

Conference Paper

The Relationship Between Exposure to Coal Dust Levels and Acute Respiratory Infection: A Literature Review

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Abstract.

Coal is a resource that humans use as fuel, including for steam power plant activities. In the process of generating electricity, coal must go through a combustion process which in the end leaves dust from burning the coal. This combustion residue contains compounds that can cause respiratory problems, one of which is acute respiratory infection (ARI). This study aimed to determine the relationship between exposure to coal dust levels and the incidence of ARI, and to identify the associations between the duration of exposure and dust concentration in coal combustion residues with the incidence of ARI. This was a literature review, with a sample of 11 journal articles obtained from Pubmed (n = 2), Proquest (n = 3), Science Direct (n = 1), EBSCO (n = 3), and Neliti (n = 1). The keywords used to search for the relevant articles were: "Acute Respiratory Infection" OR "Pneumococosis" OR "Pneumonia" AND "Coal Dust" OR "Dust" OR "PM₁₀" OR "PM_{2,5}". Thematic analysis was used to examine the results. 81.8% of the results from the articles showed that there was a relationship between exposure to coal dust levels and the incidence of ARI, while the remaining 18.2% showed no correlation. Exposure duration, dust particle size, threshold value and dust-forming compounds have a relationship with the incidence of ARI and other respiratory disorders.

Keywords: acute respiratory infection, ARI, coal dust

1. INTRODUCTION

Coal is a type of natural resource that humans have begun to use as an alternative fuel. This can be indicated by the limited availability of fuel oil and gas, while industrial activities that use fuel starting from large, medium and small scales have begun to develop. Indonesia is one of the coal producing countries. Coal resources in Indonesia are estimated at 36 billion tons, which are spread over several islands and regions in Indonesia [1].

The need for electricity makes Indonesia one of the countries that depend on coal power plant activities which indirectly increase the coal burning process every day. Combustion of coal in PLTU activities will produce residual ash which is divided

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into 20% of bottom ash which collects at the bottom of the furnace, and 80% of fly ash which will come out through the chimney of the power plant. If 80% of fly ash freely without going through a filtering process will have a bad impact on the earth's atmosphere which can lead to acid rain. The next impact occurs in the air around the PLTU area becomes contaminated which has a negative impact on life, especially for the surrounding community who are at high risk of experiencing Acute Respiratory Infection (ARI) [1].

The prevalence of ARI incidence according to the Ministry of Health of the Republic of Indonesia in 2016 showed a figure of 533,187 cases found with a percentage of 28% with 18 provinces having a prevalence that was above the national figure. Indonesia is one of the countries with a great potential for the spread of infectious diseases and one of them is Acute Respiratory Infection. Acute Respiratory Infections Diseases Also commonly found in coal workers [2] [3] [4]. According to [5] The incidence of ARI in coal workers is often found with dry cough (23.73%), cough with phlegm (25.42%), shortness of breath (13.56%), work-related asthma (11.86%), dust allergy (5.08%), chest complaints (10%) and no complaints (10.18%), and the most common respiratory problems suffered by workers were dry cough and phlegm.

Based on the above background, the researchers are interested in conducting a "Literature Study on Correlation between exposure to dust levels in coal-fired power plants and the incidence of acute respiratory infections" with the aim of this literature study to obtain a theoretical basis that can support solving the problem being researched and reveal various theories that are relevant to the case, and hope that it can be used for health purposes.

2. METHODS

2.1. Study design

The research design used in this study is a literature review. This study aimed to identify the independent variable of the effect of exposure to coal power plant dust levels on the incidence of acute respiratory infections (ARI). Based on the topic, the inclusion criteria are set as follows: international and national journals related to exposure to coal dust levels with the incidence of ARI, full text journal, international and national journals published in 2011-2020, English-language international journal, and Indonesian language national journal.

2.2. Data collection process

In Literature review research, there are stages that must be carried out so that the results of the literature study can be recognized for credibility. In this literature study, researchers identify problems through a literature study in the form of international and national research journals as the material to be studied. The problem raised by the researchers in this study was the analysis of the relationship between exposure to coal dust levels and the incidence of ARI.

