

Risk Factors for Acute Respiratory Infection in Children Under Five in Padang, Indonesia

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ABSTRACT

Background: Acute Respiratory Infection (ARI) is a major cause of acute diseases and death in infants worldwide. Percentage of ARI (year 2017) in children aged 12-59 months in Padang was 26.5% and Andalas health center was 33.2%. ARI is influenced by many factors such as environmental condition. This study aimed to analyze risk factors for ARI in children under five in Padang, Indonesia.

Subjects and Method: This was a case control study conducted at Andalas community health center, Padang, Indonesia. A sample of 90 children aged 12-59 months was selected for this study. The dependent variable was ARI. The independent variables were humidity, house ventilation, dwelling density, indoor smoke cigarette. Data on ARI status were taken from medical record. The other variables were measured by questionnaire and observation sheet. The data were analyzed by a multiple logistic regression.

Results: Poor ventilation (OR = 11.73; 95% CI = 2.16 to 63.86; p = 0.004), high dwelling density (OR = 21.99; 95% CI = 3.75 to 129.04; p = 0.001), indoor cigarette smoke (OR = 5.09; 95 % CI = 1.06 to 24.34; p = 0.042), and high air humidity (OR = 5.00; 95% CI = 0.79 to 31.51; p = 0.086) increased the risk of ARI in children under five and they were statistically significant.

Conclusions: Poor ventilation, high dwelling density, indoor cigarette smoke, and high air humidity increase the risk of ARI in children under five.

Keywords: Acute respiratory infection, dwelling density, air humidity, children under five

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BACKGROUND

Acute Respiratory Infection (ARI) is still a major cause of acute diseases worldwide and causes of death in infants. About 3.9 million children die every year due to ARI (Taksande and Yeole, 2015). ARI consists of upper respiratory tract infections and lower respiratory tract infections hanging from the affected respiratory tract area (Nandasena et al, 2013). 40% - 60% of patient visits in Puskesmas and 15% -30% of hospital patient visits are cases of ARI with episodes 3-6 (Ministry of Health, 2012). ARI is caused by bacteria and viruses. Bacterial groups include the general *Strep-*

tococcus pneumoniae, *Staphylococcus aureus*, *Pneumococci*, *Haemophilus influenzae types b* (Hib), *Bordetella*, *Korinebacterium* and other species of bacteria. Viruses that cause ARI are *Mikovirus*, *Adenovirus*, *Corona-virus*, *Phorornavirus*, *Mycoplasma*, *Herpes-virus*, *respiratory syncytial virus* (RSV), measles virus, *human parainfluenza viruses types 1,2* and *3* (PIV) -1, PIV-2 and PIV-3), influenza virus and varicella virus (Fakunle, 2012).

The government has sought to eradicate ARI with the Integrated Management of Childhood Illness (IMCI) approach to be able to screen for diseases that require an

immediate care so that mortality can be reduced and able to screen conditions that only require home care. This success depends on the number of risk factors and modification of risk factors (Wantania et al., 2008).

Several factors that contribute to the increase of ARI cases are low air quality both inside and outside the home biologically, physically and chemically. The air quality in the home space is influenced by factors including building structure, density of occupancy and also in-house activities such as smoking behavior in the house (Ministry of Health, 2011). Nearly 90% of people spend time and do their activities indoors, especially toddlers so that the room is related to the risk of air pollution (Ministry of Health 2011, Sati et al, 2015).

Humidity and occupancy density have a significant relationship with the incidence of ARI in infants (Rosdiana and Hermatwati, 2015). The presence of indoor smoke is a risk factor for ARI (Yadav et al, 2013). The temperature of a room that does not meet the requirements has a 2.29 times greater risk of experiencing ARI than the room temperature that meets the requirements (Sati et al., 2015).

Home is a part of the environment that affects the occurrence of respiratory infections. The house component consists of walls, floors, ventilation, lighting and occupant density (Masfufatun et al., 2016; MOH, 2007). Unhealthy homes can cause high bacterial colonies in homes in case groups (Fakunle, 2012; Ana et al., 2013).

