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Association Between The Physical Condition of the House and the Smoking Habits of Residents with the Incidence of Pneumonia In Children Under Five Years

Desy Mery Dorsanti[1]*, Nurjazuli[1], Mursid Raharjo[1]

[1] Departemen Kesehatan Lingkungan Fakultas Kesehatan Masyarakat, Universitas Dipenogoro, Semarang, Indonesia.

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Corresponding Author:
Desy Mery Dorsanti
desysihombing@gmail.com

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Abstract: Pneumonia is leading cause of death worldwide, with a prevalence of 44%, and is second leading cause of death among under-fives in Indonesia, at 15.5%. Pneumonia is caused by viruses and bacteria that are associated with physical conditions, air quality, and smoking habits in house. This study aimed to determine association between physical house conditions and smoking habits with incidence of pneumonia in children under five years in Cengkareng Health Center working area. This study was a case-control design analytic observational study. Population involved chindren under five aged 12-59 months with a sample of 43 cases and 43 controls calculated using Lemeshow's formula, taken using purposive sampling technique. Independent variables included floor and wall types, ventilation, occupancy density, temperature, humidity, light intensity, PM10 and PM2.5 levels, and smoking habits. Dependent vararible are incident of pneumonia. Data were collected through observation, sanitarian kits, and questionnaires. Data were analyzed using chi-square and logistic regression with 95% CI and alpha 0.05. The results showed that PM2.5 levels (p=0.010, OR=3.290, 95% CI=1.323-8.181) and indoor smoking (p=0.044, OR=2.758, 95% CI=1.027-7.410) were most significant factors associated with pneumonia. This study recommends optimizing educational programs regarding PM2.5 exposure and smoking habits to improve healthy living practices and reduce risk of pneumonia.

Keywords: Chindren under five; Pneumonia; Physical condition of the house; Smoking habits

Introduction

Pneumonia is a form of acute respiratory infection caused by bacteria, viruses, or fungi, with the main symptom being lung inflammation. This disease causes pain during breathing and limits oxygen intake into the body. The bacteria Streptococcus pneumoniae and Haemophilus influenzae type b, viruses such as respiratory syncytial virus (RSV), and several types of fungi are often the causes of pneumonia. (Kim et al., 2017) This disease is the leading cause of death in children under five worldwide, accounting for around 20% of the more than 5 million child deaths each year, particularly among children under the age of two (Walker et al., 2013). In addition, there are also other clinical symptoms that appear in children suffering from pneumonia, namely cough, fever, and vomiting (World Health Organization, n.d.).

According to UNICEF's 2019 report, more than 800,000 children under the age of five die from pneumonia annually, with over 2,000 daily deaths. The regions with the highest incidence rates are South Asia and Central and West Africa (UNICEF, 2022; UN IGME), 2019). In Indonesia, the incidence of pneumonia among children under five is also high. In 2021, pneumonia ranked second as the leading cause of death in children

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after diarrhea, with a mortality rate of 0.16%. According to the 2018 Riskesdas data, the prevalence of pneumonia diagnosed by healthcare professionals reached 2.1% (Kemenkes RI, 2018). The decrease in the percentage of pneumonia case discovery coverage in 2020 and 2021 is suspected to be motivated by the stigma due to COVID-19 which caused the number of visits to health centers for chindren under five who had difficulty breathing or coughing decreased, as a result of which the coverage did not meet the Strategic Plan target of 65% (Kemenkes RI, 2021).

In DKI Jakarta, in 2021, the number of pneumonia cases among children under five reached 13,759, with the highest distribution in West Jakarta (4,701 cases) and East Jakarta (3,215 cases) (Dinas Kesehatan Provinsi DKI Jakarta, 2021). Meanwhile, data from Puskesmas Cengkareng, West Jakarta, shows that the number of pneumonia cases continues to increase yearly. In 2021, there were 888 cases of pneumonia, which surged to 1,847 cases in 2022 and further increased to 2,155 cases in 2023. This trend suggests that pneumonia in the area is a serious problem that requires special attention (Puskesmas Cengkareng, 2023).

Pneumonia is closely related to socio-demographic factors, household environmental conditions, and indoor air pollution. Air pollution, both indoor and outdoor, significantly contributes to pneumonia-related deaths. Indoor air pollution, primarily caused by smoking and the use of unclean fuels for cooking, has a greater global health impact compared to outdoor air pollution (Rees & UNICEF., 2016). It is estimated that around two billion children aged 0-17 live in areas with air pollution levels that exceed international guideline limits (UNICEF, 2022).

Previous studies have shown that physical household conditions, such as ventilation, temperature, humidity, and floor type, influence the risk of pneumonia in children. For instance, a study by Agustyana et al. (2019) found that indoor temperatures not meeting health standards increased the risk of pneumonia by more than two times (OR=2.945). Another study by Sa'diyah et al. (2022) demonstrated that inadequate humidity levels increased the risk of pneumonia by fourfold (Sa'diyah et al., 2022). A further study by Nurjayanti et al. (2022) found a significant relationship between PM10 exposure and pneumonia in children in the working area of Puskesmas Bandarharjo, Semarang (Nurjayanti et al., 2022).

Another significant factor contributing to pneumonia risk in children is smoking habits inside the house. According to WHO data from 2018, the global smoking prevalence for people over 15 years old was 39.5%, with Indonesia ranking first among ASEAN countries with a prevalence of 36.3%. (World Health Organization, 2018) The dangers of cigarette smoke affect not only active smokers but also passive smokers, who bear 75% of the smoke's health risks. (Kemenkes RI, 2018a) A study by Adane et al. (2020) indicated that children who are passive smokers have a 2.11 times higher risk of developing pneumonia compared to non-exposed children. (Adane et al., 2020)

Poor indoor air quality, exacerbated by exposure to cigarette smoke and fine particulate matter like PM2.5, further worsens the health conditions of children living in homes with inadequate physical conditions. Indoor air pollution often arises from poor ventilation, the use of solid fuels, and smoking habits inside the house. These factors make the household environment unhealthy and high-risk for residents, particularly children. (Achmadi, 2014) A healthy home must meet certain requirements, such as having an indoor temperature of 18-30°C, humidity levels of 40-60%, lighting of at least 60 Lux, and floors and walls made from materials that are not earth or wood that easily absorb moisture. (Kemenkes RI, 2023)

A preliminary survey conducted in the Cengkareng sub-district of West Jakarta found that many homes do not meet the healthy home criteria. Some issues identified include indoor temperatures outside the recommended range, non-permanent walls, and dirt floors. Additionally, indoor air pollution, such as PM10 and PM2.5 exposure, and the high prevalence of active smokers in the area, further exacerbate the health risks for children. Given the increasing trend of pneumonia cases in children in the working area of Puskesmas Cengkareng, West Jakarta, along with poor household conditions and high indoor air pollution exposure, further research is needed to identify the relationship between household physical conditions and smoking habits with the incidence of pneumonia in children in the area. Preventive measures, such as optimizing healthy home surveys and educational programs on the dangers of smoking and air pollution, are urgently needed to reduce the risk of pneumonia in children and improve the quality of life in the community.

