



THE RELATIONSHIP BETWEEN HUMAN HOST AND ENVIRONMENTAL FACTORS ON THE SEVERITY OF PNEUMONIA AMONG UNDER-FIVE CHILDREN IN WEST JAVA PROVINCE

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ABSTRACT

Pneumonia cases in West Java Province 2018 were ranked first as the province with the highest number of cases in Indonesia with a prevalence of 58.80%. About 7-13% of severe pneumonia patients with an increased risk of death in children require intensive care. This study aims to determine the relationship between host and environmental factors on the severity of pneumonia in children under five years. The research method used cross-sectional study design approach. Data analysis techniques used chi-square, fisher's exact, and multiple logistic regression tests. The population in this study was 2,338 children under five years aged 12-59 months in West Java Province for the 2018 period, while the sample consisted of 132 respondents who met the inclusion criteria and were recorded in RISKESDAS 2018. The results showed that there was a significant relationship between host factors and the severity of pneumonia, namely prematurity (aOR= 2.446; 95% CI=1.113-5.376), while environmental factors that have a significant relationship on the severity of pneumonia, namely the habit of opening windows (aOR= 2.963; 95% CI=1.342-6.544). There is no relationship between Low Birth Weight (LBW), home ventilation conditions and lighting intensity. The most dominant factor in the severity of pneumonia is that the habit of opening windows does not meet the risk of 2.9 times higher severity of pneumonia in children under five years. This study concludes a relationship between prematurity and the habit of opening windows on the severity of pneumonia.

Keywords: severity of pneumonia, risk factors, host, environmental, under five children

Introduction

Pneumonia is a contagious infection in children, a burden of mortality and morbidity in developing countries. Pneumonia caused 740,180 children (12-59 months) deaths, or 14% of deaths worldwide in 2020.¹ United Nations Children's Fund (UNICEF) in 2021 reported that pneumonia caused mortality in children with an estimated number of 700,000 children under five every year, which should be preventable through timely diagnosis and treatment.² It is hoped that the high mortality rate due to pneumonia can be eliminated through an integrated program by UNICEF, namely the Global Action Plan for the Prevention and Control of Pneumonia and Diarrhoea (GAPPD), which is targeted to 2025.³ The trend of high mortality due to pneumonia can be caused by factors that cause pneumonia in the form of viruses and bacteria (agents), conditions of the host's immune system (host) and physical and demographic (environment) environmental factors. Host factors in children under five can affect the immune system (immunology), whereas when infected with pneumonia it occurs due to disorders of the body's immune system. Meanwhile, changes in environmental factors can affect host behavior resulting in a disease that can attack individuals or the entire population.^{4,5}

Integrated Management of Childhood Illness (IMCI) classifies pneumonia based on signs and symptoms: non-pneumonic cough, pneumonia, and severe pneumonia.⁶ Criteria for the severity of pneumonia can be determined based on the signs and symptoms experienced by children under five years, pneumonia is characterized by symptoms of rapid breathing, namely the respiratory rate in infants less than two months is more than 60 per minute, in the age group 3-12 months the respiratory rate is more than 50 per minute, and in children between the ages of 13-60 months the respiratory rate is more than 40 per minute, while for severe pneumonia it is characterized by symptoms of pneumonia accompanied by downward pulling of the inner chest wall (TDDK).⁷ Severe pneumonia in infancy is associated with increased long-term respiratory infection morbidity and disease burden; it is more fatal than non-severe pneumonia.⁸ On average 2-3% of children with severe pneumonia require hospitalization each year, for every 1000 children born around 100-150 episodes of severe pneumonia most commonly occur during the first two years of life.⁹

The results of RISKESDAS 2018 reported that in Indonesia the prevalence of pneumonia incidence was 56.51%.¹⁰ Based on the 2018 Indonesia Health Profile, West Java Province had the highest prevalence of pneumonia cases in 2018 in Indonesia, with a total of 131,382 cases (58.80%) of both severe pneumonia and pneumonia. The number of cases of pneumonia in children aged <1 year was 48,397 cases, and in the age group 1-4 years, there were 82,985 cases. This indicates that pneumonia cases in the under-five age group (12-59 months) were higher than in those aged <1 year.¹⁰ As much as 80% of the total cases of pneumonia, among others, experienced a severity that could have been prevented at an early stage. Therefore, preventive measures are

needed to control the risk factors for pneumonia in children under five so that there is no increase in the cases of severe pneumonia and pneumonia in West Java Province.