The stages are described as follows:

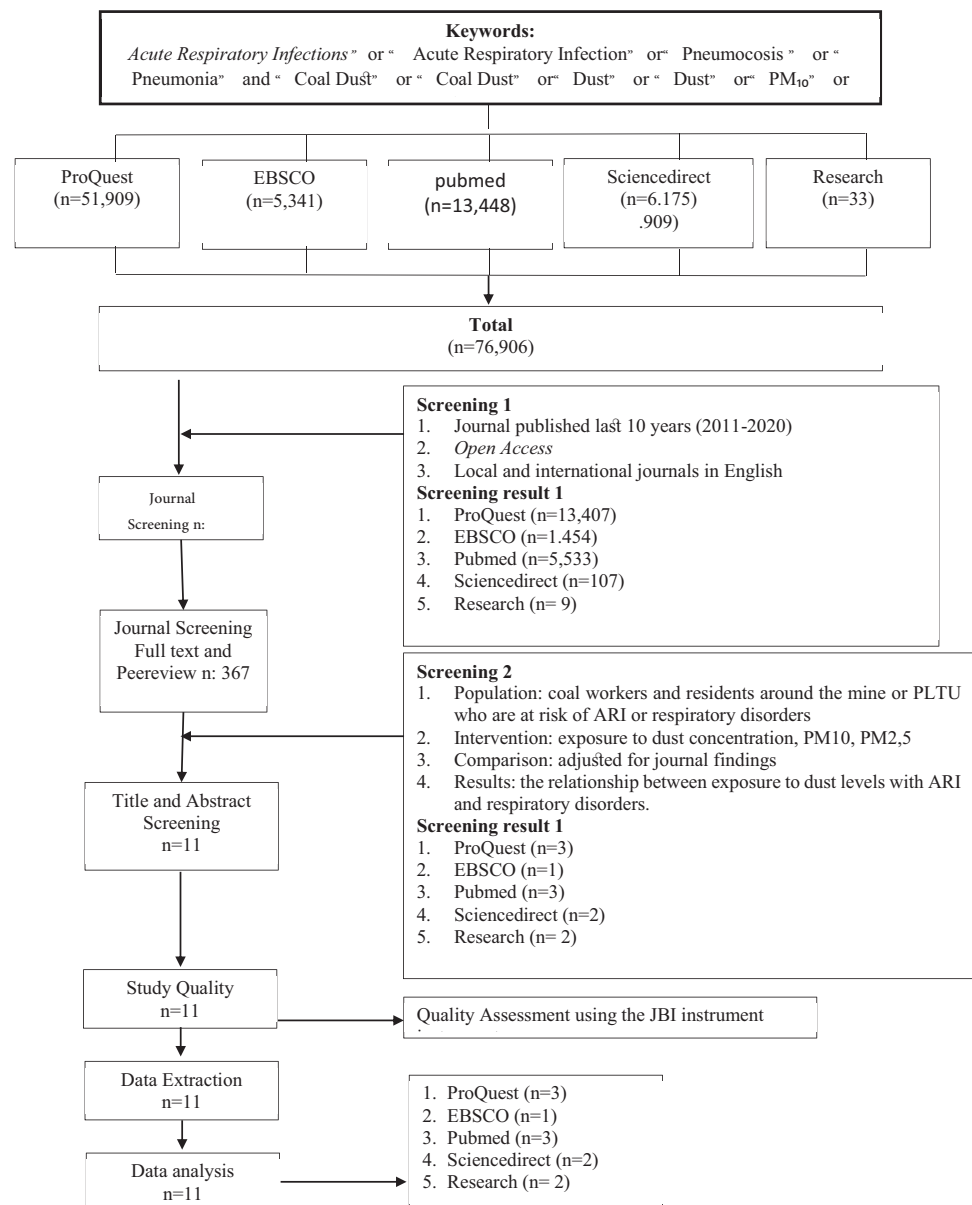


Figure 1: Flowchart of data collection.

Journal quality research is carried out by assessing journals from various relevant database sources using The Joanna Briggs Institute (JBI) Critical Appraisal Checklist. JBI is used to analyze and assess the quality of the methodology in the journals that have been obtained. There is a minimum score from the journal quality assessment if it reaches at least 50% based on the critical appraisal criteria[6]. After the quality assessment has been carried out, The 11 journals findings are worthy of being used as literature studies in this study.

3. RESULTS

3.1. Exposure risk

TABLE 1: Exposure Risk.

Journal Number	Average exposure
Journal 3	> 20 years
Journal 5	> 5 years
Journal 7	> 10 years
Journal 8	> 15 years
Journal 9	> 20 years
Journal 10	> 18 years old
Journal 11	> 23 years old

Based on the results of the analysis of 11 journals, the average exposure in each journal is different. From these results, it can be seen that the average exposure to dust in the respondents studied was more than 20 years with the lowest exposure being 5 years. The results can be concluded that workers have a high risk of respiratory disorders with a long exposure period.