Method

This study was an analytic observational study with a case-control design. This study was conducted in the working area of the Cengkareng Health Center, West Jakarta from July 2023 to February 2024. The independent variables in this study were the physical condition of the house in the form of floor type, wall type, ventilation area, house occupancy density, temperature, and humidity, and lighting intensity, indoor air quality in the form of PM 2.5 and PM 10, and smoking habits of the house occupants. The dependent variable in this study was the incidence of pneumonia in chindren under five. The case population in this study

were chindren under five aged 12-59 months who experienced pneumonia while the control population were those who did not experience pneumonia. The sample size of 43 cases and 43 controls was calculated using the Lemeshow formula with the inclusion criteria of residing in the Cengkareng Health Center working area and not renovating the house. (Soekidjo Notoatmodjo, 2014) The exclusion criteria were that there was more than one toddler in one house, the respondent was not at home when the study was conducted, and chindren under five with congenital abnormalities. Sampling was done using purposive sampling technique.

Data collection was done by observation and questionnaire. Observations were carried out using instruments such as roll meters to obtain data on house occupancy density and ventilation area, thermohygrometers to measure room temperature and humidity, lux meters to obtain lighting intensity data, digital sanitarian kits to measure indoor PM 10 and PM 2.5 levels, and observation sheets to assess the type of wall and floor type used. Interviews with questionnaires were conducted to obtain data on family members who have smoking habits in the house. Data analysis in this study used univariate, bivariate, and multivariate analysis. Univariate analysis was conducted to determine the frequency distribution of each variable and respondent characteristics. Bivariate analysis was conducted to determine the relationship between the independent variable and the dependent variable using the chi-square test at a confidence interval of 9% and alpha 0.05. Multivariate analysis was conducted to determine the most dominant variable in influencing the incidence of pneumonia in under-fives using the logistic regression test at a 95% confidence interval.

Result and Discussion

Results

Univariate Analysis

1. *Overview of Factors in the Physical Condition of Chindren under five' Homes*

Based on the results of research that has been conducted on the physical condition of chindren under five' homes in the Cengkareng Health Center working area, West Jakarta in 2024, the following results are obtained.

Table 1. Frequency Distribution of Factors of Physical Condition of Chindren under five' Houses in the Working Area of Puskesmas Cengkareng, West Jakarta in 2024

Variables	Pneumonia Incidence			
	Case		Control	
	n	%	n	%
House Floor Type				
Not eligible	3	7	1	2.3
Eligible	40	93	42	97.7
House Wall Type				
Not eligible	3	7	0	0
Eligible	40	93	43	100
House Ventilation Area				
Not qualified	34	79.1	33	76.7
Meets the requirement	9	20.9	10	23.3
House Occupancy Density				
Not qualified	11	25,6	13	30.2
Meets the requirement	32	74.4	30	69.8
Temperature				
Not qualified	17	39.5	15	34.9
Eligible	26	60.5	28	65.1
Humidity				
Not qualified	43	100	43	100
Qualified	0	0	0	0
Lighting				
Not qualified	9	20.9	5	11.6
Qualified	34	79.1	38	88.4

Table 1 explains that the types of house floors that did not meet the requirements in the case group were 3 respondents (7%) while in the control group there were 1 respondent (2.3%). The types of house walls that did

not meet the requirements in the case group were 3 respondents (7%) while in the control group all met the requirements (0%). The area of house ventilation in the case group that did not meet the requirements was 34 respondents (79.1%) while in the control group there were 33 respondents (76.7%). Occupancy density in the case group that did not meet the requirements was 11 respondents (25.6%) while in the control group there were 13 respondents (30.2%). The quality of house temperature in the case group that did not meet the requirements in the case group was 17 respondents (39.5%) while in the control group there were 15 respondents (34.9%). The quality of house humidity in the case and control groups all met the requirements. Lighting intensity that did not meet the requirements in the case group was 9 respondents (20.9%) while in the control group there were 5 respondents (11.6%).

2. *Presence of Smokers*

Based on the results of research that has been conducted on the presence of smokers in the homes of chindren under five in the Cengkareng Health Center working area, West Jakarta in 2024, the following results were obtained.

Table 2. Frequency Distribution of the Presence of Smokers in the House in the Cengkareng Health Center Working Area, West Jakarta in 2024

Variables	Pneumonia Incidence			
	Case		Control	
	n	%	n	%
Active smokers				
Available	28	65.1	27	62.8
None	15	34.9	16	37.2
Smoking habits in the home				
Yes	19	44.2	9	20.9
None	24	55.8	34	79.1

Table 2 explains that the presence of active smokers in the case group was 28 respondents (65.1%) while in the control group there were 27 respondents (62.8%). Meanwhile, the presence of active smokers who smoke in the house in the case group was 19 respondents (44.2%) while in the control group there were 9 respondents (20.9%).

3. *Overview of Indoor Air Quality in Chindren under five*

Based on the results of research that has been conducted on the presence of smokers in the homes of chindren under five in the Cengkareng Health Center working area, West Jakarta in 2024, the following results were obtained.

Table 3. Overview of Indoor Air Quality in Chindren under five in the Cengkareng Health Center Working Area, West Jakarta in 2024

Variables	Pneumonia Incidence			
	Case		Control	
	n	%	n	%
PM 2.5				
Not qualified	27	62.8	14	32.6
Eligible	16	37.2	29	67.4
PM 10				
Not qualified	31	72.1	26	60.5
Eligible	12	27.9	17	39.5

Table 3 explains that the quality of PM 2.5 that did not meet the requirements in the case group was 27 respondents (62.8%) while in the control group there were 14 respondents (32.6%). The quality of PM 10 that did not meet the requirements in the case group was 31 respondents (72.1%) while in the control group there were 26 respondents (60.5%).

4. *Overview of Individual Factors in Chindren under five*

Based on the results of research that has been conducted on the presence of smokers in the homes of chindren under five in the Cengkareng Health Center working area, West Jakarta in 2024, the following results were obtained.

