

## ASSOCIATION BETWEEN RESPIRATORY COMPLAINTS AND PM 10 CONCENTRATION IN HOUSEHOLDS IN PALEMBANG

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### ARTICLE INFO

*Article History:*

Received: July 2022

Revised: August 2022

Accepted: September 2022

Published: October 2022

**Keywords:**

Risk factors;

Respiratory disorders;

PM10 Concentration;

Household.

### ABSTRACT

**Background:** Acute Respiratory Infections (ARI) cause around 4 million under-five deaths in developing countries, including Indonesia. Air quality is strongly influenced by human activities. **Purpose:** This study was to analyze the relationship between PM10 concentrations in the house and the risk factors for the health conditions of the household environment and human characteristics on the incidence of respiratory disorders. **Methods:** This research is an analytic observational with a cross-sectional design. The number of samples calculated as many as 60 respondents were taken randomly. This research was conducted in Pulokerto Village, Gandus District, Palembang from August to December 2009. Data were collected through observation and interviews using a questionnaire, while indoor air samples were measured using the EPAM 5000 instrument by BTKL PP Palembang officers. Data were analyzed by univariate, bivariate using chi-square test, and multivariate using multiple logistic regression. **Results:** The results of statistical tests showed that the usage of insect repellent ( $p = 0.0005$ , OR = 13.095, 95% CI = 3,821-44,882), smoking habits ( $p = 0.0005$ , OR = 15.536, 95% CI = 3.114-77.519), Indoor PM10 concentration ( $p=0.021$ , OR=3.463, 95% CI (1.186 – 10.108) While the most dominant variable affecting respiratory disorders is the usage of insect repellent. **Conclusion:** The factors that have the greatest influence in causing respiratory disorders are age, gender, education, population density and the use of mosquito repellent.

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## INTRODUCTION

Air pollution is a risk factor for acute respiratory infections. There are 8 million people around the world who die every day due to air pollution, of which 4.3 million people die due to air pollution originating from the activities of householders (WHO, 2015). The effects of short-term exposure can be increase the risk of death due to cardiovascular and respiratory disorders. Based on previous studies in China, it was reported that every 10  $\mu\text{g}/\text{m}^3$  PM10 increase in the house will increase mortality due to cardiovascular disease as much as 0.36% and death due to respiratory disorders as much as 0.42%, and if exposed to PM10 for a long period, the risk of death will increase to 67% (Lu et al., 2015).

The presence of dust particles including PM10 in the household is strongly associated with the incidence of pneumonia in children under five years old (Fahimah et al., 2014). Indoor air quality is associated with the incidence of pneumonia in

infants at the Public Health Center Bandarharjo in Semarang (Sari, Budiyo, & Darundiati, 2019).

It is estimated that people spend about 90% of their time indoors such as household, schools, offices, gyms, vehicles, etc. For some people, the health risk from being exposed to air pollution indoors may be greater than those outside (Cincinelli & Martellini, 2017). Previous studies reported that exposure to PM10 can also come from weaving activities around community settlements where the average indoor dust content is PM 2.5 (0.182 mg/m<sup>3</sup>), PM 10 (0.443 mg/m<sup>3</sup>), TSP (0.556 mg/m<sup>3</sup>). , while for outdoor PM 2.5 (0.185 mg/m<sup>3</sup>) in the center of the weaving industry in Palembang City .

Therefore, this study was to analyze the relationship between PM10 concentrations in the house and the risk factors for the health conditions of the household environment and human characteristics on the incidence of respiratory disorders.

## METHODS

This research is an analytic observational with a cross-sectional design. The number of samples calculated as many as 60 respondents were taken randomly. This research was conducted in Pulokerto Village, Gandus District, Palembang from August to December 2009.

Data were collected through observation and interviews using a questionnaire, while indoor air samples were measured using the EPAM 5000 instrument by BTKL PP Palembang officers. Data were analyzed by univariate, bivariate using chi-square test, and multivariate using multiple logistic regression.

## RESULTS

The results of the univariate analysis are presented in Table below:

**Table 1**  
Distribution of Respondents by the Incidence of Respiratory Disorders, and Characteristics of Respondents (n = 60)

Variables	Frequency (n)	Percentage (%)
Respiratory Disorders		
- Yes	31	51.7
- No	29	48.3
Age		
- $\geq$ 42 years	31	51.7
- < 42 years	29	48.3
Gender		
- Male	48	80
- Female	12	20

Education Level		
- Low (elementary school, Junior High School)	27	45
- Higher (Senior High School, Diploma)	33	55
Occupation		
- No	37	61.7
- Working	23	38.3

Based Table 1, respiratory disorders were found as much as 51.7%, most of the respondents were more than 42 years old, male, and did not work.

