

# Risk Factors for Physical Conditions in the Home Environment and Numbers of Bacteria with Toddlers Pneumonia Incidence

*Bahri Bahri*<sup>1,2\*</sup>, *Mursid Raharjo*<sup>1</sup>, and *Suhartono Suhartono*<sup>1</sup>

<sup>1</sup>Department of Environmental Health, Faculty of Public Health, Diponegoro University, Semarang, Indonesia

<sup>2</sup>Department of Environmental Health, Poltekkes Kemenkes Semarang, Semarang, Indonesia

**Abstract.** Pneumonia caused the deaths of 808,694 children under the age of 5 years, 15% of all deaths toddlers in the world and 277 deaths aged 29 days-11 months in Indonesia. Pneumonia is the most common cause of death for toddlers compared to other diseases, more than the combined Acquired Immune Deficiency Syndrome (AIDS), malaria and measles. This purpose of study to determine the risk factors for the physical environment of a toddlers house and the numbers of bacteria in the incidence of pneumonia cases. The study was conducted using a case control approach with a sample size of 130 and a ratio of 1:1. The results of the analysis showed physical quality in the form of housing density variables (p value= 0.005), type of house floor (p value= 0.013), light intensity (p value= 0.035), humidity (p value= 0.030) and numbers of bacteria (p value= 0.002) who do not meet the requirements are a risk factor for the incidence of pneumonia cases in toddlers. however, the numbers of bacteria cannot be used as a risk factor due to limited validity in data sampling which did not conduct research on the types of bacteria in the sample.

## 1 Introduction

Pneumonia is an acute infectious lung disease caused by *Streptococcus pneumoniae* virus and fungus which often causes death in infants and toddlers [1]. Pneumonia is a cough and cold disease accompanied by chills, fever, headache, phlegm and shortness of breath or rapid breathing that often attacks toddlers [2]. According to the World Health Organization (WHO), in 2019 pneumonia was one of the leading causes of infectious death in children worldwide [1]. Pneumonia killed 808,694 children under the age of 5 years or 15% of all deaths of toddlers.

Pneumonia affects children and families everywhere, but is most common in South Asia and Africa. Pneumonia kills more children than any other disease, more than Acquired Immune Deficiency Syndrome (AIDS), malaria and measles combined [3]. According to the Indonesian Ministry of Health (Kemenkes RI), in 2019 infectious diseases became one of the contributors to death in the group of children aged 29 days to 11 months. Pneumonia ranks as the two main problems that cause 277 deaths in Indonesia. In the same

---

\* Corresponding author: [bhrdnk@gmail.com](mailto:bhrdnk@gmail.com)

year the case fatality rate (CFR) due to pneumonia in toddlers in Indonesia was 0,12% [4]. The mortality rate of pneumonia in the infant group was almost two times higher than the group of children aged 1-4 years [4].

The incidence of pneumonia cases is the third cause of death after cardiovascular and tuberculosis in Indonesia [5]. Pneumonia is one of the serious diseases handled in Indonesia, pneumonia is always at the top of the list of diseases that cause infant and toddlers mortality. The prevalence of toddlers pneumonia in Indonesia is 3,55% from 18.913.420 toddlers. Six provinces that have the highest prevalence of pneumonia in toddlers are Papua (3,9%), DI Yogyakarta (3,7%), Bengkulu (3.5%), North Kalimantan (3,1%), West Java (2,8 %) and Central Java (2,1%) (6). Data in the Indonesia Health Profile on 2019 explained that there was a decrease in the coverage rate for finding pneumonia in toddlers, which was 52,9% [4].

The strategic plan of the Indonesian Ministry of Health for 2020-2024 that the main causes of infant mortality in Indonesia are disorders that occur during the perinatal period (49,8%), congenital and genetic disorders (14,2%), pneumonia (9,2%), diarrhea and other gastrointestinal infections (7%), viral hemorrhagic fever (2,2%), meningitis (2%), undernutrition and metabolic disorders (1,3%)(7). The estimated number of pneumonia cases in Central Java in 2019 was 3.61%, so it was estimated that there were 83,101 cases of pneumonia in toddlers. The discovery and treatment of pneumonia sufferers in toddlers in Central Java in 2019 was 67.7%, an increase compared to 2018's achievement of 62.5%(8).

