

## The Effect of Environmental Factor and Use of Personal Protective Equipment on The Symptoms of Acute Respiratory Tract Infections in Furniture Industry Workers

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### Abstract

Dust is one type of potential hazards in the workplace that can affect the health of the workers. The occupation that are always exposed to dust is furniture industry workers so that they have higher risk of getting acute respiratory tract infection (ARI) disorder which can interfere with breathing. The wood dust is formed from some of the sawn wood and sanding that will lead to an acute respiratory tract infection. The study aimed to determine the effect of environmental factor and the use of Personal Protective Equipment (PPE) against the symptoms of acute respiratory infections in the furniture industry workers. The research method used was quantitative method with observational and cross-sectional research types and it was analysed by using logistic regression test. The population in this study was the workers of the furniture industry at Semarang street, Surabaya City, with a total of 57 people, of which 37 furniture workers as a sample. The results show that most of the workers has symptoms of acute respiratory tract infection. It could be influenced by the environmental factor such as dust exposure that produced wood dust in each manufacturing processes. Additionally, the use of PPE also affected the occurrence of acute respiratory tract infections symptoms in the workers. In conclusion, many factors can influence the occurrence of acute respiratory tract infection symptoms in the furniture industry workers. Therefore, it is necessary to minimize the dust exposure in workers by wearing PPE such as respirators.

### Keywords

Environmental factor, personal protective equipment, dust, acute respiratory tract infection symptoms

## INTRODUCTION

Occupational illness is any disease contracted primarily as a result of an exposure to risk factors arising from work activity, such as illnesses and medical

conditions can be caused by unsafe actions and conditions. One of the unsafe conditions in the environment is the presence of dust hazards in the workplace. The majority of work-related death based on the International

Labor Organization (ILO) data is cancer (34%), followed by occupational accidents (25%), respiratory diseases (21%), cardiovascular disease (15%), and others (5%) (1). Meanwhile, an acute respiratory tract infection (ARI) is a major health problem in Indonesia, with the prevalence of such disease is as much as 25.5%, where 16 provinces of which have a prevalence above the national rate. Acute respiratory tract infections rank first out of the 10 most diseases suffered by people in Indonesia. The results of RISKESDAS of Indonesia (Basic Health Research) in 2013 showed that the prevalence of Acute respiratory tract infections was 24%. In addition, pneumonia also becomes the health problem in Indonesia which is as much as 2.1%.

Acute respiratory tract infections (ARI) are acute inflammatory events in the acute or lower respiratory tract caused by microbial or bacterial, viral, or ricketts infections, without or accompanied by inflammation of the lung parenchyma (2). The factors that affect a person's risk of Acute respiratory tract infections exposure are environmental factors, individual characteristics and employee behavior. One of the environmental factors is air pollution in the workplace while the individual factors include age, gender and education level which can affect the risk of susceptibility to Acute respiratory tract infections. Meanwhile, the

worker behavior includes the use of personal protective equipment (3).

Dust is a solid chemical, caused by natural or mechanical forces such as processing, pulverizing, softening, fast packing, blasting from objects, both organic and inorganic, which have a diameter between 0.1  $\mu\text{m}$  to 500  $\mu\text{m}$  (4). There are several types of dust namely coal dust, cement, cotton, asbestos, wood dust, dust during the rice milling process or organic dust and others. Exposure to dust in the workplace can cause acute or chronic respiratory distress in the workers. Various factors affect the onset of such disease. Those factors include dust particles size and shape, dust concentration, dust chemical properties and duration of dust exposure. Individual factors also affect the onset of the disease such as lung defense mechanisms, anatomy and physiology of the respiratory tract (5).

The wood furniture industry is one of the industries that has a very rapid development. The physical process of the raw materials of the furniture manufacture tends to produce pollution such as wood dust particles. Approximately, 10 to 13% of the sawn wood and sanding will produce wood dust. This wood dust can generate particle pollution in the air and environment. In addition, the wood furniture industry workers can be exposed to dust (6). Dust level that exceed the threshold and limit value for key air pollutants can cause health problems such as respiratory

problems which can later become acute respiratory infections. High concentration of pollutants in the environment can damage the lung defense mechanism. However, dust exposure can be a cause of ARI even though the level of wood dust is below the Not Available (NAV) (7).

Therefore, this study was analyzed the influence of environmental factor which in this case is the wood dust and the use of personal protective equipment against the symptoms of acute respiratory tract infections in the furniture industry workers in Semarang street, Surabaya city, Indonesia.

