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The Environmental Factors and Sociodemographic Characteristics of Pneumonia Incidence in Indonesia

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A B S T R A C T

Pneumonia is the leading cause of death in children worldwide, including in Indonesia. Various factors can be considered individually or all at once to determine the incidence of pneumonia. This paper aims to investigate environmental and sociodemographic factors that affect the incidence of pneumonia in Indonesia using data from the 2018 Basic Health Research (Riskesdas). The study design was cross-sectional, using Riskesdas 2018 as data sources with individual analysis units. The research sample was 91,894 respondents with a population of children under five from all over Indonesia. The data were analyzed using multiple logistic regression with an alpha of 5%. This study found that regional (Nusatenggara) AOR 2.1 (95% CI AOR 1.76-2.5), housewife education (primary education) 1.92 (95% CI AOR 1.34-2.76), age group of the children (24-59 months) AOR 1.61 (95% CI AOR 1.35-1.92), and the lack of ventilation in primary bedroom AOR 1.18 (95% CI AOR 1.01-1.36), after controlling for expenditure per capita. Children under five years old are more likely to get pneumonia due to variables that behavioral modifications and health promotion can avoid. Examining the variations in sociodemographic variables and particular places can help with the best interventions.

Kata kunci:

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Balita
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A B S T R A K

Pneumonia adalah penyebab utama kematian pada anak di seluruh dunia, termasuk di Indonesia. Berbagai faktor dapat dipertimbangkan secara individual atau kolektif untuk menentukan kejadian pneumonia. Tulisan ini bertujuan untuk menganalisis faktor lingkungan dan sosio-demografi yang mempengaruhi kejadian pneumonia di Indonesia dengan menggunakan data dari Riset Kesehatan Dasar (Riskesdas) 2018. Desain studi adalah potong lintang dengan menggunakan sumber data Riskesdas 2018 dengan unit analisis individu. Sampel penelitian sebanyak 91.894 responden dengan populasi adalah anak balita dari seluruh Indonesia. Data dianalisis menggunakan regresi logistik berganda dengan alpha sebesar 5%. Penelitian ini menemukan bahwa regional (Nusatenggara) AOR 2,1 (95% CI AOR 1,76-2,5), pendidikan ibu rumah tangga (pendidikan dasar) 1,92 (95% CI AOR 1,34-2,76), kelompok usia anak-anak (24-59 bulan) AOR 1,61 (95% CI AOR 1,35-1,92), dan kurangnya ventilasi di kamar tidur utama AOR 1,18 (95% CI AOR 1,01-1,36) adalah factor yang berpengaruh terhadap kejadian pneumonia, setelah mengendalikan pengeluaran per kapita. Anak-anak di bawah lima tahun lebih mungkin terkena pneumonia karena variabel yang dapat dihindari oleh modifikasi perilaku dan promosi kesehatan. Pemahaman variasi dalam variabel sosiodemografi dan wilayah tertentu dapat membantu dengan intervensi yang lebih tepat

INTRODUCTION

An acute respiratory infection that affects the lungs is called pneumonia. The alveoli in the pneumonia-affected lungs will swell with pus and fluid, making breathing difficult and lowering oxygen intake. *Streptococcus pneumoniae*, *Haemophilus influenzae type B* (Hib), Listeria monocytogenes, Chlamydia trachomatis, Bordetella pertussis, and *Enteric gram-negative bacteria* are the most common causes of bacteria caused pneumonia in children. Meanwhile, *the virus that is most common in causing pneumonia in children is Respiratory syncytial virus,* Human metapneumovirus, Rhinovirus, Adenovirus, Enterovirus, CMV, and measles. *The most frequent cause in children with HIV is Pneumocystis jiroveci.* Especially during and right after childbirth, blood is a significant source of pneumonia transmission(Gereige & Laufer, 2013; Nguyen et al., 2017; Ruuskanen et al., 2011; The United Nations Children's Fund et al., 2021). The leading cause of pediatric death is pneumonia. Children under five die from pneumonia the most frequently (Ezbakhe and Pérez-Foguet, 2020; UNICEF et al., 2021). Pneumonia was the cause of 740,180 deaths worldwide in 2019, accounting for 22 % of all infant deaths, 14 % of all deaths in children under five, and 22 % of all fatalities in children aged one to five (World Health Organization, 2021).