Various risk factors that increase the incidence of disease severity and death due to pneumonia, nutritional status (malnutrition and poor nutrition increase the risk), breastfeeding (exclusive breastfeeding reduces risk), indoor air pollution, especially cigarette smoke and burnt smoke from the kitchen, living in a crowded house (increasing risk) and vitamin A supplementation (reducing risk), zinc supplementation (reducing risk), low birth weight infants (increasing risk), vaccination (reducing risk)(9). Similarly, toddlers with other illnesses, such as AIDS or measles, are more likely to increase the severity of pneumonia. Environmental factors, such as living in a crowded house and parental exposure to smoking or indoor air pollution play a role in increasing toddlers susceptibility to pneumonia and the severity of its effects [3].

The incidence of pneumonia is based on the interaction between the components of the host, agent and environment, a change in one component causes the balance to be disturbed, resulting in pneumonia. The risk factors for the incidence of pneumonia in toddlers are influenced by intrinsic factors (age, gender, nutritional status and immunization status) and extrinsic factors (biological, physical and social). Based on the results of research conducted in 2012, the intrinsic factors that cause pneumonia include age, exclusive breastfeeding, nutritional status, measles immunization and diphtheria, pertussis and tetanus (DPT) immunizations. Extrinsic factors for the occurrence of pneumonia are occupancy density, proportion of house ventilation area with floor area, smoking habits of family members in the house and use of health services.

The factor of house sanitation conditions physically affects the tendency of the incidence of pneumonia in toddlers with a risk level of 6 times greater. Exposure to cigarette smoke in toddlers and unhealthy homes is associated with the incidence of pneumonia. Exposure to cigarette smoke in toddlers has 18 times the risk of pneumonia, while an unhealthy home has 21 times the risk of pneumonia in toddlers. Toddlers who live in homes with high air pollution have a 7.73 times risk of developing pneumonia compared to toddlers who have low air pollution in their homes [10].

The increase in pneumonia cases both in Indonesia and in Central Java is in line with the risk factors for the physical condition of the home environment and the number of bacteria. This issue is urgently needed to be investigated, so as not to cause a worse incidence of health problems, especially in Central Java, which is one of the areas with the highest incidence of pneumonia in toddlers.

## 2 Research Method

The research method used a case-control design and was analytic observational, where the survey was conducted with a retrospective approach to cases and controls based on the results of research analysis on a risk factor [11]. Design of this study, the group of toddlers with pneumonia cases, hereinafter referred to as cases, was compared to the group of toddlers who did not experience the effects and symptoms or did not experience pneumonia cases, which were then referred to as controls [2].

The population in this study is toddlers who live in the target area where the research is carried out. Samples from the study were taken from toddlers aged 1-5 years according to the basic data for toddlers at the public health center. The number of samples was determined using purposive sampling technique and the calculation using the minimum sample size formula. There were 130 samples, consisting of 65 case samples (toddlers with pneumonia cases) and 65 control samples (toddlers without pneumonia cases) according to the criteria set by the researcher. Research data is divided into 2 types of data, consisting of primary data and secondary data. Data from interviews, questionnaires, measurements and observations using instruments were used as primary data sources. Documentation and reports of relevant agencies are used as secondary data sources. The dominant chance of a risk factor causing the incidence of pneumonia cases in children under five was analyzed based on the OR value. Analysts on the research data were analyzed using univariate (cross tabulation), bivariate (chi square) and multivariate (logistical regression) [12].

## 3 Result and Discussion

The research was carried out in the working area of public health center in one of the districts in Central Java Indonesia in 2021. The area where the research was carried out was 33,1 km<sup>2</sup> with the geographical conditions of highland or mountainous areas as much as 65% and areas with lowland contours as much as 35%. The number toddlers in the work area where the study was conducted was 1,420 people with the composition of the population of the work area where the study consisted of 12,883 males and 12,649 females with a population density of 769 people/km<sup>2</sup>. Based on gender, there are 47% of respondents who are male and 53% are female, so that the number of respondents or samples of female sex is more than the number of male respondents. The variables of the physical condition of the home environment for toddlers studied were the proportion of ventilation area with the floor area of the house, temperature, house density, humidity, type of house floor, light intensity, type of house walls and the number bacteria in the research subjects room.

The results of the data analysis presented in table 1 explain the age or age of toddlers in the case group at most with the age of 1 year as many as 22 samples or 33.8% of the total case sample, the same thing in the control group as many as 32 samples or 49.2% of the total control sample. The fewest respondents for the case sample were at the oldest age of 5 years as many as 2 people or 3.1% of the total case sample, the same thing as the control sample group of 3 toddlers or 4.6% of the total control sample. Age factor is one of the risk factors for the occurrence of pneumonia and death due to pneumonia. The older toddlers who are suffering from pneumonia, the less likely they will die from pneumonia compared to younger children [13].