Tabel 4. Gambaran Faktor Individu pada Balita di Wilayah Kerja Puskesmas Cengkareng, Jakarta Barat Tahun 2024

Variable	Pneumonia Incidence			
	Case		Control	
	n	%	n	%
Gender				
Male	26	60.5	24	55.8
Female	17	39.5	19	44.2
Age				
< 28 months	29	67.4	14	32.6
□ 28 months	14	32.6	29	67.4
Immunization Status				
Incomplete	14	32.6	6	14
Complete	29	67.4	37	86
Exclusive breastfeeding				
No	3	7	1	2.3
Yes	40	93	42	97.7
Nutritional Status				
Not good	5	11.6	8	18.6
Normal	38	88.4	35	81.4

Table 4 explains that the gender of chindren under five in the case and control groups was dominated by males as many as 26 respondents (60.5%) and 24 respondents (55.8%), respectively. The age of chindren under five in the case group was dominated by chindren under five aged < 28 months as many as 29 respondents (67.4%) while in the control group it was dominated by chindren under five aged > 28 months as many as 29 respondents (67.4%). Chindren under five with incomplete immunization status in the case group were 14 respondents (32.6%) while in the control group there were 6 respondents (14%). Chindren under five with a history of non-exclusive breastfeeding in the case group were 3 respondents (7%) while in the control group there were 1 respondent (2.3%). Chindren under five with poor nutritional status in the case group were 5 respondents (11.6%) while in the control group there were 8 respondents (18.6%).

5. *Distribution of Individual Factors and Indoor Air Quality Factors in Chindren under five*

Based on research that has been conducted on individual factors, physical condition of the house, and air quality in the homes of chindren under five in the working area of Cengkareng Health Center, West Jakarta, the following results are obtained.

Table 5. Distribution of Individual Factors and Home Indoor Air Quality Factors in Chindren under five in the Cengkareng Health Center Working Area, West Jakarta in 2024

Variabel	Mean	Median	Standar Deviasi	Min	Maks
Age	30	27	13.232	12	59
Height	86.89	87.5	11.91	60	115
Body weight	12.14	11.35	3.33	6.7	22
Temperature	29.79	30	1.92	26	39
Humidity	78.43	80	6.42	60.2	93
Lighting	95.54	80	62.27	14	370
PM 2.5	30.94	23	28.22	6	184
PM 10	119.69	90.5	84.33	22	374

Table 5 explains that the mean age of children under five was 30 months, median 27 months, standard deviation 13.232, minimum age 12 months, and maximum age 59 months. The average height of children under five was 86.89 cm, median 87.5 cm, standard deviation 11.91, minimum height 60 cm, and maximum height 115 cm. The average under-five weight was 12.14 kg, median 11.35 kg, standard deviation 3.33, minimum weight 6.7 kg, and maximum weight, 22 kg. The average indoor temperature was 29.79 oC, median 30 oC, standard deviation 1.92, minimum temperature 26 oC, and minimum temperature 39 oC. The average

humidity was 78.43%, median 80%, standard deviation 6.42, minimum humidity 60.2%, maximum humidity 93%. The average lighting intensity was 95.54 lux, median 80 lux, standard deviation 62.27, minimum lighting intensity 14 lux, and maximum 370 lux. PM 2.5 levels averaged 30.94 µm/m³, median 23 µm/m³, standard deviation 28.22, minimum PM 2.5 levels 6 µm/m³, and maximum 184 µm/m³. PM 10 levels averaged 119.69 µm/m³, median 90.5 µm/m³, standard deviation 84.33, minimum level 22 µm/m³, and maximum level 374 µm/m³.

Bivariate Analysis

1. *Association between Individual Factors of Chindren under five and Pneumonia in Chindren under f*ive

Based on the research conducted, the relationship between individual factors and the incidence of pneumonia in chindren under five in the Cengkareng Health Center working area, West Jakarta in 2024 using the chi-square test with a 95% confidence level is as follows.

Table 6. Association of Individual Factors of Chindren under five (Gender, Age, Exclusive Breastfeeding, Immunization Status and Nutritional Status) with the Incidence of Pneumonia in Chindren under five in the Cengkareng Health Center Working Area, West Jakarta, 2024

Variable	Pneumonia Incidence				*p value*	OR (95% CI)
	Case		Control			
	n	%	n	%		
Gender						
Male	26	60.5	24	55.8	0.662	0,826 (0.350 – 1.948)
Female	17	39.5	19	44.2		
Age						
<28 months	29	67.4	14	32.6	0.001	4,291 (1.1741 – 10.575)
≥28 months	14	32.6	29	67.4		
Immunization Status						
Incomplete	14	32.6	6	14	0.074	0,336 (0.115 – 0.982)
Complete	29	67.4	37	86		
Exclusive breastfeeding						
No	3	7	1	2.3	0.306	0,317 (0.032 – 3.180)
Yes	40	93	42	97.7		
Nutritional Status						
Not good	5	11.6	8	18,6	0.366	1,737 (0.519 – 5.814)
Normal	38	88.4	35	81.4		

Table 6 explains that in the gender variable, the p value = 0.662 (p > 0.05) means that Ha is accepted, which means that there is no association between gender and the incidence of pneumonia among under-fives in the Cengkareng Health Center working area, West Jakarta. Meanwhile, for the age variable, the p value = 0.001 (p < 0.05) means that H0 is accepted, which means that there is an association between age and the incidence of pneumonia among under-fives in the Cengkareng Health Center working area, West Jakarta. The calculated OR = 4.291 (OR > 1) and 95% CI = 1.1741 - 10.575 (95% CI > 1) means that chindren under five with age < 28 months have a risk of pneumonia more than 4 times compared to chindren under five with age ≥ 28 months.

In the immunization status variable, the p value = 0.074 (p > 0.05) means that Ha is accepted, which means that there is no relationship between immunization status and the incidence of pneumonia among under-fives in the Cengkareng Health Center working area, West Jakarta. In the exclusive breastfeeding variable, the p value = 0.306 (p > 0.05) so Ha is accepted, which means that there is no relationship between exclusive breastfeeding history and the incidence of pneumonia in children under five years old in the Cengkareng Health Center working area, West Jakarta. In the nutritional status variable, the p value = 0.366 (p > 0.05) so Ha is accepted, which means that there is no relationship between the nutritional status of chindren under five and the incidence of pneumonia in chindren under five in the Cengkareng Health Center working area, West Jakarta.