In 2015, more than 54% of clinical pneumonia cases were found in India, Nigeria, Indonesia, Pakistan, and China (McAllister et al., 2019). Pneumonia in children under five fluctuates in Indonesia. Based on the Riskesdas study, which the Ministry of Health typically conducts every five years. According to the research, pneumonia incidence increased from 2.4 % in 2008(Badan Penelitian dan Pengembangan Kesehatan, 2008) to 2.7 % in 2013 (Badan Penelitian dan Pengembangan Kesehatan, 2013), and it increased by 4.8 % in 2018 as well (Badan Penelitian Dan Pengembangan Kesehatan, 2019). UNICEF reports that Indonesia has improved public health, particularly in lowering child mortality, over the past 20 years. Because Indonesia has the fourth-highest percentage of children who are not immunized, this accomplishment is all the more impressive. However, by first grade, nearly one in every thirty children–out of which an estimated 91,000 are born–pass away from preventable diseases (UNICEF Indonesia, 2020).

Promotion of exclusive breastfeeding, appropriate supplemental foods other than breast milk, and vitamin A supplements are protective treatments to keep kids healthy and free from disease. Prevention initiatives aim to halt the spread of disease and shield children from getting sick. This effort is carried out through HiB immunization and pneumococcal conjugate vaccines (PCV), sanitation, hygiene, safe drinking water, reduced household pollution, and HIV prevention. Meanwhile, effective treatment calls for enhancing the system for finding and referring patients, treating diarrhea with sufficient oral rehydration and zinc, giving the right drugs, and giving oxygen (Amouzou et al., 2016; World Health Organization & The United Nations Children's Fund, 2013)

According to some literature, poverty, malnutrition, poor sanitation, and unhygienic sanitary conditions are risk factors for pneumonia (Bhutta et al., 2013). Yudiastuti et al. (2015) said factors that significantly influenced the incidence of pneumonia included the length of breastfeeding, home lighting, the number of people living in the house, and immunization. Additionally, a variety of variables, including age, gender, nutritional status, breastfeeding (type and duration), income level, residential density, indoor pollution, and passive smoking, affect the incidence of ARI, which includes pneumonia (Oyejide, 1988; Ujunwa & Ezeonu, 2014; Mathew et al., 2015). This article aims to identify environmental and sociodemographic factors on the incidence of pneumonia in Indonesia using the 2018 Riskesdas data.

METHOD

Research Design

The data used in the article comes from the Health Development Policy Agency, which can be accessed with specific requirements and procedures through www.litbang.kemkes.go.id. Riskesdas 2018 is a cross-sectional, community-based study on a national scale. The analysis unit is individual. The sample is calculated based on the population's general health issues in Indonesia and the sample's representation of the people at the national, province, and district/city levels.

Sampling

The 2018 Riskesdas sample consisted of 30,000 census blocks/cluster sampling of 300,000 households. The selection was made in two steps using systematic linear sampling according to the probability proportional to size (PPS) method. Systematic random sampling is employed in each district and city's urban and rural strata to choose the cluster. Children under five from around Indonesia make up the population of this study. In the samples, there are 91,894 respondents (Badan Penelitian dan Pengembangan Kesehatan 2019).

Variable

The dependent variable in this article is the confession of a history of experiencing pneumonia either through a doctor's diagnosis or a history of experiencing signs and symptoms of pneumonia. Riskesdas data collection was carried out through interviews with respondents' mothers. Pneumonia is defined as the respondent claims to have been diagnosed with pneumonia or has experienced symptoms of pneumonia (pneumonia) in the past year, namely high fever, cough, difficulty breathing accompanied by rapid breathing or nostril breathing, or chest indrawing.

The presence of windows, lighting, and ventilation in the primary bedroom, kitchen, and living room, as well as sociodemographic factors (children under five, head of household, and housewife), age and gender of children under five, education and occupation of the head of the family and housewife, socioeconomic status, and urban/rural designation, are the independent variables. Children under five are classified into ages 0 to 11 months, 12 to 23 months, and 24 to 60 months. The head of household age is divided into six categories: under 24 years old, between 25 and 34 years old, between 35 and 44 years old, between 45 and 54 years old, between 55 and 64 years old, and over 65. A housewife's age is divided into five categories: under 24 years old, between 25 and 34 years old, between 35 and 44 years old, between 45 and 54 years old, and over 55.

Parental education is divided into four categories: head of household/ housewife who is not in school, low education (graduated from an elementary and junior high equivalent), medium education (senior high/equivalent), and high

education (undergraduate to a PhD degree). The occupation of parents categorize into three are not working (including school), formal sector employees (government employees and private employees), and informal sector employees (entrepreneurs, farmers, fishermen, laborers/ drivers/ housekeepers, and others). Socioeconomic status is an additional factor in this study. Households are classified into five quintile categories according to their per capita spending, which determines socioeconomic status. Quintile 1 social-economic status families are those whose per capita expenditure falls within the bottom 20% of the group. Likewise, households in the top 20 % of per capita spending are classified as belonging to socioeconomic status in the quintile 5.