The incidence of pneumonia cases that can cause death in toddlers is influenced by the age of the patient as a risk factor. Toddlers who are older have a lower risk when compared to toddlers who are younger. Infants and toddlers or children aged less than 6 years generally experience an increase in infection for the first time in the respiratory tract caused by viruses and bacteria, another cause is the toddler's immune system is not fully formed so that it becomes more susceptible to infection [14].

**Table 1.** The Characteristics of Toddler Age in Case and Control Groups

No.	Age (year)	Case		Control	
		n	%	n	%
1.	1	22	33.8	32	49.2
2.	2	15	23.1	11	16.9
3.	3	17	26.2	9	13.8
4.	4	9	13.8	10	15.4
5.	5	2	3.1	3	4.6
Quantity		65	100	65	100

The results of a longitudinal study conducted in England stated that the incidence of pneumonia in toddlers had a long term impact with a decrease in pulmonary ventilation function in adulthood. This of course will greatly affect productivity so that it will reduce the potential and human resources. Therefore, pneumonia that occurs in children, especially toddlers, must be prevented and given proper medical treatment, considering that they are more at risk of developing severe pneumonia. The incidence of viral respiratory illness is soaring in infants and young children. Respiratory tract infections are generally the first infections that attack infants and toddlers, besides that the immune system experienced by infants and toddlers is not yet fully formed. Children less than 6 years of age do not yet have perfect immunity so they are very susceptible to infection [14].

Based on the data in table 2, the results of the analysis show that there is a relationship between residential density and the incidence of pneumonia case in toddlers. Statistical test results obtained p value of 0,005 means that there is a relationship between occupancy density and the incidence of pneumonia case in toddlers. The value of OR = 2,751 indicates that toddlers who live in an unqualified occupancy density with a room ratio of < 9 m<sup>2</sup>/person have a 2,751 times chance of suffering from pneumonia compared to toddlers who live with a occupancy density that adequate with the requirements and it can be stated that the residential density of toddlers house that did not adequate is a risk factor for the toddlers pneumonia incidence.

The condition of the dwelling of a dense house that is not in accordance with the provisions of the requirements causes an increase in the temperature in the house so that the temperature becomes hot and becomes humid and causes a high frequency of meeting and contact of one occupant of the house with other residents. Cases of pneumonia toddlers that are at risk for causing death are influenced by the density of residential homes, toddler rooms with more than 2 occupants have a 1.8 times chance of causing toddlers to get pneumonia. Microorganisms that cause pneumonia experience accelerated transmission from one occupant of the house to other residents of the house if the density of the houses occupancy does not meet the requirements [15]. The conclusion is the same as the previous study in 2018 by Putri Setiyo Wulandari in the fostered area of Jati Sampurna, Bekasi City, stating that the incidence of pneumonia cases in toddlers is one of them influenced by the density of residential homes where toddlers live [16].

**Table 2.** The Results of The Analysis of Risk Factors for Physical Conditions In The Home Environment and Number of Bacteria With Toddlers Pneumonia Incidence

No.	Risk factors	Case	Control	OR	95% CI	p value
		n = 65	n = 65			
1.	Occupancy density*					
	Did not adequate	38 (58,5%)	22 (33,8%)	2.751	1.349 – 5.608	0.005
	Adequate	27 (41,5%)	43 (66,2%)			

No.	Risk factors	Case	Control	OR	95% CI	p value
		n = 65	n = 65			
2.	Ventilation area					
	Did not adequate	27 (41,5)	28 (43,1)	1.065	0.531 – 2.136	0.859
	Adequate	38 (58,5)	37 (56,9)			
3.	Temperature					
	Not good	17 (26,2%)	25 (38,5%)	0,567	0,269-1,194	0.134
	Good	48 (73,8%)	40 (61,5%)			
4.	Humidity*					
	Did not adequate	40 (61,5%)	23 (35,4%)	2.922	1.432 – 5.960	0.030
	Adequate	25 (38,5%)	42 (64,6%)			
5.	The type of floor *					
	Soil	20 (30,8%)	8 (12,3%)	3.167	1.277 – 7.854	0.013
	Permanent	45 (69,2%)	57 (87,7%)			
6.	The type of wall					
	Did not adequate	4 (6,2%)	2 (3,1%)	2.066	0.365 – 11.692	0.412
	Adequate	61 (93,8%)	63 (96,9%)			
7.	Light intensity*					
	Not good	36 (55,4%)	24 (36,9%)	2.121	1.051 – 4.279	0.035
	Good	29 (44,6%)	41 (63,1%)			
8.	Number of bacterial*					
	Did not adequate	53 (81,5%)	37 (56,9%)	3,342	1,508-7,409	0,002
	Adequate	12 (18,5%)	28 (43,1%)			