2. *Association between Physical House Condition Factors and Pneumonia in Chindren under five*

Based on the research conducted, the relationship between the physical condition of a toddler's home and the incidence of pneumonia in chindren under five in the Cengkareng Health Center working area, West Jakarta

in 2024 using the chi-square test with a 95% confidence degree is as follows.

Table 7. Relationship between factors of house physical condition (temperature, humidity, lighting, ventilation area, floor type, wall type, and density) and the incidence of pneumonia among children under five years old in the Cengkareng Health Center Working Area, West Jakarta, 2024

Variable	Pneumonia Incidence				*p value*	OR (95% CI)
	Case		Control			
	n	%	n	%		
House floor type						
Not eligible	3	7	1	2.3	0.306	3.150 (0.314 – 31.552)
Eligible	40	93	42	97.7		
House wall type						
Not eligible	3	7	0	0	0.078	-
Eligible	40	93	43	100		
House ventilation area						
Not qualified	34	79.1	33	76.7	0.795	1.145 (0.413 – 3.175)
Meets the requirement	9	20.9	10	23.3		
House occupancy density						
Not qualified	11	25.6	13	30.2	0.631	0.793 (0.308 – 2.041)
Meets the requirement	32	74,4	30	69.8		
Temperature						
Not qualified	17	39.5	15	34.9	0.655	1.221 (0.508 – 2.930)
Eligible	26	60.5	28	65.1		
Humidity						
Not qualified	43	100	43	100	-	-
Qualified	0	0	0	0		
Lighting						
Not qualified	9	20.9	5	11.6	0.243	2.012 (0.614 – 6.594)
Qualified	34	79.1	38	88.4		

Table 7 explains that in the variable type of house floor, the p value = 0.306 (p > 0.05) means that Ha is accepted, which means that there is no association between the type of house floor and the incidence of pneumonia in children under five years old. In the variable type of house wall, the p value = 0.078 (p > 0.05) so Ha is accepted, which means that there is no relationship between the type of house wall and the incidence of pneumonia in children under five years old in the Cengkareng Health Center working area, West Jakarta. In the variable of house ventilation area, the p value = 0.795 (p > 0.05), so Ha is accepted, which means that there is no relationship between house ventilation area and the incidence of pneumonia in children under five years old in the Cengkareng Health Center working area, West Jakarta. In the variable of house occupancy density, the p value = 0.631 (p > 0.05) so Ha is accepted, which means that there is no relationship between house occupancy density and the incidence of pneumonia among children under five years old in the Cengkareng Health Center working area, West Jakarta.

In the temperature quality variable, the p value = 0.655 (p > 0.05) means that Ha is accepted, which means that there is no relationship between the quality of house temperature and the incidence of pneumonia in chindren under five in the Cengkareng Health Center working area, West Jakarta. The variable of house humidity quality could not be continued to the statistical test stage because the case and control groups had homogeneous or similar data in the Cengkareng Health Center working area, West Jakarta. In the variable of house lighting intensity, the p value = 0.243 (p > 0.05) was obtained so that Ha was accepted, which means that there is no relationship between the intensity of lighting in the house and the incidence of pneumonia in chindren under five in the Cengkareng Health Center working area, West Jakarta.

3. Association between Indoor Air Quality Factors and Pneumonia in Chindren under five

Based on the research conducted, the results of the relationship between indoor air quality factors and the incidence of pneumonia in children under five years old in the Cengkareng Health Center working area, West Jakarta in 2024 using the chi-square test with a 95% confidence degree are as follows

Table 8. Associations between Indoor Air Quality Factors (PM 2.5 and PM 10) and Pneumonia in Chindren under five in the Cengkareng Health Center Work Area, West Jakarta, 2024

Variable	Pneumonia Incidence				*p value*	OR (95% CI)
	Case		Control			
	n	%	n	%		
PM 2.5						
Not qualified	27	62.8	14	32.6	0.005	3.496 (1.438 – 8.498)
Eligible	16	37.2	29	67.4		
PM 10						
Not qualified	31	72.1	26	60.5	0.254	1.689 (0.684 – 4.172)
Eligible	12	27.9	17	39.5		

Table 8 explains that the PM 2.5 variable obtained a p value = 0.005 (p < 0.05) so that H0 is accepted, which means that there is a significant relationship between the quality of PM 2.5 in the air at home and the incidence of pneumonia in chindren under five in the Cengkareng Health Center working area, West Jakarta. The OR value was 3.496 (OR > 1) and 95% CI = 1.438 - 8.498 (95% CI > 1), which means that chindren under five living in homes with PM 2.5 levels in the air that do not meet health requirements are more than 3 times more likely to experience pneumonia than chindren under five living in homes with PM 2.5 levels in the air that meet health requirements. Meanwhile, in the PM 10 variable, the p value = 0.254 (p > 0.05) means that there is no significant relationship between PM 10 levels in the air and the incidence of pneumonia among under-fives in the Cengkareng Health Center working area, West Jakarta.

4. *Association between House Smoking Habits and Pneumonia in Chindren under five*

Based on the research conducted, the relationship between the presence of smokers in the house and the incidence of pneumonia in children under five years old in the Cengkareng Health Center working area, West Jakarta in 2024 using the chi-square test with a 95% confidence degree is as follows.

Table 9. Association between the Presence of Smokers in the House and Pneumonia among Chindren under five in the Cengkareng Health Center Working Area, West Jakarta, 2024

Variable	Pneumonia Incidence				*p value*	OR (95% CI)
	Case		Control			
	n	%	n	%		
Smoking Habits in the Home						
Available	19	44,2	9	20,9	0,021	2,991 (1,157 – 7,731)
None	24	55,8	34	79,1		

Table 9 explains that the variable of family members who have a habit of smoking in the house obtained a p value = 0.021 (p < 0.05) so that H0 is accepted, which means that there is a significant relationship between family members who have a habit of smoking in the house with the incidence of pneumonia in chindren under five in the Cengkareng Health Center working area, West Jakarta. The OR value was 2.991 (OR > 1) with 95% CI = 1.157 - 7.731 (95% CI > 1) which means that chindren under five who live in homes with family members who smoke in the house have a risk of pneumonia more than twice compared to chindren under five who live in homes with family members who do not smoke in the house.

Multivariate Analysis

At the initial stage, bivariate selection was carried out to determine the relationship that occurred independently on the dependent variable. At the level of significance, the p-value ≤ 0.25 was selected to be the variable that entered the multivariate analysis. If the independent variable is substantially important even though it has a p-value ≥ 0.25, it will still be included in the multivariate analysis. The results of the analysis conducted can be seen in Table 10.