3.2. Dust Concentration

Regarding the relationship between dust concentration and the incidence of ARI, it was found from the analysis of 11 journals from the interpretation of journals, it was found that several compounds such as SO₂, NO₂, H₂S, and SiO₂ are compounds that cause air pollution. This compound is contained in coal dust particles which when it enters the respiratory system will cause interference or damage to the respiratory system. These chemical compounds also have a very small size which is often referred to as PM_{2.5} or PM₁₀. This very small dust particle size can easily enter the lungs and cause damage to the respiratory tract that is passed. Of the 11 journals that have been analyzed, there are

TABLE 2: Dust Concentration.

Journal Number	Dust Concentration
Journal 1	SO ₂ , NO, H ₂ S, and PM10
Journal 2	NAV: 11.9 – 16.4 mg/m ³
Journal 3	PM10 and PM2.5
Journal 4	PM2.5
Journal 5	PM
Journal 6	NAV: 0.96, 2.02, 3.36
Journal 7 Journal 8 Journal 9	NAV: 3.36 NAV: 3.12 and 3.28 SiO ₂

2 journals that do not explain in detail what dust concentrations affect the occurrence of ARI and other respiratory system disorders.

3.3. The Relationship between Exposure to Coal Dust Levels with the Incidence of ARI or Respiratory Disorders

TABLE 3: The Relationship between Exposure to Coal Dust Levels with the Incidence of ARI or Respiratory Disorders.

Journal Number	Outcome	N	%
Journals 1, 2, 3, 4, 6, 7, 8, 9, 11. Journal 5, 10	<i>Related Not related</i>	9 2	81.8% 18.2%

Based on table 3, it can be seen the percentage relationship between exposure to coal dust levels with the incidence of ARI and respiratory disorders from the results of the analysis of 11 journals. 9 (81.8%) research journals showed a relationship between exposure to coal dust levels with the incidence of ARI and respiratory disorders and the remaining 2 (18.2%) journals showed no relationship.

4. DISCUSSION

The duration of exposure is the duration in which a person begins to be exposed to coal dust. The longer the duration of exposure to dust, the higher the risk of a person experiencing disorders of the respiratory system. The duration of dust exposure is also related to the concentration of inhaled dust. One of the diseases that are often caused by exposure to coal dust is pneumonia[7] [8] [9].

Based on the results of the analysis of 11 journals, the average exposure in each journal is different. From these results, it can be seen that the average exposure to dust in the respondents studied was more than 20 years with the lowest exposure being 5 years. So, it can be concluded that workers have a high risk of respiratory disorders

with a long exposure period. In the results of data analysis from [10] describes the frequency of workers exposed and diagnosed with CWP (Coal Workes Pneumocosis) with workers exposed without a diagnosis of CWP (Coal Workes Pneumocosis). The results show that workers with CWP (Coal Workes Pneumocosis) have a longer duration of exposure, namely 24 years, while workers who are exposed without CWP (Coal Workes Pneumocosis) have an average duration of work of 23 years. In accordance with the theory presented [7] it can be concluded that the longer the duration of exposure to coal dust it also increases the risk of respiratory system disorders.

From the results of the analysis of 11 journals, it was also found that the average size of the dust formed due to coal combustion. It is known from several journals that particulate grains were found to be between 2.5 microns to 10 microns in size. These particulates are commonly referred to as PM_{2.5} and PM₁₀. Research results from [11] states that there is a relationship between dust particle size and respiratory disorders [12] [13]. It is explained in his research that PM₁₀ or particulate matter measuring 10 microns with PM_{2.5} or particulate matter measuring 2.5 microns can both cause adverse effects on health and damage tissues, especially the respiratory system. However, PM_{2.5} is able to travel deeper into the lungs and is also able to enter the bloodstream and spread throughout the body. According to theory [1] who explained that fine particles of coal dust/particulate matter were the main cause of respiratory disease. So, small particulate grains are often referred to as PM₁₀ or particulates that have a size smaller than 10 microns. These particulates come from sulfur and nitrogen compounds contained in coal. If the particulate is inhaled by humans it will cause lung damage, acute respiratory infections to pneumonia.

The results obtained from the analysis of 11 journals there are several factors that influence the incidence of ARI in the area around coal mines, namely the length of exposure, the concentration of total or inhaled dust, the compounds contained in the dust and the size of the dust particles formed due to the coal combustion process. Literature studies that have been carried out on the analysis of the relationship between coal dust levels and the incidence of ARI show the results that there is a relationship between coal dust exposure and the incidence of ARI and other respiratory tract disorders. This condition occurs because several previous studies have shown dust levels that exceed the threshold value, PM_{2.5}.

5. CONCLUSION

From the results of the analysis of 11 journals, it was found that 9 journals had a relationship, while 2 journals stated that there was no relationship between dust levels and the incidence of ARI or respiratory disorders. Exposure duration, dust particle size, Threshold Value and dust-forming compounds have a relationship with the incidence of ARI or respiratory disorders.

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