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The Effect of House Environmental Factors on the Incidence of Pneumonia in Toddlers

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Abstract.
Pneumonia is an infection of the lower respiratory tract and it is a leading cause of death in toddlers around the world, especially in developing countries including Indonesia. Environmental factors have an important role in the incidence of pneumonia. This study aimed to determine the house environmental factors that influence the incidence of pneumonia in children < 60 months in the working area of Public Health Center P. This study used a cross-sectional design that involved 114 children (aged < 60 months) with their mothers. We conducted interviews and observations, and filled in the 9 checklists of the house environment: floor type, wall type, ventilation, density, cooking fuel, smoking habit, humidity, light intensity, and temperature. The data were analyzed with the Chi-square test and logistic regression. The results showed that the factors of the house enviroment affecting pneumonia in children < 60 months were light intensity (p = 0.001; OR = 5.032; 95% CI = 1.94, 13.046), humidity (p = 0.003; OR = 6.98; 95% CI = 1.91, 25.421) and density (p = 0.019; OR = 3.140; 95% CI = 1.21, 8.154). Preventive programs from health workers are very important (i.e., counseling and health education). Support from local government and the community is necessary to promote healthy households.

Keywords: pneumonia, children < 60 months, house environment

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1. BACKGROUND

Acute respiratory infections are still the main cause of death in children under 5 years, and 90% of deaths in ARI are caused by pneumonia originating from bacteria especially in developing countries like Indonesia caused by bacteria in developing countries such as Indonesia [1].

About 935,000 children died each year and an estimated 2,500 children died every day where pneumonia accounts for 15% of death in children under 5 years and 2% of them are newborns [2]. In developing countries, more than 150 million children under 5 years old have episodes of pneumonia each year [3].

In 2018, the incidence of pneumonia in toddlers in Indonesia was 478,000 cases, while in East Java province there were 92,913 cases. In the city of Kediri in 2017 there

were 964 case of under-five pneumonia where the Puskesmas P ranked for the second (15,2%), while in 2018 there were 928 case of under-five pneumonia and Puskesmas P in the first rank (19,5%). Data in Puskesmas P from 2017 to 2018 happened increasing cases of pneumonia in toddlers as much as 21,4% [4], [5], [6], [7], [8].

Pneumonia in toddlers was due to an imbalance of host, agent, and environmental factors. Environmental which is not healthy have an important role in the incidence of pneumonia in toddlers like the density of the house, a kind of wall and floor of house, pollution in the home due to cooking fuek and cigarette smoke, and the others [9].

2. METHOD

This study was observational analytic with *cross sectional* design. Samples in this study children <60 months months and their mothers in the working area of Public Health Center (Puskesmas) P in 2019 that fulfill the inclusion criteria.

A total of 114 samples of children < 60 months and their parents were taken by total sampling which consisted of 57 pneumonia and 57 nonpneumonia. Then samples completed the informed consent. Then we conducted interview, observation and fill in the 9 checklists of house environment, i.e. floor type, wall type, ventilation, density, cooking fuel, smoking habit of the family members, humidity, light intensity, and temperature.

Data was analyzed bivariately with chi square test followed by multivariate analysis with logistic regression test using SPSS for windows 23rd version.

3. RESULT

The respondent in the study was 114. A number of 57 toddlers who have experienced pneumonia (50%) And as many as 57 toddlers have never experienced or pneumonia (50%).

The most age categories of 114 respondents following the study were respondents who had age (24-59 months) of 64 infants (56.14%) While the number of other respondents with the age of 12-23 months as many as 50 infants (43.86%).

The nutritional status of the most respondents was in the good category as many as 98 toddlers (85.96%), then toddlers with less nutritional status as many as 12 children (10.53%) and the least were toddlers with more nutritional status with the number of respondents 4 toddlers (3.51%).

Table 1: Univariate.

