KnE Life Sciences
The 2nd International Meeting of Public Health 2016
The 2nd International Meeting of Public Health 2016 with theme
"Public Health Perspective of Sustainable Development Goals:
The Challenges and Opportunities in Asia-Pacific Region"
Volume 2018

Conference Paper

Indoor Air Pollution Impact On Students in Surabaya

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Abstract

Students living in unhealthy housing environments experience the health impacts of indoor air pollution. These impacts include Acute Respiratory Infection (ARI). The objective of our study was to analyze the impacts of indoor air pollution on students in Surabaya. Case-control was used to design the study. Study participants were students of Airlangga University at Campus C in Mulyorejo. The case group consisted of students with a history of ARI as determined by clinical test, while the control group consisted of students with no ARI as determined by clinical test. Data collection was performed using structured interviews. The results of multivariate analysis show that bedroom ventilation (p=0.000; OR=46.009), bedroom humidity (p=0.001; OR=19.991), insecticide usage in bedroom (p= 0.040; OR=17.567), cubicle dwelling/residential density of bedroom (p=0.003; OR=16.006), bedroom temperature (p=0.030; OR=15.001), and duration of living in the settlement (p=0.006; OR=9.601) are related to ARI. The most impactful factor for ARI is room ventilation. The recommendation is to manage indoor pollutants to reduce the risk of ARI on a productive age group such as students.

Keywords: Air Pollutant, Ventilation, Acute Respiratory Infection (ARI), Students

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Received: 21 January 2018
Accepted: 8 April 2018
Published: 17 May 2018

Publishing services provided by Knowledge E

Selection and Peer-review under the responsibility of the 2nd International Meeting of Public Health 2016 Conference Committee.

1. INTRODUCTION

Acute Respiratory Infection (ARI) is a disease that affects the upper or lower respiratory tract. It is usually infectious, which can cause a spectrum of illnesses ranging from asymptomatic disease or mild infection to severe illness and death, depending on the pathogen, environmental factors, and host factors. ARI is defined as an acute respiratory disease caused by an infectious agent transmitted by humans. The onset of symptoms is usually rapid, i.e. within a few hours to several days. Possible symptoms include fever, cough, often sore throat, *coryza (*runny nose), shortness of breath, wheezing, and difficulty in breathing (Jason DT et al. 2006).

How to cite this article: Ririh Yudhastuti and Aldio Yudha Trisandy, (2018), "Indoor Air Pollution Impact On Students in Surabaya" in *The 2nd International Meeting of Public Health 2016 with theme "Public Health Perspective of Sustainable Development Goals: The Challenges and Opportunities in Asia-Pacific Region"*, KnE Life Sciences, pages 137–143. DOI 10.18502/kls.v4i4.2271

ARI is more prevalent in developing countries (25-30%) than in developed countries (10-15%) and the mortality of children under five due to ARI in Southeast Asia reached 2.1 million in 2004 [12] India, Bangladesh, Indonesia, and Myanmar had the highest numbers of infant deaths caused by ARI [1]. ARI has always been ranked as the most common disease in Indonesia. Based on the results of *Riskesdas* in 2013, the prevalence of ARI was found to be 25.0%. The population with the highest occurrence of ARI (25.8%) was children aged 1-4 years [4]. In 2014 there were 657,490 cases of ARI in children under five (29.47%) (Hecht SS 2011).

There are several factors that may cause respiratory disease. According to WHO in 2007, The severity of ARI varies based on several factors: environmental conditions, the availability and effectiveness of medical care and steps to prevent the spread of infection, and host factors such as age, smoking habits, immune system status, nutritional status, previous or concurrent infections caused by other pathogens, public health conditions, and pathogenic characteristics. Risk factors related to ARI include home construction, home density, and population density. Home environmental risk factors that influence the incidence of ARI include residential density, ventilation, temperature, and humidity. The average proportion of houses that conform to regulations in the study area is only about 40%. The aim of our study is to investigate the effects of indoor air pollution on students at Surabaya. The study used case control design with an Airlangga University student population at Campus C in Mulyorejo.

2. METHODS

This research was conducted at Campus C of Airlangga University in Surabaya in 2015. It used a case-control study design. The study population of students lived in boarding houses or rented houses for approximately two years. The case group consisted of 40 students aged 17-25 years who had been clinically determined to be affected by ARI. The control group consisted of 80 students without ARI, as determined by clinical test. Data was collected using a questionnaire. Residential density was calculated using the Healthy Home Standard (Kementrian Kesehatan 1999). Temperature was measured using a room thermometer, and air humidity was measured by using a hygrometer. Variables examined included the home environment (including the construction of the house, i.e. walls, roof/ceiling, and floor), residential density, ventilation, temperature, humidity inside the house, duration of living in the settlement or the length of stay in the house, the recurring use of insect repellent spray/coils, smoking habits. Data analysis included univariate analysis (frequency distribution and proportion of variables), bivariate analysis (identification of candidate multivariate model variables), and multivariate analysis to determine the relationships of independent variables with the dependent variable (incidence of ARI).