Note: \*Significant

The ratio of occupants must be adjusted to the area of the house, if the area of the house is narrow while the number of family members will be unbalanced. Crowded housing conditions trigger the growth of bacteria and viruses that cause pneumonia which can be transmitted through the respiratory tract. Children who are underage are very susceptible to contracting these bacteria and viruses. The floor area of a healthy house must be sufficient for the occupants of the house in it, meaning that in order to avoid excess occupants in the house, the number of occupants must be adjusted to the floor area of the house. The toddler's bedroom has a minimum area of 3m<sup>2</sup>/person and the bedroom is not terraced. In addition, the bedroom is not occupied by more than 2 people. Except husband and wife and children less than 2 years old. This is to control the density of occupancy in the house, so as to reduce the risk of pneumonia in toddlers [17]. Residential density that does not adequate with requirements will affect the number of colonies of disease germs, especially diseases of the respiratory tract. Density of occupancy that does not adequate with requirements due to the large number of occupants with narrow residential land causes a lack of air exchange in the house which can affect the air quality in the house [5].

Table 2 shows the results of the analysis that there is no relationship between the proportion of ventilation area and floor area with the incidence of pneumonia in toddlers at the research working area. The results of statistical tests obtained p value of 0,859 and OR = 1,065, meaning that there is no relationship between the proportion of ventilation area and floor area with the incidence of pneumonia in toddlers because the p value is  $>$  from the  $\alpha$ . The ventilation area of the house that does not adequate with the requirements can be caused by the type of small house due to small land ownership. Fewer land ownership due to expensive land prices and an increasingly dense population [17]. Ventilation is useful for providing indoor air and removing dirty air from an enclosed space. Including ventilation is an air window with a minimum requirement of 10% of the floor area. Lack of ventilation will cause the humidity to rise. High humidity is a medium for the growth of bacteria, especially pathogenic bacteria [18]. So it can be stated that the proportion of ventilation area and floor area of a toddlers house that did not adequate is not a risk factor for the incidence of pneumonia in toddlers.

The results of the analysis of the relationship between house temperature conditions and the incidence of pneumonia in toddler at the research working area showed statistical test results with a p value of 0,134 and OR = 0,567, meaning that there was no relationship between house temperature conditions and the incidence of pneumonia in toddlers because the p value  $>$  of the  $\alpha = 0,05$ . This study is in line with the results of research conducted by Fahimah in 2014 which showed that there was no relationship between indoor air temperature and the incidence of pneumonia in toddlers with p value = 0,663 [19] and in accordance with Sari research conducted in 2018 with p value = 1,000 [20]. So it can be stated that the temperature of a toddlers house that not good temperature is not a risk factor for the incidence of pneumonia in toddlers.

The results of the analysis of other research in Astambul District, Banjar Regency using the chi square test obtained p value = 0,244  $>$  (0.05) which states that there is no relationship between temperature and the incidence of pneumonia in toddlers [21]. Low air temperature can cause microorganisms to be more stable in the air, so that indoor conditions that tend to be cold can facilitate the occurrence of pneumonia transmission, especially in toddlers with weak immune systems [20]. The reason for this is that there is no relationship between temperature and the incidence of pneumonia in this study because there is no significant difference in house temperature in the case and control groups.

The results of the analysis showed that there was a relationship between house humidity and the incidence of pneumonia in toddlers at the research working area. The results of statistical tests obtained p value of 0,003 meaning that there is a relationship between humidity in the house and the incidence of pneumonia in toddlers. The value of OR = 2,922 indicates that toddlers who live in humid conditions with humidity levels  $<$  40% and  $>$  70% have a 2,922 times chance of suffering from pneumonia compared to toddlers who live in homes with non humid conditions. It can be stated that the house humidity of toddlers house that did not adequate is a risk factor for the toddlers pneumonia incidence.

