

ORIGINAL ARTICLE

Analysis of Factors Affecting Pneumonia in Toddlers Based on Theory Epidemiology Triad

Iqlima Dwi Kurnia^{1*}, Ilya Krisnana¹, Eliesa Rachma Putri², Yuni Sufyanti Arief¹, Pratuma Rithpho³

¹ Faculty of Nursing, Airlangga University, East Jawa, Surabaya, Indonesia

² Bachelor Nursing Student, Faculty of Nursing, Airlangga University, East Jawa, Surabaya, Indonesia

³ Faculty of Nursing, Naresuan University, Thailand

ABSTRACT

Introduction: The incidence of Pneumonia in Indonesia has increased. East Java Province ranks second in the number of pneumonia sufferers under five in Indonesia with 92,913 patients under five. The purpose of this study was to analyze the factors based on the theory of epidemiology triad: host factors (age, gender, birth weight, immunization status, nutritional status and exclusive breastfeeding), environmental factors (exposure to cigarette smoke, clean and healthy living behavior, distance from house to factory and distance from house to road). **Methods:** The research design in this study used a cross sectional. The population were toddlers with pneumonia aged 12-59 months. The study sample totaled 112 respondents based on cluster random sampling. The instrument used was a questionnaire, contains of exposure to cigarette smoke, clean and healthy living behavior, distance from house to factory, and to road demographic characteristic (age, gender, birth weight of toddlers and current weight of toddlers, immunization status, nutritional status, exclusive breastfeeding). This research was analysis used Spearman's rho test with $\alpha = 0.05$. **Results:** the factors that influence the incidence of pneumonia in children under five include; age, gender, birth weight, exclusive breastfeeding, immunization status, nutritional status, clean and healthy living behavior, exposure to cigarette smoke, distance from house to factory and also roads. **Conclusion:** The incidence of pneumonia in toddlers were related to host and environmental factors. It is expected that health workers and parents can control the risk factors for pneumonia by paying attention to children who are more susceptible to pneumonia.

Keywords: Pneumonia, Toddlers, Theory Epidemiology Triad

Corresponding Author:

Iqlima Dwi Kurnia, Ns.M.Kep

Email: iqlima.dwi.k@fkn.unair.ac.id

Tel: +06285731676686

the form of industry and services, with many factories or companies there is a risk of factory smoke pollution or the accumulation of waste wood dust. This has an impact on increasing the risk of toddlers being exposed to ARI (5).

INTRODUCTION

Pneumonia is an infectious disease that causes the largest single cause of death in children worldwide (1). Pneumonia in children can also lead to significant chronic disease and chronic illness, such as; restrictive lung disease, obstructive pulmonary disease, bronchiectasis, chronic bronchitis, and asthma (2). In children 1 to 4 years old, the pneumonia cases in Indonesia is the most common (3).

East Java ranks second in the number of children under five with pneumonia in Indonesia with 92,913 cases under five (3). The highest ARI cases in East Java were found in Sidoarjo, with 8,539 children under five (4). Sidoarjo Regency is one of the regencies in East Java which has the main economic sector in

A study in a hospital in the northeastern region of Brazil found that there was a significant difference between the age of under five and over one year of age on the incidence of pneumonia, (6,7). Toddlers with low birth weight are at risk of developing pneumonia because they have low levels of immunity. The study results show that in developing countries like India, pneumonia is a common childhood disease with risk factors such as lower maternal education, delay in complementary feeding, and also socioeconomic conditions.(8). Incomplete immunization increases the risk of developing pneumonia (9,10). Many factors determine a child under five to have risk in pneumonia. This study applies the epidemiological triangle theory to determine factors associated with the incidence of

pneumonia. This theory describes the interaction of three components that cause a disease such as human (host), cause (agent), and environment (environment) (11). However, studies that explain the factors that cause pneumonia are based on the epidemiological triangle theory do not yet exist. The purpose of this study was to explain the factors that cause the incidence of pneumonia in accordance with the epidemiological triangle theory of three main factors that play a role in the occurrence of diseases and other health problems, namely: host, agent, and environment. If one of the factors changes so that it becomes unbalanced, it will cause disease, such as an agent that becomes stronger, the host becomes more susceptible, or the environment changes conditions so that it can weaken the host.

