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Limestone Dust Exposure against Increased Tnfα and Decreased Pulmonary Function Miners on Village Jadi Kecamatan Semanding Kabupaten Tuban

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Abstract:- This study aims to analyze the influence of limestone dust levels to the progressive increase in the **levels of TNFα personal and decreased lung function in miners. Analytical observational research methods,** from time approach are *a prospective longitudinal study* research. The sample in the study group 7 miners exposed limestone and unexposed groups 6 office employees Village Jadi Kecamatan Semading Kabupaten Tuban. Data collection techniques with interviews, measurements of total dust working environment, personal dust measurements, blood sampling, and spirometry. TNFα and pulmonary function were measured before and after work. Independent variable is the amount of dust limestone Personal miners. Variable depending on the levels of TNFα and pulmonary function. Age, years of service and smoking habits are variable confounding. Result: The mean levels of personal dust miners after working for 8 hours at 10,407 mg/m ^{3} and village officials for 0,265 mg/m $^{3.}$ Increased TNFα on the miners was 71.43% and the employee's office as much as 16.7% rural. The decline in FVC and FEV_1 miner is 85.7% and 71.4%, while the FVC and FEV_1 for village officials by 50% and 16.7%. By using multiple regression analysis, personal limestone dust does not significantly affect the increase in TNFα ($p > 0.05$), but the personal limestone dust effect on lung function decline in miners ($p < 0.05$). Age, years of service and smoking habits did not affect the increase in TNFα and decrease lung function. Conclusion: personal limestone dust does not affect the increase in TNFα, but personal limestone dust effect on lung function decline in miners.

Keyword:- Limestone dust, Limestone Miners, Blood Serum TNFα, Pulmonary function.

I. INTRODUCTION

Dust or solid particles with small size particles originating from the destruction of a large and very dangerous to the health of the workers when floating freely in the air. The size of the smaller dust particles when inhaled will result in the accumulation of the system in the respiratory tract [1]. Dust is considered as an agent that causes disease and respiratory systems are the most influential agents on the incidence of a disease.

During the process of limestone mining takes place, will generate chalk dust that is one solid particles in very large quantities. Based chalk dust composition derived from the class of inorganic and when viewed from its chalk dust including dust profilferate, where the dust in the lung group will form scar tissue (fibrosis), which can lead to hardening of the tissues of the alveoli, resulting in lung capacity disorders. The nature of the limestone particles are not classified as irritant and carcinogen, causing lung disorder that occurs in both acute and chronic [2].

Characteristics of dust particles, exposure time, number and airway response to dust particles is a major factor in the pathogenesis of pneumoconiosis. Tests were conducted to determine lung function aimed as supporting the diagnosis of obstructive lung disease and to differentiate between obstructive and restrictive ventilation disorder, where the disorder or obstructive disorder affecting the ability of expiration whereas restrictive disorders affect the ability of inspiration [3]. To determine the course of the disease and determine the prognosis of the diseases pulmonary function examination is also required [4].

Pulmonary function research due to limestone dust [5,6] Showed that the respirable dust levels had a significant association with the occurrence of lung problems as well as the probability of the occurrence of lung problems for respondents who worked in the workplace Concentrations with respirable dust have a meaningful relationship with occurrence of pulmonary function impairment.

The emergence of non-specific defense mechanisms of reactions that occur as a result of dust inhaled by workers in the form of limestone miners sneezing, coughing, mukosilier transport disruption and phagocytosis by macrophages. Due to the influence of the interaction of monocytes, macrophages and neutrophils also release inflammatory mediators will happen the *Tumor Necrosis Factor* (TNF)-α, *Interleukin* (IL), *Interferron* (IF) and *platelet activating factor* (PAF) [7]. The release of inflammatory

mediators, namely *tumor necrosis factor* (TNF)-α excessively will have an impact on increasing the number of blood serum TNFA. Levels of dust with high intensity against the miners should be the cause of the increase in TNFα, so that miners at risk of *Coal Worker's pneumoconiosis.* It is expected that after the employment ends TNFα remains a strong indicator in predicting the prognosis of pneumoconiosis on someone [8].

