Research Article

Risk Factor of Pnemonia among Children Aged Under 5 Years. A Case Control Study in Samarinda, Indonesia

Iwan M. Ramdan[1], Novita Anggun P[2], Ade Rahmat F[3].

[1]Assistant Professor, Department Health and Safety, Faculty of Public Health Mulawarman University, Indonesia
[2]Bachelor Science in Public Health, Faculty of Public Health Mulawarman University, Indonesia
[3]Assistant Professor, Department of Environmental, Faculty of Public Health Mulawarman University, Indonesia

Corresponding Author: Dr. Iwan M. Ramdan

Abstract:
Introduction: Pneumonia is still a global health problem especially in developing countries because it is the leading cause of death in children aged under 5 years old. In Indonesia the incidence of children pnemonia is still high.
Material and methods: The risk factors of pneumonia studied consist of house temperature, lighting, house humidity, occupancy density, exposure to cigarette smoke, and family disease history. Temperature and humidity of the house were measured by heatstress monitor, room lighting was measured by lux meters, the occupancy density was measured by direct observation, exposure to cigarette smoke and family disease history were measured by questionnaire. Data analysis using odds ratio and chi square.
Results: Obtained by the value of odds ratio: room lighting (OR = 3.18), cigarette smoke exposure (OR = 10.45), home temperature (OR = 0.337), humidity (OR = 0.192), occupancy density (OR = 0.214), and family history of disease (OR = 0.753). Humidity (p = 0.024) and occupancy density (p = 0.028) associated with pneumonia.
Conclusion: Room lighting and exposure to cigarette smoke is a major risk factor for the occurrence of pneumonia in children aged under 5 years in Samarinda, the incidence of pneumonia is significantly related to house humidity and occupancy density.

Keyword: Children pnemonia, room lighting, exposure to smoke cigarrete.

Introduction

Pneumonia is a global health problem especially in developing countries because it is the main cause of death in children aged under 5 years old. The incidence of pneumonia estimated about 0.29 events per year in developing countries and 0.005 events per year in developed countries. Worldwide, the incidence of pneumonia is around 156 million, 151 million of which occur in developing countries. The highest incidence rates occur in India (6 million each), China (21 million each) and Pakistan (10 million each) and other countries such as Bangladesh, Indonesia and Nigeria (6 million each). Pneumonia is considered responsible for 19% of all child deaths under 5 years, more than 70% occur in Sub-Saharan Africa and South-east Asia.[1] Acute respiratory infections are the first-class disease and the leading cause of death in children aged under 5 years in developing countries, 29% of which are pneumonia.[2]

According to WHO[3], the number of deaths caused by penumonia in Indonesia in 2013 is quite high at 22,000 cases and are in 8th place after India (174,000), Nigeria (121,000), Pakistan (71,000), DRC (48,000), Ethiopia (35,000) China

(33,000), and Angola (26,000). Pneumonia is the second leading cause of death in children aged under 5 years after diarrhea, the number of patients with Pneumonia in 2014 of 29.47% and then increased in 2015 to 63.45% and continues to increase in 2016 to 65.27% and death as a result of Pneumonia by 0.13% (in the 1-4 age group) and 0.06 in the infant group.[4]

Pnemonia is acut lower respiratory infection (ALRI), is a form of respiratory infection that is often fatal, has increased health costs, and leads to developmental disorders of the child.[2] Risk factors Pnemonia is broadly categorized into 3 groups: the definite factor (most evidence consistently pointing to the role of the risk factor); likely (most evidence consistently pointing to the role) or possible (with sporadic and inconsistent reports of the role in some contexts.[5] Other research proves pneumonia risk factors is indoor air pollution, malnutrition, lack of breast feeding, low maternal education, low socio economic status (SES), poor acces to care, micronutrient deficiencies, vitamin A and D deficiency, smoking tobaco and concominant illnesses.[6] This study aims to identify risk

factors and factors associated with the incidence of Pnemonia in children aged under 5 years in Samarinda city of Indonesia.