3. RESULTS

Based on bivariate analysis, it appears that 90% of ARI cases occur in high cubicle dwelling density (87%). Ventilation did not meet health requirements (92%). There were uncomfortable room temperature (57.3%), inappropriate humidity (92.7%), brick stone wall construction (65%), stucco-storey houses (76%), roofs without ceilings (50%), lengths of stay in the homes ≥ 2 years (88.6%), the use of anti-mosquito spray/coils (56%), and smoking habits (71%). Using the chi-square test (α = 5%), the relationships of variables with ARI were determined. Candidate research variables that met the criteria of a basic model ($p < 0.25$) for ARI were: cubicle dwelling density, ventilation, temperature, humidity, and the behavior of respondents (Table 1).

Table 1: Relationship of Research Variables and ARI.

Variables	Category	p value
Cubicle Dwelling Density	Inappropriate (<4 m2/person) Appropriate (≥4 m2/person)	0,000
Temperature of the room	Uncomfortable place to stay Comfortable	0,000
Humidity / living room	Inappropriate (<40% or >70%) Appropriate (40% - 70%)	0,111
Wall construction	Without plaster Plastered wall construction	0,000
Ventilation	Inappropriate ventilation area (<10% of floor space) Appropriate (≥10% of floor space)	0,000
Roof	Without ceiling With ceiling	0,089
Floor Plastering / tiling / Dachshund	Floor Plastering / tiling / Dachshund Ceramic	0,189
Length of stay in the study site (house) ≥ 2 years	≥2 years <2 years	0,000
Use of anti-mosquito spray/coils	Use Do not use	0,000
Smoking habits	Yes No	0,000

The multivariate analysis in this research used logistic regression to relate several independent variables together with the dependent variable. After screening for statistical significance, in which variables were removed one by one to determine their significance, six variables were found that have a significant relationship with the occurrence of ARI: cubicle dwelling density, humidity of room, room temperature, duration of living in the settlement or length of stay, anti-mosquito insecticide usage, and ventilation (Table 2).

Table 2: Multivariate Analysis of Research Variables with ARI.

Variables	B	Wald	p value	OR
Bedroom ventilation	3,900	15,878	0,000	46,009
Bedroom humidity	3,100	09,871	0,001	19,991
Insecticide usage	3,099	09,290	0,040	17,567
Cubicle dwelling density	3,100	9,870	0,003	16.006
Bedroom temperature	2,234	7,200	0,003	15,001
Duration of living in site	3,900	15,878	0,006	09,601

Bedroom ventilation (p=0.000; OR=46.009), bedroom humidity (p=0.001; OR=19.991), insecticide usage in bedroom (p=0.040; OR=17.567), residential density in bedroom (p=0.003; OR=16.006), bedroom temperature (p=0.03; OR=15.001), and duration of living in the settlement (p=0.006; OR=9.601) were all significant factors for ARI.

4. DISCUSSION

ARI poses a greater risk when people live in inappropriate bedroom densities [3, 7]. More people in a room leads to higher concentrations of microorganisms because each person is carrying microorganisms, which come from the nose, throat, mouth, and skin. As a result, the risk of disease spreading in the room will be higher. The risk of ARI transmission during sleep is also higher with closer contact between the occupants. If the number of occupants of the room is not proportional to the area of the room, the volume of clean air will be reduced and carbon monoxide will rapidly increase as the result of expiration process [8] (Hecht SS 2011).

House temperature is significantly associated with the incidence of ARI. Multivariate analysis shows that respondents living in a house or room with an uncomfortable temperature (<18°C or >30°C) have 13 times the risk of ARI than those staying in a room with a comfortable temperature [7]. High temperature is a stimulating factor of ARI because without air circulation, a room will be hot, pathogens and other pollutants in the room cannot exit the house/room, and the concentration of microorganisms increases and make the occupants of the house susceptible to ARI [7].

Multivariate analysis also shows that being at home with inappropriate humidity (<40% or >70%) increases the risk of ARI by 16 times compared to those living in homes with appropriate humidity. Inappropriate room humidity may make a room seem wet and facilitate the transmission of the disease. Most of the respondents in a house or dwelling with inappropriate ventilation (<10% of floor area) have a risk of ARI that is 17 times higher than that of those living at home with appropriate ventilation. Ventilation, temperature, and humidity are significantly associated with the incidence of ARI and are also closely related to air circulation in the house. If the air circulation does not conform to regulations, the air will be stuffy, smelly, and raise pathogenic bacteria and other pollutants that can harm health. Ventilation plays an important role because it will provide a proper speed of air flow. It is important to speed up the process of cleaning the air in a house/room. Inappropriate ventilation is dangerous to health and may stimulate indoor air contamination by microorganisms such as bacteria, fungi, viruses, and various chemicals [6, 7].

