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The Relationship of Exposure to PM 10 and PM 2.5 Dust with Respiratory Disorders in Lime Stone Mining Workers: Literature Review

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Abstract

Introduction: Karst areas are natural formations formed from carbonate rocks such as limestone and chalk over thousands of years, storing biological and non-biological resources. Although limestone quarries provide an economic source of income, their impact on the environment and health is often negative, especially through air pollution by particulates such as PM10 and PM2.5. Lime dust can cause lung problems, eye irritation and respiratory system problems, especially for lime mine workers. The limestone industry generally operates informally, often ignoring health and safety protections.

Objective: To analyze the relationship between exposure to PM 10 and PM 2.5 dust with respiratory disorders in limestone mining workers.

Method: Literature review from various studies and journals relevant to the research objectives over the last 10 years.

Results: There is a relationship between length of work, age, smoking, and history of illness with respiratory disorders in limestone mine workers.

Conclusion: There is a relationship between exposure to PM 10 and PM 2.5 dust and respiratory disorders in limestone mining workers.

Keywords: Particullate Matter 10; Particullate Matter 2.5; Respiratory disorders; Lime Mining

INTRODUCTION

Karst areas are natural landscapes that were formed over thousands of years and are composed of carbonate rocks (limestone/limestone) which have undergone a dissolution process to form unique morphological features and hydrological structures. Karst stores biological resources in the form of various plants and animals and also contains non-biological natural resources in the form of limestone, one of which is class C mining material. Lime mining has two sides, the first side of lime mining can be a source of income for the people involved in the mining process processing to marketing, so that from an economic perspective lime mining has a positive side, but on the second side lime mining has an impact on environmental damage due to mining and health problems due to exposure to lime dust which can cause respiratory problems for workers and the community, so on this side, mining Lime has a negative side. Limestone is formed in various ways, including organic, chemical and mechanical. In general, limestone is formed from organic processes originating from deposits of shells and snails. The color of limestone varies, depending on the mineral impurities. Generally white, but there are also other colors such as gray, brown and black. The carbonate mineral found in chalk is aragonite which can change into calcite over a certain period of time due to a metastable process. (2)

Air pollution from limestone arises from the process of extracting limestone from nature, the burning process and the packaging process. Air pollution arising from the lime mining industry is particulates. Particulates that are harmful to health are particulates measuring 0.1 to 10 microns. PM10 is a particulate that is less than 10 microns in size. If inhaled, these particles can enter the respiratory tract and can stick to the mucosa of the upper respiratory tract. Meanwhile PM2.5 is particulates measuring less than 2.5 microns. These particles can enter deeper into the respiratory tract and settle in the bronchioles in the middle respiratory tract. (3)Particleor Dust: Solid matter suspended in the air with a size of 0.3 μm to 100 μm. Particles (dust) are classified according to their size, and dust larger than 10 μm is called falling dust. Dust with a particle size of less than 10 μm is called suspended particulate matter (SPM) and is suspended in the air.Ambient air pollution that occurs can be in the form of TSP, NO2, SO2, CO and HC, which can come from smoke from burning limestone, which can endanger human health, especially workers. (4)

The main impacts of lime dust on lime mine workers are lung disorders, both acute and chronic, disruption of physiological functions, eye irritation, sensory irritation and the accumulation of hazardous materials in the bodies of lime mine workers. In the respiratory tract, it can disrupt the respiratory system which can result in increased mucus production, narrowing of the respiratory tract, loss of cilia and cell layers of mucous membranes and difficulty breathing. (5) The limestone industry is generally an informal industry. Informal industries are usually managed by the community with simple technology, without being much touched by statutory regulations, so that all regulations relating to health and safety protection for workers and the surrounding community receive little attention. (6) One step to overcome the acceleration of functional disruption lungs in limestone industry workers is to carry out early diagnosis, by measuring lung function, so that preventive measures can be taken (7).

