

Association between Dust Exposure and Pulmonary Dysfunction in Indonesian Wood Workers: A Literature Review

Salma Salsabilla¹, Sulistiyan Sulistiyan¹, Mursid Raharjo¹

¹Environmental Health Departement, Public Health Faculty, Diponegoro University, Indonesia

Abstract: Occupational pulmonary disease is a pulmonary disease caused by dust, vapors or hazardous gas which workers are inhaled at work. Dust has adverse effect to health because it can enter human respiratory system. The aim of this study was to analyse the association between dust exposure and pulmonary dysfunctions in wood workers. This study was a literature review with a simplified approached, to analyse data in a simple manner which aims to collect and summarise research data which has been done before. The literature searches were undertaken through online database such as NCBI, Google Scholar, Portal Garuda, and Science Direct. Out of 162 articles which could be found only 8 articles could be reviewed. The result of this study, 3 articles (37,5 %) showed there was an association between inhalable dust and pulmonary dysfunction, with the mean of p value= 0,029 and the mean of level dust was 1,76 mg/m³. 3 articles (37.5%) showed there was an association between total dust in working place and pulmonary dysfunction, with the mean of p value = 0,034 and the mean of total dust level was 6,72 mg/m³. The percentage range of pulmonary dysfunction was 56.67% - 85,7%

Keywords: Pulmonary dysfunction, dust, wood workers, occupational disease

1. Introduction

Working place condition will affect to worker's health,. Dust in working place will affect to productivity and health of workers. They are at risk for suffering illness, such as infectious and non-infectious disease.⁽¹⁾⁽²⁾Dust that is inhaled by workers will trigger pulmonary dysfunction. That abnormality occur due to damage to lung tissue, this will affect to productivity and work quality of workers. Lung disease causes by dust, also known as an occupational lung disease, occurs due to workers or work environment factors, and also known as man-made disease, it because of human activity. Dust in working place will make inconvenience in workers, vision impairment, pulmonary dysfunction moreover poisoned.⁽³⁾⁽⁴⁾

Pulmonary dysfunction is classified into obstructive, restrictive and mixed. Obstructive is the decline in the ability to expiration, due to narrowing of the respiratory tracts. Asthma, bronchitis and emphysema are the types of obstructive. While restrictive, is the decline in the ability to inspiration. Restrictive can be lung parenchymal disorder such as lung tumor, pneumonia, lung abscess, lung edema, atelectasis, lung fibrosis the abnormality in pleura such as pleura effusion, tumor pleura pneumothorax, and pleuritis sicca/ schawarte. the abnormality in the sternum such as rib fracture, pectus excavatum. Pulmonary dysfunction mixed is the combination of restrictive and obstructive, hence FEV1 and FVC decline.⁽⁵⁾⁽⁶⁾Lung function declining in workers who exposed to dust frequently can caused by some factors, such as the use of personal protective equipment, smoking habit, working duration, age, sex type, exercise habit, body mass index and respiratory disease..⁽⁷⁾⁽⁸⁾

According to International Labour Organization (ILO), an abnormality that occur due to the accumulation of dust in lung can cause pneumoconiosis, its symptoms are cough with phlegm, fatigue, breathless with wheezing. ILO showed that there were 2,3 million people died every year in the world due to occupational activity, both due to occupational disease and occupational accident. The major cases were caused by occupational disease, 2,02 million people died. According to Dr. Francisco Santos O'connor, an occupational safety and health specialist from ILO office in Bangkok, the number of death in the world was increasing significantly, around 2,8 million people died due to exposed to toxic substances in working place.⁽⁶⁾⁽⁹⁾According to WHO annual report which title is State of Global Air 2017, more than 90% world population who lived in area with bad air condition was primary factor to suffer disease even more death. Premature death due to pollution was direct impact of cardiovascular disease, respiratory disease and lung cancer.¹⁰

The wood manufacture is one of the industries that is growing very rapidly, this is related to the consumption of forest products which reaches 33 million m³ per year. The industry produces wood dust which is generated during the processing process. From processed wood, around 10-13% will produce dust particles that fly in the air and pollute the surrounding environment.¹¹

According to WHO, estimated 2 million people in the world regularly exposed to wood dust when worked. The highest exposure was reported from furniture industry and manufacture, particularly in sanding machine. The adverse effects to body that often reported were dermatitis, skin rash and respiratory disorder.¹² Wood dust exposure will worsen pulmonary function, increase prevalence of respiratory disease, cancer and

death, besides that wood contains microorganism (fungi), poison and chemical, hence wood dust effect to human health.¹³