Table 10. Bivariate selection of physical house factors, indoor air quality factors, and smoking habits of homeowners with the incidence of pneumonia among chindren under five

Variable	*p-value*	Description
House floor types	0.306	Exit
Type of wall	0.078	Candidates
Ventilation area of the house	0.795	Exit
Occupancy density of the house	0.631	Exit
Temperature	0.655	Exit
Humidity	-	Exit
Lighting	0.243	Candidate
PM 2.5	0.005	Candidate
PM 10	0.254	Exit
Smoking habit in the house	0.021	Candidate

Table 10 shows that the variables included in the logistic regression modeling are the type of house wall, lighting, PM 2.5, and indoor smoking. Candidate variables were entered together into the regression modeling by the backward method. Then, variables that have insignificant values will be removed one by one from the highest p value until a fit modeling is obtained. The first logistic regression modeling can be seen in the following table.

Table 11. First Logistic Regression Modeling

Variable	B	*p value*	*Exp B*	95% CI *Lower*	*Upper*
House wall type*	20,330	0,999	-	-	-
Lighting*	0,960	0,145	2,612	0,719	9,492
PM 2.5	1,299	0,007	3,665	1,431	9,385
Smoking habit in the house	1,005	0,049	2,731	1,004	7,428
Constant	Constant	0,002	0,004		

* *excluded from modeling*

Table 11 explains that the variables of house wall type and lighting with p values of 0.999 and 0.145, respectively, were excluded from the modeling. Then, the candidates were retested together in Table 12.

Table 12. Second Logistic Regression Modeling

Variable	B	*p value*	*Exp B*	95% CI *Lower*	*Upper*
PM 2.5	1.191	0.010	3.290	1.323	8.181
Smoking habit in the house	1.015	0.044	2.758	1.027	7.410
Constant	-3.523	0.002	0.030		
Nagelkerke	0.231				

Table 12 explains that the variable most associated with the incidence of pneumonia among under-fives in the Cengkareng Health Center working area, West Jakarta in 2024 is PM 2.5 with a p value = 0.010, OR = 3.290, and 95% CI = 1.323 - 8.181 which means that under-fives living in homes with PM 2.5 levels that do not meet health requirements have a risk of more than 3 times to experience pneumonia compared to under-fives living in homes with PM 2.5 levels that meet health requirements. Meanwhile, the second variable most associated with the incidence of pneumonia among chindren under five in the Cengkareng Health Center working area, West Jakarta in 2024 was the habit of family members smoking in the house with a p value = 0.044, OR = 2.758, and 95% CI = 1.027 - 7.410 which means that chindren under five who live in homes with family members who have a habit of smoking in the house have a risk of more than 2 times to experience pneumonia compared to chindren under five who live in homes with family members who do not have a habit of smoking in the house. From the calculation of Nagelkerke's r square, a value of 0.231 was obtained,

which means that PM 2.5 and family members who smoke at home simultaneously affect the incidence of pneumonia in chindren under five in the Cengkareng Health Center working area, West Jakarta by 23.1%.

DISCUSSION

Pneumonia has been reported to be a serious disease that claims the lives of thousands of people every year, especially among infants and chindren under five. Pneumonia that occurs in chindren under five often coincides with an acute infectious process in the bronchi (bronchopneumonia). Pneumonia in chindren under five is caused by disease agents (microorganisms), namely bacteria, viruses or fungi, but is influenced by many factors such as dust, air pollution, malnutrition, low birth weight, inadequate breastfeeding, overcrowding, incomplete immunization, inadequate home ventilation, smoking behavior of residents and others. Pneumonia is a disease that attacks human breathing by presenting fluid or pus in the lungs with symptoms such as coughing, shortness of breath, and loss of consciousness. The incidence of pneumonia among under-fives in West Jakarta City during the period 2018-2023 always experienced a different number of cases each year.

This section will discuss the research results and analysis of the thesis entitled 'The Relationship between House Physical Condition and Smoking Habits of Householders with the Incidence of Pneumonia in Chindren under five in the Cengkareng Health Center Working Area, West Jakarta. The independent variables studied were house conditions, occupant behavior, air pollution and characteristics of chindren under five, while the dependent variable studied was the incidence of pneumonia in chindren under five.

The incidence of pneumonia in DKI Jakarta based on Puskesmas data in the 6-year period experienced the highest number in 2019 at 85317 while the lowest occurred in 2020 at 22886. The age pattern of pneumonia among under-fives in 2023 was around 55% and there was an increase in pneumonia cases as of July 2023. This can be seen in the graph below. Based on data from the West Jakarta City Health Office, the realization of under-five pneumonia data almost always exceeds the estimates based on basic management at each health center (breath count/TDDK). The realization of under-five pneumonia finding itself consists of pneumonia and severe pneumonia.

The results of the analysis on the description of individual characteristics of chindren under five with the incidence of pneumonia explained that the age of chindren under five was related to the incidence of pneumonia (p = 0.001). The results of the calculation of the OR value were obtained 4.291 with a 95% CI in the range of 1.174 – 10.575 which means that chindren under five who are less than 28 months old are more than 4 times more likely to experience pneumonia than chindren under five who are more than 28 months old. This indicates that apart from the factors of physical condition of the house, indoor air quality, and smoking habits of family members in the house, individual characteristics also affect the incidence of pneumonia in chindren under five in the working area of the Cengkareng Health Center, West Jakarta. Chindren under five less than 28 months old, children's immune systems are still in the developing stage, so they are more susceptible to infections, including pneumonia (Fadl et al., 2020)

This result was also reinforced by a statistical analysis on the immunization status of chindren under five which showed that chindren under five with incomplete immunization status were more likely to experience pneumonia (32.6%) compared to children who had complete immunization (67.4%). Although statistically this association does not reach a strong level of significance (p = 0.074), an OR of 0.336 indicates a tendency that complete immunization provides significant protection against pneumonia. The results of the differential test between the case group and the control group obtained a value of p = 0.042, which means that there was a significant difference between the immunization status in the case group and the control group. Incomplete immunization status can make chindren under five more susceptible to respiratory infections because they do not get adequate immunity to the pathogens targeted by the vaccine. This lack of immunity allows the infection to develop into a serious disease such as pneumonia. In contrast, complete immunization helps prevent infection, reduce the severity of symptoms, and lower the risk of complications.(Sutriana et al., 2021)