## MATERIALS AND METHODS

This research method was a quantitative research using observational research types and cross-sectional approach. This research was carried out in Semarang street, Surabaya City, East Java. The population in this study were the workers in the furniture industry in

Semarang street, Surabaya City, Indonesia, with a total of 57 people, of which 37 furniture workers were as the sample. The sampling technique in this study was done by simple random sampling technique.

The variables in this study consisted of independent variables and dependent variable. The independent variables were environmental factor (dust) and the use of personal protective equipment. Meanwhile, the dependent variable was acute respiratory tract infections. Data collection techniques was done by using interview and observation with a questionnaire. Data were calculated by logistic regression analysis.

## RESULTS

### Distribution of Acute Respiratory Tract Infection Symptoms

Based on the results regarding the distribution of workers who experienced ARI symptoms are shown in Table 1.

**Table 1.** Distribution of Acute Respiratory Tract Infection Symptoms in Personal Characteristics of The Respondents

Variable	Description	Number of participants	%
Acute respiratory tract infection symptoms	No	13	35
	Yes	24	65
	Total	37	100

Table 1 shows that the number of workers who experienced symptoms of acute respiratory tract infections was as many as 24 people out of 37 respondents (65%). Based on the data above, it can be concluded that the

majority of workers in the Semarang Road Furniture Industry has symptoms of acute respiratory tract infections.

### Analysis of Environmental Factors on Symptoms of Acute Respiratory Infection

The analysis of environmental factors (wood dust) that affects the symptoms of

acute respiratory tract infections in the respondents using bivariate logistic regression tests is presented in Tabel 2.

**Table 2.** Environmental Factor Analysis of Symptoms of Acute Respiratory Tract Infections

Variable	B	Wald	Df	Sig	Exp(B) CI 95%	Cox & Snell R Square
<b>Environmental Factor (Dust Exposure)</b>	1.805	5.640	1	0.018	6.080	0.152

\*Logistic regression analysis

Table 2 elaborates the results of an analysis of environmental factors (wood or environmental dust) with criteria above the threshold value and below the threshold value. These results indicated that dust above the threshold value has a significant effect on symptoms of acute respiratory tract infections with p-value  $0.018 < 0.05$ . The level of risk of dust on the occurrence of acute respiratory tract infections symptoms in the furniture workers based on the value of exp (B) is 6.080. It can be interpreted that the workers exposed to dust above the threshold

value have 6 times more risk of experiencing acute respiratory tract infections symptoms compared to the workers who were exposed to dust below the threshold value.

### Analysis of The Use of Personal Protective Equipment Against Acute Respiratory Tract Infections Symptoms

The results of the analysis on the effect of the use of personal protective equipment against symptoms of acute respiratory tract infections in respondents by using a bivariate logistic regression test showed in Table 3.

**Table 3.** Results of Analysis of PPE on Symptoms of Acute Respiratory Tract Infections

Variable	B	Wald	Df	Sig	Exp(B) CI 95%	Cox & Snell R Square
<b>PPE (Mask)</b>	1.569	4.496	1	0.034	4.800	0.121

\*Logistic regression analysis

Based on the results of the logistic regression test in Table 3, the use of mask has a significant effect on the symptoms of acute respiratory tract infections p-value  $0.034 <$

$0.05$ . These results also show level of risk of the use of personal protective equipment against the occurrence of acute respiratory tract infections symptoms in the furniture

workers based on an exp (B) value of 4.800. This can be interpreted that the workers who worked without using personal protective equipment have a 4.8 times higher risk of experiencing acute respiratory tract infections symptoms compared to those who use personal protective equipment.

## DISCUSSION

### Symptoms of Acute Respiratory Infection

ARI is an acute inflammation of the above and below respiratory tract due to microbial or bacterial, viral, and rickets infection, without or accompanied by inflammation of the lung parenchyma (2). ARI (acute or lower respiratory tract disease), according to WHO, can usually be contagious which can then cause a variety of diseases, from asymptomatic or mild infections to severe deadly diseases (8). ARI is an infectious disease that attacks one part and or more of the airways, starting from the nose (acute channel) to the alveoli (lower channel) including related tissues, such as sinus, middle ear cavity and pleura (9).