The severity of pneumonia in children aged 12-59 months is closely related to various risk factors which directly or indirectly include malnutrition, not getting exclusive breastfeeding, immune system disorders, nutritional status, home occupancy density, and disease comorbidities.¹¹ Risk factors for pneumonia are based on the epidemiological triangle theory or triangle model of infection which describes the interaction of three components: agent factors, host factors and environment. Factor agents such as bacteria, viruses and fungi.¹¹ One of the host factors, namely prematurity, can increase the chance of pneumonia severity by 2.5 times because babies who experience prematurity have a risk of lung function abnormalities and respiratory failure due to rudimentary lung organ structure.¹² Another risk factor is prematurity which is the second leading caused of death in children aged 12-59 months and neonatal death. As much as 35% of neonatal deaths in the world are caused by complications of premature birth.¹³ The prevalence of a history of premature birth in children aged 0-59 months in West Java Province was 23.48%, while in the group of children (12-59 months) the prevalence of a history of prematurity was 24.26%.¹⁰ Low Birth Weight (LBW) has a risk of pneumonia by 1.5 times greater. This can be caused by poor lung function and low immune system in low birth weight patients so that they are more susceptible to severe respiratory infections.¹⁴ Another factor that can affect the occurrence of pneumonia is a house that does not meet the requirements of healthy home indicators. Such as home ventilation conditions, window conditions and lighting intensity can be predisposing factors or media sources of environment-based disease transmission.¹⁵

Based on various previous studies that have been conducted, these factors have a significant relationship with the occurrence of pneumonia. Further knowledge of risk factors affecting the severity of pneumonia in children aged 12-59 months is needed to reduce mortality from pneumonia. Studies in several developing countries tried to identify risk factors for severe pneumonia in children under five years.^{16,17,18} However, only a few studies conducted in Indonesia identify risk factors for severe pneumonia.^{19,20} More clinical studies are needed from Indonesia because the case fatality rate due to pneumonia in children aged 12-59 months in Indonesia reaches 0.16%, it is estimated that there are 444 children in Indonesia who died from pneumonia in 2021.²¹ In general, the results of research related to pneumonia risk factors are only carried out in the working areas of a community health center and within the district or city scope, but there are still rare studies that describe pneumonia risk factors by province, especially in West Java Province. An effort needs to be made to reduce the prevalence of pneumonia, one of which is by looking at the risk factors for pneumonia. By knowing these risk factors for the severity of pneumonia, it is hoped that planning for pneumonia prevention in children aged 12-59 months will be more effective. Based on the limitations of previous studies, this prompted researchers to uncover the problem of

risk factors for the severity of pneumonia. This study investigate the relationship between human host and environmental factors on the severity of pneumonia in children under five years in West Java Province in 2018.

Methods

This study used an analytic observational method with a cross-sectional study that used 2018 Basic Health Research Data of Indonesia, which had been compiled by the Indonesian Health Research and Development Agency (Balitbangkes RI). The population in this study was children under five with an age range of 12-59 months as many as 2,338 people per period in 2018 in West Java Province who were recorded in the 2018 Basic Health Research Data. The samples in this study were pneumonia sufferers in children aged 12-59 months based on the signs and symptoms experienced. The inclusion criteria in this study included children under five years aged 12-59 months and residing in West Java. Exclusion criteria included incomplete data, birth weight >4000 grams, and birth age >42 weeks. After the data cleaning stage, the number of samples in this study was 132 children under five years who fit the inclusion criteria. The sample selection process is shown in Figure 1.

