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RESEARCH

THE EFFECT OF DUST EXPOSURE ON LUNG FUNCTION IN WORKERS IN PT CEMENT PUGER JAYA RAYA SENTOSA JEMBER

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ABSTRACT

The purpose of this study was to influence dust exposure on lung function in workers at PT Cement Puger Jaya Raya Sentosa Jember. This research method was quantitative while based on time, including cross sectional. The number of samples in this study amounted to 40 samples, which were taken by proportional random sampling. The data obtained were further analyzed using the Spearman Rho test to test the effect of significance ($\alpha = 0.05$). The results show that the pvalue <0.05 so that there was an effect of dust exposure on lung function in workers at PT Cement Puger Jaya Raya Sentosa Jember, with a positive correlation direction, and a correlation coefficient value of 0.801 which meant there was a strong influence of dust exposure on lung function where the higher the concentration of dust inhaled, the more severe lung function disorders experienced by workers at PT Cement Puger Jaya Raya Sentosa Jember
Keywords: dust, lung function, workers

INTRODUCTION

Impaired pulmonary function in industrial workers in various sectors was one of the causes of high pain and death of workers caused by exposure to dust in the work environment (1). Impaired lung function could disrupt the body's metabolism and reduce the quality of human life. Increased incidence of lung function disorders caused by increased industrialization in various countries including Indonesia. The development of industry causes an increase in air pollution and could directly affect the pulmonary function of its workers. Impaired lung function of workers mainly due to industrial dust including cement dust. The cement industry could remove cement dust particles, sulfur dioxide gas, carbon dioxide, ammonia, and hydrocarbons attached to the alveoli wall so that it disrupts lung function. Lung function in cement factory workers was important to study because cement dust could decrease lung function and increase respiratory resistance which results in increased morbidity and mortality in cement factory workers (2). Impaired lung function due to exposure to the results of the cement industry was still receiving less attention, even though this should be prevented but often overlooked due to economic benefits. The dust produced by the activities of the cement industry affects the environment and humans. Dust that was inhaled by labor could

cause lung dysfunction. These abnormalities occur due to damage to lung tissue which could affect productivity and quality of work (3).

Nordby et al (2016) research results on 4966 workers in 24 cement production plants in Norway show that exposure to cement dust was associated with a reduction in forced expiratory volume in 1 second (FEV1), forced expiratory volume in 6 seconds and forced vital capacity (FVC). The higher the dust level, the higher the lung function disorder experienced by workers. The results of the study (4) of 38 workers who worked in the Cement Carrying Unit of PT. Tonasa Line Bitung City suggested the results that workers who experience lung function disorders as many as 21 people (55.3%). The results of the study (5) of 10 Finish Mill unit operators at PT Semen Indonesia showed that 22.2% of operators who had inhaled dust levels> 3 mg/m3 experienced pulmonary physiology.

The results of a preliminary study conducted on November 7, 2019 at PT Cement Puger Jaya Raya Sentosa Jember showed that workers in the open space were crusher, raw material vessel, combustion, cement container, packing, security, welder, and loader operator, totaling 152 people , and in a closed room namely the office, laboratory and quality control which includes analysis, instruments, control, and finishing, and the control room, totaling 82 people. Preliminary observations on 5 workers encountered during the preliminary study showed 3 workers (60%) did not wear masks while working and appeared to cough as cement dust burst from the cement packing. The factory worker health report for 2018 showed that there were 21 workers (8.97%) who experienced COPD.

Workers in a cement factory were exposed to air (dust) particles generated from cement and raw materials during cement production. Employees in the construction industry were also exposed to dust containing cement, although in lower concentrations (6). Clinker was the main component of cement. Clinkers were made by heating a mixture of fine particles from limestone and clay, and other sources of constituents needed for calcium, silicon, iron and aluminum, in kilns up to 1450 0C. The clinker was ground with gypsum, forming cement, which had different properties from the raw material. Cement had strong alkali and irritation properties when mixed with water. Inhaling dust during semen production had been linked to airway symptoms and obstructive pulmonary changes (7).