MATERIALS AND METHODS

Study Design

The method used is a cross-sectional approach. The sampling method used was the quota sampling method. The independent variables in this study were the child’s age, gender, birth weight immunization status, nutritional status, exclusive breastfeeding, clean and healthy living habits, exposure to cigarette smoke, distance between the house and the factory, distance between the house and the Highway. The dependent variable in this study is the incidence of pneumonia.

Population, Samples and Sampling

The population in this study children who were suffering from pneumonia or undergoing of pneumonia children with aged 12-59 months and their mothers at Waru Health Center, Sidoarjo Regency with 158 total participants and obtained 112 samples. The research was conducted in May 2020.

The formula for determining the sample size of this cross-sectional study uses the sample formula according to Lemeshow (1997) with the following calculations:

$$n = \frac{Z^2 \cdot N \cdot p \cdot q}{d^2(N-1) + Z^2 p \cdot q}$$

n = Sample

N = Population

Z= Standar deviation 95% (1,96)

p= Proportion of target population 0,5

q = Proportion without atribut 1-p = 0,5

d = Error rate (d= 0,05)

$$n = \frac{(1,96)^2 \cdot 158 \cdot 0,5 \cdot 0,5}{(0,05)^2 \cdot (158-1) + (1,96)^2 \cdot 0,5 \cdot 0,5}$$

$$n = \frac{151,7432}{0,3925 + 0,9604}$$

$$n = 112,194$$

Instruments

This study uses a demographic data questionnaire, the exposure to cigarette smoke was taken and modified from research conducted by Uprianingsih (2018) and the hygiene practice was taken and modified from research conducted by Ayudiah (2018) which the validity and reliability has been tested. The data were collected using online questionnaire sent by google form link via whatsapp application because COVID-19 pandemic was still ongoing and this situation limited people doing face to face contact.

Procedure

The researcher immediately coordinated with the person in charge of pneumonia at the puskesmas to discuss the data collection method to be carried out and modify the data collection method to be carried out according to the conditions at that time (the outbreak phenomenon) and the characteristics of the Waru community health services. Researchers conducted online research with the help of the person in charge of pneumonia by giving the respondent’s phone number, namely mothers who had children with pneumonia in the last month recorded in the Waru Health Center register. The researcher determines the respondents of mothers and children according to the inclusion and exclusion criteria (according to the purpose of the research problem) which can be obtained from the data from the Waru Health Center during the initial survey, so that the sample can represent the characteristics. Researchers recruited mother and child respondents using the absent lottery that had been made by researchers based on data on children with pneumonia from the Waru Health Center. Before giving an online questionnaire to mothers, the researcher gave an explanation of the purpose of the research and an explanation of how to fill out the questionnaire or google form. If the mother agrees, then she can give her consent by filling in the agreement and giving an online signature.

Data Analysis

While the data analysis technique used the Spearman rho ‘correlation test with a significance level of 0.05 or (p<0.05).

RESULTS

Characteristic Respondent

The distribution of data in this study (Table I) among 112 participants showed the most children age category were aged 1-2 years , the most gender were female, the majority of the birth weight were low (50.9%), more than half of the participants had incomplete child immunization status (51.8%), the most nutritional status in the good category (53,6%), and most of mothers did not exclusively breastfeed their children, as many as 58 children (51.8%).

Table I : [Distribution of participants by demographic characteristics based on child's age, sex, birth weight, immunization status, nutritional status, exclusive breastfeeding] n: 112

Characteristics	Criteria	F	%
Age of child	1 - 2 years	60	53,6
	3 - 5 years	52	46,4
Gender	Male	53	47,3
	Female	59	52,7
Birth Weight	Low Birth Weight	57	50,9
	Non Low Birth Weight	55	49,1
Immunization Status	Complete	54	48,2
	Incomplete	58	51,8
Nutritional Status	Good	51	45,5
	Lack	61	54,5
	Bad	0	0
Exclusive Breastfeeding	Exclusive	54	48,2
	Non Exclusive	58	51,8

Table II showed most of participants had poor hygiene practices (57.1%). Most of the children under five became passive smokers (46.4%). Most children under five have a high risk because of the distance from their house to the factory (<11 meters) (52.7%), the distance from their house to the road (54.5%). Most of the children under five were diagnosed with pneumonia once a month; as (80.4%).