According to Ronsumbre (2010) in furniture industry in Jayapura City, showed there was an association between inhalable dust and pulmonary dysfunction. The measurement of lung vital capacity in workers showed out of 30 workers, 16 (53,3%) workers suffered from pulmonary dysfunction.¹⁴

2. Method

This study was a literature review with a simplified approach, to analyse data in a simple manner which aims to collect and summarise research data which has been done before. The literature searches were undertaken through online database. The inclusion criteria were articles which have same topic with this study, the articles were the last 10 years (2010 – 2020), articles have been registered on online database, such as GoogleScholar, NCBI, Science Direct, and Portal Garuda, accessible, articles were in Indonesian or English, and the exclusion criteria, articles were not full text. Out of 162 articles which could be found only 8 articles could be reviewed.

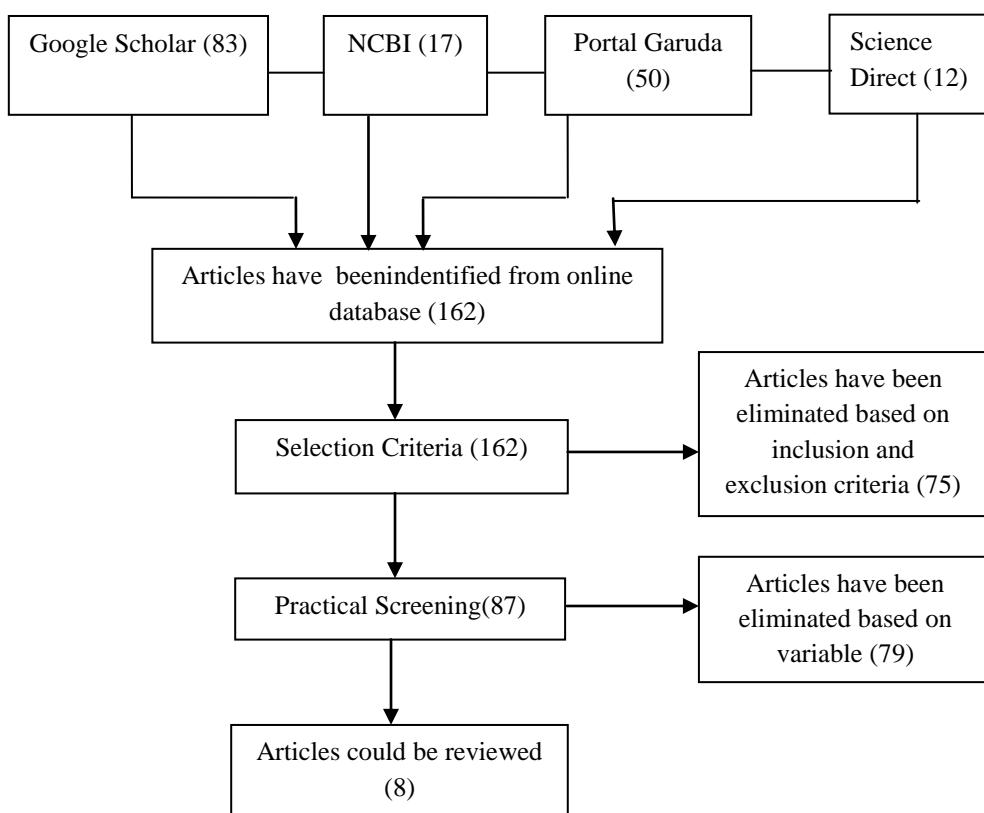


Figure 1: Flow Chart for Article Search

3. Result and Discussion

Tabel 1. Showed there were 2 variables in this study, inhalable dust level and total dust level in working place.. 3 articles (37,5 %) showed there was an association between inhalable dust and pulmonary dysfunction, with the lowest of p value= 0,023 and the lowest of level dust was 0,222 mg/m³. 3 articles (37,5%) showed there was an association between total dust level in working place and pulmonary dysfunction, with the lowest of p value= 0,019 and the lowest of total dust level was 0,123 mg/m³

Tabel 1. The Association Between DustExposure And Pulmonary Dysfunction

Variable	Association with Pulmonary dysfunction		Range of p value	Range of Dust Level (mg/m ³)
	Yes	No		
Inhalable Dust	3 (37,5%)	1 (12,5%)	0,023 - 0,629	0,222 – 15,56
Total Dust	3 (37,5%)	1 (12,5%)	0,019 – 0,46	0,123 – 9,78