Pulmonary function was not only affected by cement dust, but could also be caused by age factors where increasing age causes the ability to develop lung wall decreases and loss of expiratory muscle strength, height because a person's height also affects the size of the lungs, an increase in body weight could decreases total lung capacity, and was also influenced by gender where men had larger lungs than women, and consequently, greater bronchial counts, greater alveolar surface area, and broader airway caliber. The position of the body affects lung function because the lung volume was higher when the subject was standing than in other positions, due to an increase in chest cavity volume. Race/ethnicity was also considered to affect lung function although there were still no adequate indicators besides height in certain ethnicities (8). Pulmonary function was also influenced by exercise habits. Exercise could increase blood flow to the lungs so that oxygen could diffuse into the lung capillaries with a greater or maximum volume (9).

Regulation of the Minister of Manpower and Transmigration Number 13 of 2011 concerning Threshold Value of Physical Factors and Chemical Factors in the Workplace and Regulation of the Minister of Health of the Republic of Indonesia Number 70 of 2016 concerning Standards and Health Requirements of the Industrial Work Environment that was equal to 3 mg/m^3. Operators who work continuously in a work environment with inhaled dust dust levels exceeding the threshold value would be very dangerous because they could cause

chronic respiratory diseases such as pulmonary emphysema, bronchial asthma, chronic bronchitis and even lung cancer resulting in worker death (6).

Efforts could be made to prevent greater exposure to cement dust, workers could use masks to prevent the flow of dust into the lungs. Lung physiology examination for workers was an effort to prevent/detect early so that chronic obstructive pulmonary disease (COPD) does not occur which was irreversible. Pulmonary physiology tests were recommended for workers exposed to dust to be carried out annually (10). Much research had been done on cement factory workers about the detrimental effects of exposure to cement dust on the respiratory system and had focused on lung function and symptoms, but the relationship between cement dust exposure and impaired lung function was still difficult to explain due to various other factors involved such as age , sex and smoking. Based on the background above, the researchers were interested in examining the effect of dust exposure on lung function in workers at PT Cement Puger Jaya Raya Sentosa Jember.

METHODS

This type of research was observational analytic and quantitative, while based on time, including cross sectional. The dependent variable was lung function which includes FVC, FEV1, FEV1%, FVC% Prediction using spirometry. While the independent variable was dust exposure. The number of samples in this study amounted to 40 samples, which were taken by proportional random sampling. The data obtained were further analyzed using the Spearman Rho test to test the effect of significance ($\alpha = 0.05$) with the help of a computer application program based on SPSS. The data collection tools used were spirometer and observaso sheet. Researchers conducted a research ethics test at the medical faculty in Jember University with certificate number 663/UN25.8/KEPK/DL/2019.

RESULTS

Table 1 Descriptive Characteristics Statistics at PT Cement Puger Jaya Raya Sentosa Jember February 2020

Characteristics	n	Min	Max	Mean	SD
Age (years)	40	26	45	32.32	3.82
Height (cm)	40	160	187	168.20	6.77
Weight (kg)	40	47	102	64.68	11.22

Based on the table above, from 40 respondent workers at PT Cement Puger Jaya Raya Sentosa Jember it could be seen that the youngest respondent's age was 26 years and the oldest was 45 years with an average of 32 years and a standard deviation of 3.82, a minimum height of 160 cm and the highest 187 cm with an average of 168 cm and a standard deviation of 6.77, a minimum body weight of 47 kg and a maximum of 102 kg with an average of 65 kg and a standard deviation of 11.22.

Table 2 Characteristic Frequency Distribution at PT Cement Puger Jaya Raya Sentosa Jember February 2020

Characteristics	f	%
Workspace		
Closed	13	32.5%
Open	27	67.5%
Smoking habit		
Do not smoke	13	32.5%
Smoke	27	67.5%
Sports Habits		
Regular exercise	15	37.5%
No Exercise Routine	25	62.5%
PPE usage		
Do not use PPE	17	42.5%
Using PPE	23	57.5%
	40	100%

Based on the results of the descriptive analysis in the above table, it was informed that of the 40 workers at PT Cement Puger Jaya Raya Sentosa Jember, the majority of 67.5% of respondents worked in open spaces, and 32.5% of respondents worked in closed spaces. Based on the characteristics of smoking habits it was known that 67.5% of respondents smoke, and 32.5% of respondents did not smoke. Based on the characteristics of exercise habits it was known that 62.5% of respondents did not routinely did sports, while those who routinely did sports were 37.5%. Based on the use of PPE it was known that 57.5% of respondents wear masks and 42.5% of respondents did not use PPE.