Data analysis

The analysis described the features of the children in terms of frequency and proportion. The association between the independent variable and pneumonia was proved via cross-tabulation. The effects of each independent variable on the dependent variable were investigated using univariate analysis. The variables with alpha values less than 0.25 were then selected as suitable candidates for multivariate analysis. The ideal model for understanding the factors that influence the incidence of pneumonia in children under five is searched after. A multivariate study was carried out utilizing prediction models of multiple logistic regression. The models were gradually eliminated via backward elimination, beginning with the highest alpha value result. If the odd ratio value changes by more than 10%, the variable will be returned to the model. Contrary, if less than 10%, the variable will be removed from the model. Weighting was employed as survey data for univariate and multivariate analysis.

RESULT AND DISCUSSION

The dependent variable in this study was the proportion of children under five who had pneumonia, which was 4316 (4.7 %). The primary bedroom, kitchen, and living room lighting, along with the occupancy density, are indicators of the physical condition of the housing environment in this study. The participant's primary bedroom is of satisfactory quality, with most windows opened daily to a maximum of 59.99 %, ventilation 10 % equal to/more expansive than the floor area, and adequate lighting (74.57%). Most kitchen settings have easily accessible windows that are opened daily (50.9 %), adequate lighting (72.38 %), and a ventilation area that covers equal/more than 10% of the kitchen floors (46.58%). While the highest occupancy density is > 8 m2/person (qualified), occupancy rates can reach 78.49 %.

Males made up 51.87 % of the study's participants under the age of five, and their average age was 24-59 months (61.24%). Most household heads are between the ages of 31 and 40 (50.4%), have only a high school (51.36%), and work in the informal sector (77.57 %). When it comes to housewives, most work in the informal sector (54,73%) and the age range of 31 to 40 years (44.17 %). Most respondents (26.16%) came from households with socioeconomic status in quintile 1, lived in the Sumatra region (31.06%), and resided in rural areas (59.66 %).

Figure 1 shows the proportion of pneumonia in each province. Pneumonia has nearly doubled in the regional provinces of Nusa Tenggara and Papua. Some Sumatra provinces include North Sumatra, Riau, Riau Island, Bangka, and Belitung Island. Java Region, namely East Java and DI Yogyakarta, as well as Center Sulawesi in Sulawesi region, have higher rates of pneumonia than other provinces in Indonesia.

Table 1
Distribution of the dependent variable and the characteristics of the home environment

characteristics of variable's	n (%)
Incidence of Pneumonia	
No	87578(95,3)
Yes	4316(4,7)
Window, Ventilation, Lighting condition, and Occupancy Density	
Windows of primary bedroom	
Yes, open every day	54559(59,99)
Yes, it rarely opened	22674(24,93)
None	13715(15,08)
Ventilation of primary bedroom	
Yes, ≥ 10% of floor area	46477(51,1)
Yes, < 10% of floor area	31923(35,1)
None	12548(13,8)
The lighting of the primary bedroom	
Adequate	67816(74,57)
Not	23132(25,43)
Windows of kitchen	
Yes, open every day	45923(50,90)
Yes, it rarely opened	16869(18,70)
None	27436(30,41)
Ventilation of kitchen	
Yes, ≥ 10% of floor area	42025(46,58)
Ada, < 10% of floor area	30747(34,08)
None	17456(19,35)
The lighting of the kitchen	
Adequate	65309(72,38)
Not	24919(27,62)
Windows of living room	
Yes, open every day	53794(60,94)
Yes, it rarely opened	23776(26,93)
None	10705(12,13)
Ventilation of living room	
Yes, ≥ 10% of floor area	51307(58,12)
Ada, < 10% of floor area	27077(30,67)
None	9891(11,2)
The lighting of the living room	
Adequate	72113(81,69)
Not	16162(18,31)
Occupancy density	
Not Qualified	19765(21,51)
Qualified	72129(78,49)

The most common cause of pneumonia in master bedrooms was rarely opened windows (5.12%), followed by windows that were opened frequently (4.43%), with a significant difference (P value 0.05). The primary bedroom window, which is rarely opened, can potentially increase the incidence of child pneumonia by 1.16 times. The absence of windows in the living room (5.41 %) and kitchen (5.15 %) has a more significant impact than the presence of windows that are frequently or never opened. When there are no windows in the kitchen, Children are more likely to get pneumonia (1.17; 95 % CI: 1.05; 1.34; P value 0.05) than toddlers who reside in homes where windows are often opened. In this study, the presence or absence of windows in the living room had no discernible impact on the incidence of pneumonia in children under five (Table 3).