These results are consistent with another study conducted in North Semarang District which stated that there was a significant relationship between humidity and the incidence of pneumonia in toddler on p value = 0,001 and 95% CI (2,867 – 20,135). This is also in accordance with research conducted in the Jatibarang Public Health Center Work Area, Brebes Regency which stated that the humidity in the toddlers room was the dominant risk factor for the incidence of pneumonia in toddlers with p value = 0,037 [22]. Humidity that is too high causes the growth of disease microorganisms to thrive. High humidity is a good medium for pathogenic bacteria. These microorganisms can enter the human body through the transmission of air that is inhaled by the respiratory tract, resulting in infection of the respiratory tract [5].

At a certain temperature and humidity allow the growth of microorganisms to be inhibited or even not grow at all or die. But at a certain temperature and humidity can also grow and reproduce very quickly. This is dangerous because the more often children are in a room with these conditions for a long time, the toddlers will be exposed to these risk factors, as a result, the greater the chances of children contracting pneumonia [23]. Based on the results of field observations, most toddlers spend all day in the family room and rooms with most of the windows not opened. Ventilation is closely related to humidity, house ventilation that is never opened will block sunlight from entering the house, so the humidity in the room will increase. Humidity outside the home can naturally affect the humidity inside the house [24]. Humid spaces allow for the growth of microorganisms that cause pneumonia [25]. Increased humidity in the room which is a good medium for pathogenic microorganisms to live [26].

The results of the research analysis in table 2 show that there is a relationship between the type of floor of the house and the incidence of pneumonia in toddlers at the working area of the Baturraden II Public Health Center. The results of statistical tests obtained p value of 0,01, meaning that there is a relationship between the type of floor of the house and the incidence of pneumonia in toddlers. The value of OR = 3,167 indicates that children under five who live in a house with a soil type of floor have a 3,167 times chance of suffering from pneumonia compared to toddlers who live in a house with a permanent type of floor condition. It can be stated that the type of floor of toddlers house from soil material is a risk factor for the toddlers pneumonia incidence.

The results of this study are the same as other studies conducted at the Plumbon Public Health Center, Indramayu Regency with the results of bivariate analysis obtained by statistical test results with p value = 0,010 ( $p < 0,05$ ) which states that statistically there is a statistical relationship between the type of floor of the house and the incidence of pneumonia in children under five (27). Furthermore, research conducted at the Puring Public Health Center, Kebumen Regency, showed that there was a relationship between the type of floor and the incidence of pneumonia in children under five ( $p = 0,015$ ). The magnitude of the risk of suffering from pneumonia can be seen from the value of OR = 3,4 with 95% CI = 1,355 - 8,531 which means that children under five who live in houses with floor types that do not adequate with the requirements have a risk of developing pneumonia by 3,4 times greater than toddlers who live in a house with this type of floor adequate the requirements [28].

Houses that use non permanent walls will cause air to enter more easily which brings dust into the house so that it is dangerous if inhaled by toddlers. The walls of the house that do not adequate with the requirements create abnormal humidity and become a precondition for the growth of bacteria or pathogenic microorganisms that can cause disease for the occupants [22]. The results of the statistical test for the type of wall in table 2 obtained a p value of 0,403 and OR = 2,066, meaning that there is no relationship between the type of wall and the incidence of pneumonia in toddlers because the p value is  $>$  from the value, which is  $> 0,05$ . So it can be stated that the type of wall of a toddlers house that did not adequate is not a risk factor for the incidence of pneumonia in toddlers.

The results of this analysis are in accordance with research conducted in the work area of Pangandaran Public Health Center, Ciamis Regency with a p value = 0,463 which states that the type of wall does not have a close relationship with the incidence of pneumonia in toddlers [29] and other studies conducted in the working area of the Mijen Public Health Center, Semarang City. which states that the type of wall is not proven to have an effect on the incidence of pneumonia in toddlers with p value = 0,208 [30]. Another study conducted in Tegalratu Ciwandan Village, Cilegon City stated that the type of wall did not show a significant effect on the incidence of pneumonia in children under five [31].