Dust content in PT Cement Puger Jaya Raya Sentosa Jember.

Table 3 Distribution of Frequency of Dust Exposure to Workers at PT Cement Puger Jaya Raya Sentosa Jember February 2020

No	Kategori	Frequency (f)	Percentage
1	≤ Treshold 3 mg/m^3	12	30.0
2	> Treshold 3 mg/m^3	28	70.0
	n	40	100 %

Based on the results of the descriptive analysis in the table above, it was informed that of the 40 workers at PT Cement Puger Jaya Raya Sentosa Jember, at most 70.0% of respondents received dust exposure above the 3 mg/m3 threshold, while 30.0% of respondents received dust exposure ≤ threshold 3 mg/m3. The lowest dust exposure was 1.83 mg/m3, while the highest dust exposure was 19.57 mg/m3 with an average of 9.20 mg/m3. This suggested that workers at PT Cement Puger Jaya Raya Sentosa Jember get dust exposure above the threshold.

Lung Function at Workers at PT Cement Puger Jaya Raya Sentosa Jember

Table 4 Descriptive Statistics of Lung Functions in Workers at PT Cement Puger Jaya Raya Sentosa Jember in February 2020

Characteristics	n	Min	Max	Mean	SD
Forced Vital Capacity (FVC) (L)	40	1.73	4.70	3.26	0.63
Forced Expiration Volume 1 second (FEV1) (L)	40	1.62	3.59	2.69	0.53
FEV1%	40	46.50	97.20	84.09	1.59
FVC% prediction	40	48.20	98.10	81.26	1.23

Based on the results of the descriptive analysis in the above table, it could be seen that the respondent's FVC was at least 1.73 L and the largest was 4.70 L with an average of 3.26 L and a standard deviation of 0.63, the FEV1 of the respondent was the smallest 1.62 L and the highest was 3.59 L with an average of 2.69 L and standard deviation of 0.53, FEV1% of respondents at least 46.50% and greatest of 97.20% with an average of 84.09% and standard deviations of 1.59, FVC% Prediction of the smallest respondents 48.20% and the greatest of 98.10% with an average of 81.26% and standard deviations 1.23.

Table 5 Distribution of Lung Function Disorders Frequency in Workers at PT Cement Puger Jaya Raya Sentosa Jember February 2020

No	Category	Frequency (f)	Percentage
1	Combination of Obstructive and Restrictive	5	12.5%
2	Obstructive Pulmonary Function	8	20.0%
3	Restrictive Lung Function	14	35.0%
4	Normal Lung Function	13	32.5%
	n	40	100 %

Based on the results of the descriptive analysis in the above table, it was informed that of the 40 workers at PT Cement Puger Jaya Raya Sentosa Jember, the most experienced restrictive pulmonary function impairment was 35%, while the least was obstructive and restrictive combination lung function impairment as much as 12.5%. This suggested that workers at PT Cement Puger Jaya Raya Sentosa Jember mostly experienced lung function disorders.

Effect of Dust Exposure on Lung Function

Table 8 Cross Tabulation of Dust Concentration with Lung Functions in Workers at PT Cement Puger Jaya Raya Sentosa Jember

Dust Concentration	Lung Function								Total	
	Normal		Restrictive		Obstructive		Combination			
	f	%	f	%	f	%	f	%	f	%
≤ Treshold 3 mg/m^3	12	100	0	0	0	0	0	0	12	100
> Treshold 3 mg/m^3	1	3.6	14	50.0	8	28.6	5	17.9	28	100
Total	13	32.5	14	35	8	20.0	5	12.5	40	10

The results of the cross tabulation showed that all (100%) of the 12 respondents who received dust exposure ≤ treshold 3 mg/m^3 had normal lung function, while half (50%) of the 28 respondents who received dust exposure> treshold 3 mg/m^3 had impaired function restrictive lung. Impaired pulmonary function was obtained from a combination of FEV1%, FVC% Prediction, so that known pulmonary function of normal workers, experiencing restrictive, obstructive, or a combination of obstructive and restrictive.