The increase in TNFα as a result of exposure to dust under study, did not cause toxicity in macrophages, personal dust samples also failed to activate macrophages and pro-inflammatory cytokine production. TNFα is increased in some personal dust samples but not significantly. TNFα-producing cells are macrophages and other types of cells with different biological activities in target cells including the immune system or not [9]. A number of new types of cells that will produce TNFα when getting a suitable stimulation [10]. *Tumor Necrosis Factor* (TNF)-α on leukocytes and endothelial working at low levels that induce acute inflammation. At the level of being, TNFα plays an important role in systemic inflammation. While in the high state, TNFα can cause pathological abnormalities of septic shock [11]. There are many factors in multilevel cell ragulasiteraktifitasi that control expression of TNFα with increased serum TNFα within 90 min after the stimulation process and then followed by decreasing levels of TNFα to normal levels within 4 hours [12].

Kecamatan Semanding is a limestone-producing in KabupatenTuban area of limestone hills were quite extensive. Village Jadi, Kecamatan Semanding, KabupatenTuban is one of the villages that serve as a kind of limestone mining is an activity carried out small-scale mining limestone called artisanal mining is mining limestone which is usually done by the individual or by the people that live around the mining area, so that its implementation using a simple tool, but some are using the machine as a tool to cut limestone. Air pollution and dust in large quantities merupaan result of limestone mining activities can cause a decrease in lung function and increased blood serum TNFα miners. This is supported by the miners who work habits without the use of APD (goggles, masks, gloves and boots). Increased respiratory and vision complaints against the miners caused due to increased levels of chalk dust, it becomes subjective complaints that the authors found in the field. The complaint cause discomfort and be the cause of respiratory tract disease caused by the accumulation of dust in the lungs of miners lime.

This study aims to analyze the influence of personal limestone dust levels to decrease lung function and improving the blood serum levels of TNFA miners.

II. MATERIALS AND METHODS

By type, this study was an observational analytic study. Judging from the time approaches *prospective longitudinal* research *study* conducted in 2 populations the exposed population (studies) and unexposed populations (comparison), observation and sampling carried out before and after work.

The study population, the study group is limestone miners needle in the hamlet village Semanding So the District and the comparison group in the village so the District SemandingTuban. The study sample for the study group was 7 miners following the inclusion criteria and comparison groups totaling 6 randomized simple by adjusting the characteristics (matching) with the study group in terms of age, years of service and smoking habits.

The independent variable of this study is mined limestone dust levels and levels of personal dust limestone miners. The dependent variable of this study that the blood serum TNFα levels and pulmonary function. For potentially confounding variables such as age, years of service and smoking habits.

Data was collected by using personal dust sampling *Personal Dust Sampler* instrument that measured for 8 hours of work *(cross-shift),* lung function measurements were performed using a spirometer before and after work, TNFA levels obtained with blood sampling before and after work, then in a centrifuge to take the serum and then used the ELISA technique. Data collection age, years of service and smoking habits diperoeh by interview using a questionnaire Test test and multiple regression used to assess the influence between variables.

III. RESULTS AND DISCUSSION

III.1 Personal Dust Levels

Table 1 Distribution of Personal Dust Levels of Index Based Workplace

Dust levels of personal	Workplace	
	Personal Miners limestone dust (mg/m^3)	Personal Dust Village Office Employees (mg/m^3)
NAB ≤ (≤ 3 $mg/m^{3)}$	3	6
> NAB (> 3 $mg/m^{3)}$	4	0
Minimum	2.0119	<LD
Maximum	22.4292	0.8023
Mean±SD	10,407±8.49	0.265 ±0.263

Under the Indonesian National Standard (SNI) 19-0232-2005 of Chemical Substances Threshold Limit Values in the Workplace Air, for respirable dust is the threshold value of 3 mg/m3 for 8 hours a day or 40 hours a week, the amount is equal to the recommended by the American Conference Of Govermental Industrial Hygienists (ACGIH).

Threshold value or Treshhold Limit Value (TLV) recommended by the American Conference OfGovermental Industrial Hygienists (ACGIH) is based on workplace inhalation hazard. This is because the determination of the potential hazards of dust in the air is affected by the concentration or concentration and size of the dust particles. Dust size largely determines where the dust willterdesposisi in the respiratory tract and affect the health effects will arise. It is also in line with the opinion of [13] which says that there are two decisive factors to determine the toxicity of particulates inhaled by workers that the chemical composition of the dust and the dust size.