Relationship between variables

The result of relationship between variables is showed in Table III. Children aged 1 to 2 years had a significant relationship between the child's age and pneumonia incidence with a weak correlation value (Spearman Rho $r = -0.351$, $p = 0.000$). There was a significant relationship between gender and the incidence of pneumonia with a very low correlation value (Spearman Rho $r = 0.199$, $p = 0.036$). Children birth weight had a significant relationship between birth weight and pneumonia incidence with a weak correlation value (Spearman Rho $r = -0.234$, $p = 0.047$). There was a significant relationship between immunization status and the incidence of pneumonia with a very low correlation value (Spearman Rho $r = -0.198$, $p = 0.037$). This negative correlation showed completed immunization status

had lower risk of pneumonia incidence among children under five.

Children nutritional status had a significant relationship between nutritional status and pneumonia incidence with a weak correlation value (Spearman Rho $r = -0.188$, $p = 0.013$). This shows that the greater the nutritional status, the incidence of pneumonia in children under five became smaller. There was a significant relationship between exclusive breastfeeding and the incidence of pneumonia with a very low correlation value (Spearman Rho $r = -0.342$, $p = 0.000$). This negative correlation showed exclusive breastfeeding had lower risk of pneumonia incidence among children under five.

Hygiene practices had a significant relationship between hygiene practices and pneumonia incidence with a weak correlation value (Spearman Rho $r = -0.227$, $p = 0.016$). This shows that good hygiene practices could lower the incidence of pneumonia in children under five. There was a significant relationship between exposure to cigarette smoke and the incidence of pneumonia with a very low correlation value (Spearman Rho $r = 0.188$, $p = 0.047$). This positive correlation showed higher exposure

Table II : [Distribution of the respondent variables factors that affect the incidence of pneumonia] n: 112

Characteristics	Catagory	F	%
Healthy Lifestyle	Good	10	8,9
	Moderate	38	33,9
	Poor	64	57,1
Cigarette Smoke Exposure	1 Smoker	52	46,4
	>1 Smoker	44	39,3
	Not at all	16	14,3
The Distance Between House and Factory	Low Risk (distance >50 meters)	17	15,2
	Moderate Risk (distance 11-50 meters)	36	32,1
	High Risk (distance <11 meters)	59	52,7
The Distance Between House and Highway	Low Risk (distance >50 meters))	17	15,2
	Moderate Risk (distance 11-50 meters))	34	30,4
	High Risk (distance <11 meters))	61	54,5
Incidence of Pneumonia	1x diagnosed (1 months)	90	80,4
	>1x diagnosed (1 months)	22	19,6

to cigarette smoke had higher risk of pneumonia incidence among children under five. The distance between the house and the factory had a significant (Spearman Rho $r = -0.192$, $p = 0.043$). This shows that larger distance between the house and the factory, the incidence of pneumonia in children under five became smaller. There was a significant relationship between the distance of the house and the highway with the incidence of pneumonia.

DISCUSSION

Factors related to the incidence of pneumonia in children based on the epidemiological triad theory include age, sex, birth weight, immunization status, nutritional status and exclusive breastfeeding of pneumonia incidence. Based on the research findings, the majority of participants have children aged 1-2 years, which shows that the smaller the age of the toddler, the more susceptible to infection compared to the bigger the age of the toddler. This research is in line with research conducted by da Fonseca Lima, E. J., et al, 2016 that showed the risk of pneumonia is greater in children under 18 months of age compared to older ages. Another research show that factor contributing TB including, sex and age. (13). Based on the analysis of the data and characteristics of the participants, girls had higher risk of pneumonia in under-five children (6).

A study in Bangladeshi hospitals gave similar results in that more girls had very severe pneumonia than boys. This showed that there was a tendency for boys to be seen by a doctor before symptoms worsen compared to girls who were just taken to the hospital when the symptoms are severe. So the study showed girls toddlers with very severe pneumonia are four times more likely to die than boys (14).