**Table 3.** Results of Multivariate Analysis of The House Environment and Number of Bacterial

Variable	B	P value	OR	95% CI
Occupancy density	0,843	0,038	2,324	1,046-5,162
Humidity	1,414	0,001	4,112	1,771-9,544
Type of floor	1,116	0,032	3,052	1,102-8,447
Number of bacterial	1,529	0,002	4,613	1,793-11,863

The results of the analysis showed that there was a relationship between the light intensity in the house and the incidence of pneumonia in children under five at the research working area. Statistical test results obtained a p value of 0,035, meaning that there is a relationship between light intensity in the house and the incidence of pneumonia in toddlers. The value of OR = 2,121 indicates that toddlers who live in homes with poor light intensity conditions have a 2,121 times chance of suffering from pneumonia compared to toddlers who live in homes with good light intensity conditions in the home, which is in the range of 60-120 lux. In general, bacteria or other microorganisms can live well in normal light exposure of 60 lux indoors [32]. The results of the research conducted in the working area of the Jatibarang Health Center, Brebes Regency, stated that there was a statistically significant relationship between lighting and the incidence of pneumonia in children under five with p value = 0,030 and OR = 2,202 with 95% CI = 1,130 <OR < 4,292. It can be stated that the light intensity of toddlers house that did not adequate is a risk factor for the toddlers pneumonia incidence.

A healthy home requires sufficient lighting (sunlight), nothing less and nothing more. The lack of light entering the house, especially the natural light of the sun, in addition to causing discomfort, is also a good place or medium for living and breeding disease. This light is very important besides being useful for reducing humidity and can kill pathogenic bacteria such as tuberculosis bacteria, eye diseases and respiratory diseases. Therefore, efforts must be made so that the incoming sunlight is not blocked by trees, buildings or high walls [22]. Lighting that suits your needs can help kill disease bacteria. The house as a place to live must be able to provide a healthy life so that residents of the house can have and feel a healthy life both physically, mentally and socially [10]. According to the results of previous studies, home lighting that does not adequate with requirements is one of the risk factors for pneumonia case in toddlers [18].

Based on the results of multivariate data analysis using logistic regression backward LR method shown in table 3, it can be seen that four variables have an influence on the incidence of pneumonia case in toddlers at the research working area, including occupancy density (p value = 0,038), humidity (p value = 0,001), the type of house floor (p value = 0,032) and the number of bacterial (p value = 0,002). The independent variable with the largest OR value is the number of bacterial, which is 4,613, meaning that the number of bacterial variable is the most dominant variable affecting the incidence of pneumonia case in toddlers. However, the results of the research on the risk factors for the condition number of bacteria with the incidence of pneumonia in toddlers may experience invalid results because there is no identification of the specific types of microorganisms in the samples examined.

The results of this research analysis are in line with previous research conducted in Kenjeran District, Surabaya which stated that the number of bacterial was significant with p value = 0,04 so that the number of bacterial affected the incidence of pneumonia in toddlers (10). Another study stated that the number of bacterial that did not adequate had a 1,93 times risk of suffering from pneumonia compared to toddlers who lived at home with the condition of the number of bacterial in the house that adequate with requirements with the number of bacterial < 700 CFU/m<sup>3</sup> [33].

An unhealthy house environment can trigger infectious diseases and other health problems, including respiratory tract infections. Small houses that are polluted by smoke,



both cigarette smoke or smoke coming from the kitchen which does not have adequate air circulation, will spread viruses or bacteria and result in acute or chronic respiratory infections. A dense, cramped and slum housing environment can potentially cause children to be infected with bacteria that come from a dirty environment. Human health can be disrupted due to air pollution in the house or space because humans spend more time at home. The house as a micro environment is closely related to air pollution. The health condition of the air in the room of the house can be influenced by various factors ranging from the components of the house, the structure of the building, activities in the house, the density of the dwelling and the quality of the air in the house. The number of occupants in one house also has an important role in the speed of transmission of microorganisms in an environment [10].

## 4 Conclusion and Suggestion

The research data that has been analyzed proves that there is a relationship between the variables of the physical environment of the house being studied and being a risk factor, that is the density of house, humidity in the house, type of house floor, light intensity and number of bacteria with the incidence of pneumonia cases in toddlers. Based on multivariate analysis, the number of bacteria has the highest OR value of 4.613 so that it becomes the most dominant variable affecting the incidence of pneumonia cases in toddlers. However, it cannot be used as a risk factor due to limited validity. This research needs to be developed further by using other parameters to measure variables with different sizes and methods.

## Acknowledgments

Acknowledgments are conveyed to all parties who have helped obtain primary and secondary data on the incidence of pneumonia cases in toddlers in the research area who have become research respondents.