Variable	Category	Sum	(%)
Pneumonia	Yes	57	50
	No	57	50
Age	12-23 months	50	43,86
	24-59 months	64	56,14
Nutritional Status	Over	4	3,51
	Good	98	85,96
	Severe	12	10,53
	Bad	0	0
Sex	Male	57	50
	Female	57	50
Exclusive Breast feeding	Yes	84	73,68
	No	30	26,32
Immuni zation	Complete	109	95,61
	Incomplete	5	4,39
Birth weight	<2500	1	0,88
	≥2500	113	99,12
Floor Type	Qualified	112	98,24
	Not Qualified	2	1,75
Wall Type	Qualified	114	100
	Not Qualified	0	0
Ventilation Width	Qualified	65	57,01
	Not Qualified	49	42,99
Human Density	Qualified	47	41,22
	Not Qualified	67	58,78
Cooking Fuel	Qualified	100	100
	Not Qualified	0	0
Smoking habit	Yes	46	59,65
	No	68	40,35
Humidity	Not Humid	86	75,43
	Humid	28	24,57
Light Intensity	Qualified	58	50,87
	Not Qualified	56	49,13
Temperature	Qualified	82	71,92
	Not Qualified	32	28,08

Of the 114 respondents who followed the study were toddlers with male gender as much as 57 (50%) and toddlers with female gender as much as 57 (50%).

Respondents totaling 114 toddlers, the majority received exclusive breastfeeding with a total of 84 toddlers (73.68%). Whereas 30 toddlers who did not get exclusive breastfeeding (26.32%).

Respondents totaling 114 toddlers, the majority of complete immunizations 109 toddlers (95.61%) and as many as 4 respondents (4.39%) incomplete immunizations.

Respondents totaling 114 toddlers, the majority with birth weight ≥2500 as many as 113 respondents (99.12%) and as many as 1 respondent (0.88%) with birth weight <2500.

Out of a total of 114 respondents living in a house with a qualified floor of 112 respondents (98.24%) And as many as 2 respondents (1.75%) Living on a house with an ineligible floor type.

Based on 114 respondents, they all have an eligible wall type of 114 respondents (100%).

Respondents amounting to 114 infants, the majority have a condition of a house with a fully qualified ventilation area with a total of 65 toddlers (57.01%) While as many as 49 respondents (42.99%) Unqualified ventilation.

In the density factor was obtained as much as 67 respondents (58.78%) With ineligible density and as many as 47 respondents (41.22%) of a qualified density.

A total of 114 respondents (100%) Live in a family that uses gas in cooking day.

In the habit factor smoking family respondents as much as 68 respondents (59.65%) Has a habit of smoking, while as many as 46 respondents (40.35%) Have no smoking habit.

The humidity level of the respondent is different, the majority in respondents have a qualified moisture level with a total of 86 respondents (75.43%) And as many as 28 respondents (24.57%) With ineligible moisture levels.

In 114 respondents had a home condition with light intensity in the house that qualified 58 respondents (50.87%) And as many as 56 respondents (49.13%) Have an ineligible light intensity.

Room temperature in 114 respondents differed differently, where the majority of respondents had an eligible room temperature with a total of 82 respondents (71.92%) And as many as 32 respondents (28.08%) With unqualified room temperature.

On the variables of ventilation area, humidity level, density level and light intensity fulfilled the requirements of the Chi-Square Test because expected count value <20% obtained p value ventilation width (p=0.000), humidity (p=0.000), human density (p=0.002) and light intensity (p=0.000). This means that the variables of ventilation area,

Table 2: Bivariate.

Independent Variable	Category	Not Pneumonia	Pneumonia	P value
Floor Type	Qualified	56	1	1.000 (*Chi-Square)*
	Not Qualified	56	1	
Wall Type	Qualified	57	57	- (*Chi-Square)*
	Not Qualified	0	0	
Ventilation	Qualified	43	22	0.000 (*Chi-Square*)
	Not Qualified	14	35	
Humidity	Qualified	53	33	0.000 (*Chi-Square)*
	Not qualified	4	24	
Human Density	Qualified	32	15	0.002 (*Chi-Square)*
	Not Qualified	25	42	
Cooking Fuel	Qualified	57	57	- (*Chi-square)*
	Not Qualified	0	0	
Light Intensi ty	Qualified	42	16	0.000 (*Chi-Square)*
	Not Qualified	15	41	
Temperature	Qualified	42	40	0.835 (*Chi-Square)*
	Not qualified	15	17	
Smoking's habit	Yes	35	33	0.849 (*Chi-Square*)
	No	22	24	

humidity level, density level and light intensity have an influence on the occurrence of pneumonia in infants because the significance value is <0.05.