While most of the respondents' education is of a high level.

**Table 2**

Distribution of Respondents by Occupancy Density, Smoking Habits and Activities in the Household in Pulokerto Village, Gandus Subdistrict, Palembang (n=60)

Variables	Frecuency (n)	Percentage (%)
Occupancy Density		
- ≤ 5 persons	31	51.7
- > 5 persons	29	48.3
Use of Cooking Fuel		
- LPG	37	61.7
- No	23	38.3
Use of mosquito reppelent		
- coils	32	53.3
- spray	28	46.7
Smoking habits in household		
- Yes	43	71.7
- No	17	28.3

Based on Table 2, there are 48.3% of the occupants of the house with more than five people, 61.7% of houses using elpigi fuel, 53.3% using

mosquito coils and 71.7% found smoking habits in the house.

**Table 3**

Distribution of Respondents by Physical House Condition in Pulokerto Village, Gandus Subdistrict, Palembang (n=60)

Variables	Frecuency (n)	Percentage (%)
House Wall Condition		
- Wood	31	51.7
- Brick	29	48.3
Floor Type		
- Tile	23	55
- Not Tile	27	45
Kitchen location		
- Separated	34	56.7
- Not separated	26	43.3
Ventilation		
- Qualify	29	48.3
- Not qualify	31	51.7

Based Table 3, that most of the house walls are made of wood, tile floors, kitchen space

is not separated and ventilation is not good.

Table 4. PM10 Concentration Measurement Results Based on The Location of Household Room in Pulokerto Village, Gandus District, Palembang

Measurement Location	Mean	Median	SD	Varian	Range ( $\mu\text{g}/\text{m}^3$ )
Kitchen Rooms	72.12	71.5	7.026	49.359	60-89
Middle room	66.78	64.5	5.539	30.681	60-79
Terrace	78.12	79.00	5.660	32.037	64-90
Mean of all room	72.34	71.67	5.627	31.659	62-86

Based on Table 4 that the average of PM10 Concentration Measurement Results was

more than 70  $\text{g}/\text{m}^3$ , it was found in the kitchen rooms and terrace.

Table 5 Associations between Respondents Characteristics with Respiratory Disorders (n = 60)

Variables	Respiratory Disorders				Total		OR 95%CI	<i>p</i> value
	Yes		No					
	n	%	n	%	n	%		
<b>Age Groups</b>								
1. $\geq 42$ years	12	38.7	19	61.3	31	100	0.33 (0.116-0.953)	0.038
2. $< 42$ years	19	65.5	10	34.5	29	100		
<b>Gender</b>								
1. Male	30	62.5	18	37.5	48	100	18.333 (2.181-154,100)	0.001
2. Female	1	8.3	11	91.7	12	100		
<b>Education Level</b>								
1. Low	18	66.7	9	33.3	27	100	3,077 (1.064-8.899)	0.035
2. High	13	39.4	20	60.6	33	100		
<b>Occupation</b>								
1. No	30	57,7	22	42,3	52	100	9,545 (1,094-83,294)	0,024
2. Working	1	12,5	7	87,5	8	100		

Based on Table 5 that respiratory disorders are associated with age group, gender, education level and occupation.

The age group less than 42 years, with female gender, less educated and not working experienced more respiratory problems.

Table 6 Associations between Density of Occupants, Activities in the Household, and Smoking Habits with Respiratory Disorders in Pulokerto Village, Gandus Subdistrict, Palembang (n=60)

Variables	Respiratory Disorders				Total		OR	<i>p value</i>
	Yes		No					
	n	%	n	%	n	%	95%CI	
<b>Occupancy Density</b>								
- ≤ 5 persons	19	63,3	11	36,7	30	100	2,591	0,071
- > 5 persons	12	40,0	18	60	30	100	(0,914-7,342)	
<b>Use of Cooking Fuel</b>								
- LPG	25	78,1	7	21,9	32	100	13,095	0,0005
- No	6	21,4	22	78,6	28	100	(3,821-44,882)	
<b>Use of mosquito repellent</b>								
- Coils	9	39,1	14	60,9	23	100	0,438	0,126
- spray	22	59,5	15	40,5	37	100	(0,151-1,270)	
<b>Smoking habits in household</b>								
- Yes	29	67,4	14	32,6	43	100	15,536	0,0005
- No	2	11,8	15	88,2	17	100	(3,114-77,519)	

Based on Table 6, the variables that are significantly related to respiratory disorders are the

use of the type of fuel and smoking habits in the household.

