



WALUYA THE INTERNATIONAL SCIENCE OF HEALTH JOURNAL

The Effect of Nickel Mining on Acute Respiratory Infection Cases in Boenaga Village, Lasolo District, North Konawe Regency

Elfrina Ginting¹, Timbul Supodo², Sunarsih², Putri Ayu Sudirman¹, Muhammad Reinaldy Juliansyah²

¹ South Sulawesi Health Departmen, Indonesia

² Mandala Waluya University, Indonesia

Correspondence : g.elfrina01@gmail.com

ARTICLE INFO

Article history

Received : July 14th, 2022

Revised : July 18th, 2022

Accepted : July 24th, 2022

Keywords

Mining,
ARI.

ABSTRACT

Introduction: Nickel mining industry with air with nickel dust and combustion gases. The main effects of dust on workers are either acute lung disorders or chronic physiological disorders, eye irritation, sensory irritation, and accumulation of harmful substances in the body. One of the negative impacts of nickel processing activities is environmental degradation which is characterized by air and many diseases related to the respiratory tract. This greatly affects the people who live close to mining areas, based on data from the Lasolo Island Health Center shows that ARI cases in 2020 were 126 cases, Asthma 85 cases, and Toddler Pneumonia 23 cases. The purpose of this study was to determine the effect of mining on cases of ARI in mining areas in the village of Boenaga.

Method: The type of research used in this study is an observational study with a cross sectional analytic study.

Result: The results showed that there was a relationship between dust exposure and cases of respiratory disease.

Conclusion: The condition of indoor and outdoor air quality in exposed areas was higher than in non-exposed areas, but all of these are still below the permissible threshold value. The incidence of ARI in exposed locations increased significantly compared to non-exposed locations in Pomalaa district.

Introduction

ARI is an acute infectious process that attacks one part and or more of the respiratory tract from the nose to the lung sacs (alveoli) including adnexal tissue such as sinuses/cavities around the nose (paranasal sinuses), middle ear cavity and pleura.^[1]

Most cases of ARI occurred in India at 43 million, China with 21 million, Pakistan with 10 million, and Bangladesh, and Indonesia, each with 6 million episodes. Of all cases that occur in the community, 7-13% of cases are severe and require hospitalization. ARI is one of the main causes of patient visits at Puskesmas (40%-60%) and hospitals (15%-30%).^[2]

In Indonesia, ARI cases always rank as the first cause of infant mortality. A total of 36.4% of infant deaths in 2018 (24.4%) in 2019 (30.1%) in 2020 and 25%. In addition, ARI is often on the list of the ten most sufferers of the disease in hospitals. One of the locations in Indonesia with large nickel reserves is North Konawe District. The mining location in this study is the main mine in the village of Boenaga.^[3]

Nickel is an important metal in modern technology and infrastructure, with the most use in stainless steel (~58%), nickel alloys (~14%), steel alloys (~9%), electroplating (~9%), and batteries refill (~5%). In general, nickel comes from two types of ores, namely sulfide and later. Sulfide ores come from volcanic or hydrothermal processes and usually contain copper (Cu) and/or cobalt (Co), and not infrequently valuable metals such as gold (Au) or platinum (Pt), palladium (Pd), and rhodium (Rh). While lateritic ores are formed near the ground surface due to extensive weathering, and often occur in tropical locations near the equator.^[3]

Nickel mining activities are carried out by PT. Paramitha Persadatama in Lasolo District, North Konawe Regency has polluted the air with dust and gases from the nickel processing process in the work environment, this will result in people being exposed to dust and gases at different concentrations and sizes. Effects on the respiratory

tract are the occurrence of acute respiratory infections (ARI), increased mucus production, narrowing of the respiratory tract, the release of cilia and mucous membrane cell layers, and difficulty breathing. Based on data from the Lasolo Islands Health Center, shows that there were 126 cases of ARI in 2020, 85 cases of asthma, and 23 cases of toddler pneumonia.

This condition is in accordance with the results of initial observations made by researchers, where nickel mining activities in this area show a high number of ARI cases for people who live close to mining companies. Based on the description above, the purpose of this study is to examine the effect of mining on cases of ARI in mining areas in Boenaga Village.