## References

1. WHO, Pneumonia [Internet] [cited 2021 Apr 17]. Available from: <https://www.who.int/news-room/fact-sheets/detail/pneumonia> (2021)
2. M. Indrayani, Faktor-Faktor Yang Memengaruhi Kejadian Pneumonia Pada Bayi di Rumah Sakit Imelda Pekerja Indonesia Medan Tahun 2017, Universitas Sumatera Utara (2017)
3. UNICEF/WHO, Pneumonia: the forgotten killer of children, (2006)
4. Kemenkes RI, Profil Kesehatan Indonesia Tahun 2019, Jakarta (2019)
5. F. El. Syani, M. Raharjo, Hubungan Faktor Risiko Lingkungan Terhadap Kejadian Penyakit Pneumonia Balita Dengan Pendekatan Analisis Spasial Di Kecamatan Semarang Utara. *J Kesehat Masy*, **3(3)**, 732–44 (2015)
6. Kementerian Kesehatan RI, Laporan Nasional Riskesdas 2018, Laporan Nasional Riskesdas 2018. Jakarta (2018)
7. Menteri Kesehatan Republik Indonesia, Permenkes Nomor 21, Indonesia (2020)
8. Dinkesprov Jateng, Profil Provinsi Jawa Tengah Tahun 2019, **3511351(24)**, 1–261 (2020)

9. M. Juni, N. Nurjazuli, S. Suhartono, Hubungan Faktor Kualitas Lingkungan Rumah Dengan Kejadian Pneumonia Pada Bayi di Wilayah Kerja Puskesmas Banjarmangu 1 Kabupaten Banjarnegara, *J Kesehat Lingkung Indones*, **15(1)**, 6 (2016)
10. F.N. Rahmawati, Relationship between House Sanitation and Number of Bacterial in Bed Room with Pneumonia Case of Children Under Five Years Old in Kenjeran Sub District Surabaya. *J Kesehat Lingkung*, **10(3)**, 306 (2018)
11. Dewiningsih. Faktor Lingkungan dan Perilaku Kejadian Pneumonia Balita Usia 12-59 Bulan. *HIGEIA (Journal Public Heal Res Dev)*, **2(3)**, 453–64 (2018)
12. M.R. Slodia, P.T. Ningrum, Analisis Hubungan Antara Sanitasi Lingkungan dengan Kejadian nalisis Hubungan Antara Sanitasi Lingkungan dengan Kejadian Stunting di Kecamatan Cepu, Kabupaten Blora, Jawa Tengah. *J Kesehat Lingkung Indonesia*, **21(1)**, 59–64 (2022)
13. Puskesmas Baturraden II, Profil Puskesmas Baturraden II Tahun 2020, Banyumas, 156 (2020)
14. R. Garmini, R. Purwana, Polusi Udara Dalam Rumah Terhadap Infeksi Saluran Pernafasan Akut pada Balita di TPA Sukawinatan Palembang. *J Kesehat Lingkung Indones*. **19(1)**, 1 (2020)
15. A.R. Okoko, E. Hossie, I.C. N'djobo-Mamadoud, E. Moyen, G.E. Bowassa, G. Moyen, Pneumonia of Children under 5 Years of Age in Brazzaville (Republic of Congo). *Open J Pediatr*. **07(03)**, 178–91 (2017)
16. P.S. Wulandari, D. Suhartono, Hubungan Lingkungan Fisik Rumah Dengan Kejadian Pneumonia Pada Balita di Wilayah Kerja Puskesmas Jatisampurna Kota Bekasi. *J Kesehat Masy*. **4**, 7–12 (2016)
17. C.D. Trisiyah, C.U. W, Hubungan kondisi lingkungan rumah dengan kejadian pneumonia pada balita di wilayah kerja Puskesmas Taman Kabupaten Sidoarjo. *Indones J Public Heal*. **13(1)**, 119–29 (2018)
18. M. Henny, D. Sartika, O. Setiani, N.E. W, D. Amerika, Faktor Lingkungan Rumah Dan Praktik Hidup Orang Tua Yang Berhubungan Dengan Kejadian Pneumonia Pada Anak Balita Di Kabupaten Kubu Raya Tahun 2011. *J Kesehat Lingkung Indones*. **11(2)**, 153–9 (2013)
19. R. Fahimah, E. Kusumowardani, D. Susanna, Kualitas Udara Rumah dengan Kejadian Pneumonia Anak Bawah Lima Tahun (di Puskesmas Cimahi Selatan dan Leuwi Gajah Kota Cimahi. *Makara J Heal Res*. **18(1)**, 25–33 (2014)
20. D.A. Sari, Y.H. Darundiati, Hubungan antara Kualitas Udara dalam Ruang dengan Kejadian Pneumonia pada Bayi di Wilayah Kerja Puskesmas Bandarharjo Kota Semarang. *JKLI*. **18(3)**, 12–8 (2019)
21. T. Nindia, I. Santoso, J. Juanda, Kualitas Fisik Rumah Dengan Kejadian Pneumonia Pada Balita. *J Kesehat Lingkung J dan Apl Tek Kesehat Lingkung*. **16(2)**, 809 (2019)
22. H. Padmonobo, O. Setiani, Hubungan Faktor Lingkungan Fisik Rumah dengan Kejadian Pneumonia di Wilayah Kerja Puskesmas Jatibarang Kabupaten Indramayu. *J Kesehat Terpadu (Integrated Heal Journal)*. **10(2)**, 36–43 (2012)
23. A.T Darmawati, E. Sunarsih, I. Trisnaini, Hubungan faktor Kondisi Fisik Rumah Dan Perilaku Dengan Insiden Pneumonia Pada Anak Balita Di Wilayah Kerja Puskesmas Yosomulyo Kota Metro. *J Ilmu Kesehat Masy*. **7(1)**, 6–13 (2016)
24. G. Prajadiva, Y. Ardillah, Determinan Lingkungan Fisik Rumah Terhadap Pneumonia pada Balita di Pinggiran Sungai Musi. *J Kesehat*. **7621(1)**, 1–11 (2019)