Table 7 Relationship of Respiratory Disorders with Physical Conditions of Houses in Pulokerto Village, Gandus District, Palembang

Variables	Respiratory Disorders				Total		OR	<i>p value</i>
	Yes		No					
	n	%	n	%	n	%	95%CI	
<b>Floor Type</b>								
- Tile	18	54,5	15	45,5	33	100	1,292	0,622
- Not Tile	13	48,1	14	51,9	27	100	(0,466 – 3,582)	
<b>House Wall Condition</b>								
- Wood	16	57,1	12	28	42,9	100	1,511	0,427
- Brick	15	46,9	17	32	53,1	100	(0,544-4,194)	
<b>Ventilation</b>								
- Not qualify	15	51,7	14	48,3	29	100	1,004	0,993
- Qualify	16	51,6	15	48,4	31	100	(0,365 – 2,767)	
<b>Kitchen location</b>								
- Separated	19	55,9	15	44,1	34	100	1,478	0,455
- No	12	46,2	14	53,8	26	100	(0,530 – 4,123)	

Table 8 Results of Multiple Logistic Regression Analysis of Respiratory Disorders in Pulokerto Village, Gandus District, Palembang (n=60)

Variables	B	<i>p wald</i>	OR	95% CI
Age	-1,905	0,038	0,149	0,025-0,901
Gender	4,285	0,012	72,610	2,592-2000,03
Education Level	3,093	0,014	22,047	1,854-262,131
Occupancy Density	1,722	0,064	5,596	0,902-34,702
Use of mosquito reppelent	2,747	0,003	15,601	2,590-93,988
<i>Cox &amp; Snell R Square</i>	50,7			
<i>Nagelkerke R Square</i>	67,6			

Based on Table 8 showed that the variables that have a dominant influence in determining risk factors for respiratory disorders from 14 variables are age, gender, education level, occupancy density, and use of mosquito repellent, after controlling for other variables. The results of statistical tests showed the value of OR = 72.610 for the gender variable, it means that the male sex is 72.610 times riskier than the female. Education

variable OR = 22,047, it means that low education is 22,047 times riskier than higher education. The variable density of occupants OR = 5.596, it means that houses with dense occupants are 5.596 times riskier than those with non-density. While the variable density of occupants OR = 15,601, it means that use mosquito repellent are 15,601 times riskier than those that do not use mosquito repellent.

## DISCUSSION

This study provides an overview of the condition of air quality in the house in Pulokerto Village, Gandus District, Palembang by looking at the characteristics of the respondents, the activities of the occupants of the house, the physical condition of the house and its relationship with respiratory disorders experienced by the residents of the house. The measured air quality, namely the concentration of PM10 in three locations in the house consisting of the kitchen room, middle room and terrace. The results showed that the risk factors that affect respiratory disorders are the characteristics of the respondents, the use of mosquito coils, and smoking habits.

According to the results of the study which stated that smoking activities carried out at home could contribute to an increase in the concentration of particulate matter (PM) and affect the incidence of asthma in children (Breysse et al., 2010; Kumar et al., 2015). In addition, reported that residents who smoke indoors have higher pollutant particles compared to residents who do not smoke in the household (Klepeis et al., 2017). Burning one cigarette will contribute 7.23 mg of PM2.5 to the air (Rodgman & Perfetti, 2008), and parental smoking habits in the household affect respiratory disorders (Rachmadi Purwana, 2007).

Burning mosquito repellent used inside the household can also increase ARI in toddlers as much as 2.1 times and can worsen the condition of toddlers who suffer pneumonia compared to toddlers pneumonia patients living with don't use mosquito coils on fire in his house (Lindawaty, 2010).

Concentration of dust particles in the house including PM10 can cause ARI in the occupants density of the household (Rahim & Camin, 2018). PM10 was a predictor of home ventilation efficiency and affects the health effects of the occupants of the house, namely respiratory disorders (Rachmadhi Purwana, 2005).

The limitations of this study, the number of respondents, and several variables need to be added, including room area, ventilation area, number of ventilation, and other physical conditions as well as activities carried out by residents of the household, namely the frequency of cleaning the house, the use of house cleaning materials and other activities. Besides outdoor activity factors such as environmental conditions in the household area because activities outside the household can affect the air inside the house.

## CONCLUSION

The average of PM10 concentration in household was more than 70 g/m<sup>3</sup> in the kitchen and terrace. Several variables were found to cause respiratory problems, namely age, gender, education level, occupation, use of insect repellent and smoking habits in the household. The most dominant variables in determining the incidence of respiratory disorders are age, gender, education level, and the use of mosquito coils.

It is necessary to monitor indoor air quality periodically by the health center.

## ACKNOWLEDGMENTS

The author would like to thank all parties who have been involved in conducting the research.

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