The Government through the Regulation of the Minister of Health of the Republic of Indonesia Number 1077 / MENKES / PER / V / 2011 concerning Guidelines for Air Sanitation in Home Rooms establishes air quality requirements in the home space biologically, physically, and chemically. Biologically, the space with air in a healthy

home must be free from maximum airborne germs <700 CFU/m³. Physical quality consists of air temperature, lighting, and humidity.

Based on the 2013 Riskesdas data, West Sumatra is the 10th province with the highest prevalence of ARI in Indonesia (25.7%). Based on data from the Padang City Health Office in 2017, the proportion of ARI in infants in Padang City was 26.5%. ARI in toddlers is highest in Andalas Health Center with a total of 2,821 cases (33.2%).

Healthy home ownership in the Andalas Community Health Center work area is still low. Of the 15,393 homes in the Andalas Community Health Center work area, 2,400 (15.6%) houses were examined for their health requirements and stated that they met the health requirements of 2101 healthy homes (87%), while the 100% target (Andalas Health Center, 2016).

SUBJECTS AND METHOD

1. Study Design

This was an analytic observational with a case control design. The study was conducted at Andalas Health Center, Padang, Indonesia.

2. Population and sampels

The study population was children in Padang, Indonesia. A sample of 90 children aged 12-59 months was selected for this study by random sampling.

3. Study Instruments

Data on air germ were measured by the water volume sampler. Data on lighting were measured by lux meter. Air humidity and temperature were measured by thermohygrometer. The data were analyzed by a multiple logistic regression.

RESULTS

1. Study subject characteristics

The frequency distribution of the characteristics of the study subjects was

mostly <32 years old at 49 people (54.4%), high school education (46.7%), and t working at home (28.9%) (table 1).

Table 1. Study Subject Characteristics

Variable	n	%
Age		
<32 years	49	54.4
≥ 32 years	41	45.6
Education		
JHS graduate	8	8.9
SHS graduate	42	46.7
Graduate≥SHS	40	44.4
Occupation		
Civil servants/Soldier	10	11.1
Private worker	26	28.9
Private entrepreneur	25	27.8
Labor	2	2.2
Housewife	26	28.9
Housemaid	1	1.1

2. Bivariate Analysis Result

Bivariate analysis was conducted to determine the relationship of independent variables (number of airborne bacteria, temperature, humidity, lighting, indoor cigarette smoke, ventilation, and dwelling density) and the incidence of ARI (table 2).

The number of airborne germs that did not qualify in the case group was 68.9% compared to the control group (24.4%). The proportion of germs that do not qualify is higher in the case group. Humidity that did not meet the requirements was (71.1%). The lighting that did not meet the requirements (53.3%) in the case group was higher than the control group (28.9%). Smoking inside the house was higher in the case group (66.7%) than in the control group (42.2%).

Table 2. Bivariate analysis on the risk factors of acute respiratory infection

Independent Variables	ARI				Total		OR	95 % CI	p
	Cases		Control		n	%			
	n	%	n	%					
Number of Air Germ									
High	31	73.8	11	26.2	42	100	6.84	2.71 to 17.31	0.001
Low	14	29.2	34	70.8	48	100			
Temperature									
Low	14	66.7	7	33.3	21	100	2.45	0.88 to 6.86	0.135
High	31	44.9	38	55.1	69	100			
Humidity									
High	32	76.2	10	23.8	42	100	8.62	3.32 to 22.36	0.001
Low	13	27.1	35	72.9	48	100			
Lighting									
Low	24	64.9	13	35.1	37	100	2.81	1.18 to 6.72	0.032
High	21	39.6	32	60.4	53	100			
Indoor cigarette smoke									
Yes	30	61.2	19	38.8	49	100	100	1.16 to 6.45	0.034
No	15	36.6	26	63.4	41	100			
Floor									
Poor	20	58.8	14	41.2	34	100	100	0.75 to 4.20	0.277
Good	25	44.6	31	55.4	56	100			
Wall									
Poor	26	61.9	16	38.1	42	100	100	1.06 to 5.80	0.057
Good	19	47.3	29	52.7	48	100			
Ventilation									
Poor	35	77.8	10	22.2	45	100	100	4.53 to 33.10	0.001
Good	10	22.2	35	77.8	45	100			
Dwelling Density									
High	33	71.7	13	28.3	46	100	100	2.69 to 17.04	0.001
Low	12	27.3	32	72.7	44	100			