Table 2
Sociodemographic characteristics of respondents and their parents

Respondent Characteristic	n (%)
Sociodemographic factors	
Children under five sex	
Male	47661(51,87)
Female	44233(48,13)
Children under five age groups	
Up to 11 months	17774(19,34)
12-23 months	17842(19,42)
24-59 months	56278(61,24)
Head of the household age groups	
< 20 years old	549(0,67)
21-30 years old	20758(25,5)
31-40 years old	41035(50,4)
41-50 years old	16691(20,5)
51-60 years old	2101(2,58)
61+The age	284(0,35)
Head of the household education	
Not at all	1891(2,32)
Basic Education	41820(51,36)
Medium education	28130(34,55)
High education	9577(11,76)
Head of the household occupation	
Not working	1734(2,13)
Formal sector employees	16526(20,3)
Informal sector employees	63158(77,57)
Housewife age groups	
< 20 years old	3365(3,84)
21-30 years old	38165(43,59)
31-40 years old	38674(44,17)
41-50 years old	7105(8,11)
51-55 years old	165(0,19)
56	83(0,09)
Housewife education	
Not at all	2174(2,48)
Basic Education	45422(51,88)
Medium education	27757(31,7)
High education	12204(13,94)
Housewife occupation	
Not working	47917(54,73)
Formal sector employees	8949(10,22)
Informal sector employees	30691(35,05)
Household expenditure per capita	
Quintile 1	19272(26,16)
Quintile 2	16354(22,2)
Quintile 3	14340(19,47)
Quintile 4	12847(17,44)
Quintile 5	10852(14,73)
Regional	
Sumatera	28544(31,06)
Jawa & Bali	26664(29,02)
Nusatenggara	6857(7,46)
Kalimantan	9269(10,09)
Sulawesi	12892(14,03)
Maluku	3510(3,82)
Papua	4158(4,52)
Residence area	
Urban	37070(40,34)
Rural	54824(59,66)

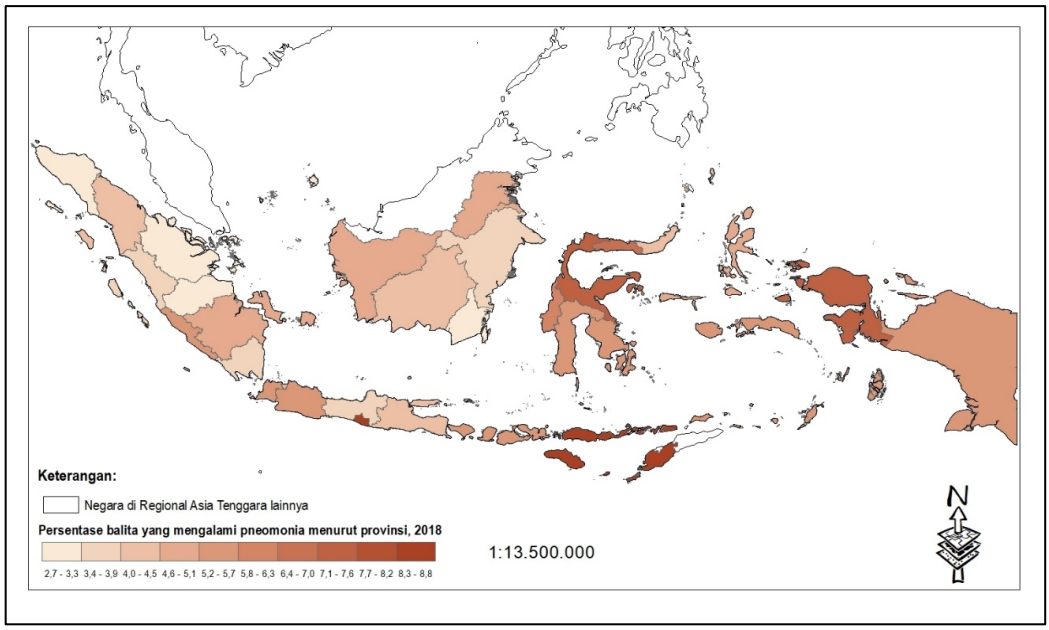

Figure 1
The proportion of children under five who have pneumonia in 2018 by province,