Severity of pneumonia can be determined based on the signs and symptoms experienced by children under five years, for pneumonia characterized by symptoms of rapid breathing (according to age <2 month: >60 per minute, 2-11 month : >50 per minute, 12-59 months: >40 per minute, while for severe pneumonia characterized by pneumonia symptoms accompanied by lower chest wall indrawing.²² The variables studied include the degree of severity of pneumonia cases which is a dependent variable classified into two categories, namely severe pneumonia and pneumonia.²² Then independent variables that included host factors included prematurity and low birth weight. Prematurity was classified into two categories, namely premature if the mother's gestational age is less than 37 weeks and non premature if the gestational age is normal for 37-42 weeks.²³ The variable Low Birth Weight (LBW) was categorized into LBW if the birth weight <2500 grams and non LBW if the birth weight \geq 2500 grams.²⁴ While the environmental factors studied include variables of window opening habits with two categories, namely non qualified and qualified.²⁵ Home ventilation conditions are classified into two categories, namely non qualified if the ventilation area is <10% and qualified if the area is \geq 10%.²⁶ Home lighting intensity is classified into two categories, namely non qualified if the lighting intensity is <60 lux and qualified if the lighting intensity is \geq 60 lux.²⁷ The instruments in this study were taken from individual questionnaires (RKD18.IND) and households (RKD18.RT) 2018 Basic Health Research Data.

The data analysis technique used included three stages of analysis univariate, bivariate and multivariate analysis. Data were analyzed using SPSS 26 software. Bivariate analysis was performed using the chi-square statistical test and fisher's exact alternative test. Then, multivariate

analysis using multiple logistic regression tests. The role of risk factors will be displayed in the form of adjusted odds ratio (Adj. OR), significance value (P), and 95% confidence interval (CI). This research has met the ethical requirements of the Health Research Ethics Commission (HREC) Faculty of Dentistry, Airlangga University, with proof of certificate number 978/HRECC.FODM/VIII/2023.