There are several factors that can influence a person's risk of getting ARI, such as environmental factors, individual characteristics and employee behavior. Environmental factors include air pollution that can be generated from industrial product, dust, cigarette smoke, and others. Meanwhile, individual factors affecting ARI are age, sex and education level. Lastly, the

worker behaviors such as smoking and the use of masks or other personal protective equipments also influence the risk of getting ARI (3).

Exposure to dust can cause either acute or chronic respiratory health problems. Dust particles that can cause acute respiratory problems are industrial products that can pollute the air such as wood dust, coal, cement, asbestos, chemicals, and the others. There are several factors that influence the emergence of diseases or disorders of the respiratory tract due to dust. These factors are dust particles, dust shape, concentration of dust, dust solubility and dust chemical properties as well as duration of dust exposure. Whereas, the individual factors include defense mechanisms or lung strength, anatomy and physiology of the respiratory tract (5).

Based on the results of this research, the number of workers who experienced symptoms of acute respiratory tract infections was 24 out of 37 correspondent. It represents 65% of the workers. It can be concluded that the majority of workers have symptoms of ARI. Acute respiratory infections have several symptoms, for example cough, flu, nasal congestion, sore throat, shortness of breath, fever, headache to muscle aches. However, many symptoms of acute respiratory tract infections were not examined properly. Many cases of ARI can cause complications, access to timely health

services will reduce the risk of disease severity and even death. Therefore, the need for supervision of symptoms of acute respiratory tract infections in workers.

### **Effect of Environmental Factors on Symptoms of Acute Respiratory Tract Infection**

The result of this research indicated that dust exposure above the threshold limit value has a significant effect on symptoms of acute respiratory tract infections  $p$ -value  $<0.05$ . The risk level of dust on the occurrence of symptoms of acute respiratory tract infections in the furniture workers based on the value of exp (B) was 6.080. It can be interpreted that the workers who was exposed to dust above the threshold limit value have 6 times more risk of experiencing symptoms of acute respiratory tract infections compare to those who were exposed to dust below the threshold limit value.

Dust is one material that is often referred to as particles floating in the air with a size of 1-500  $\mu\text{m}$ . Dust is often used as an indicator of pollution both inside and outside the building. It is also used to indicate the level of danger to the environment and to the occupational health and safety. High dust concentrations can be related to ARI events. PM10 (Particulate Matter Below 10  $\mu\text{m}$ ) or dust is found in the furniture manufacturing process or it can also be found in household fuel use. PM10 particles consist of complex

particles of 0.1-10  $\mu\text{m}$ , covering all sizes of viruses (0.1-1  $\mu\text{m}$ ) and bacteria (0.5-5  $\mu\text{m}$ ). The pathogen is free and it can move in the air (10). Recent findings suggest that short-term dust exposure is associated with health effects even in low concentrations  $\leq 100 \mu\text{g}/\text{m}^3$ . In this study, it was found that an average PM10 concentration of 70.60  $\mu\text{g}/\text{m}^3$  resulted in ARI in the furniture industry workers. PM10 is a pollutant oxidant that can be inhaled by the respiratory tract. Oxidants are electrophilic chemicals that can move the electrons from various molecules which will lead to oxidation from these molecules. Oxidants can damage body cells through lung parenchyma cells, both alveolar cells and its matrix (11).

The threshold limit value for dust is a criterion in the workplace as a preventive guideline in order that the workers are still able to work without causing adverse health effect for no more than 8 hours a day or 40 hours a week (Minister of Manpower and Transmigration Regulation, 2011). The threshold limit value for dust as stated in Minister of Manpower and Transmigration Regulation (No. PER.13/MEN/X/2011 about the Threshold Limit Values of Physical and Chemical Substances in the Workplace Air) must not exceed 3.0  $\text{mg}/\text{m}^3$ . If the workplace contains dust exceeding the threshold limit value, it is very risky to cause health problems, one of which is an ARI.



## **Effect of Use of Personal Protective Equipment on Symptoms of Acute Respiratory Tract Infections**

The results of the analysis in this study showed that the use of personal protective equipment (masks) has a significant effect on symptoms of acute respiratory tract infections. These results can be known from the significance value or p-value  $0.034 < 0.05$ . The risk level of the use of personal protective equipment against the occurrence of acute respiratory tract infections symptoms in the furniture workers based on an exp (B) value was 4.800. It can be interpreted that the workers who were not wearing protective mask have 4.8 times higher risk of experiencing acute respiratory tract infections symptoms compared to those who did.

