malaria 8% and measles 1% (WHO, 2008). The incidence of pneumonia in Indonesia has increased, from 2007 about 2.1% and in 2013 about 2.7%. Pneumonia in toddler in Indonesia is an issue that is important to do the actions of prevention and control pneumonia. The purpose of this research is to analyze the effect of air exposure and exposure in the neighborhood residence to the risk of pneumonia incidence in toddler.

Subject and Method: The design that used in this research is observational analytic using case control approach. The study was conducted on August 1 - September 14, 2016 in Batur District, Banjarnegara regency, Central Java, Indonesia. The independent variables are exposure to CO2, exposure to SO2, CO exposure, H2S exposure and exposure to household fumes. Dependent variable is toddler pneumonia. The sampling technique used was fixed disease sampling, with a ratio of 1: 1 between the disease (case) and non-disease (control) groups, totaling 140 respondents. Data collection techniques used questionnaires, checklists and medical records. Data were analyzed using Logistic Regression Analysis with Multilevel Approach using Stata 13 program.

Results: There is no effect of SO2, CO2, CO (OR=1.16; CI=0.39-3.39; p=0.785), H2S (OR=1.000; CI=0.41-2.40; p= 1.000) with the incidence of pneumonia in toddler. There is an effect of air exposure in the home (OR=3.98; CI=1.96-8.07; p<0.001) with the incidence of pneumonia in toddler. The condition of each RT has a contextual influence on the variation of the incidence of pneumonia in toddler (ICC = 33.30%; role of thumb 5-8%; likelihood ratio p = 0.001; CI(95%) = 0.47-5.69).

Conclusion: There is no effect of CO, H2S, CO2 and SO2 exposure to pneumonia in toddler. There is an effect of air exposure in the home with the incidence of pneumonia in toddler. The condition of each RT has a contextual influence on the variation of the incidence of pneumonia in toddler, so it needs to be considered.

I. INTRODUCTION

Pneumonia is characterized by symptoms like cough or breathing difficulties such as rapid breathing and pull of the lower chest. Pneumonia is categorized as air infectious disease (Ministry of Health, 2011 and WHO, 2012). Pneumonia is the leading cause of illness and death toddler in the world. Estimated 1.6 million, or 14% of child deaths are due to pneumonia every year, more than AIDS with 2%, malaria 8% and measles with 1% (WHO, 2010). In developed and developing...
countries, pneumonia is still a serious and life-threatening. Every year more than half of new cases of pneumonia in the world are concentrated in only five countries, 44% of children in the world are less than five years old: India (43 million), China (21 million), Pakistan (10 million), and Bangladesh, Indonesia and Nigeria contributed 6 million each (WHO, 2008).

The pneumonia in Indonesia is the second most common cause of death of toddler, after diarrhea. RISKESDAS (Health Research Department) reported that the incidence of pneumonia last month (period prevalence) increased in 2007 by 2.1% to 2.7% in 2013 (RISKESDAS). The prevalence of pneumoniac according to the Indonesian Demographic and Health Survey (SDKI) every year is increase and still continue, from 7.6% in 2002 to 11.2% in 2007 (IDHS, 2007).

The pneumonia sufferers are toddler in central java are increase, in 2013 is about 73,615 cases (25.85%) compared to 2012 (24.74%). The rate is still very far from the target of Minimum Service Standard (SPM) in 2010 (100%). Banjarnegara regency has 7555 patients with pneumonia in toddler in 2013, decreased in 2014 with 7532 patients in toddlers and handled 45.5%. In 2015 increased with 10059 pneumonia in toddler patients and handled by 46.6%. Based on the place origin of pneumonic patients, Batur Puskesmas 1 and 2 have position in the high place area, compared to other health centers that in 2065 MAS (meter above sea).

Batur district has two health center, Puskesmas Batur 1 and Puskesmas Batur 2. The incidence of pneumonia in Puskesmas Batur 1, in 2014 is 233 children suffered from pneumonia, with the number of handling is only 42 (18%) of children under five. The incidence of pneumonia in 2015 about 543 toddler suffered from pneumonia, with number of handling experienced is decreased, 96 (17.7%) toddler. The incidence of pneumonia Puskesmas Batur 2, in 2014 is 116 children suffered from pneumonia and handled by 46 (39.6%) patients handled. In 2015, 144 children suffered from pneumonia and 26 (18%) toddler handled.