The results of statistical analysis of exclusive breastfeeding history showed that both in the case group (93%) and control (97.7%), they received exclusive breastfeeding. This suggests that most of the babies involved in the study had good access to the benefits of exclusive breastfeeding, both in the group affected by pneumonia and those who did not. The results of the analysis showed that exclusive breastfeeding did not have a significant association with the incidence of pneumonia (p = 0.306), and a low OR value (0.317) indicated that exclusive breastfeeding did not provide significant protection against the incidence of pneumonia in chindren under five. This result was also strengthened by the results of the differential test between the case group and the control group obtained a value of p = 0.309 which means that there was no significant difference in the coverage of exclusive breastfeeding in the case and control groups. Although exclusive breastfeeding has many benefits for the health

of chindren under five, including strengthening the immune system, these results show that in this study, exclusive breastfeeding did not significantly provide protection for chindren under five with pneumonia.(Sutriana et al., 2021)

The results of this study are supported by a study conducted by Fadl, et al. in 2020 which explained that chindren under five under 12 months are more at risk of developing pneumonia (p = 0.001, OR = 1.925).(Fadl et al., 2020) In addition, a study conducted by Sutriana, et al. in 2021 explained that not giving exclusive breast milk (OR = 7.95) to chindren under five and incomplete basic immunization (OR = 4.47) are at risk of pneumonia in chindren under five aged 10 – 59 months. This indicates that an exclusive history of breastfeeding and a complete basic immunization status can provide protection for chindren under five against the incidence of pneumonia.(Sutriana et al., 2021)

The Relationship between House Physical Condition and the Incidence of Pneumonia in Children Under Five

The results of data analysis on the house floor type variable obtained a p value of 0.306 > α (0.05), so it can be said that there is no relationship between floor type and the incidence of pneumonia in chindren under five in the working area of the Cengkareng Health Center, West Jakarta. The absence of a relationship between physical condition of the floor and the incidence of pneumonia is due to the small and almost balanced proportion of ineligible floor types between the case and control groups. In the case group, only 3 respondents (7%) were obtained with the type of dirt floor or not tiles, while in the control group there were 1 respondent (2.3%). This research is in line with the results of a study conducted by Sa'diyah, et al. in 2022 in Baturraden District, Banyumas Regency explained that unqualified house floors are not at risk of pneumonia in chindren under five.(Sa'diyah et al., 2022) However, research conducted by Pramudiyani and Prameswari also shows that floor conditions are one of the physical factors of the home environment related to the incidence of pneumonia.(Pramudiyani & Prameswari, 2011)

The results of data analysis on the variable of house wall type showed a p-value of 0.078 > α (0.05) so that it can be said that there is no significant relationship between the type of house wall and the incidence of pneumonia in chindren under five. This can be due to the small proportion of ineligible wall types between the case and control groups. In the case group, there were only 3 respondents (7%) who had a type of wall that was not a wall compared to the control group who had all had a type of wall. This result is in line with a study conducted by Sa'diyah, et al. in Baturraden District, Banyumas Regency explaining that the walls of houses that do not meet health requirements are not related to the incidence of pneumonia (p = 0.327).(Sa'diyah et al., 2022) However, this result is not in line with the research of Nurjayanti, et al. (2022) in the working area of the Tawang Health Center, Tasikmalaya City, explaining that there is a relationship between the type of house wall type and the incidence of pneumonia in chindren under five (p = 0.018).(Nurjayanti et al., 2022)

The results of the analysis of the ventilation area variable showed a *p-value* of 0.795 > α (0.05), so it can be said that there is no relationship between ventilation area and the incidence of pneumonia in chindren under five in the Cengkareng Health Center work area. This is due to the proportion of ventilation area that does not meet health requirements, which is less than 10% of the floor area between the case and control groups, which has an almost balanced number of 34 respondents (79.1%) and 33 respondents (76.7%), respectively. The results of this study are in line with research conducted by Mahendra, et al in 2024 at the Temayang Health Center, Bojonegoro Regency explaining that the ventilation area is not related to the incidence of pneumonia in chindren under five (p = 0.135).(Mahendra et al., 2024) However, this result is not in line with the research of Nurjayanti, et al. (2022) in the Working Area of the Tawang Health Center, Tasikmalaya City which stated that there was a relationship between ventilation area and the incidence of pneumonia (p = 0.011).(Nurjayanti et al., 2022)

The results of data analysis showed that for housing density, a *p-value* of 0.631 > α (0.05) was obtained, so it can be said that there was no relationship between housing density and the incidence of pneumonia in chindren under five in the working area of the Cengkareng Health Center. This is because the proportion of unqualified residential density between the case and control groups is almost balanced. In the case group, there were 11 respondents (25.6%) with unqualified housing density, while in the control group, there were 13 respondents (30.2%). The results of this study are in line with research conducted by Jannah, et al. (2020) in the working area of the Banda Raya Health Center, Banda Aceh City, explaining that the level of residential density is not related to the incidence of pneumonia (p = 0.178).(Mahalastri, 2014) However, the results of this study are not in line with the research of Mardani, et al. in 2019 in the working area of the Dinoyo Health Center, Malang City which explained the relationship between housing density and the incidence of pneumonia in chindren under five (p = 0.012).(Mardani et al., 2019)

The physical condition of the building, which includes floor type, wall type, ventilation area, and occupancy density, theoretically affects the incidence of pneumonia in chindren under five. Dusty floors are a form of indoor air pollution. Dust in the air when

inhaled will stick to the lower airways. This accumulation will cause lung elasticity to decrease, thus making it difficult for chindren under five to breathe. A good floor should be waterproof, not damp, the floor material is easy to clean, and in a dry state and not produce dust. Houses with floors made of dirt, walls instead of walls, and roofs without ceilings cause the space to become hot, dusty, and become more humid which increases the risk of growing mold and *pneumococcus* bacteria, thus triggering pneumonia.(Padmonobo et al., 2012) Poor ventilation exacerbates this problem by trapping pollutants and moisture in the air, while high occupancy densities reduce air circulation and increase the likelihood of transmission of respiratory infections among occupants.(Ningrum E.Kusuma, 2015)