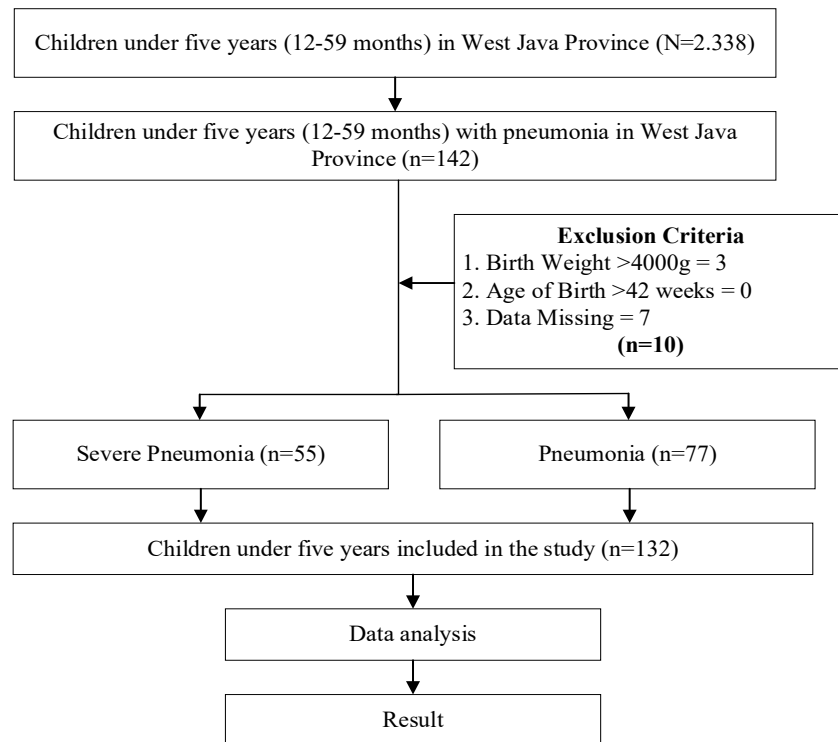


Figure 1. Flowchart of sample selection

Results

Based on the results of the univariate test, the characteristics of the respondents can be described in Table 1. There were 132 respondents who met the inclusion criteria, 55 respondents with severe pneumonia and 77 respondents with pneumonia. The severity of pneumonia is more in pneumonia status, with a proportion of 58.3%, while severe pneumonia is 41.7%. Based on the age of the respondents were in the 12-23 month age group, with a proportion of 32.6%, and the largest gender was male with a proportion of 53%. The results of a review of the characteristics of the host variables in Table 1 show that there are more respondents who do not have a history of being premature (70.5%) than respondents who have a history of being premature (29.5%). Meanwhile, ten respondents (7.6%) had a history of LBW compared to 92.4% of respondents born with normal birth weight.

Table 1. Characteristics of Respondents

Variable	n=132	%
Pneumonia Severity		
Severe Pneumonia	55	41.7
Pneumonia	77	58.3
Age		
12-23 months	43	32.6
24-35 months	36	27.3
36-47 months	22	16.7
48-59 months	31	23.5
Gender		
Man	70	53.0
Woman	62	47.0
Prematurity		
Premature	39	29.5
Non-Premature	93	70.5
Low Birth Weight (LBW)		
LBW	10	7.6
Non-LBW	122	92.4
The Habit of Opening the Windows of the House		
Non-Qualified	72	54.5
Qualified	60	45.5
Home Ventilation Conditions		
Non-Qualified	96	72.7
Qualified	36	27.3
Home Lighting Intensity		
Non-Qualified	55	41.7
Qualified	77	58.3

Based on the results of a review of the characteristics of the environmental influence variables, the quality of the house is in accordance with the indicators of a healthy house seen from the habit of opening the windows, ventilation conditions and lighting intensity. The results of the review of the habit of opening the windows are more that do not meet the requirements at the respondents residence of 54.5%. The same thing also happened to the ventilation conditions of the respondents houses where more did not meet the requirements with a proportion of 72.7% compared to ventilation conditions that met the requirements. Whereas for the house lighting intensity factor, more lighting conditions were found that met the requirements with a proportion of 58.3%.

The results of bivariate analysis of host and environmental factors on the severity of pneumonia are shown in Table 2. In a history of prematurity, severe pneumonia in children aged 12-59 months is more common (56.4%) than pneumonia (43.6%). Chi-square analysis of the severity of pneumonia with host factors, namely a history of prematurity, has a p-value of 0.042 (ORc = 2.353; 95% CI = 1.098-5.043) showing a significant relationship with the severity of pneumonia. The results obtained an ORc value of 2.353 means that children with a history of prematurity have a risk of 2.3 times more risk of pneumonia severity. While the results of the analysis of environmental factors related to the severity of pneumonia, namely the habit of opening the windows with a p-value of 0.021 (ORc = 2.467; 95% CI = 1.201-5.068). The result of an ORc value of 2.467 means that children who live in homes with non-qualified window opening habits

have a 2.46 times greater risk of pneumonia severity. The results of the fisher's exact test analysis for the LBW variable (ORc= 0.928; 95% CI = 0.249-3.458) have no significant relationship to the severity of pneumonia. In children under five with a history of LBW, 71 respondents (58.2%) who did not have low birth weight developed pneumonia, while 51 respondents (41.8%) who did not have LBW developed severe pneumonia. Other environmental factors are based on the results of the chi-square analysis for the house ventilation condition variable (ORc = 0.855; 95% CI = 0.395-1.853) and the intensity of house lighting (ORc= 1.306; 95% CI = 0.648-2.632) has a p-value> 0.05 so it has no significant relationship to the severity of pneumonia.