Method

The type of research used in this study is an observational study with a cross sectional analytical study to describe the circumstances/facts and the phenomenon of how mining affects the Acute respiratory infection case in the mining area in Boenaga Village.^[4] The population in this study was the entire community of Boenaga Village totaling 128 people using a sampling technique, namely purposive sampling with a total sample of 56 people. This research was carried out in the village of Boenaga, the working area of the Lasolo Islands Health Center. The procedure for collecting this data is to use secondary data, namely data obtained from the Lasolo Islands Public Health Center. Dust measurements were carried out using a Low Volume Air Sampler.

Result

Measurement of air pollution measures the quality of the air inside the house (indoor) and outside the residents' homes (outdoor). Parameters for indoor air quality include PM_{2.5}, H₂S, SO₂, NO₂ and for outdoor air quality parameters include PM₁₀, H₂S, SO₂, NO₂.

Table 1 showed that the average value for parameter SO_2 is higher, as well as for parameter NO_2 , parameter H_2S , $PM_{2.5}$.

Table 2 showed that outdoor air quality for parameters SO_2 , NO_2 , H_2S , and $PM_{2.5}$ the average value (mean) is higher.

Table 3 shows that with exposure to dust that does not meet the requirements, there are 21 (84%) who suffer from ARI, while by fulfilling the

requirements there are 14 respondents (45.2%) who do not suffer from ARI.

The results of the Chi-Square statistical test at the 95% confidence level ($\alpha = 0.05$) showed that p-value is 0.024 so H_a was accepted, which means that there is a relationship between dust exposure and the incidence of ARI in Boenaga Village, Lasolo District, North Konawe Regency.

Table 1
Outdoor Air Quality in the Nickel Mining Area in Boenaga Village, Lasolo District, North Konawe Regency

Parameter	Max	Min	Mean
SO_2 (μg)	25.220	75.261	34.662000
NO_2 (μg)	18.650	44.342	15.133000
H_2S (μg)	0.025	0.061	0.003340
PM_{10} (μg)	27.32	155.62	113.23410

Table 2
Indoor Air Quality in the Nickel Mining Area in Boenaga Village, Lasolo District, North Konawe Regency

Parameter	Max	Min	Mean
SO_2 (μg)	0.0152	0.0424	0.023210
NO_2 (μg)	0.0016	0.0103	0.012325
H_2S (μg)	0.0025	0.0043	0.002412
PM_{10} (μg)	14.30	121.40	71.2100

Table 3
The Relationship between Dust Exposure and Acute Respiratory Infection Incidence in Boenaga Village, Lasolo District, North Konawe Regency

Dust Exposure	ARI incident				Amount		p-value
	Suffer		No Suffering		n	%	
	n	%	n	%			
TMS	21	84.0	4	16.0	25	44.6	0.024
MS	17	54.8	14	45.2	31	55.4	
Total	38	67.9	18	32.1	56	100	

Discussion

Based on the results of the study, most of them met the requirements, all dust was stimulating and could cause a reaction even though it was mild. This reaction is in the form of excessive mucus production, if it continues, hyperplasia of the mucous glands can occur. This is in line with research conducted, which states that there is a significant relationship between high dust concentrations and the occurrence of lung function abnormalities.^[5] Dust that enters the inspiratory tract causes a non-specific defense mechanism reaction in the form of coughing, sneezing, impaired mucociliary transport, and impaired phagocytosis of macrophages. The mucociliary system is also impaired and causes increased mucus production and stimulated smooth muscles around the airways, causing constriction. In the same exposure period, abnormalities that arise in different respondents, the impact can also be different.^[6]

The case of ARI in Boenaga Village occurred depending on exposure to dust for a long time and with the results of indoor and outdoor air quality inspections in residential areas being higher, with values higher than the threshold, this was possible due to the condition of the Nickel factory which is very close to residential areas.

The incidence of ARI disease in the community has a risk of being exposed to dust or smoke that causes ARI, this is because some people do not use masks according to health protocols, therefore the use of masks needs to be done to reduce dust exposure, also always apply a healthy lifestyle with adequate rest, diligent exercise, eat healthy foods, don't smoke and you should check your health regularly.^[7]

Acute Respiratory Infection (ARI) is an acute respiratory tract disease that includes the upper respiratory tract.^[8] The main factors are due to pollution, poor environmental conditions, and others, namely: Environmental conditions (eg, air pollutants, the density of family members), humidity, cleanliness, season, and temperature.