Majority of participants had low birth weight which the formation of anti-immune substances in their bodies was still developing, so they are more susceptible to inflammation, especially pneumonia and other respiratory diseases. This research is in line with research conducted by Ramezani, M., Aemmi, S. Z., et al, 2015. The study stated that it refers to the role of low birth weight in infants suffering from acute lower respiratory infections. It is estimated that 19% of all children born in developing countries had low birth weight (<2.500 grams). Incomplete immunization status had a higher risk with the incidence of pneumonia in children under five. This research is in line with research conducted by Hadisuwarno, W., Setyoningrum, R. A., et al., 2015. The study states that immunization status also plays a role in the risk of pneumonia. Incomplete immunization increases the risk of developing pneumonia. Most

Table III : [Relationship Between Independent and Dependent Variables] p<0,05

Variable	Category	Incidence of pneumonia					Total	P Value	R
		1x diagnosed		>1x diagnosed					
	F	%	f	%	Σ	%			
Age of child	1 - 2 years	56	50,0	4	3,6	60	53,6	0,000	-0,351
	3 - 5 years	34	30,4	18	16,1	52	46,4		
	Total	90	80,4	22	19,6	112	100		
Gender	Male	47	42,0	6	5,4	53	47,3	0,036	0,199
	Female	43	38,4	16	14,3	59	52,7		
	Total	90	80,4	22	19,6	112	100		
Birth Weight	Low Birth Weight	51	45,5	6	5,4	57	50,9	0,013	-0,234
	Non Low Birth Weight	39	34,8	16	14,3	55	49,1		
	Total	90	80,4	22	19,6	112	100		
Immunization Status	Complete	39	34,8	15	13,4	54	48,2	0,037	-0,198
	Incomplete	51	45,4	7	6,3	58	51,8		
	Total	90	80,4	22	19,6	112	100		
Nutritional Status	Good	36	32,1	15	13,4	51	45,5	0,017	-0,225
	Lack	54	48,2	7	6,3	61	54,5		
	Total	90	80,4	22	19,6	112	100		
Exclusive Breastfeeding	Exclusive	51	45,5	3	2,7	54	48,2	0,000	-0,342
	Non Exclusive	39	34,8	19	17,0	58	51,8		
	Total	90	80,4	22	19,6	112	100		
Healthy Lifestyle	Good	6	5,4	4	3,6	10	8,9	0,016	-0,227
	Enough	28	25,0	10	8,9	38	33,9		
	Lack	56	50,0	8	7,1	64	57,1		
Cigarette Smoke Exposure	Total	90	80,4	22	19,6	112	100	0,047	0,188
	1 Smoker	38	33,9	14	12,5	52	46,4		
	>1 Smoker	37	33,0	7	6,3	44	39,3		
The Distance Between House and Factory	Not at all	15	13,4	1	0,9	16	14,3	0,043	-0,192
	Total	90	80,4	22	19,6	112	100		
	Low Risk	13	11,6	4	3,6	17	15,2		
The Distance Between House and Highway	Moderate Risk	24	26,7	12	10,7	36	32,1	0,032	-0,203
	High Risk	53	47,3	6	5,4	59	52,7		
	Total	90	80,4	22	19,6	112	100		
The Distance Between House and Highway	Low Risk	13	11,6	4	3,6	17	15,2	0,032	-0,203
	Moderate Risk	22	19,6	12	10,7	34	30,4		
	High Risk	55	49,1	6	5,4	61	54,5		
The Distance Between House and Highway	Total	90	80,4	22	19,6	112	100		

participants do not complete immunization of their children, perhaps because participants do not have good knowledge about immunization, which causes less awareness in carrying out complete immunizations.

The lack of nutritional status had higher risk of pneumonia incidence in children under five. This research is in line with research conducted by Piliang, N. S., & Filda, 2018. The study stated that underweight children would be more susceptible to pneumonia due to lack of immunity. It can be concluded that the nutritional status with the incidence of pneumonia in children under five has a relationship because inadequate nutritional status can cause the immune system to decrease so that it is prone to infection. The infection itself will cause toddlers to have no appetite and lead to malnutrition. In a state of malnutrition, toddlers are more prone to pneumonia because they are more susceptible to infection due to reduced immunity. Based on the research findings, the majority of participants did not exclusively breastfed. Providing exclusive breastfeeding from birth to the first 6 months of a baby's life is the mother's obligation to provide the best food that meets the highest standards both in terms of breastfeeding and the nutritional content of breast milk to guarantee the child's right to grow and develop optimally. This research is in line with research conducted by Wulandari RA (2018). The study stated that children under five who are not exclusively breastfed had higher risk of disease because they do not get the full benefits of exclusive breastfeeding which to form antibodies as a defense against disease.