In this study, the results of statistical testing of room temperature variables which had a significance value of 0.655 were also obtained, which means that there was no relationship between room temperature and the incidence of pneumonia in chindren under five. This is because the proportion of room temperature that does not meet the requirements between the case and control groups is almost balanced, namely 17 respondents (39.5%) and 15 (34.9%). Meanwhile, room humidity variables cannot be tested statistically because the data is homogeneous. This study is in line with research conducted by Prasetyo and Syafei in 2022 in Wonorejo, Surabaya and its surroundings explaining that there is no correlation between temperature and humidity and the incidence of pneumonia with p-values of 0.098 and 0.532 respectively.(Prasetyo & Syafei, 2022) Hot temperatures can increase evaporation in the room so that not only the humidity increases but also the pollutant content that comes from the building materials of the house. High humidity (> 80%), which means that the moisture content in the air is quite high, is a good condition for the growth and survival of bacterial cells (*pneumococus*) so that bacteria can grow quickly.(Caesar et al., 2015) This study is not in line with the results of research by Agustyana, et al. (2019) in the working area of the Bergas Health Center, Semarang Regency explained that the humidity level at home is not at risk of pneumonia in chindren under five (p = 0.228, OR = 0.424, 95% CI = 0.134 – 1.346).(Agustyana et al., 2019)

The results of the data analysis obtained *a p-value* of 0.242 > α, so it can be said that there is no relationship between the intensity of light in the room and the incidence of pneumonia in chindren under five in the working area of the Cengkareng Health Center, West Jakarta. The absence of a relationship between indoor lighting intensity and the incidence of pneumonia in chindren under five is due to the small proportion of pneumonia incidence between the case group and the control at unqualified light intensity. In the case group, 9 respondents (20.9%) and the control group 5 respondents (11.6%). This research is in accordance with the results of research by Sari, et al. in 2019 which was carried out in the working area of the Bandarharjo Health Center, Semarang City, explaining that lighting in houses that do not meet the requirements is not related to the incidence of pneumonia.(D. Sari et al., 2019) Light has the property of being able to kill bacteria. Lack of lighting will cause high humidity in the house and has great potential for the proliferation of bacteria that cause pneumonia, including *Sterptococcus* pneumonia.(E. L. Sari et al., 2014)

The Relationship between Indoor Air Quality and the Incidence of Pneumonia in Chindren under five

Healthy air quality in the home is a basic need for every human being. Air quality in the home is very important and determines a healthy life for everyone including chindren under five, who spend most of their time indoors. Hazardous substances emitted from buildings, construction materials and indoor equipment or due to human activities indoors, such as cooking, heating, and cigarette smoke can cause various health problems and can even be fatal. (Dinas Kesehatan Provinsi DKI Jakarta, 2021)

Indoor air quality is affected by three sources including outdoor pollutant sources that enter the room such as particulate matter. Pollutant sources such as indoor cooking and heating activities produce particulate matter, carbon monoxide, nitrogen dioxide, and volatile organic compounds. Indoor chemical sources that produce pollutants include formaldehyde, acetaldehyde, acetonitrile, methanol, ethanol, acetone, benzene, toluene, xylene, styrene, and monoterpenes.(Adaji et al., 2019a) In addition, indoor air pollution is influenced by poor ventilation because poor ventilation will make indoor pollutants accumulate.(Andualem et al., 2020) Building a house if it does not meet the standard physical requirements of the house such as humidity, ventilation, lighting, and air circulation that meets the requirements can have a negative impact on the occupants of the house. Indoor air pollution if the concentration exceeds quality standards can have direct and indirect impacts on human health and chindren under five. Direct health impacts include the incidence of pneumonia in chindren under five. This variable is the focus of several research articles that have been published in several journals. The findings and reviews of home environment factors that correlate with the incidence of pneumonia in children under five are presented below:

Associations of Exposure to PM10 Levels with Under-5 Pneumonia

The results of the data analysis showed that for PM 10, the p-value was 0.254 > α (0.05), so it can be said that there is no relationship between air quality factors in the form of PM 10 and the incidence of pneumonia in children under five years old in the Cengkareng Health Center working area, West Jakarta. This is because the proportion of PM10 levels that did not meet the requirements between the case and control groups was almost equal. In the case group, there were 31 respondents (72.1%) with PM 10 levels in the house that did not meet the requirements while in the control group there were 26 respondents (60.5%). This study is not in line with research conducted by Sari, et al in 2019 in the Bandarharjo Health Center working area, Semarang City which explains that there is a relationship between inhaled PM 10 levels and the incidence of pneumonia in chindren under five (p = 0.039).(D. Sari et al., 2019)

Air quality in the home is a determining factor that affects health status and the occurrence of pneumonia, in general, homes with air pollution that exceeds established quality standards such as Particulate Matter (PM10) exceeding 70 µg/m3 are very risky for the health of chindren under five and humans in general who live in the house. Chindren under five are a very vulnerable age group at risk of pneumonia if exposed to excessive PM10. Exposure to PM10 air pollution has measurable and potential effects on the growth and performance of lung function in children and chindren under five due to its small size. PM10 is so toxic that it can damage the lung tissue system. PM10 can also irritate the respiratory tract which reduces mucosilier function to prevent germs from entering. Chindren under five are a vulnerable group that is easily exposed to PM10, more easily at risk of pneumonia because their immune system is not yet perfect to ward off bacteria or germs that can irritate their respiratory system(Kevat et al., 2022).

Associations of Exposure to PM 2.5 levels with Under-5 Pneumonia

The results of data analysis showed that for PM 2.5, a *p-value* of 0.005 ≤ 0.05, OR = 3.496, and 95% CI = 1.438 – 8.498 was obtained, so it can be said that there is a relationship between air quality factors in the form of PM 2.5 and the incidence of pneumonia in chindren under five in the working area of the Cengkareng Health Center, West Jakarta with a risk in chindren under five who live at home with PM 2.5 levels that do not meet health requirements more than 3 times compared to chindren under five who live at home with PM 2.5 levels that meet health requirements. This can be caused because the proportion of unqualified PM 2.5 levels in chindren under five' homes in the case and control groups has a significant difference. In the case group, there were 27 respondents (62.8%) with PM 2.5 levels in the house who did not meet the requirements compared to the control group of 14 respondents (32.6%).