METHOD

This writing uses the literature review method, a literature review is a research method that reviews a particular topic which focuses on a single question that has been identified systematically, assessed, selected and concluded according to predetermined criteria based on high quality research evidence that is relevant to the research question. .(8) The source of this research data was obtained from literature taken from the internet in scientific research publications in various sources over the last 10 years. Data collection was carried out with the help of Google Scholar, Pubmed and Scince Direct using the keywords PM 10 and PM 2.5 and symptoms of respiratory problems in workers. The research source or journal taken is expected to describe the results of the latest research.

RESULTS

Review literature can be seen in the following table:

Table 1. Literature Review

Writer's name	Research design	Sample and Population	Results
Fahmita A (2019)	cross-sectional.	Sample of 18 people, total sampling technique	Shows that the dust content measured in the limestone kilns in Plumpang District, Tuban Regency is above the NAB (Threshold Limit Value)
Jati Firmanto, Mela Firdaust, Hikmandari (2019)	cross-sectional.	The sample in this study was 32 respondents from the exposed group and 32 respondents from the non-	The average PM10 dust level was 0.16663 mg/kg/day in the exposed group and 0.04252 in the unexposed group. Meanwhile, the percentage of respondents who had respiratory system

		exposed group	complaints was 65.6% in the exposed group and 34.4% in the unexposed group.
Erdi Nur, Basuki Ario Seno, Rahmi Hidayanti (2021)	Environmental Health Risk Analysis (ARKL).	The sample was 53 respondents.	The concentration of PM10 is 0.152 µg/m3, exceeding the quality standard in accordance with Government Regulation Number 41 of 2009. The intake value of PM10 exposure by inhalation at point four has an RQ value > 1, indicating that exposure is unsafe for the community along the Gunung Sarik road so control needs to be carried out. .
Mirza Fathan Fuadi, Yura Witsqa Firmansyah, Muhammd Fadli R (2022)	cross-sectional.	The total sample was 60 respondents	The results show variables that have a relationship, namely exposure to inhaled dust (p=0.031), work period (p=0.046), total dust particulate levels (p=0.048), use of PPE (p=0.034). Based on research results, the risk factor for ARI is 2 times greater in limestone kiln workers who have exposure to inhaled dust above the NAB (≥1 mg/m3). To prevent the risk of exposure to ISPA, workers are advised to use complete PPE when working.
Gaffar, Muhammad Khidri, Nur Ulmy Mahmud (2021)	Cross-sectional.	the sample size was 35 people	The dust content at point A is good at 5.980 while at point B it is less good at 0.118.
Siti Yulaekah, M. Sakundaro Adi, Nurjazuli (2017)	Cross-sectional.	The research sample size was 60 from a population of 160 people	exposure to inhaled dust has a significant effect on the incidence of lung function disorders (p = 0.02 and Odds Ratio = 5.833 with 95% CI: 1.865 – 18.245). the exposure factor for inhaled dust exceeding the Threshold Value of 3 mg/m3 is 68.6%. Most respondents were exposed to dust and it had a significant relationship with the occurrence of lung disorders.
Widhy Yudistira Nalapraya , et al (2021)	Cross-sectional.	The total sample was 90 people	Pneumoconiosis was found in 11/73 (15.1%) subjects. Dust concentrations were higher at mining sites in the pneumoconiosis group compared to mining sites in the non-pneumoconiosis group (61.41±103.98 vs 14.92±55.17 mg/m3, P=0.030). This study shows that work duration and mining site dust concentration are risk factors for pneumoconiosis; but not significant (OR=14.6, P=0.999 and OR=7.171, P=0.998).
Rahayu Hasan Akili, Febi Kolibu, Ardainsyah C. Tucunan. (2017)	Cross-sectional.	as many as 40 people (total sampling)	The results show that there is a relationship between length of work, age, smoking behavior, which is related to cases of respiratory disease. Meanwhile, the period of work has nothing to do with cases of respiratory disease in limestone mining workers in Buliide District, West City Regency, Gorontalo Province.
As'ari, Rosa Masita. (2022)	cross-sectional	The total sample was 9 people	PM 2.5 and PM 10 concentrations exceed WHO quality standards. Symptoms of respiratory problems in the form of shortness of breath experienced by respondents (56%). The greatest risk is in areas close to industry (485 m).
Leni Widdianti (2018)	cross-sectional	total sampling totaling 185 respondents	The results of the study showed that there was a significant relationship between the variables length of work, age, smoking behavior and history of illness and respiratory tract disease in limestone mining workers in Buliide District, West Kota Regency, Gorontalo Province.