Clean and healthy living behavior has a relationship with the incidence of pneumonia in toddlers, the better the clean and healthy living behavior the smaller the incidence of pneumonia. Exposure to cigarette smoke has a relationship with the incidence of pneumonia in toddlers, the greater the exposure to cigarette smoke received by toddlers, the higher the incidence of pneumonia. The distance between the house and the factory has a relationship with the incidence of pneumonia in children under five, the farther the distance from the house to the factory, the smaller the incidence of pneumonia. The distance from the house to the road has a relationship with the incidence of pneumonia in children under five, the farther the distance from the house to the road, the smaller the incidence of pneumonia. Poor hygiene practices had higher risk of pneumonia incidence in children under five. This research is in line with research conducted by Sundari, S., & Pratiwi, 2015. The study stated that the poor hygiene practices carried out by mothers included the mother's habit of not covering her nose and mouth when coughing, mothers did not immediately wash their hands with soap if the hands were exposed to nasal and mouth

fluids when coughing, the mother does not wash her hands with soap when the hands are in direct contact with the nose and mouth when coughing could put the toddlers at risk in pneumonia. The results of research conducted Permatasari, M. D., Winarno, M. E., & Tama, 2019 stated that good ventilation indicated that damp rooms and non-functioning windows have a significant relationship with the incidence of pneumonia. Research results are in line with research with the title "The Association between Sanitation and Hygiene Practices and the Occurrence of Childhood Pneumonia in Abia State, Nigeria. (Enebeli, 2019). The results of another study showed that Mycobacterium tuberculosis in the air (OR = 2.667) and physical condition of the house (OR = 2.667) were risk factors for pulmonary TB (19,20). Based on the research findings, toddlers whose parents are smoking are more susceptible to respiratory diseases such as pneumonia, because cigarette smoke from parents or residents of one roof house is a serious contamination material in living spaces to toddlers and will increase the risk of pain from toxic substances in children. This research is also in line with research conducted by Supriyatin & Sulistyarningsih, 2015 stated that the incidence of pneumonia is closely related to exposure to cigarette smoke. Toddlers who are exposed to cigarette smoke are 18,480 times more likely to experience pneumonia than toddlers who are not exposed to secondhand smoke.

The larger distance of house from the factory, the smaller the pneumonia incidence in children under five. The research findings showed that Waru is one of the main industrial areas in the south of Surabaya. The residential area, which is close to the lower area of the chimney, will feel the smoke pollution from the factory. Transmission of pneumonia is through polluted air and enters the body through the respiratory tract. This research is in line with research conducted by Hananto, 2016. The study stated that there was a significant relationship between risk factors for respiratory disease from environmental factors outside the home, especially the distance from the house to pollution. Distance from the house to the industry/factory for more than 50 meters giving the risk of asthma by 30.2 times, with a significance level $p=0.005$. The larger distance of house from the main road, the smaller the incidence of pneumonia in children under five. Waru as a sub-district borders the city of Surabaya had the heavy traffic vehicles that cause air pollution make the environmental conditions worse. This research is in line with research conducted by (22), that stated there was a significant relationship between the distance between living quarters/roads and the incidence of pneumonia in children. This means that children whose homes are close to the main road are 3.09 times more likely to develop

pneumonia than children whose homes are far from the main road.

CONCLUSION

Based on the epidemiological triad theory, the factors that influence the incidence of pneumonia in children under five include; age, gender, birth weight, exclusive breastfeeding, immunization status, nutritional status, clean and healthy living behavior, exposure to cigarette smoke, distance from house to factory and also roads. From these findings, the researcher recommends the field of nursing as the basis for developing Nursing Science, especially Child Nursing. Respondents, especially mothers of toddlers, are expected to pay attention to the health of toddlers and participate in efforts to prevent and control pneumonia in toddlers and are advised to always improve clean and healthy living behavior, improve poor nutritional status by eating a nutritious and balanced diet, and using masks when leaving the house so that toddlers are protected from exposure to road and industrial pollution. Family members can remind each other not to smoke in the house or when in contact with toddlers.

Study Limitation

The one method of data collection used in this study was to use a Google form so that the researchers did not meet directly with the respondents. There was a personal contact phone number for the researcher so could have been contacted by the respondent if there was information that was not understood.

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