Tabel 2. Showed the highest pulmonary function percentage was 85,7% and the highest of normal was 43,33%

Tabel 2. Percentage of Pulmonary Dysfunction Indication

Indication	Percentage range
Pulmonary Dysfunction	56,67% - 85,7 %
Normal	14,3 % - 43,33%

Dust is one of the substances that can cause air pollution and have an impact on human health, especially in respiration. The higher the level of dust that is inhaled, the higher the risk for pulmonary dysfunction. Wood dust can be inhaled deposited in the nose, esophagus, or lungs, depending on the size of the dust. Accumulation of dust in the lungs occurs when dust is inhaled 1-3 μ which is called inhalable dust. Inhalable dust represents dust by size the most dangerous because it will stick and bury in the terminal bronchioles and alveoli, while for dust that is 0,1-1 μ will move in and out of the alveoli according to Brownian Motion. Every inhalation 500 particles per cubic millimeter in the air, then 10% of the amount will accumulate in the lungs. Concentrations that exceed 5,000 particles per cubic millimeter often associated with events pneumoconiosis. Inhalable dust is dust or particles that are small enough that can enter the upper respiratory system and enter the inner lungs. Particles that enter the inner lung can not be removed by the body's natural mechanism (cilia and mucus) so as a result these particles will stay forever in the lungs. The presence of dust deposits measuring 1-3 microns in the alveoli cause changes in the permanent structure of the alveoli and the formation of permanent scar tissue. The formation of scar tissue reduces the elasticity of the lung to expand and contract.⁽¹⁾⁽¹⁵⁾

The association between dust exposure and pulmonary function capacity is dust exposure that is inhaled into the respiratory tract will cause nonspecific defense mechanism reactions, namely sneezing, coughing, and others. Then the inhaled dust particles will form a locus and gather at the lung lymph channels. Therefore, if a worker is exposed to dust for a long time, it will cause occupational disease in the form of impaired pulmonary function capacity.¹⁶ Workers who are exposed to dust are at risk for suffering health problems, both infectious and non-infectious (cancer). In addition, the health effects of dust exposure that are frequently reported are dermatitis, impaired pulmonary function, and several types of cancers of the respiratory tract.¹⁷ this is in the line with 3 articles that showed there was an association between inhalable dust level and pulmonary dysfunction, with the mean of p value= 0,029 and the mean of level dust was 1,76 mg/m³

Working place always contains various potential hazards that possible to cause occupational diseases. One of the chemical factors in the working place is dust. Dust level in the air is affected by many factors including temperature and humidity. High temperatures accelerate pollution levels' changes in the air. Whereas, low temperatures affect the comfort in working. Humidity is related to the amount of water vapor in the air. The higher the water vapor in the air, the higher the humidity therefore the density of pollutants will increase. Low humidity can affect the occurrence of disorders such as irritation of mucous membranes, dry eyes and sinuses.¹

Accumulation of dust in the lungs occurs when dust is inhaled 1-3 μ in size which is called inhalable dust. The presence of dust deposits measuring 1-3 microns in the alveoli cause changes in the permanent structure of the alveoli and the formation of permanent scar tissue. Dust decreases the vital lung capacity, the respiratory tract leads to non-specific defense, mechanisms such as coughing, sneezing, mucociliary transport

disorders (the mechanism in the nose to clean the nasal passages by transporting odd particles trapped in the mucous palate towards the nasopharynx or back cavity of nose) and macrophage phagocytosis (a method of removal bacteria or odd objects by white blood cells and are important activities in the immune system). The mucociliary system is disrupting and increasing mucus production as well and stimulate the fine muscles around the breath apparatus thus causing constipation. If more mucus is accompanied by imperfect mechanisms, then there will be respiratory tract resistance such as respiratory tract, obstruction.¹ this is in the line with 3 articles that showed there was an association between total dust level in working place with pulmonary dysfunction, with the mean of p value= 0,034 and the mean of total dust level was 6,72 mg/m³

4. Conclusion

Based on articles that have reviewed, 3 articles (37,5 %) showed there was an association between inhalable dust and pulmonary dysfunction, with the mean of p value= 0,029 and the mean of level dust was 1,76 mg/m³. 3 articles (37,5%) showed there was an association between total dust level in working place and pulmonary dysfunction, with the mean of p value= 0,034 and the mean of total dust level was 6,72 mg/m³. The percentage range of pulmonary dysfunction was 56,67% - 85,7 %

5. Suggestion

Personal protective equipment such as a mask is needed, it can reduce dust entering respiratory tract, hence can prevent pulmonary dysfunction in workers.

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