Table 2. Analysis of the Relationship between Host and Environmental Factors with Pneumonia Severity

Variable	Pneumonia Severity				p-value	OR _{crude} (95% CI)
	Severe Pneumonia		Pneumonia			
	n	%	n	%		
Prematurity						
Premature	22	56.4%	17	43.6%	0.042 ^{*a}	2.353 (1.098-5.043)
Non-Premature	33	35.5%	60	64.5%		
Low Birth Weight (LBW)						
LBW	4	40%	6	60%	1.000 ^b	0.928 (0.249-3.458)
Non-LBW	51	41.8%	71	58.2%		
The Habit of Opening the Windows of the House						
Non-Qualified	37	51.4%	35	48.6%	0.021 ^{*a}	2.467 (1.201-5.068)
Qualified	18	30.0%	42	70.0%		
Home Ventilation Conditions						
Non-Qualified	39	40.6%	57	59.4%	0.843 ^a	0.855 (0.395-1.853)
Qualified	16	44.4%	20	55.6%		
Home Lighting Intensity						
Non-Qualified	25	45.5%	30	54.5%	0.571 ^a	1.306 (0.648-2.632)
Qualified	30	39.0%	47	61.0%		

Information:

*p-value<0.05

^achi-square test; ^bfisher exact test

According to the results of multivariate analysis using multiple logistic regression analysis in Table 3, it was found that a risk factor that was proven to significantly increase the risk of pneumonia severity, namely prematurity (ORa = 2.446; 95% CI = 1.113-5.376) and the habit of opening the windows of the house (ORa = 2.963; 95% CI = 1.342-6.544). The largest Adjusted OR value in the data analysis showed that the independent variable habit of opening the windows of the house was the variable that had the greatest influence on the severity of pneumonia in children under five years. With ORa = 2.963 (95% CI = 1.342-6.544) which shows that children under five years who live at home with the habit of opening windows do not qualify for a 2.9 times greater risk of pneumonia severity.

Table 3. Multivariate Analysis between Host and Environmental Factors with Pneumonia Severity in West Java

Variable	Initial Modeling		Final Modeling	
	OR _{crude} (95% CI)	p-value	OR _{adjusted} (95% CI)	p-value
Prematurity				
Premature	2.458 (1.095-5.515)	0.029	2.446 (1.113-5.376)	0.026
Non-Premature	Ref		Ref	
Low Birth Weight (LBW)				
LBW	0.790 (0.181-3.449)	0.754	-	-
Non-LBW	Ref			
The Habit of Opening the Windows of the House				
Non-Qualified	2.915 (1.312-6.480)	0.009	2.963 (1.342-6.544)	0.007
Qualified	Ref		Ref	
Home Ventilation Conditions				
Non-Qualified	0.481 (0.185-1.252)	0.134	0.567 (0.239-1.345)	0.198
Qualified	Ref		Ref	
Home Lighting Intensity				
Non-Qualified	1.373 (0.604-3.125)	0.449	-	-
Qualified	Ref			

Discussion

Risk factors for pneumonia in children under five years can be identified based on the concept of the epidemiological triangle, including agent, host, and environmental factors. In addition to agent factors, one of the factors that play the most role in the process of infectious disease travel to humans is the state of the host's own body resistance (host).²⁸ Host factors can drastically alter the causative ability to cause infection, or produce disease, and increase immunity in general. Risk factors for pneumonia severity derived from host factors include a history of premature birth which shows a significant association with the severity of pneumonia (p-value = 0.042) and statistically showed an increased risk of pneumonia severity (ORa = 2.446), this means that children under five with a history of premature birth are 2.44 times more susceptible to severe pneumonia than children under five who do not have a history of prematurity. Similar research in the Philippines showed that the incidence of very severe pneumonia had a significant relationship with infants with a history of premature birth and had a 1.9 times greater risk of pneumonia severity than children under five years who did not have a history of premature birth.²⁹ Similar results were also reported in the community-based study conducted in India, stated that babies born prematurely have an increased risk of severe pneumonia.¹⁷ The effect of babies born prematurely is the risk of malnutrition which results in stunted growth and development of the baby. This is in contrast to studies conducted in South Africa, which found no significant association (p-value = 0.31) between prematurity and pneumonia severity. The results of the study are not significant because they can be caused by the research design and population sampling used.³⁰