Availability and effectiveness of health services and infection prevention measures to prevent spread (eg, vaccines, access to health care facilities, isolation room capacity). Characteristics of the pathogen, such as mode of transmission, infectiousness, virulence factors, and number or dose of microbes (inoculum size).^[9]

From the description above that most of the people of Boenaga suffer from ARI, this is because at the time of the study interview, 38 (67.9%) people felt complaints such as coughing, runny nose, hoarseness, breathing, and fever, while a small percentage of 18 (32,1%) had no symptoms suggestive of respiratory tract infection.

This shows that people who experience symptoms of respiratory tract infections are caused by environmental factors, where their settlements are very close to the PT Paramitha Persadatama industry, so they are easily exposed to dust and smoke which are factors that cause respiratory infections. If no preventive measures are taken, it will have a serious impact, namely chronic respiratory infections. Therefore, if people feel dry throat or cough and runny nose, it is recommended to check at the Puskesmas or other health services. The results of the Chi-Square statistical test at the 95% confidence level ($\alpha = 0.05$) show that $= 0.024$ so H_a is accepted which means there is a relationship between dust exposure and the incidence of ARI in the Boenaga Village community.

ARI in general is a bacterial infection in various areas of the respiratory tract, including the nose, middle ear, pharynx, larynx, trachea, bronchi and lungs. Symptoms can vary, including coughing, shortness of breath, dry throat and stuffy nose. It is said that ISPA Ringer is if you get satay or more, the symptoms are cough, runny nose, hoarseness and fever.^[10] In moderate ARI there are symptoms of Ringer's ARI plus one or more tench and symptoms in the form of a respiratory rate of more than 54/merit, wheezing, a temperature of 39°C or more.^[11] The best ARI category is if there are ringer or moderate ARI symptoms plus one or more symptoms in the form of retraction of the

seta ribs in the suprasternal fossa during inspiration, stridor, cyanosis, nasal flaring, seizures, dehydration, decreased consciousness, diphtheria membranes.^[12]

The main factor is due to pollution, and poor environmental conditions. The longer humans are exposed to dust at work, which can be seen from the length of time they work, the more likely the dust will accumulate in the lungs.^[13] This is the result of the accumulation of inhalation during work. Years of work can affect the health of workers due to the frequent exposures.

From the description above, with exposure to dust that does not meet the requirements, there are 21 (84%) who suffer from ARI, while by fulfilling the requirements there are 14 respondents (45.2%) who do not suffer from ARI. People who have houses very close to the industry will inhale dust in concentrations and for a long period, it will be dangerous. As a result of inhaling dust, what we will immediately feel are shortness of breath, sneezing, and coughing due to disturbances in the respiratory tract.^[14]

This is evidenced by the results of the others study stating that there is a relationship between dust exposure and the incidence of acute respiratory infections (ARI).^[15] In a society with a dusty environment, more and more dust can settle in the lungs because theoretically it is known that the effect of dust exposure depends on the dose or concentration, place and time of exposure. Exposure time is defined as the frequency or length of time the respondent is exposed to dust, so the longer the exposure, the higher the possibility of interference, especially if it is supported by high concentrations of exposure substances.^[16]

Conclusion

Based on the research objectives and discussion, it can be concluded as follows: most of the dust exposures that meet the requirements are 31 (55.4%), and most of the incidence of acute respiratory infections (ARI) suffer from ARI as many as 38 (67.9%). There is a significant

relationship between dust exposure and the incidence of acute respiratory infection (ARI) in the community of Boenaga Village, Lasolo District, North Konawe Regency.

Therefore, it is recommended that the government, in this case, the health office, conduct material counseling about the dangers of dust exposure to nickel mining workers, and how to prevent and overcome the dangers of dust. Maintain the health of yourself and your family members by consuming nutritious food, getting enough rest, creating clean air (by planting trees), and creating a healthy environment. Immediately seek health checks if any occupants of the house are sick to reduce the risk of transmitting the disease to other family members.

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