On the variables of floor type, wall type, cooking fuel, temperature and smoking's habit does not meet the requirements because the expected count value is> 20%.

Table 3: Multivariate.

Variable	B	Wald	Sig.	Exp(B)	95% C.I.for EXP(B)	
					Lower	Up
Ventilation width	0,886	3,623	0,071	2,425	0,927	6,341
Human density	1,144	5,524	0,019	3,140	1,209	8,154
Humidity	1,943	8,681	0,003	6,980	1,916	25,421
Light intensity	1,616	11,050	0,001	5,032	1,941	13,046

Of all the variables processed using backward LR from the logistic regression test, the fourth best variables included ventilation, occupancy density, humidity and light exposure. The fourth variables are influential because they have a value of p <0.05. variable of light exposure is the most influential variable because it has the highest p value of 0.001, in the second order the influential variable is humidity variable with p equal to 0.003, then for the third in the variable affecting the incidence of pneumonia is the occupancy density with a p value of 0.019.

4. DISCUSSION

The statistical results from the bivariate Chi-square test obtained p = 1,000 (p> 0.05), this explains that there is no relationship between the type of floor and the incidence of pneumonia in infants in the area of Puskesmas P Kediri. The results of this study are also in line with the research of Mifta, Suhartono and Jazuli 2019 with the results of the Chi-square test obtained that the value of p = 1,000 showed that the relationship between types of floors with the incidence of pneumonia was not significant.[10] This is because in this study, most houses have used the type of floor that meets the requirements as much as 98.24% of the total houses studied. The type of house floor that can cause an increase in the incidence of pneumonia is the type of house floor that is not waterproof. House floors that are not waterproof will cause an increase in humidity, where when there is an increase in humidity it will be easy to invite animals such as cockroaches and also mice. Mice and cockroaches will carry bacteria and viruses that have an effect on the occurrence of lung infections. Because viruses and bacteria easily develop in humid environments [10].

The results of this study indicate that the type of wall cannot be tested statistically, because there are no variations in the case and control groups. All respondents already have the type of wall in the form of a wall and meet the criteria of a healthy home. The results of this study are in line with research conducted by Safira Fatichaturrachma 2016 stating that there is no relationship between the type of wall and the incidence of pneumonia in infants [11]. This research is not in line with the research conducted by Umar 2018. Where it is said that there is a relationship between the type of wall against the incidence of breastfeeding in infants with a value of p = 0.001 and OR = 9.00 [12].

According to Zhang et al. 2012 in Lestari et al. 2017, lack of ventilation is one of the environmental factors that can cause pneumonia. In line with this, the results of this study indicate that there were 22 (33.8%) children with pneumonia who had adequate ventilation, while 35 (71.4%) did not meet the requirements of pneumonia toddlers who

had poor ventilation. The bivariate test results in this study explain that there is a relationship between home ventilation and the incidence of pneumonia with p = 0,000 (p <0.05) [13]. However, the results of multivariate tests did not show significant results with p = 0.071 (p> 0.05). Good ventilation can reduce the risk of respiratory infections, through levels of clearance or microbial cleansing from the household environment. Through good ventilation, the concentration of particles in the room can be reduced which can reduce the risk of lung injury [14]. In addition, there are also other factors that make the condition worse for ventilated homes that do not meet the requirements, namely sharing beds with people who are coughing and diagnosed with pneumonia. Sharing a bed with patients with severe pneumonia has a significance of p = 0.001[15].

Based on the results of the bivariate Chi-square test obtained a significance value (p = 0.001), this explains that there is a relationship between the level of density with the incidence of pneumonia in infants. Several other studies explain that the condition of house density can indeed cause the transmission of respiration pathogens to occur faster and bigger, which means that these studies are in line with this study [16], [17], [18], [19], [20].

Some studies are also not in line with this study, which says that the density level is not related to the incidence of toddler pneumonia due to sleeping density that still meets the requirements [21], [22].

In this study, the type of cooking fuel from all respondents, both cases and controls, was obtained using the gas as a whole. So statistically it cannot be tested because there are no variations. However, some previous studies said that there was a relationship or there was no relationship between the type of cooking fuel and the incidence of pneumonia in infants [23], [24], [25]. This research was conducted in the work area of P health center. From the survey results, respondents stated that because it is an urban area, it is difficult to find fuel such as wood or charcoal, and it is more practical to use LPG gas cylinders, especially subsidized gas cylinders. Although this study provides meaningless results, it would be nice to continue to provide interventions in the form of counseling so that the kitchen is equipped with adequate ventilation.