Dust requires a relatively long period in a state of hovering in the air. Floating dust would enter the body through the respiratory system so harmful to health. Dust in the air can also conduct chemical reactions and therefore the composition of the dust particles in the air will be very complicated because of the dust in the air is a mixture of several materials with different sizes [14].

The mean personal dust at the village office workers when compared to the standard is still said to be safe and meet the requirements, while the mine is said to dust personal ineligible due to exceeding the standards set by SNI 19-0232-2005 namely that the threshold value is 3 respirable dust mg/m3 for 8 hours a day or 40 hours a week.

III.2 Blood Serum TNFα

Table 2 Distribution of Δ Index of Blood Serum TNFα in Respondents

TNFA Δ	Limestone Miners		The village office workers	
	N	%	N	%
Increased	5	71.43	1	16.7
Decreased	2	28.57	3	50
Fixed	0	0	2	33.3
Total	7	100	6	100
Minimum / Maximum	-2.67 / 12.00		-51.56 / 4.89	
Mean±SD	2.51±4.72		-9.82±21.21	
p = 0.160				

p> 0.05 (not significant)

Δ (difference)

Tumor Necrosis Factor (TNF)-α is a group that has an important role in the physiological and pathological processes in cell proliferation, differentiation, apoptosis, modulation of the immune response and the induction of inflammation [12]. TNFα is a proinflammatory cytokine multifunsi and impact on lipid metabolism, coagulation, insulin resistance and endothelial function. Macrophages produce cytokines and one of the cytokines produced at the beginning is that TNFα plays an important role in phatogenesis inflammation, tissue damage and *septic shock.* Although macrophages become a major producer in producing TNFα, but TNFα can also be produced by other similar cells with a wide range of biological activity in the target cells, including immune system or not [10].

There are many factors in activated cells yan multilevel regulatory control of TNFα expression with increased serum TNFα within 90 min after the stimulation process and then followed by a decrease in the levels of TNFα at levels to undetectable levels within 4-6 hours [12].

III.3 Pulmonary function

Table 3 Distribution Index Δ FVC and FEV $_1$ Respondents

Pulmonary function parameters	Respondents		p
	Limestone Miners	Employees Village Office	
Δ FVC (mean ± SD)	-0.13±0.15	-0.09±0.17	0,656
Δ FEV_1 (Mean ± SD)	-0.10±0.17	0.07±0.08	0.038 *

*** P <0.05 (significant)**

Lung function was measured before and after working for 8 hours *(cross-shift),* so that the known decline in lung function of each respondent. There is a significant difference between the decline in pulmonary function limestone miners village officials that the parameter FEV_1 between before and after work. The mean

decline in pulmonary function in new miners lime is Δ FVC 85.7% and 71.4% in $FEV_{1,}$ whereas the mean decrease in pulmonary function for the village officials Δ FVC 50% and FEV_1 of 16.7%.

Differences in lung function values before and after working on the miners and office workers are statistically village can be seen in Table 3 is known that there is no statistically significant difference in Δ FVC limestone miners and village officials. As for the parameters Δ FEV_1 there is a statistically significant difference in the limestone miners and village officials. It also looks at differences in pulmonary function values from each respondent before and after work. In miners impaired FEV_1 greater than village officials.

Impaired lung function is on one of the frightening Consequences of the problem of occupational diseases that occur in dusty work environment. Dust inhaled by the workers and entered into the alveoli depends on the solubility and reactivity, due to the higher reactivity of a substance that can reach the alveoli can cause an acute inflammatory reaction.

Age is one important variable occurrence of pulmonary function disorders, Because a person's age Affects the elasticity of the lung. Decline in lung function may occur after the age of 30 years and will Accelerate the decline in pulmonary function after 40 year old man. Therefore it is said that the older the person, the greater the likelihood of decline in lung function, par-ticularly if accompanied by adverse environmental conditions and is supported by other factors that can worsen the condition of a person's lungs. This is evidenced by the age of 30 years miners still have normal lung function as a Measured before and after working.

III.4 Analysis of Effect of Limestone Dust Levels of Personal Against Increased Blood Serum TNFA α and Employee Limestone Miners Village Office

Table 4 Results of Multiple Regression Testing the Blood Serum TNFA Bound Variables, with Dust Levels of Personal Variables and Variable penganggu At Limestone Miners Village Offices and Employees

	TNFA Δ
Group of Respondents	0,160
Levels of Personal Dust	0,250
Age	0.226
Work Period	0.748
Smoking Habits	0.846

p> 0.05 (not significant)

From the results of statistical analysis using multiple regression analysis, the results showed that the levels of personal limestone dust limestone miners statistically no effect on the increase of serum TNFα where p> 0.05. So also at the village office workers, dust levels did not affect the increase in blood serum TNFα. The variables of age, years of service and smoking habits did not affect the increase in TNFα in the blood serum miners and village officials.