Method

An analytic survey with case control design was conducted on 21 case samples and 21 control samples taken randomly in Samarinda. The pneumonia case data was obtained from the monthly report of the acute respiratory infections control program at the Public Health Center of Samarinda, while the control group was taken from a neighboring toddler suffering from pneumonia. Risk factors studied (independent variables) consisted of house temperature, lighting, house humidity, occupancy density, exposure to cigarrete smoke, and family disease history. While the dependent variable is the incidence of pneumonia. Temperature and humidity of the house was measured with heatstress monitor, home lighting was measured by lux meter, occupancy density was measured by direct observation, exposure to cigarette smoke and family disease history were measured by questionnaire. Data analysis using chi square to know odd ratio (risk factor) and relation between independent variable with dependent variable.

Result

Table 1. Characteristics of respondent (n=42), Odds ratio and Association between It's Variables to Pnemonia of children aged under 5 years

Characteristics	Case		Control		Amount		OR	p
	F	%	F	%	F	%	(95% CI)	
Age (month)								
12-23	9	42.8	8	38.1	17	40.5		
24-35	7	33.3	6	28.6	13	30.9		
36-47	3	14.3	5	23.8	8	19		
48-60	2	9.5	2	9.5	4	9.5		
Sex								
Male	11	52.4	7	33.3	18	42.9		
Female	10	47.6	14	66.6	21	57.1		
Room termperature							0.337 (0.057-1.977)	0.410
Poor (<18°C or >30°C)	16	76.2	19	90.5	35	83.3		
Good (18°C - 30°C)	5	23.8	2	9.5	7	16.7		
Humidity							0.192 (0.051-0.731)	0.028
Poor (<40% and >60%)	5	23.8	13	61.9	18	42.9		
Good (40% - 60%)	16	76.2	8	38.1	24	57.1		
Lighting							3.188 (0.794-12.80)	0.090
Poor (< 60 lux)	17	80.9	12	57.1	29	69.1		
Good (> 60 lux)	4	19.1	9	42.9	13	30.9		
Occupancy density							0.214 (0.055-0.855)	0.024
Good (Room ratio with number of occupants <9m2 / person)	4	19.1	11	52.4	15	35.7		
Poor (Room ratio with number of occupants >9m2 / person)	17	80.9	10	47.6	27	64.3		
Exposure to cigarete smoke							10.450 (1.928-5.663)	0.006
Yes	19	90.5	10	47.6	29	73.8		
No	2	9.5	11	52.4	13	26.2		
Family history of disease							0.753 (0.171-3.312)	0.707
Yes	4	19.1	5	23.8	9	21.4		
No	17	80.9	16	76.2	33	78.6		

Based on table 1 it can be seen that the age of the children in the case group is mostly in the range of 12-32 months (42.8%) and 24-35 months (33.3%), as well as in the control group, mostly in the range of 12-32 months (38.1 %) and 24-35 months (28.6%). The sexes in the case group were almost the same ie 52.4% male and 47.7% female, while in the control group most of the women (66.6%). The house temperature between case groups and control groups is almost the same, ie 90.5% and 83.3% are mostly over 30°C. the humidity of the case group house is mostly good (76.2%) (humidity 40-60%), so also the moisture of the control house house is mostly good (57.1%). House lighting in the case group was mostly poor (80.9%) (less than 60 lux), as were the controls mostly bad but the presentation was smaller than the case group (69.1%). The occupancy density in the case group was mostly poor (80.9%), while the control group was mostly good (52.4%). Case groups were mostly exposed to secondhand smoke (90.5%), while the control group was mostly never exposed to secondhand smoke (52.4%), and the case group was largely without family history (80.9%), as did the control group most had no history of pneumonia (76.2%).