Table 3.
Correlations among environmental factors of the pneumonia incidence

Home environmental characteristics	% (95% CI)	Crude OR (95% CI)	P Value	N
Windows of primary bedroom				
Yes, open every day	4,43(4,16-4,72)			54559
Yes, it rarely opened	5,12(4,68-5,61)	1,16(1,04-1,31)	0,009	22674
None	4,88(4,35-5,48)	1,11(0,96-1,27)	0,152	13715
Ventilation of primary bedroom				
Yes, ≥ 10% of floor area	4,53(4,23-4,86)			46477
Yes, < 10% of floor area	4,63(4,28-5,01)	1,02(0,92-1,14)	0,690	31923
None	5,49(4,88-6,17)	1,22(1,06-1,41)	0,006	12548
The lighting of the primary bedroom				
Adequate	4,54(4,29-4,81)			67816
Not	5,15(4,71-5,62)	1,14(1,02-1,27)	0,020	23132
Windows of kitchen				
Yes, open every day	4,44(4,14-4,76)			45923
Yes rarely opened	4,57(4,09-5,10)	1,03(0,90-1,18)	0,654	16869
None	5,15(4,75-5,59)	1,17(1,05-1,31)	0,006	27436
Ventilation of kitchen				
Yes, ≥ 10% of floor area	4,36(4,06-4,68)			42025
Yes, < 10% of floor area	4,60(4,25-4,98)	1,06(0,95-1,18)	0,318	30747
None	5,74(5,19-6,36)	1,34(1,17-1,52)	0,000	17456
The lighting of the kitchen				
Adequate	4,58(4,33-4,85)			65309
Not	5,07(4,64-5,53)	1,11(1,00-1,24)	0,059	24919
Windows of living room				
Yes, open every day	4,63(4,35-4,93)			53794
Yes, it rarely opened	4,83(4,41-5,29)	1,05(0,93-1,17)	0,447	23776
None	4,78(4,18-5,46)	1,03(0,89-1,21)	0,667	10705
Ventilation of living room				
Yes, ≥ 10% of floor area	4,60(4,31-4,90)			51307
Yes, < 10% of floor area	4,70(4,31-5,12)	1,02(0,91-1,14)	0,694	27077
None	5,41(4,71-6,20)	1,19(1,01-1,39)	0,036	9891
The lighting of the living room				
Adequate	4,68(4,43-4,94)			72113
Not	4,87(4,37-5,42)	1,04(0,92-1,18)	0,500	16162
Occupancy density				
Not Qualified	5,21(4,70-5,78)	1,14 (1,01-1,29)	0,04	19765
Qualified	4,61(4,37-4,87)			72129

Based on ventilation (air) conditions, the lack of ventilation in the primary bedroom (5.49 %), the kitchen (5.74 %), and the living room (5.41%) were all higher than the availability of good ventilation by standards (≥ 10 % of the room area) or below. Primary bedroom, kitchen, and living room ventilation conditions had a statistically significant impact (P value < 0.05) on pneumonia in children under five. Compared to ventilation that satisfies the criteria, the kitchen increases the risk of pneumonia by 1.34 times, the living room by 1.19 times, and the primary bedroom by 1.22 times. The incidence of pneumonia is higher in households with inadequate lighting in the primary bedroom (5.15%), kitchen (5.07%), and living room (4.87%) than in homes with adequate lighting. Except for the living room (P value > 0.05), inadequate lighting has the potential to increase the incidence of pneumonia in children under five years old in the primary bedroom (1.14 times), kitchen (1.11 times), and living room (1.04 times). Based on occupancy density, it was determined that the occupancy that was not qualified (5.21 %) had a higher incidence than qualified (4.61 %). The univariate analysis revealed a significant relationship between the frequency of pneumonia in children under five living at home and the density of occupancy that did not fulfill the standards (1,14) (Table 3).

Simple logistic regression suggests that the presence of windows, ventilation, and lighting in the primary bedroom, as well as the presence of windows and ventilation in the kitchen, ventilation in the living room, and occupancy density, are significantly correlated with the incidence of pneumonia. Pneumonia is at risk due to indoor pollutants(Adaji et al., 2019; Bruce et al., 2013; Buchner & Rehfuess, 2015; Sonego et al., 2015). To maintain clean air in the bedroom, kitchen, and living room, windows, and air vents help with air circulation and lower the concentration of particulate emissions, such as dust particles or combustion smoke from cooking. In addition, there is a significant correlation between the incidence of pneumonia and occupancy density. A precondition for disease transmission is occupancy density. The denser the population, the quicker the disease spreads. The number of microbial colonies that cause infectious diseases, including respiratory tract infections, will be impacted by occupancy density. This study's findings align with previous studies that indicate proper ventilation and high occupancy levels can lower the incidence of pneumonia (Zheng et al., 2013); Anwar & Dharmayanti, 2014; Abebo, 2016; Rahmiza et al., 2018).

Sociodemographic factors and the incidence of the pneumonia

Table 4 shows the impact of sociodemographic variables on the incidence of pneumonia based on the characteristics of children under five and their parents. The socioeconomic level (per capita expenditure), the region, the gender of the children under five years old, their ages, the household head's education, and occupation significantly influence (P value 0.05). In this study, males (5.01%) had a higher incidence of pneumonia than females (4.45%), with a crude OR of 1.13. (95 % CI 1.03-1.25). Most infants that acquire pneumonia appear to be between the ages of 12-23 months (5.94%) with a crude OR of 1.24 (95 % CI: 1.38-1.86) and 24-59 months (4.65%) (crude OR 1.24; 95 % CI: 1.09-1.4).