Environmental conditions around Batur District there are some that are exposed to high CO2 and some are low. Geological Agency-Center of Volcanology and Geological Hazard Mitigation has made measurements in determining the high and low gas points that affect the condition of local people (Supriyati, 2007). Unhealthy environments and homes like inadequate house lighting (especially ultraviolet light), lack of house ventilation, humid room conditions, overcrowded dwellings lead to increased CO2 levels in the home. Increased CO2, strongly supports the development of bacteria thereby increasing the risk of various diseases such as tuberculosis, cataracts and pneumonia (Sacrial, 2009; Sharma, 1998). SO2 gas is generated from the burning of sulfur-containing compounds, causing impacts on humans and animals, such as damage to plants occurring at levels of 0.5 ppm and throat irritation occurring at 5 ppm or more. CO gas is a toxic gas and odorless. At concentrations as low as 667 ppm can cause 50% of the body's hemoglobin to turn into carboxyhemoglobin (HbCO), which results in ineffective transport of oxygen in the body. H2S gas is a gas that is colorless, toxic, flammable and smells like rotten eggs. This gas can cause rusting on metal and cripple the human sense of smell.

Densely populated homes and exposure to household fumes such as the use of wood as a cooking fuel in the kitchen can increase the susceptibility of pneumonia in toddler (WHO, 2012; Ezzati and Kammen, 2001). Health behavioral factors at risk for infectious diseases, such as the behavior of clean and healthy life that exist in the District of Banjarnegara, especially in District Batur is still low, namely in Puskesmas Batur 1 the number of participants who do PHBS only 48.5%.

II. RESEARCH PURPOSES

Based on the above description, it can be concluded that pneumonia in toddler in Indonesia is an important problem for the control of pneumonia of various factors by considering the micro level and macro level, considering the condition in the surrounding environment of the patient. H.L.Bloom explains that health is influenced by health services, individuals, lifestyles and the environment. The purpose of this research is to analyze the effect of exposure of CO2, SO2, CO and H2S, exposure of domestic household smoke to the risk of pneumonia incidence in toddler with multilevel analysis approach.
III. RESEARCH METHODS

The design that used in this research is observational analytic using case control approach. The study was conducted on August 1 - September 14, 2016 in Batur District, Banjarnegara regency, Central Java, Indonesia. The independent variables are exposure to CO\textsubscript{2}, exposure to SO\textsubscript{2}, CO exposure, H\textsubscript{2}S exposure and exposure to household fumes. Dependent variable is pneumonia in toddler, whereas the strata of the assessed area is RT area. The population is divided into two, namely the target population and population of research sources. The target population of research is toddlers in Banjarnegara District. Population source (population affordable) research is a toddler in the District Batur Banjarnegara. The sampling technique used was fix disease sampling, with a ratio of 1: 1 between the diseased (case) and non-diseased (control) groups, totaling 140 respondents. Data collection techniques used questionnaires, checklists and medical records. Data were analyzed using Logistic Regression Analysis with Multilevel Approach using Stata 13 program.

IV. RESEARCH RESULTS AND DISCUSSION

A. Research Results

1. Characteristics of Research Subjects

The result of characteristic of research subjects in table 1 shows that from 140 research subjects have different distribution. Description of research variables described by characteristics, criteria, frequency and percentage (%).

The comparison of study subjects with pneumonia and and without pneumonia was balanced, 50%: 50%. Most of the research subjects were not exposed to CO\textsubscript{2} (0 ppm) is 140 research subjects (100%), not exposed SO\textsubscript{2} (0 ppm) is 140 research subjects (100%), low CO exposure (0.150 ppm) is 125 subjects (89.3%), exposure to low H\textsubscript{2}S (0.120 ppm) of 116 study subjects (82.9%), exposure to household in-house fumes were 77 subjects (55%).

Table 1 Characteristics of Research Subjects

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Criteria</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toddlers aged</td>
<td>2 months - &lt; 5 months</td>
<td>140</td>
<td>100</td>
</tr>
<tr>
<td>Monther aged</td>
<td>&lt; 20 years</td>
<td>13</td>
<td>9.28</td>
</tr>
<tr>
<td></td>
<td>20 – 35 years</td>
<td>125</td>
<td>89.28</td>
</tr>
<tr>
<td></td>
<td>&gt; 35 years</td>
<td>2</td>
<td>1.44</td>
</tr>
<tr>
<td>Education</td>
<td>Basic Education</td>
<td>85</td>
<td>60.72</td>
</tr>
<tr>
<td></td>
<td>Further Education</td>
<td>55</td>
<td>39.28</td>
</tr>
<tr>
<td>Jobs</td>
<td>Peasants</td>
<td>33</td>
<td>23.58</td>
</tr>
<tr>
<td></td>
<td>Farmer</td>
<td>3</td>
<td>2.14</td>
</tr>
<tr>
<td></td>
<td>Self employed / Traders</td>
<td>2</td>
<td>1.42</td>
</tr>
<tr>
<td></td>
<td>Worker factory / industry</td>
<td>27</td>
<td>19.29</td>
</tr>
<tr>
<td></td>
<td>Not work</td>
<td>75</td>
<td>53.57</td>
</tr>
</tbody>
</table>