A study conducted by Ceng, et al. (2018) explained that there was a stronger association with ER visits in cases of pneumonia with septicemia in relatively healthy patients. Exposure to PM 2.5 can increase the risk of pneumonia in chindren under five through several mechanisms, such as PM 2.5 which can cause irritation to the respiratory system which can trigger an inflammatory reaction so that swelling occurs and increased mucus production which can be a breeding ground for pathogens that cause pneumonia. This can narrow the airways and make chindren under five more susceptible to pathogens that cause pneumonia. In addition, PM 2.5 can also interfere with the function of immune cells in the respiratory tract, when the defense system is weakened, pathogens are more likely to multiply and cause infections in the lungs.(Cheng et al., 2019) The results of a systematic review conducted in developing countries explained that PM2.5 exposure is significantly associated with an increased risk of pneumonia in children under five years of age, particularly in low- and middle-income countries.(Adaji et al., 2019b; Nhung et al., 2017)

The Relationship between Smoking Habits of Family Members in the Home and the Incidence of Pneumonia in Chindren under five

The results of the data analysis showed that for chindren under five who had active smoking family members, a *p-value* of 0.021 < 0.05 was obtained, so it can be said that there is a significant relationship between the smoking habits of family members in the home and the incidence of pneumonia in chindren under five in the working area of the Cengkareng Health Center, West Jakarta. The results of the calculation of the OR value were obtained 2.991 with a 95% CI in the range of 1.157 – 7.731 which means that chindren under five who live at home with family members who smoke in the house are at more than 2 times the risk of developing pneumonia compared to chindren under five who live at home with family members who do not have the habit of smoking in the house. These results are in line with the theory that the proportion of family members who have the habit of smoking indoors in the case and control groups has a significant difference. In the case group, there were 19 respondents (44.2%) with family members who had the habit of smoking in the house, while in the case group, there were only 9 respondents (20.9%).

A study conducted by Kiconco et al. (2021) at the Teaching Hospital in Bushenyi District, Western Uganda explained that there was a significant relationship between exposure to cigarette smoke and the incidence

of pneumonia in chindren under five with a p value = 0.007. In addition, this study also explained that chindren under five exposed to cigarette smoke had a 3 times greater risk compared to chindren under five who were not exposed to cigarette smoke (OR = 3.0). The results of the above study can be concluded that indoor cigarette smoke caused by members with smoking status in the household can increase the risk of pneumonia in chindren under five.(Kiconco et al., 2021)

The exposure of cigarette smoke to chindren under five in the study was caused because some parents or family members of chindren under five were active smokers. Chindren under five who are exposed to cigarette smoke are at risk of developing pneumonia because their lungs are still small, chindren under five also breathe more often so that the potential for chemical substances from cigarette smoke to enter is greater than that of adults. Cigarette smoke residues and chemicals can stick to dust, be re-emitted, and react with oxidative gases that are normally present in the indoor environment (ozone, nitric acid) to form toxic nitrosamines and carcionogens. The oxidation process occurs in the environment which makes it even more toxic. Excessive mucosal secretion due to exposure to cigarette smoke through breathing can cause inflammation and function to be disrupted due to the chemical properties of cigarettes. This condition can lower the airway defense from pathogenic agents including the causative agent of pneumonia.(Buought, 2004)

Cigarette smoke can increase the risk of infectious diseases because it has a suppressive effect on immunity in the respiratory system so that it can increase the risk of pneumonia in chindren under five. The effect of infection can occur for people who smoke and also other people who inhale cigarette smoke, including chindren under five. Children with parents who smoke have a higher risk of exposure to secondhand smoke because they have more frequent physical contact with their parents, as well as with surfaces and veins contaminated by cigarette smoke. If a child is exposed to cigarette smoke continuously, it can potentially cause chronic inflammation of the lungs. This inflammation increases tissue permeability, so pathogenic bacteria more easily enter the alveolus and trigger pneumonia infection.(Mahalastri, 2014)

The results of the same study were shown from a study conducted by Mahalastri in 2014 at the Mojo Health Center with a sample of 60 respondents, showing that there is a relationship between chindren under five exposed to cigarette smoke and pneumonia. Exposure to cigarette smoke and the incidence of pneumonia shows consistency that the smoking habits of family members in the same household are significantly related to the occurrence of pneumonia in chindren under five. The results of the study stated that the habit of smoking members in the house produces cigarette smoke which causes air pollution and disrupts the respiratory system and triggers pneumonia in chindren under five. (Mahalastri, 2014) This is emphasized by research conducted by Sari, et al. in 2019 in the fish smoking area of Bandarharjo Village, Semarang City, that smoking behavior in the house is related to pneumonia in chindren under five, this is marked by a value of p = 0.029.(D. Sari et al., 2019)

Associations of House Physical Condition, Indoor Air Quality, and Smoking Factors with the Incidence of Pneumonia in Chindren under five

At the initial stage, bivariate selection was carried out to determine the relationship that occurred independently on the dependent variable. At the level of significance, the p-value ≤ 0.25 was selected to be the variable that entered the multivariate analysis. If the independent variable is substantially important even though it has a p-value ≥ 0.25, it will still be included in the multivariate analysis. The bivariate selection results showed that there were 4 variables that had a p-value ≤ 0.25, namely the type of house wall (p = 0.078), lighting (p = 0.243), PM 2.5 (p = 0.005), and smoking habits in the house (p = 0.021)

From the multivariate analysis modeling, 2 variables were found to be most associated with the incidence of pneumonia in the Cengkareng Health Center working area, West Jakarta, namely PM 2.5 and indoor smoking habits. Based on statistical significance and OR, PM 2.5 air exposure as an independent variable has the greatest risk compared to other variables. In this multivariate analysis, the p value of the PM 2.5 variable was p = 0.010 with an OR value = 3.290 and 95% CI in the range of 1.323 - 8.181, which means that chindren under five who live in homes with PM 2.5 levels that do not meet health requirements have a risk of more than 3 times to experience pneumonia compared to chindren under five who live in homes with PM 2.5 levels that meet health requirements. The second variable most associated with the incidence of pneumonia among under-fives was smoking habits in the home. The calculation of the p value in the multivariate analysis obtained p = 0.044 with OR = 2.758 and 95% CI = 1.027 - 7.410 which means that chindren under five who live in homes with family members who have smoking habits in the house are at risk of more than 2 times the incidence of pneumonia compared to chindren under five who live in homes with family members who do not have smoking habits in the house. From the multivariate analysis modeling, the Nagelkerke value of 0.231 was obtained, which means that the PM 2.5 variables and smoking habits in the home simultaneously affect the incidence of pneumonia among under-fives in the

Cengkareng Health Center working area, West Jakarta by 23.1%.

Conclusion

There was a significant association between PM 2.5 levels and the habit of family members smoking in the house with the incidence of pneumonia among under-fives. There was no association between floor type, wall type, ventilation area, house occupancy density, temperature, humidity, lighting intensity, and PM10 levels with the incidence of pneumonia among under-fives. PM 2.5 levels and indoor smoking habits were the most dominant variables in influencing the incidence of pneumonia among under-fives in the Cengkareng Health Center working area, West Jakarta.

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