Premature birth status can affect the immunity (immunology) of the children body so that it is vulnerable to infectious disease disorders. Pneumonia infection is a respiratory tract disease that can attack individuals with low immunity.³¹ Organ systems in premature infants that are not perfect

and function on their own can cause complications and increase mortality and morbidity of infants. As a result of immature or immature organ systems, premature babies have difficulty adapting to conditions outside the uterus after birth.³² The development of the lungs in the respiratory system of premature infants is still immature (imperfect) and the amount of surfactant in the lungs is inadequate. In premature infants where type II pneumocyte cells that produce surfactant are immature so that surfactant production is also reduced.³³ Deficiency of this surfactant will result in alveoli collapsing and the lungs not expanding completely (atelectasis) so that the baby will experience impaired lung function which is characterized by shortness of breath, nostril breathing, retractions to respiratory failure. This lung disorder can cause severe pneumonia and other lung infections such as respiratory distress syndrome (RDS).³⁴ Severity of pneumonia in the form of severe pneumonia can occur due to lack of surfactant in the lungs for respiration. Surfactant is a liquid or lipoprotein that coats the surface of the lungs which helps and keeps the lungs to contract and expand easily. The main functions of surfactants include lowering the surface tension between air and fluids thereby preventing the alveoli from collapsing or the air sacs from collapsing at the end of expiration, protecting the lungs from injury and infection caused by foreign bodies or pathogens, and to modulate the immune response.³⁵

Other host factors, namely the incidence of low birth weight has no significant relationship to the severity of pneumonia in children under five years (p -value = 1.00). However, based on the OR value of 0.928 ($OR < 1$), this indicates that LBW is a protective factor against the severity of pneumonia. Low birth weight is a preventable factor during the prenatal period, and it is associated with a higher risk of pneumonia and mortality. The results of a study conducted in Padang City showed that a history of low birth weight did not have a significant relationship with the severity of pneumonia.³⁶ The result showed that a history of LBW was a protective factor for the occurrence of pneumonia. This is because currently intensive care and treatment of babies with a history of LBW have received increasing attention from mothers and health facilities so that this can reduce morbidity and mortality due to LBW. In contrast to the results of a study conducted in Brazil, shows that children born with a body weight of less than 2500g have a 5.96 times greater chance of developing pneumonia than children born with a normal weight of 2500g or more.³⁷ Another study conducted in Bali also showed that the risk of pneumonia infection is higher in the condition of babies with low birth weight.³⁸

The two main mechanisms by which children with low birth weight are at risk of developing pneumonia are reduced immunocompetence and defects in lung function.³⁹ The study also explained that the incidence of pneumonia is higher in conditions of poor nutritional status and short duration of breastfeeding which is prone to occur in infants with low birth weight. In addition, LBW can cause zinc and iron deficiency in the body, both of which are elements that form red blood cells and white blood cells as components of the immune system. The occurrence of

deficiency of these substances can reduce the body's immune system, thereby increasing the inflammatory process or disease infection.⁴⁰ Children under five years with LBW are susceptible to infection due to low levels of serum IgA (Immunoglobulin A). IgA in the body is present in the secretions of the lung mucosa produced by plasma cells to protect the lungs against pathogens that attack mucous membranes.⁴¹ The presence of IgA can prevent the colonization of microorganisms in the upper respiratory tract so as not to cause immune system failure or infection with pathogenic organisms. Reactions that occur due to decreased serum IgA levels can cause a decrease in the body's immunity which has an impact on respiratory tract disorders to exacerbate the degree of infection from pneumonia.⁴² The limitation of the results of this study is that the sample size of children with LBW is too small so that it cannot represent the severity of pneumonia in West Java.