Source: Data Processed, 2016
2. Bivariate Analysis

The variables in the study were the status of pneumonia of children under five, CO$_2$ exposure, SO$_2$ exposure, H$_2$S exposure, CO exposure, household smoke exposure in the house. The method used is chi-square test.

Table 2 Hasil Analisis Bivariat

<table>
<thead>
<tr>
<th>No</th>
<th>Variabel Independen</th>
<th>Nilai OR</th>
<th>Nilai p</th>
<th>CI (95%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CO exposure</td>
<td>1.16</td>
<td>0.785</td>
<td>0.39 – 3.39</td>
</tr>
<tr>
<td>2</td>
<td>H$_2$S exposure</td>
<td>1.00</td>
<td>1.00</td>
<td>0.41 – 2.40</td>
</tr>
<tr>
<td>3</td>
<td>CO$_2$ exposure</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>SO$_2$ exposure</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>Household smoke exposure in the house</td>
<td>3.98</td>
<td>&lt;0.001</td>
<td>1.96 – 8.07</td>
</tr>
</tbody>
</table>

Source: Data Processed, 2016

3. Multivariate Analysis of Logistic Regression with Multilevel Approach

Multivariate effects explain the effect of air exposure factor in the neighborhood with the incidence of pneumonia in toddler.

Table 3. Results of Logistic Regression Analysis with Multilevel Approach Factors of Air Exposure in the Living Environment on the Risk of Pneumonia Occurrence in Toddler

<table>
<thead>
<tr>
<th>Variabel Independen</th>
<th>OR</th>
<th>CI(95%)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Batas Atas</td>
<td>Batas Bawah</td>
</tr>
<tr>
<td>Fixed Effect</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO exposure</td>
<td>1.10</td>
<td>0.19 – 6.42</td>
<td>0.910</td>
</tr>
<tr>
<td>H$_2$S exposure</td>
<td>0.92</td>
<td>0.21 – 3.90</td>
<td>0.915</td>
</tr>
<tr>
<td>CO$_2$ exposure</td>
<td>0</td>
<td>0 – 0</td>
<td></td>
</tr>
<tr>
<td>SO$_2$ exposure</td>
<td>0</td>
<td>0 – 0</td>
<td></td>
</tr>
<tr>
<td>Household smoke exposure in the house</td>
<td>3.96</td>
<td>1.95 – 8.06</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Random Effect
Condition of RT area condition
Var (constanta) | 1.64
The suitability of the ICC model (Intraclass Correlation) | 33.30% 0.47  5.69
Likelihood Ratio Test p = 0.008

Source: Data Processed, 2016

Table 3 shows ICC = 33. 30%, the indicator shows that the condition of each RT area has a contextual influence on the variation of the occurrence of toddler pneumonia by 33. 30%. This figure is greater than the benchmark number of role of thumb 5-8%, then the contextual influence of RT area condition as indicated from multilevel analysis is important to note. In the table also indicated likelihood ratio = 0. 008 means there are statistically significant differences between the models without taking into account the contextual influences and models that take into account the contextual influences. In this case the condition of each neighbourhood area.
B. Discussion

1. Influence Exposure CO, H$_2$S, CO$_2$ and SO$_2$ with Pneumonia Occurrence in Toddlers

The results showed that toddler living in the environment exposed to CO and H$_2$S exposure tend to have a greater risk of developing pneumonia than toddlers living in an environment not exposed to CO and H$_2$S. Exposure to CO$_2$ and SO$_2$ results in no measurable exposure in toddler’ quarters. The results showed no effect of H$_2$S, but there is influence of CO exposure with the incidence of pneumonia toddler and not significant. This is in line with Soemirat S. J (2015) statement, which explains that poor home conditions can interfere with the health of the body, caused by the lack of oxygen in the air, while carbon dioxide increases.