Discussion

Lighting as a risk factor of pnemonia

This study proves that home lighting is a risk factor for the incidence of pneumonia in children aged under 5 years in Samarinda City. The proportion of poor house lighting in the case group was higher (80.9%) than in the control group (57.1%). This trend is supported by the results of statistical tests that showed a significant correlation between home lighting with the incidence of pneumonia. As previously described, healthy homes require sufficient light, especially natural light in the form of ultraviolet light. Ultraviolet light from sunlight in addition to functioning for lighting, can also kill germs, bacteria, viruses, and fungi that can cause infection, allergies, asthma or other diseases. According to Yin et al,[7] Ultraviolet light will inhibit the growth of Gram-positive S. aureus, Bacillus cereus and S. epidermidis, and Gram-negative E. coli, P. aeruginosa and Klebsiella pneumoniae. Ultraviolet light will damage microbial DNA (germs, bacteria, viruses and fungi) so that microbial DNA becomes sterile. If microbes are exposed to ultraviolet light, the microbes will not be able to reproduce and eventually die. In addition, ultraviolet light works for vitamin D synthesis, where vitamin D deficiency increases the risk of respiratory tract infections of children.[8]

Exposure to cigarete smoke as a risk factor of pnemonia

We found exposure of cigarette smoke is a risk factor for the incidence of pneumonia in children aged under 5 years in Samarinda. The proportion of cigarette smoke exposure for in the case group was much larger (90.5%) than in the control group (47.6%). This trend is supported by the results of statistical tests that prove a significant relationship between exposure to cigarette smoke and the incidence of pneumonia.

Cigarette smoke is an indoor air pollutant that increases the risk of pneumonia in infants. Cigarette smoke is an indirect factor that can cause lung disease and weaken the immune system of infants. Infants with immune decreased susceptible to infectious diseases such as pneumonia.[1] Furthermore, Campagna et al[9] explains that exposure to cigarette smoke may increase the risk of pneumonia, because exposure to cigarette smoke can disrupt the immune response both adaptive and innate. Sebelumnya, WHO[10] states that the number of adults who smoke in the home affects children who live in one house because the child becomes a passive smoker so that the increased risk of respiratory inflammation, pneumonia, middle ear infections, asthma and lung growth delay. According to Greenberg[11], cigarette smoke in the home is a risk factor for pneumonia due to the presence of neisseria meningitis bacteria, streptococcus pneumoniae and haemophilus influenza.

The results of this study has support previous research on the risk factors of pneumonia occurrence in developing countries which concluded the exposure of cigarette smoke is a risk factor for the occurrence of pneumonia in children under 5 years,[2] dan indoor air pollution is significantly associated with the incidence of pneumonia in children under five years living in slums of Dibrugarh town.[12] However, these results differ with the results of Onyango et al[5] which concluded Co-morbidity, contact with upper respiratory tract infection and delay in seeking treatment are risk factors for severe pneumonia among children aged 2-59 months in Western Kenya.

Relationship of house humidity with the incidence of Pneumonia

In this study the humidity of the house proved to be significantly associated with the incidence of pneumonia in children aged under 5 years. This result is consistent with the previous explanation that microbial growth and survival are influenced by room humidity, nutrient availability, indoor temperature, weather condition, indoor ventilation, intrusion of moisture and the outdoor microbial load.[13] High indoor air temperatures can allow bacteria to grow and multiply properly. Pneumonia-causing bacteria, such as streptococcus pneumoniae, can grow within a temperature range of 25^0C - 40^0C, but can grow optimally at 31^0C - 37^0C. Hot temperatures can increase indoor evaporation to increase moisture and increase pollutant contents from building materials. High humidity (> 80%), means that the moisture content in the air is high enough, is a good condition for the growth and survival of bacterial cells (pneumococcus) so that bacteria can grow rapidly. Previous research by Bhaskar et al14. shows that home air temperatures are associated with increased cases of pneumonia and deaths from influenza in Ahmedabad, a mega city in Gujarat State in western India.