The results of this study are in line with the previous research (12) about PM10 on ARI in the Furniture Industry Workers. It was elaborated that there was a significant relationship between the use of personal protective (masks) on the occurrence of ARI (p-value 0.001; CI (95%) 2.39 – 148.010) of the 43 furniture workers who have ARI, almost all workers do not use PPE, such as masks or other nose caps. The results of this research are also consistent with another study. Rizki (14) analyzed the risk factors of ARI events on the workers in the Block Rubber production section of PT. Sri Trang, Indonesia. It is stated that there was a

significant relationship between the use of PPE (masks) and the incidence of ARI in those workers with a p-value of 0.010 CI (95%) 1.375-4.253 (13).

Personal protective equipments can prevent harmful particles such as gas, steam, and dust that can enter the respiratory system. Therefore, masks or respirators can be used as personal protective equipments to prevent the workers from inhaling dangerous particulates.

## **CONCLUSIONS**

Based on the results of the study, the furniture industry workers have a risk of experiencing acute respiratory tract infections symptoms. The workers who were exposed to dust above the threshold limit value have 6 times more risk of experiencing acute respiratory tract infections symptoms compared to those who were exposed to dust below the threshold limit value. In addition, the workers who were not using personal protective equipment (mask) have 4.8 times more risk of experiencing acute respiratory tract infections symptoms compared to those who used personal protective equipment while working.

The management of the furniture industry at Semarang street, Surabaya, should technically improve a routine supervision of the dust exposure control and their employee' working performance, especially the use of personal protective equipments. The workers

must obey the rule of using masks to protect themselves from ARI. Moreover, the employee's health status should be checked regularly. Lastly, a healthy lifestyle

recommendation should also be implemented by the workers.

## CONFLICT OF INTEREST

There are no conflicts of interest.

## REFERENCES

1. AP H. The relationship between work period and the use of personal protective equipment with vital lung capacity in the spinning unit workers 1 part of the ring frame Pisma Putra Pekalongan Textile. *Unnes J Public Heal.* 2013;2(3):1-9.
2. Trisnawati YT, Juwarni. The relationship of smoking behavior of parents with ARI in toddlers in the working area of the Rembang health center in Purbalingga district. *Scientific Journal of Public Health.* 2013;6(1):35-42.
3. Sormin KR. The relationship between the characteristics and behavior of workers exposed to cotton dust and ARI events at PT. Unitex. Depok; 2012.
4. Rohilla A, Sharma V, Kumar S, Sonu. Upper Respiratory Tract Infections: An Overview. *Int J Curr Pharm Res.* 2013;5(3):1-3.
5. Cahyana A, Djajakusli R, RM. Factors associated with the occurrence of lung function disorders in coal miners PT. Indominco Mandiri East Kalimantan in 2012. Makassar; 2012.
6. Halim F. The Relationship between Physical Work Environment Factors and the Occurrence of Acute Respiratory Infection in Tukrejo Hamlet Furniture Industry Workers, Bondo Village, Bangsri District, Jepara Regency, Central Java Province in 2012. Jakarta; 2012.
7. Ministry of Health Republic of Indonesia. Guidelines for Control of Acute Respiratory Infection. 2012.
8. WHO. The WHO Air Quality Guideline. 2010.
9. Aditama T. Guidelines for controlling acute respiratory infections. Bandung: CV Dipenogoro; 2012.
10. Wijayanto A. PM10 Exposure and ARI Symptoms in Batako Manufacturing Plant Workers in Banyuasin District. Jakarta; 2008.
11. Osman E, Pala K. Occupational Exposure to Wood Dust and Health Effects on the Respiratory System in A Minor Industrial Estate in Bursa/ Turkey. *Int J Occup Med Environ Heal.* 2009;22(1):43-50.
12. Yusnabeti, Wulandari AW, Luciana R. PM10 and Acute Respiratory Infection in Furniture Industry Workers. *Makara Journal of Health Reseach.* 2010;4(1):25-30.
13. Sudarmaji, Anindya M. Relationship between Characteristics of Workers and Total Dust Levels with Respiratory Complaints in Wood X Industry Workers in Lumajang Regency. *Journal of Environmental Health Perspective.* 2015;1:1-12.
14. Rizki SR. Analyzed The Risk Factors of ARI Events on The Workers in The Block Rubber Production Section of PT. Sri Trang, Indonesia. Universitas Sriwijaya. 2014.