Children under five will receive the mother's immunity at birth and through breast milk. In Indonesia, 84.9 % of infants aged 6 to 11 months, and 93 % of infants aged 0 to 5, are still breastfed. However, the percentage drops off after 2 years (Badan Penelitian dan Pengembangan Kesehatan, 2019). Breast milk contains macrophages, T cells, stem cells, and lymphocytes, which serve as the immune system in addition to nutrition (Ichikawa et al., 2003; Riskin et al., 2012; Sabbaj et al., 2012; Ballard & Morrow, 2013; Indumathi et al., 2013; Wijaya, 2019). Since they are no longer breastfed, Children under five's resistance to infection will decline. The multiple logistic regression analysis's findings are consistent with the hypothesis that infants aged 12-23 months (OR 1.61; 95% CI OR 1.35-1.92) and 24-59 months (OR 1.17; 95% CI OR 1.01-1.36) had a better chance of passing than infants aged 0–11 months respectively. These findings align with earlier research (Victora et al., 1994; Karki et al., 2014; Dadi et al., 2014; Fitriyah, 2019) (Fitriyah, 2019. However, some studies have produced negligible or contradictory findings (Sugihartono et al., 2012; Ujunwa & Ezeonu, 2014; Abebo, 2016; Rigustia et al., 2019; Awol et al., 2022).

The age group, occupation, and household head's characteristics had a minor impact on the incidence of pneumonia. Under-fives with household heads did not attend school, and only a primary education differed significantly from the reference group (those with higher education) (P value 0.05), like how housewife characteristics, various age groups, and education substantially impact pneumonia incidence. Aged 21 to 30 in the housewife group, 4.96 % demonstrated a significant effect with reference. It shows that housewife education has a linear relationship with the occurrence of pneumonia in children under five. The proportion of children under five that have pneumonia increases with the housewife's lower level of education. Education levels continuously significantly impact health behaviors (Cowell, 2006; Raghupathi & Raghupathi, 2020). People with higher levels of education are more likely to learn about health risks, which increases their literacy and comprehension of complicated issues. Education can also result in more accurate health knowledge, improving skills, and self-advocacy while influencing lifestyle decisions(VCU Center on Society and Health, 2015). In this study, the household head's education (OR 2.12; 95 % CI OR 1.45-3.08), as well as housewife (OR 2.43; 95 % CI OR 1.8-3.27) had a significant impact on the incidence of pneumonia in multiple logistic regression was only the mother's education was have a considerable effect (OR 1.92; 95 % CI OR 1.34-2.76; and OR 1.43; 95 % CI OR 1.18-1, 74). These findings back up earlier local and global research (Dadi et al., 2014; Ujunwa & Ezeonu, 2014; Gritly et al., 2018).

Children under five from the household with quintile 1 (the lowest total per capita expenditure per month) (5.38%) had the highest incidence of pneumonia compared to those in quintiles 2 (4.95%), 3 (4.81%), 4 (3.9%), and 5 (3.9%) in terms of household socioeconomic status (4.5 %). As compared to the reference group (household quintile 4), children under five from household quintiles 1 (crude OR 1.40; 95 % CI OR: 1.19-1.65), 2 (crude OR 1.28; 95 % CI OR: 1.09-1.51), and 3 (crude OR 1.24; 95 % CI OR: 1.04-1.49) had a higher risk of contracting pneumonia.

Depending on corporate norms and job characteristics, the type of employment and workplace have a significant social impact on health behavior and disease risk. In this study, the kind of work–housewife or head of household–had no bearing on the incidence of pneumonia in children under five (P value > 0.05). Lower socioeconomic status is also frequently linked to unhealthy behaviors like smoking, sedentary activity, and difficulties making health decisions. Type of employment influences income as a component of socioeconomic status (Tsutsumi et al., 2003; Landsbergis et al., 1998). In this study, the socioeconomic level had a

significant impact (P value 0.05), notably in quintiles 1 (OR 1.40; 95% CI OR 1.19-1.65), quintile 2 (OR 1.28; 95% CI OR 1.09-1.51 and quintile 3 (OR 1.24; 95% CI OR 1.04-1.49) when compared to the reference group (quintile 4). These findings remain in line with earlier research on the impact of socioeconomic level on the incidence of pneumonia (Anwar & Dharmayanti, 2014; Suzuki et al., 2009; Nirmolia et al., 2018). However, Un the multiple logistic regression test, the socioeconomic level was left out of the model and instead served as a confounding factor.