Risk factors for pneumonia can be caused by environmental factors where children under five years live and the surrounding environment. One of the environmental factors can come from the living environment related to healthy home indicators, including: the habit of opening the windows, home ventilation conditions, and home lighting intensity. Based on research, one of the environmental factors, namely the habit of opening windows, has results that does not meet the requirements has a risk of 2.96 times greater for the severity of pneumonia than the habit of opening the windows that meet the requirements (ORa = 2.963; 95% CI = 1.342-6.544). The habit of opening windows for family members had a significant relationship to the incidence of pneumonia because the opportunity for air circulation and entry of light into the house with the windows open was better and could kill microorganisms, the results of this study obtained an OR value of 3.007 which means that the risk of habitually opening windows that do not meet the requirements is 3.0 times higher than windows that are opened every day (p-value = 0.019; ORa = 3.007).⁴³ Another study also states that the behavior of opening windows every day has a significant effect on the incidence of pneumonia, where the risk is ten times higher in children under five who live in homes with rarely opened windows.⁴⁴

The condition of windows in the house such as permanently closed windows or rarely opened can affect pneumonia in children under five because air circulation in the house becomes difficult. This makes the air in the room more humid and increases the humidity level, which can become a breeding ground for bacteria, germs, fungi, and viruses that cause disease.⁴⁵ The habit of opening windows is a behavior that can be done as a prevention of the spread of microorganisms through the air. Windows that are rarely opened or not opened will affect the increase in carbon dioxide in the room which can be at risk of causing respiratory infections for the occupants of the house.⁴⁶ Reducing the concentration of carbon dioxide (CO₂) contained in indoor air can be done by means of an air circulation system adding fresh, oxygen-rich air (O₂) into the room. Indoor air quality affects the health condition of household members including children. Substances contained in air pollutants can be inhaled by children and then enter the lung tissue and cause inflammation of

the lungs. If this happens for a long time, the pollutant content will accumulate and become worse, causing a severe effect on pneumonia. The effect of the long exposure time of air pollutants that occurs in children under five years causes the possibility of severe pneumonia that requires hospital treatment due to the accumulation of air pollutants in the lungs.⁴⁷

Ventilation is a means of circulating air from inside and outside the room which aims to maintain humidity in the room. The area of proportion of house ventilation that meets the requirements for a healthy house is $\geq 10\%$ of the floor area.⁴⁸ Pathogenic microorganisms of pneumonia disease more easily develop in humid air and contain many dust particles due to unqualified home ventilation, making the respiratory tract of toddlers more sensitive and susceptible to infection.⁴⁹ The study results obtained an ORa value of 0.567 (OR <1), it states that ventilation conditions are not a risk factor for the severity of pneumonia but a protective factor. This is supported by research conducted in Semarang City, that there is no relationship between ventilation conditions that do not meet the requirements with the occurrence of pneumonia because families have a habit of opening windows and doors that can help provide good air circulation and good indoor lighting conditions can affect room humidity levels. Indoor air quality can be affected by outdoor climate and weather conditions.⁵⁰ Weather conditions can affect whether the occupants of the house use artificial air circulation such as air conditioners and fans (exhaust fans). The presence of indoor ventilation or air conditioning can control the growth of bacteria and fungi that are affected by indoor humidity due to changes in climatic conditions.⁵¹

Availability of ventilation can also be a proxy for sun exposure which directly reduces the survival of disease pathogens. Ventilation in the room affects the levels of carbon dioxide (CO₂) originating from the outside air and is an indicator of retention of hazardous substances because its concentration increases with room ventilation that does not meet the requirements.⁵² CO₂ concentrations also increase from the results of human respiration. If the body lacks oxygen, it will cause the respiratory muscles to work forcibly to breathe, or it is called chest wall retraction (pulling of the chest wall inward) which indicates severe pneumonia. Chest wall retraction is a sign where there are symptoms of respiratory failure in infants due to obstruction in the respiratory organs. Small airways due to obstruction make breathing efforts greater so that the respiratory muscles are seen to contract more deeply which can affect the severity of pneumonia.⁵³ Therefore, the solution to prevent pneumonia is to meet ventilation standards when building a house. Pneumonia and other diseases can be prevented by improving air circulation conditions.