Ventilation that does not meet the requirements is 77.8% higher in the case group

compared to the control group (22.2%). Dense occupancy density was higher in case

groups (73.3%) and in the control group (28.9%).

3. Multiple Logistic Regression

Table 3 showed the result of multiple logistic regression. Table 3 showed that the poor ventilation (OR= 11.73; 95% CI= 2.16 to 63.86; p= 0.004), high dwelling density

(OR= 21.99; 95% CI= 3.75 to 129.04; p= 0.001), indoor cigarette smoke (OR= 5.09; 95% CI= 1.06 to 24.34; p= 0.042), and high humidity (OR= 5.00; 95% CI= 0.79 to 31.51; p= 0.086) increased the risk of ARI in children under five and they were statistically significant.

Table 3. The Result of Multiple Logistic Regression Analysis

Independent Variables	OR	95% CI		P
		Lower limit	Upper limit	
Poor ventilation	11.73	2.16	63.86	0.004
High dwelling density	21.99	3.75	129.04	0.001
Smoking inside the house	5.09	1.06	24.34	0.042
Non-permanent wall	1.48	0.33	6.70	0.609
High number of air germ	2.96	0.44	19.84	0.263
Temperature	3.24	0.60	17.54	0.172
Floow	3.35	0.62	18.09	0.161
High Humidity	5.00	0.79	31.51	0.086
Lighting	3.76	0.70	20.37	0.124
R ² = 76.9%				

DISCUSSIONS

1. The relationship between dwelling density and the incidence of ARI

Dwelling density was positively associated with the incidence of ARI. This study was in line with Syahidi (2013) in Tebet, South Jakarta, that there was an effect of dwelling density on the incidence of ARI (OR= 5.59; 95% CI= 2.16 to 14.50). Dwelling density was the ratio of the total floor area of the room divided by the number of residents, at least 8m²/person. The recommended area of the bedroom was 8m²/person and it was not recommended for two people to sleep in one room, except children under the age of 5 years old (Health Department, 2007). While the dwelling density of the observations in the field was 7.49m², this mean that the house in the Andalas Health Center has a dense dwelling.

Density of dwelling could affect humidity, this was due to the large number of residents so that it could increase the amount of water vapor and CO₂ which reduced the oxygen levels and have an

impact on the decrease in room air quality (Wulandari, 2013).

The density of the room also affected the room temperature caused by heat dissipation which would increase humidity due to water vapor from the breathing. Narrow buildings that were not in accordance with the number of residents would lead to the lack of oxygen in the room so that the resident's immune system was decreased, and it could accelerate the risk of respiratory diseases such as ARI (Affandi, 2012).

The result of this study was in line with a study done by Sati et.al in 2015, in Ogan Hilir District, it stated that there was a significant relationship between dwelling density and the incidence of ARI (OR= 6.61; 95% CI= 1.02 to 42.82). Dwelling density was pre requisite for disease transmission process. Density of dwelling in the house was very important to be considered, this was because the great number of the residents in the house would accelerate the occurrence of air pollution in the spread of

microorganisms around the house (environment).

2. The relationship between house ventilation and the incidence of ARI

The results of this study showed that there was a relationship between the ventilation which did not fulfill the requirements and the incidence of ARI. Ventilation served to free the air from bacteria, especially pathogenic bacteria and keep the house to always in optimum humidity. Ventilation which did not fulfill the requirements would trigger the high humidity in the room, high humidity would be a good medium for the growth of disease-causing bacteria (Sati *et al*, 2015).