According to Gao[15], the reproduction, development and dynamics of population vector disease is influenced by environmental humidity and other weather factors that will impact the incidence and spread of infectious diseases. An

increasingly warm and humid climate is associated with aeroallergenic density, and indirectly can affect the incidence and prevalence of allergic diseases. In addition, humidity also plays a major role in the transmission of viral diseases. Meanwhile, according to Balbus,[16] children are inherently sensitive to climate change because physiologically and metabolically less effective in adapting to environmental humidity and other weather related exposures. A relatively non-optimal immune system increases the risk of serious consequences of various infectious diseases.

Relationship between occupancy density with pnemonia

We found a relationship between density of occupancy with density the incidence of pneumonia in children aged under 5 years. The results of this study are consistent with the results of previous studies which concluded that people living in houses have an important role in the speed of transmission of microorganisms in the environment, so the density of house occupancy should be the concern of all family members, especially if associated with the spread of infectious diseases. The high density of housing will affect the house temperature. Overcrowded house occupants will increase the temperature inside the house due to the expenditure of body heat. High indoor air temperatures can allow bacteria to grow and multiply with. According to Fujiyos et al[17] bacterial concentrations in built environments change depending on numbers of human occupancy.

The results of this study in accordance with previous research that room occupancy density is a risk factor for the incidence of pneumonia in children under 5 years in West Lombok, Indonesia,[18] sharing with someone with cough is an important risk factor for severe pneumonia,[19] a densely populated home allows the transmission of bacteria and viruses causing pneumonia by breathing from the inhabitants of one house to the other home dwellers more easily and quickly.[20]

The results of this study may complement the results of previous studies that conclude respiratory infections such as pneumonia will increase in the house with the number of occupants of more than 7 people with an increase of 1.83 times each increased 1 person. Increased risk of pneumonia by as much as 1.15 times when a child under five years sleeps with more than 3 people in one room, and an increase of 2.87 times when staying at home with high density. The increased risk of pneumonia occurs because disease-causing pathogens can spread more rapidly in dense environments.[21, 22]

Conclusion

Lighting in the room (OR = 3.118) and exposure to cigarette smoke (OR = 10,450) are two major risk factors for pneumonia in children aged under 5 years in Samarinda city of Indonesia. Although the value of OR is less than 1 (not a risk factor), but based on data analysis, the humidity in the house (p = 0.028) and occupancy density (p = 0.024) are significantly related to the incidence of pneumonia. Home temperatures (p = 0.410) and illumination (p = 0.09) were not statistically related to pneumonia.

References

[1] Rudan, I. Pinto, CB., Biloglav, Z., Mulholland, K and Campbell, H. Epidemilogy and etiology of childhood pnemonia. Bulletin of the World Health Organization 2008;86:408-416.

[2] Ramezani, M., Aemmi, SZ and Moghadam, ZE. Factors affecting the rate of pediatric pnemonia in developing countries: a riview and literature study. International Journal of Pediatric 2015;3 (24):1173-1181.

[3] WHO. 2013. *Pneumonia : Fact Sheet. Geneva.* http://www.who.int/mediacentre/.factsheet/fs331/en/

[4] Indonesian Minister of Health. 2017. Health profile of Indonesia 2016. Jakarta: Indonesian Minister of Health.

[5] Onyango, D., Kikuvi., G., Amukoye, E and Omolo, J. Risk factors of severe pnemonia among children aged 2-59 months in western Kenya: a case control study. PanAfrican Modecal Journal 2012;13 (45):1-13.

[6] Wonodi, CB., Knoll, MD., Feikin, DR., Deluca, AN., Driscoll, A.J., Moisi, JC., Johnson, HL., Murdoch, DR., O'Brien, KL., Levine, OS., and Scott, JA. Evaluation of risk factors for severe pnemonia in children: The pnemonia etiology research for child health club. Clinical Infectious Diseases 2012;54(S2):S124–31.