Adequate lighting intensity is an indicator of a healthy home, especially from natural lighting in the form of sunlight that enters through doors, windows, and ventilation. The intensity of sunlight in the form of ultraviolet light can kill bacteria, germs, and viruses that cause infectious diseases.⁵⁴ The results stated that lighting intensity conditions in homes that did not meet the requirements had a 1.3 times greater risk of pneumonia than houses with lighting intensity that met

the requirements ($OR_c = 1.306$; $95\% CI = 0.648-2.632$). In line with research conducted in Semarang City, it shows that lighting intensity that does not meet the requirements is not a risk factor for pneumonia.²⁷ However, this condition is a risk factor that is 2 times higher for children under five years who live at home with adequate lighting. In contrast to other studies that state that there is a 2.9 times greater risk of pneumonia in the condition of the house with lighting intensity that does not meet the requirements ($p\text{-value} = 0.028$; $OR_a = 2.971$).⁵⁵

Natural lighting in the house is very important to kill bacteria that cause infection and reduce humidity in the house. The limited intensity of sunlight that enters the house can be a medium for the development of bacteria and the proliferation of diseases, one of which is pneumonia. Adequacy of sunlight in the house is an important indicator of a healthy home, sufficient sunlight wavelength is <290 nm. The antimicrobial effect possessed by ultraviolet light with a wavelength of 253.7 nm can kill pathogenic microorganisms that can cause infection and damage tissues. Ultraviolet light also has effect the occurrence of Vitamin D synthesis. In particular, the immunomodulatory effect of vitamin D is very important and can directly regulate human intrinsic immunity and adaptive immunity, such as restoring immunological balance disturbances that are associated with respiratory infectious diseases.⁵⁶ Furthermore, vitamin D deficiency is a risk factor for pneumonia and has direct connections to lung function impairment. Therefore, the incidence of lung disease is not only influenced by vitamin D levels, but also by the severity of pneumonia.⁵⁷ The difference in the results of this study can be influenced by the location or condition of the respondent's house, as well as the influence of climate and weather factors that can affect the intensity of house lighting. The condition of a dense and closed house can limit the sunlight entering the house.²⁷

The limitation of this study is that it used secondary data so that the research data must be adjusted to those in the 2018 RISKESDAS instrument. The research instrument refers to the questionnaires available in the institution. This results in a lack of opportunity for authors to explore information related to the variables used and can lead to recall bias. Another limitation is that the research data is implemented with a cross sectional study design, where data collection is only carried out on one observation or measurement and only reports conclusions about possible relationships and cannot conclude causal relationships because the time sequence cannot be determined. The advantage of using RISKESDAS 2018 data is due to the large sample size, so that it can represent provincial and national areas, so that the data can be used to achieve the purpose of investigating the relationship of various factors related to the severity of pneumonia in children 12-59 months in West Java Province.

Conclusion

There is a relationship between host and environmental factors with pneumonia severity in children under five years. The severity of pneumonia was higher in children under five years with pneumonia (58.3%), while severe pneumonia was (41.7%). The host factor that showed a significant association with pneumonia severity was prematurity. Meanwhile, environmental factors, namely the habit of opening windows, have a significant relationship with the severity of pneumonia. Other variables did not show a relationship with pneumonia severity, namely LBW, home ventilation conditions, and lighting intensity. The most dominant variable affecting the severity of pneumonia is the habit of opening windows. Suggestions that can be given include: routine prenatal examinations for mothers to other health workers to reduce the risk of preterm labour, for parents to be able to increase the role of families and cadres in the implementation of healthy homes for the community related to the habit of opening the windows of the house by routinely opening windows in the morning and evening to improve air circulation in the room. Then, West Java Provincial Health Office can increase pneumonia screening activities as early as possible and health education efforts related to the factors that cause pneumonia severity as a preventive measure in reducing pneumonia morbidity and mortality in children aged 12-59 months.

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Conflict of Interest

There is no conflict of interest in this research.

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