DISCUSSION

PM 10 and PM 2.5 Against Respiratory Disorders

Limestone mining is an industry that has very dangerous levels of air pollutants and can harm the health, especially of workers. (9) The limestone industry has polluted the air with dust and combustion gases. This process can produce substances in the form of particles that fly freely in the air. Particles in the air can be influenced by differences in temperature, humidity, wind speed and direction. The lower the temperature, the higher the humidity. At high humidity dust particles will settle more quickly than at low humidity. High humidity will cause particles to bind with water and form larger particles so they can easily settle to the earth's surface and increase pollutant concentrations. Apart from that, low wind speeds also cause high concentrations of dust/PM, this is because low wind speeds cause pollutants to accumulate and can pollute the air in places where people live around the location of the pollution. (10)

Agents that are at risk of causing health problems in communities around brick manufacturing sites are Particulate Matter (PM10 and PM2.5) in the air which originates from the combustion process using wood, coal, factory waste and coconut husks. This produces smoke which can pollute the surrounding environment. Particulate MatterLimestone can be detrimental to health if inhaled by humans, including causing problems with breathing, such as shortness of breath or the occurrence of pneumoconiosis. The main effects of lime dust on workers include the occurrence of respiratory problems in the lungs, both acute and chronic, disruption of physiological functions, eye irritation, sensory irritation. (11)

Age

Several research results show that as workers get older, more alveoli will be damaged and their immune system will also decrease, coupled with a decline in their respiratory system when they are over 30 years old. Therefore, age can be said to be a risk factor for workers which can increase the incidence of acute respiratory infections (ARI). (12)

Use of PPE

PPE is personal protective equipment that can protect workers from accidents or dangers at work in accordance with safety and comfort standards for workers. The working environment in the limestone mining industry has a high concentration of dust so that the minimum possible workforce must wear PPE in the form of masks to avoid the entry of dust particles and lime particles into the respiratory tract and air purifiers to filter the air that enters the body to avoid pollutant poisoning and lime dust. PPE that can be used in limestone mining includes masks, glasses, hats, gloves and boots. (13)

Years of service

Work period is the length of time you work in a place, the size is years. The negative impact of the work period describes the period of time workers are exposed to possible sources that can cause symptoms of health problems in the work environment. The longer a person works, the more exposure they have to the dangers posed by the work environment. The permissible duration of exposure to dangerous particles for a worker is 5 years and if it exceeds the predetermined figure then the worker must be rolled over or dismissed from work. (14)

Length of working

Length of Work Several research results show that the length of time a person works is generally around 6-8 hours a day. If the working time is extended, it will cause high inefficiency and even cause disease due to prolonged exposure to pollutants in the work environment. (15) Therefore, the variable length of work is not a risk factor that is directly related to respiratory disorders, this is because the variable length of work work cannot stand alone to influence respiratory disorders, so it requires other variables to jointly influence respiratory disorders. (16)

Smoking habit

The effect of cigarette smoke on both active and passive smokers is a risk for health problems. Workers who have habits As a person ages, their susceptibility to the effects of exposure will increase, which can also be influenced by their daily activities, including the tendency to smoke, which can worsen the condition of their lung function. Smoking activities can cause changes in the structure, function of the airways and tissues. Enlargement of mucosal cells (hypertrophy) and mucus glands increasing in number (hyperplasia) occurs in the large airways, in addition to mild inflammation to narrowing due to the addition of cells and accumulation of mucus in the small airways. (14)

CONCLUSION

This research concludes that there isThe relationship between the variable's length of work, age, smoking behavior and history of illness with respiratory tract diseases in limestone mine workers. Meanwhile, PM10 and PM2.5 levels are related to respiratory problems if they are above the specified threshold and if the respondent is close to the source of pollution. Most respondents were exposedPM10 and PM2.5and has a significant relationship with the occurrence of respiratory disorders.

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