[7] Yin, R., Dai., T., Avci, P., Jorge, AES., Melo, WC., Vecchio, D., Huang, YY., Gupta, A and Hamblin, MR. Light based anti-infectives: ultraviolet Cirradiation, photodynamic therapy, blue light, and beyond. Curr Opin Pharmacol. 2013 October; 13 (%) : doi:10.1016/j.coph.2013.08.009

[8] Esposito, S and Lelii, M. 2015. Vitamin D and respiratory tract infections in childhood. BMC Infectious Disease (2015); 15: 487. DOI: 10.1186/s12879-015-1196-1

[9] Campagna, D., Amaradio, MD., Sands, MF and Polosa, R. Respiratory infections and pnemonia: potential benefits of switching from smoking to vaping. Journal of Pnemonia (2016) 8:4; DOI 10.1186/s41479-016-0001-2

[10] WHO. 2011. Global Adult Tobacco Survey: Indonesia. National Institute of Health Research and Development , Indonesian Ministry of Health, Jakarta.

[11] Greenberg D, Givon-Lavi N, Broides A, Blancovich I, Peled N, Dagan R. The Contribution of smoking and exposure to tobacco smoke to streptococcus pneumoniae and haemophilis influenzae carriage in children and their mother. *Clin Infect Dis.* 2006;42(7):897-903

[12] Nirmolia, N., Mahanta, TG., Boruah, M., Rasaily, R.,

Kotoky, RP, and Bora, R. 2017. Prevalence and risk factors pf pnemonia in under five children living in slums og Dibrugarh town. Clin Epidemiol Glob Health (2017), http://dx.doi.org/10.1016/j.cegh.2017.07.004

[13] Park, DU., Yeom, JK and Lee, KM. Assesment of the levels of Airborne Bacteria, Gram-Negative Bacteria, and Fungi in Hospital Lobbies. Int J Environ Res Public Health. 2013 Feb; 10(2): 541-555.

[14] Bhaskar BV , Mehta VM. Atmospheric Particulate Pollutants and their Relationship with Meteorology in Ahmedabad. *Aerosol Air Qual Res.* 2009;10:301–315.

[15] Gao J, Sun Y, Lu Y, Li L (2014) Impact of Ambient Humidity on Child Health: A Systematic Review. PLoS ONE 9(12): e112508. https://doi.org/10.1371/journal.pone.0112508

[16] Balbus JM, Malina C (2009) Identifying vulnerable subpopulations for climate change health effects in the United States. Journal of occupational and environmental medicine/American College of Occupational and Environmental Medicine 51:33–37

[17] Fujiyosi, S., Tanaka, D and Maruyama, F. Transmission of Airborne Bacteria across Built Environments and Its Measurement Standards: A Review

[18] Front Microbiol. Nov 2017; 8:2336. doi: 10.3389/fmicb.2017.02336

[19] Korelia, E. R. . The Relationship Between The Physical Environment of The House and The Incidence of Pneumonia in Children. Health Notions, [S.l.], v. 1, n. 4, p. 375-382, dec. 2017. ISSN 2580-4936.

[20] Howie, S.R.C., Schellenberg, J., Chimah, O. Ideh, IC., Ebruke, B.E., Oluwanala, C., Mackenzie, G., Kallow, M., Njie, M., Dionisio, K.L., Golberg, G. et al. Childhood pneumonia and crowding, bed-sharing and nutrition: a case-control study from The Gambia. Int J Tuberc Lung Dis. 2016 Oct; 20(10): 1405–1415. doi: 10.5588/ijtld.15.0993

[21] Cardoso, MRA, Counsens, SN., De Goes Siquera, LF., Alves, FM., D'Angelo, LA. Crowding: risk factor or protective factor for lower respiratory disease in developing countries. BMC Public Health. 2004;3(4):19.

[22] Kovesi T, Gilert NL, Stocco C, Fugler D, Dales RE, Guay M, et al. Indoor air quality and the risk of lower respiratory tract infections in young canadian inuit children. *CMAJ.* 2007;177(2):155-160

[23] Grant CC, Emery D, Milne T, Coster G, Forrest CB, Wall CR, et al. Risk factors for community-acquired pneumonia in pre-school-aged children. *J Paediatric Child Health*, 2011;48(5):402-410.