Factors that can increase the risk of pneumonia such as toddler characteristics, housing conditions, sources of indoor and outdoor air pollution (pollution), and density of occupancy. Poisonous gases such as Carbon monoxide (CO) can cause asphyxic effects in which hemoglobin (COHb) binds, causing a disruption of oxygen flow in the body, due to too much carbon dioxide. CO$_2$, SO$_2$ exposure, CO and H$_2$S around the house has a number below the normal limit with a safe distance of 1000 meters from the crater, even for CO$_2$ and SO$_2$ no one is scattered around the houses, just around the crater as a natural occurrence process. Meanwhile, for CO and H$_2$S also fall below the normal limits so as not to affect fast to health. Exposure to CO$_2$, SO$_2$, CO and H$_2$S is not so high as scattered because when the sun has appeared CO$_2$, SO$_2$, CO and H$_2$S will decompose by sunlight, so it has no effect to health (Surip, 2016). Weight crater is one of the craters in Dieng which has a high concentration of CO$_2$ exposure of 1. 8% volume or 18000 ppm, H$_2$S level of 0.6 ppm and SO$_2$ of 0.2 ppm.

Based on this matter, it can be concluded that there is influence of CO and H$_2$S exposure with the incidence of pneumonia in toddler. Thus results are in accordance with previous research and existing theories.
2. The Effect of Household Smoke Exposure in Home with Pneumonia Incidence in Toddlers

The results indicate that toddlers living in homes exposed to household in-house fumes are more likely to be five times more likely to be affected by pneumonia than toddlers living in homes that are not exposed to household in-house fumes. Household smoke exposure in the home can come from the use of firewood during cooking.

The results according to research conducted in Birmingham (UK) mentioned that the increased risk of pneumonia can come from exposure to fuel burning fumes, and there is some evidence that the use of stoves can reduce smoke exposure. Maskey Research et. al. (2012) in Nepal, about 87% of households use solid biomass fuel as the main source of fuel, there are a total of 1.284 exposed to respiratory infection and pneumonia.

Personal Research (2008), homes that use the type of wood fuel when cooking has an OR value of 6.8 times increase the risk of pneumonia toddler incidence. According to the MOH (2012), indoor air pollution such as the use of anti-mosquito fuel, cooking fuel and the presence of smokers may increase the risk of pneumonia in toddler.

Batur District is an area with cold environmental temperature conditions and the average family in the Dieng area has a cooking habits using a stove and also firewood. In addition, the habit of using charcoal stoves to warm the house temperature, usually done at night with a joke with family. This certainly increases the exposure of air to the condition of the body, especially toddlers who have a vulnerable body condition. Charcoal or firewood containing carbon monoxide, organic gas, particulate matter and nitritoxide, can improve health problems in the body, such as respiratory disorders. There are seven questions to determine the effect of exposure to household smoke on the incidence of pneumonia in toddler, which has the highest number is six points on lighting in the kitchen, this is in accordance with the conditions of home sanitation that many are classified as unhealthy. Less lighting in the kitchen area resulted in the development of disease seeds. The first answer to the answer is that there is no ventilation in the kitchen, which has a lot of "yes" answers. This certainly increases the risk of respiratory distress, with the lack of ventilation of disturbed air exchanges.

Based on this matter, it can be concluded that there is influence of household smoke exposure incidence of pneumonia in toddler. Thus results are in accordance with previous research and existing theories.

3. Influence of neighbourhood Condition on Pneumonia Under Fives

Multilevel analysis results show ICC = 33.30%, the indicator shows that the condition of each RT area has a contextual influence on the variation of the occurrence of pneumonia in toddler of 33.30%.
Gordon's theory in Candra's book (2007) interaction between bacteria (agent), human (host) and environment (environment), environment outside the individual (host) plays an important role in the increase of pneumonia disease in toddlers. Based on the findings in the field, that the RT area affect the incidence of pneumonia in toddler. This is due to the different residential conditions per RT, there are several RT that house the distance from each other, so that the airflow to each house is better than the RT which has narrow and densely populated homes, where sometimes the lighting to pass through the windows is often closed by another house.

In addition, prevention of diseases performed per neighbourhood vary, in neighbourhood whose citizens are aware of health will usually affect the surrounding houses to both care about health. Citizens residing in the environment with health awareness are less likely to be involved in the surrounding community and are not aware of their negative behavior.

V. CONCLUSION

There is no effect of CO, H₂S, CO₂ and SO₂ exposure to pneumonia in toddler. There is an effect of air exposure in the home with the incidence of pneumonia in toddler. The condition of each RT has a contextual influence on the variation of the incidence of pneumonia toddler, so it needs to be considered.

VI. BIBLIOGRAPHY