High germ concentration was in the air, and it was closely related to the adequacy of ventilation which served as a means to ensure the quality of air to come out and come in (Yusuf *et al*, 2016). Children who lived in well-ventilated houses were less likely to have ARI than children who lived in houses with poor ventilation (Wantania *et al*, 2008).

Ventilation problems in general were insufficient fresh air from outside into the room, poor distribution and air exchange, air filtration problems due to poor maintenance of the ventilation system. Health problems such as the respiratory tract caused by bacteria might come from the ventilation system. The source of microbiological contamination came from carpets, damp furniture, or puddle in the ventilation system (Fitria, *et al* 2008).

Inadequate ventilation was the cause of low indoor air quality. Contamination in the room can be increased because the ventilation was in the level that could disturb or reduce the comfort of the residents (EPA, 1991). The effect of ventilation on health could occur in more vulnerable people (Fitria *et al*, 2008).

Adequate ventilation could reduce pathogenic germs which transmitted by obligate and preferential transmission through airborne, including URTI (WHO, 2007). The broad standard of home ventilation was 10% of the floor area. Ventilation that did not qualify could lead to a reduction in oxygen levels in the air of the room, and it caused a stuffy odor released by the human's skin, clothing, and mouth; causing an increase in indoor air temperature and increased the humidity in the houses (Gunawan, 2009).

3. The relationship between indoor cigarette smoke and the incidence of ARI

In addition to the dwelling density and ventilation, the variable which was significantly associated with the results of multivariate analysis of logistic regression was smoking in the house. The result of this study was similar to a study done by Syahidi *et al*. (2016) which stated that there was a significant relationship between smoking inside the house and the incidence of ARI among toddlers (OR= 8.02; p= 0.001). Cigarette smoke from parents or residents in the houses was a serious pollution material in a house and increased the risk of illness, especially respiratory problems in children. The more cigarettes that the family have, the greater the risk of URTI incidents.

The three main ingredients of cigarettes that have a negative impact on health were tar, nicotine, and carbon monoxide. Cigarette smoke increased the risk of developing respiratory tract disease in children. Cigarette smoke could stimulate the enhancement in mucus and reduce the ability of cilia so that the accumulation of thick mucus was increased and trapped by the particles or microorganisms in the airway so that it reduced air movement in the body (Ahyanti and Duarsa, 2013).

The existence of smokers in the house caused indoor air pollution and increased the incidence of URTI in children (Safarina, 2015). The exposure of cigarette smoke to children was very high in the house. Cigarette smoke from parents or residents was a serious pollution material in room and would increase the risk of illness. Continuous exposure to cigarette smoke could cause respiratory problems (Milo *et al*, 2015). The risk of sudden death in infants was 3 times higher in children who exposed to cigarette smoke from pregnant smokers (Seguel *et al*, 2016).

Families who have babies and have family members who smoke inside the house were more likely to have URTI than babies who did not have a smoker family (Basuki and Febriani, 2016). More than 4000 chemical ingredients were found in cigarette smoke and 40 of these chemicals were cancer-causing carcinogens in vapor and particle phases. Side cigarette smoke (secondhand smoke) was carcinogenic compared to the main smoke inhaled by active smokers (Nandasena *et al*, 2013).

This research was expected as a recommendation for policy holders or programs in preventing ARI in children under five at the Padang Health Office. The related program was the Prevention and Eradication Section of Communicable Diseases and the Environmental Health Section in order to increase cooperation in the prevention of URTI by maximizing the Sanitation Clinic Program as a communication place for URTI patients and health personnels. According to the Minister of Health Regulation No. 13 of 2015 concerning the Organization of Environmental Health Services in Health Center in reducing the environmental risk factors, environmental health services were carried out in the form of counseling, environmental health inspection, and environmen-

tal health interventions. This could greatly support the efforts to reduce environmental-based disease risk factors.

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