Based on the results of the bivariate Chi-square test obtained a significance value (p = 0.703), this explains that there is no relationship between smoking habits and the incidence of pneumonia in infants . In line with previous studies because the majority of smokers smoke more outside the home so it does not cause exposure to toddlers. In contrast to several other studies which stated that there was a significant relationship between smoking habits and the incidence of under-five pneumonia, one of them was caused by tobacco smoke that caused irritation from the respiratory tract.

The result of bivariate Chi-square test shows that the significance value of the house humidity level is (p = 0,000), which means that there is a relationship between the humidity level of the house and the incidence of pneumonia in infants, because of the value (p <0.05). This is in line with the research conducted by Yuwono (2008), about the physical environment factors of the house associated with the incidence of pneumonia in infants.[30] The study found that there was a significant relationship between the physical environment of home factors such as the type of floor, wall conditions, ventilation area, population density, humidity level, wood fuel use and smoking habits of family members in children who experienced pneumonia.[31] Humidity that does not meet the requirements for good health is a good place for the growth of microorganisms that cause pneumonia that can affect toddlers.[32] Miftah et al., 2014, which reported that physical conditions of houses that did not meet health requirements increased the risk of transmitting the disease.

Based on the results of the bivariate Chi-square test, the significance value of p = 0.000, explaining that there was an influence between the intensity of home light on the incidence of pneumonia, because the value of p <0.05. These results are in line with several studies, namely Fataruba, Suhartono, and Sulistiyani 2019, Mifta, Suhartono and Jazuli 2019 with significance results of each p = 0.000, P = 0.006 based on bivariate tests, where there is a relationship between light intensity in the house against the incidence of pneumonia. Based on the study of Mifta, Suhartono and Jazuli 2019 if the room at home does not get the intensity of sunlight that is good (stuffy and moist), then the virus microorganisms or pathogenic bacteria can cause pneumonia to develop.[10] Ultraviolet light will inhibit the growth of Gram positive S. aureus, Bacillus cereus and S. epidermidis, and Gram-negative E. coli, P. aeruginosa and Klebsiella pneumoniae. Ultraviolet light also works for the synthesis of vitamin D, where vitamin D deficiency increases the risk of respiratory infections in children.

Based on the results of the bivariate Chi-square test, the significance value of p = 0.835, this explains that there is no relationship between room temperature and the incidence of pneumonia. This result is in line with other studies conducted by Ramdan, Anggun and Rahmat 2018 with a significance value of p = 0.410, with the result that there is no correlation between temperature and incidence of pneumonia.[19] Viruses and bacteria can grow optimally above 30^0C and humidity below 60%. According to Fataruba, Suhartono &Sulistyani 2019 high housing densities will affect home temperature. Residents of houses that are too dense will increase the temperature in the house due to discharging body heat. High indoor air temperatures allow bacteria to grow and multiply. Moisture that does not meet health requirements is a good place for the growth

of microorganism pneumonia. Climate factors such as temperature, humidity have been shown to have an impact on the transmission of respiratory viruses.

5. CONCLUSION

Ventilation, density, humidity, and light intensity of the house affected the incidence of pneumonia in children ≤ 60 months.

The promotive and preventive aspects of health workers were very important i.e. counseling about healthy house indicators, the danger of pneumonia, the importance of exclusive breastfeeding, complete basic immunization, balanced nutrition, and routine integrated ANC. So, the people can maintain the hygiene of the house environment and have a knowledge about how to prevent pneumonia, even though renovating a house required expensive costs.

The results of this study can be the source of data for preliminary studies in further researches. Case control design should be recommended because this study was an etiological research and need a furhter checked about other variables that can also increase pneumonia apart from environmental factors in the house i.e. host factors (age, sex, immunization status, nutritional status, birth weight, and exclusive breastfeeding) and the agent factors (viruses, bacteria, and fungi).

In addition, the local government needed to register and socialize the BSPS (Bantuan Stimulan Perumahan Swadaya) program in realizing the distribution of healthy house equally for the public community.[33]

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