Compared to other regions, the Nusa Tenggara region had the highest pneumonia rate in children under five (7.26 %). Regional Papua (6.90%), Sulawesi (5.65%), Maluku (5.08%), Java & Bali (4.83%), Kalimantan (3.95%), and Sumatra were next in line (3.77%). Children in the following areas have a significantly higher risk of contracting pneumonia than those in the Sumatra region: Java & Bali (Crude OR 1.30; 95 % CI: 1.15-1.46), Maluku (Crude OR 1.37; 95 % CI: 1.07-1.75), Nusa Tenggara (Crude OR 1.89; 95 % CI: 1.53-2.35), Sulawesi (Crude OR 1.53; 95 %CI: When comparing the incidence of pneumonia by location of residence, rural areas (4.85 %) have a greater rate than urban areas (4.63 %). However, in the simple logistic regression test that there is no significant effect (P value > 0.05%) between the two (Table 4).

Refers to the fundamental principle of spatial analysis, or geography, as stated by Tobler, according to which everything is related to everything else. Still, that close things geographically are more connected than those further away(Fotheringham et al., 2002). The health condition and the local characteristics (thought to be homogeneous) can be described using area-based population analysis, both regionally and in rural and urban areas. Based on the results of the univariate analysis, although statistically speaking, there was no statistically significant difference between rural and urban areas in terms of the incidence of pneumonia (P value > 0.05), there was a significant correlation between the incidence of pneumonia and regional factors.

Table 4.
Simple logistic regression analysis of the pneumonia incidence: sociodemographic features of children under five, household heads, and housewives

Sociodemographic Characteristics	% (95% CI)	Crude OR (95% CI)	P Value	N
Children under five sex				
Male	5,01(4,71-5,33)	1,13(1,03-1,25)	0,009	47661
Female	4,45(4,15-4,76)			44233
Children under five age groups				
Up to 11 months	3,79(3,41-4,22)			17774
12-23 months	5,94(5,39-6,55)	1,60(1,38-1,86)	0,000	17842
24-59 months	4,65(4,38-4,94)	1,24(1,09-1,4)	0,001	56278
Head of household age groups				
< 20 years old	5,28(3,46-7,98)	1,28(0,75-2,17)	0,364	549
21-30 years old	4,89(4,45-5,37)	1,18(0,87-1,6)	0,295	20758
31-40 years old	4,44(4,13-4,78)	1,06(0,79-1,44)	0,683	41035
41-50 years old	4,75(4,27-5,27)	1,14(0,84-1,56)	0,404	16691
51-60 years old	4,18(3,16-5,52)			2101
61+The age	5,7(2,20-14,00)	1,38(0,49-3,89)	0,537	284
Head of the household education				
Not at all	7,96(5,78-10,87)	2,12(1,45-3,08)	0,000	1891
Basic Education	4,83(4,53-5,16)	1,24(1,05-1,47)	0,010	41820
Medium education	4,46(4,08-4,88)	1,14(0,96-1,36)	0,141	28130
High education	3,93(3,40-4,54)			9577
Head of the household occupation				
Not working	5,14(3,84-6,84)	1,22(0,88-1,69)	0,244	1734
Formal sector employees	4,26(3,80-4,79)			16526
Informal sector employees	4,75(4,49-5,02)	1,12(0,98-1,28)	0,100	63158
Housewife age groups				
< 20 years old	4,89(3,93-6,08)	1,13(0,88-1,43)	0,340	3365
21-30 years old	4,96(4,62-5,33)	1,14(1,03-1,27)	0,014	38165
31-40 years old	4,37(4,07-4,70)	1,02(0,84-1,23)	0,873	38674
41-50 years old	4,44(3,74-5,26)			7105
51-55 years old	6,61(2,62-15,70)	1,55(0,59-4,08)	0,378	165
56	7,21(2,77-17,50)	1,70(0,62-4,65)	0,302	83
Housewife education				
Not at all	8,62(6,78-10,89)	2,43(1,8-3,27)	0,000	2174
Basic Education	5,17(4,85-5,52)	1,40(1,19-1,65)	0,000	45422
Medium education	4,18(3,83-4,55)	1,12(0,94-1,34)	0,195	27757
High education	3,74(3,24-4,31)			12204
Housewife occupation				
Not working	4,81(4,50-5,13)	1,18(0,99-1,42)	0,071	47917
Formal sector employees	4,1(3,49-4,81)			8949
Informal sector employees	4,71(4,36-5,08)	1,16(0,96-1,39)	0,126	30691
Household expenditure per capita				
Quintile 1	5,38(4,89-5,92)	1,40(1,19-1,65)	0,000	19272
Quintile 2	4,95(4,47-5,48)	1,28(1,09-1,51)	0,003	16354
Quintile 3	4,81(4,26-5,42)	1,24(1,04-1,49)	0,016	14340