25. T.K.P Nguyen, T.H. Tran, C.L. Roberts, G.J. Fox, S.M. Graham, B.J. Marais, Risk factors for child pneumonia - focus on the Western Pacific Region. *Paediatr Respir Rev* [Internet]. 2017;21:95–101. Available from: <http://dx.doi.org/10.1016/j.prrv.2016.07.002>
26. R.P.P.K. Mardani, H.E. Wardani, R.W. Gayatri, Hubungan Faktor Lingkungan Fisik Rumah, Status Pendidikan Ibu, Dan Status Pekerjaan Ibu Terhadap Kejadian Pneumonia Balita Di Wilayah Kerja Puskesmas. *J Sport Sci Heal.* **(3)**, 233–42 (2019)
27. H. Akbar, B.H, S.R. Hamzah, M. Paundanan, L.O. Reskiaddin, Hubungan Lingkungan Fisik Rumah dengan Kejadian Pneumonia pada Balita di Wilayah Kerja Puskesmas Plumbon. *J Kesmas Jambi.* **5(2)**, 1–8 (2021)
28. M. Khasanah, S. Suhartono, D. Dharminto, Hubungan Kondisi Lingkungan Dalam Rumah Dengan Kejadian Pneumonia Pada Balita Di Wilayah Kerja Puskesmas Puring Kabupaten Kebumen. *J Kesehat Masy.* **4(5)**, 27–34 (2016)
29. L. Yulianti, O. Setiani, Y.H. D, Faktor-Faktor Lingkungan Fisik Rumah Yang Berhubungan Dengan Kejadian Pneumonia Pada Balita Di Wilayah Kerja Puskesmas Pangandaran Kabupaten Ciamis. *J Kesehat Lingkung Indones.* **11(2)**, 187–93 (2013)
30. Fajar, Sulistiyani, O. Setiani, Faktor – Faktor Yang Mempengaruhi Kejadian Pneumonia Pada Balita Di Wilayah Kerja Puskesmas Mijen Kota Semarang. *J Kesehat Ibnu Sina.* **1(1)**, 1–10 (2019)
31. K.N. Nalasari, W.E. Pertiwi, Physical Conditions and Indoor Air Pollution in house and Pneumonia In Toddlers. *J Kesehat Lingkung.* **11(4)**, 259 (2019)
32. D.L. Caesar, N.E. W, Hubungan Jumlah Bakteri Patogen dalam Rumah dengan Kejadian Pneumonia pada Balita di Wilayah Kerja Puskesmas Ngesrep Banyumanik Semarang Tahun 2014 Relationship. *J Kesehat Lingkung Indones.* **14(1)**, 21–6 (2015)
33. C.C. Grant, D. Emery, T. Milne, G. Coster, C.B. Forrest, C.R. Wall, et al, Risk factors for community-acquired pneumonia in pre-school-aged children. *J Paediatr Child Health.* **48(5)**, 402–12 (2012)