TumorNeucrosis Factor (TNF)-α miners after work has increased but the increase was not significant happens when analyzed using a statistical test. So that the levels of inorganic dust is limestone dust do not affect the increase in TNFα in the blood serum.

This is in line with research conducted by [9] that none of the samples of chalk dust cause toxicity in macrophages, personal dust samples also failed to activate macrophages and pro-inflammatory cytokine production. TNFα is increased in some personal dust samples but not significantly.

Another study conducted by [15] that is induced by silica dust samples showed that the increase in IL-1β is the highest increase in workers due to inhalation of silica dust levels. It is inversely proportional to the increase in TNFα and IL-6 were significantly increased but not to the levels of silica dust.

Other studies are in line with this research is research conducted by [16] that the increase in IL-1β is more meaningful to increased levels of dust, when compared with the increase that occurred in TNFα. Because despite the increase, the amount of dust does not significantly affect the increase in TNFα.

One of the proinflammatory cytokines TNFα will coordinate and will lead to an increase in other cytokines such as *IL-1* and *IL-6* induces antigiogenesis, the increase in these cytokines can also occur in the systemic circulation in addition to the respiratory tract. Increased proinflammatory cytokines in the airways is petada local inflammation, it also will give an idea to an increase in systemic inflammatory cells including neutrophils and lymphocytes [17].

III.5 Analysis of Effect of Limestone Dust Levels Decrease Personal against Lung `Function and Employee Limestone Miners Village Office

Table 5 Results of Multiple Regression Test Bound Variables between Decreased lung function, with Dust Levels of Personal Variables and Variable penganggu at Limestone Miners Village Offices and Employees

	Δ FVC	Δ FEV_1
Group of Respondents	0.864	0,036 *
Levels of Personal Dust	0.427	0.404
Age	0.182	0.449
Work Period	0.152	0.704
Smoking Habits	0.783	0.534

*** P <0.05 (significant)**

Changes in lung function that resulted in indications of a common respiratory disease after a person inhales dust particles with a small particle size. In this study by using multiple regression analysis showed that the levels of limestone dust statistically significant effect on the decline in FEV_1, but the amount of dust does not affect the decrease in FVC. Where there is a significant difference in the decrease in FEV_1 between the variables limestone miners and village officials posed by chalk dust levels. Miners decline in FEV_1 was greater after doing mine when compared with village officials.

Personal dust measurement results on limestone miners found an average personal dust has exceeded a predetermined NAB. while the village is known for the employee's office personal respirable dust still under NAB standard has been set, it is supported by the village office environment which is flanked by large trees and cool air.

Dust concentrations have exceeded the NAB should watch out, because of the nature of the dust that floated in the air and small particle size so that the dust will be inhaled by miners continuously during breathing in the mine environment. Dust levels that occur continuously can cause pulmonary reactions mengakitakan lung tissue formation (fibrosis) that affect when a person develops lung disorders [18].

This study is in line with research [5] that examines the content of chalk dust on pulmonary function impairment, which states that the respirable dust levels had a significant association with impaired lung function (p=0.02) and the probability of occurrence of lung problems for respondents who work in the workplace with respirable dust concentration above the NAV 3 mg/m^3 has a significant relationship with the occurrence of pulmonary function impairment.

Another study conducted by [6] stated the same thing, namely the amount of dust has a significant relationship to the decrease in lung capacity obtained using rgegresi test p=0.021. The same was obtained from penelitain done by [19] on the factors affecting the decline in pulmonary function, one of the factors that affect lung function decline is chalk dust levels in large numbers and occur continuously.

In this study the factors of age, years of service and smoking habits did not give significant influence on the decline in pulmonary function limestone miners and village officials.

IV. CONCLUSION

Personal limestone dust levels significantly affect pulmonary function decline in limestone miners when compared with a reduction in lung function village officials. Personal limestone dust levels do not affect the increased blood serum TNFα miners, but the amount of dust effect on the decline in pulmonary function miners.

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