Quintile 4	3,9(3,45-4,40)			12847
Quintile 5	4,5(3,87-5,22)	1,16(0,95-1,42)	0,147	10852
Regional				
Sumatera	3,77(3,45-4,11)			28544
Jawa & Bali	4,83(4,47-5,21)	1,30(1,15-1,46)	0,000	26664
Nusatenggara	7,26(6,46-8,16)	2,00(1,71-2,34)	0,000	6857
Kalimantan	3,95(3,45-4,52)	1,05(0,89-1,24)	0,561	9269
Sulawesi	5,65(5,13-6,22)	1,53(1,34-1,75)	0,000	12892
Maluku	5,08(4,09-6,30)	1,37(1,07-1,75)	0,012	3510
Papua	6,90(5,76-8,26)	1,89(1,53-2,35)	0,000	4158
Residence area				
Urban	4,63(4,30-5,00)			37070
Rural	4,85(4,59-5,12)	1,05(0,95-1,16)	0,347	54824

Multiple logistic regression analysis of pneumonia incidence based on environmental and sociodemographic factors

The analysis's findings indicate that out of the home's two sociodemographic and environmental characteristics, only the primary bedroom's ventilation remains in the final model. The other four sociodemographic predictors–gender, children's age, head of household's education, and region–are eliminated from consideration. The regional variable, specifically the Nusa Tenggara region, is the most vital component of the model. Children under five in Nusa Tenggara had a 2.1 (95% CI: 1.76-2.5) higher likelihood of contracting pneumonia than children under five in the Sumatra region. In contrast to a housewife with higher education, a housewife with primary education has a 1.92 (95% CI: 1.34-2.76) chance of having children under five with pneumonia. The group of children in the 24–59-month 1.61(95% CI 1.35-1.92)) without ventilation in the primary bedroom is next (crude OR 1.18 (95% ci 1.01-1.36). Because they had a P value greater than 0.05 in this study, occupancy density, per capita expenditure, household age group, and household head education were not included in the analysis.

Using Hosmer and Lemeshow's test, the regression model's goodness of fit was evaluated to see whether the model's predictions were supported by the empirical data (there is no difference between the model and the data so that the model can be said to be fit). The model is beneath the observation value so that it may forecast the value according to the goodness of fit test result of 0.420.

Table 5.
Logistic regression analysis of environmental risk factors and sociodemographic characteristics of pneumonia

Variable	Category	Crude OR (95%CI)	P value
Windows of primary bedroom	Yes, open every day	Reference	
	Yes, it rarely opened	1,05(0,93-1,18)	0,470
	None	1,18(1,01-1,36)	0,033
Children under five age groups	Up to 11 months	Reference	
	12-23 months	1,61(1,35-1,92)	0,000
	24-59 months	1,17(1,01-1,36)	0,035
Housewife education	Not at all	1,92(1,34-2,76)	0,000
	Basic Education	1,43(1,18-1,74)	0,000
	Medium education	1,17(0,96-1,43)	0,111
	High education	Reference	
Region	Sumatera	Reference	
	Jawa & Bali	1,32(1,16-1,51)	0,000
	Nusatenggara	2,10(1,76-2,50)	0,000
	Kalimantan	1,08(0,90-1,29)	0,436
	Sulawesi	1,60(1,37-1,88)	0,000
	Maluku	1,53(1,09-2,13)	0,013
	Papua	1,76(1,36-2,29)	0,000
Household expenditure per capita	Quintile 1	1,14(0,96-1,35)	0,129
	Quintile 2	1,17(0,99-1,39)	0,070
	Quintile 3	1,17(0,97-1,41)	0,096
	Quintile 4	Reference	
	Quintile 5	1,2(0,97-1,48)	0,098

LIMITATION OF THE STUDY

The boundaries of the study were not included several independent factors, such as host factors (measles immunization, nutritional status), pollution in the home owing to the use of cooking utensils, as well as smoking practices in the house due to a lack of data

CONCLUSIONS AND SUGGESTIONS

The incidence of pneumonia was significantly linked with the presence of windows, ventilation, and lighting in the primary bedroom, windows, ventilation in the kitchen, ventilation in the living room, and high occupancy density. In addition to these sociodemographic characteristics, socioeconomic level, geographical location, and whether a person resides in an urban or rural area significantly affect

the incidence of pneumonia (the gender and age of children under five, the education and occupation of the household's head, and the age and education of the housewife). After adjusting for economic status, the multiple logistic regression method revealed that ventilation in the primary bedroom, the under-five age group, housewife education, and regional are risk factors for pneumonia in children under five in Indonesia. Therefore, factors that may be prevented using behavioral modifications and health promotion are responsible for pneumonia in children under five. Examining the differences between sociodemographic characteristics and particular locales might facilitate action.

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The author declares that there is no potential conflict of interest

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