House sanitation is closely associated with morbidity of infectious diseases, especially respiratory infection. The housing environment is very influential on the incidence and spread of ARI. The relationship between home sanitation and health conditions is well-known. In communities with poor sanitation homes, the prevalence of infectious diseases including ARI will be high. This is caused by house construction (e.g., walls, roof, and floor) that does not meet health requirements, high population density, and lack of clean water. A small house window causes improper air exchange, and smoke from the kitchen or anti-mosquito insecticide fumes may collect in a room in the house. Infants and children are often sensitive to air pollution inside the home, but it can also occur in people of childbearing age, such as college students between the ages of 17 to 22 years. At that age, their immune systems are already complete. High moisture also facilitates the occurrence of air pollution inside the home [6].

Other disorders, such as reduced oxygen levels and increased carbon monoxide levels. The length of stay of the respondents affected the incidence of ARI. Our analysis showed that a length of stay ≥2 years increased the risk of ARI by 8 times compared to the risk to those who have not been living that long in the study site. The use of anti-mosquito spray in the room may create or add more indoor pollutants. Respondents' smoking habits increase the risk of ARI by 42 times compared to the risk of non-smokers. Living in a house with brick or concrete block wall construction, with or without plastering, showed no significant relationship to ARI risk. Likewise, the ceilings or roofs of both groups showed no significant difference. Floors with plaster/tiles and ceramics showed no significant difference in both groups. [6, 7]

5. CONCLUSIONS

Environmental factors of housing affect the incidence of ARI. These factors include residential density of living rooms or bedrooms, ventilation, room temperature, humidity, length of stay in the house, use mosquito repellent, and smoking habits. House construction factors including roof/ceiling, walls, floor, residential density, and population density in a settlement area did not show a significant association with the incidence of ARI [1].

6. RECOMMENDATION

To prevent ARI and improve students' achievement, it is recommended that the quality of residential neighborhood settlements be improved and that the use of mosquito repellent/insecticides be reduced.

References

[1] Ghimire M, Bhattacharya SK, Narain JP. 2012. *Pneumonia in South-East Asia Region: Public Health Perspective*. Indian J Med Res. 135:459–468.

[2] Hecht SS. HEI. 2010. *Outdoor Air Pollution And Health in The Developing Countries of Asia: A Comprehensive Review.* Special Report 18. Boston: Health Effects Institute.

[3] Kementerian Kesehatan Republik Indonesia Keputusan Menteri Kesehatan no 829 tahun 1999 tentang Persyaratan kesehatan perumahan. Jakarta: Kementerian Kesehatan tahun.

[4] Kementrian Kesehatan Republik Indonesia. 2013. Riset Kesehatan Dasar (RISKESDAS) 2013. Jakarta: Kementrian Kesehatan Republik Indonesia

[5] Mendell MJ, Mirer AG, Cheung K, Tong M, Douwes J. 2011. *Respiratory And Allergic Health Effects of Dampness, Mold, and Dampness-Related Agents: A Review of The Epidemiologic Evidence.* Environt Health Perspect. 119:748–756.

[6] Oberg M, Jaak kola MS, Woodward A, Peruga A, Prüss-Ustün A. 2011. *Worldwide Burden of Disease From Exposure To Second-Hand Smoke: A Retrospective Analysis of Data From 192 Countries.* Lancet. 377:139–146.

[7] Park JH, Cox- Ganser JM. 2011. *Mold Exposure and Respiratory Health in Damp Indoor Environments.* Front Bio sci (Elite Ed) 3:757–771.

[8] Yudhastuti, R. 2008. *Housing and Acute Respiratory Tract Infection Among Undergraduate Students in Indonesia Asia Pacific. Journal of Public Health* 20:262-6.

[9] Jamison DT, Breman JG, Measham AR, et al., editors.

[10] Washington (DC): The International Bank for Reconstruction and Development / The World Bank;

[11] New York: Oxford University Press; 2006. Available at https://www.ncbi.nlm.nih.gov/books/NBK11786/

[12] World Health Organization. 2012. Data and Statistics. Available at http://www.who.int/gho/child_health/en/index.html

[13] World Health Organization . 2007 Infection prevention and control of epidemic- and pandemic-prone acute respiratory diseases in health care.

[14] Available at http://www.who.int/csr/resources/publications/WHO_CDS_EPR_2007_6c.pdf

[15] Kementerian Kesehatan Republik Indonesia. Keputusan menteri kesehatan no. 829 tahun 1999 tentang persyaratan kesehatan perumahan. Jakarta: Kementerian Kesehatan Republik Indonesia; 1999