Spearman's rho bivariate test results on the effect of dust exposure on pulmonary function show that:

Table 9 Results of the Spearman-s Rho Test

Result	Value
Coeffisien correlation	0.801
pvalue	0.000

The table above suggested that the pvalue <0.05 so that there was an influence of dust exposure effect on lung function in workers at PT Cement Puger Jaya Raya Sentosa Jember, with a positive correlation direction, and a coefficient correlation value of 0.801 which meant there was a strong influence of dust exposure on lung function where the higher the concentration of dust inhaled, the more severe lung function disorders experienced by workers at PT Cement Puger Jaya Raya Sentosa Jember.

Effect of Respondent Characteristics on Lung Function

Table 10 Loglinear Modeling Results for Age, Height, Weight, Smoking Habits, Work Space, Sports Habits, PPE Use Against Lung Function in Workers at PT Cement Puger Jaya Raya Sentosa Jember

Characteristics	*pvalue*	*Rsquared*
Age	0.009	
Height	0.249	
Weight	0.755	
Smoking habit	0.026	0.708
Workspace	0.000	
Sports Habits	0.202	
PPE usage	0.978	

The table above suggested that simultaneously, worker characteristics affect lung function by 0.708 or 70.8% while 29.2% were influenced by other factors. Factors that had a significant partial effect were age, smoking and workspace, while height, weight, exercise habits, and PPE usage did not had a significant effect.

DISCUSSION

Effect of Dust Exposure on Lung Function

The test results show a pvalue <0.05 so that there was an influence of the effect of dust exposure on lung function in workers at PT Cement Puger Jaya Raya Sentosa Jember, with a positive correlation direction, and a correlation coefficient value of 0.801 which meant there

was a strong influence of dust exposure on the function lung where the higher the concentration of dust inhaled, the more severe lung function disorders experienced by workers at PT Cement Puger Jaya Raya Sentosa Jember. Impaired pulmonary function obtained from a combination of FEV1%, FVC% Prediction, so that known lung function of normal workers, restrictive, obstructive, or a combination of obstructive and restrictive.

Impaired lung function of workers mainly due to industrial dust including cement dust. The cement industry could remove cement dust particles, sulfur dioxide gas, carbon dioxide, ammonia, and hydrocarbons attached to the alveoli wall so that it disrupts lung function. Cement dust could reduce lung function and increase respiratory resistance (2). The dust produced by the activities of the cement industry affects the environment and humans. Dust that was inhaled by labor could cause lung dysfunction (3).

Respirable dust was dust or particles that were small enough to enter the nose to the upper respiratory system and into the inner lungs. Particles that enter the inner part of the lungs or the inner respiratory system in general cannot be removed by the body's natural mechanism system (cilia and mucous) so as a result these particles would stay forever in the lungs. The vast surface of the lungs, which was only separated by a thin membrane from the circulatory system, theoretically results in a person being vulnerable to the entry of foreign matter (dust) and bacteria that enter with inspirational air (11). Polluted air enters the body through the mouth to the lungs and then absorbed into the bloodstream, settled or could be removed from the lungs by fine hair cells (2).

The results of this study were consistent with the results of previous studies conducted by Nordby et al (2016) which show that exposure to cement dust was associated with a reduction in forced expiratory volume in 1 second (FEV1), forced expiratory volume in 6 seconds and forced vital capacity. For FEV1%, it was predicted that a decrease in annual excess of 0.84 percentage points was found in the highest exposure quintile compared to the lowest. Exposure to higher levels found in this study could cause a dynamic decrease in lung volume. According to the researchers, based on the theory and results of the research that supports the above, respondents who experienced dust exposure exceeding the threshold, almost all of them experienced obstructive, restrictive, or combined lung function disorders, this was due to a decrease in dynamic lung function especially FEV1 and FVC, because in people who had normal lung function, the FVC value was almost the same as the VC value, but in an obstructive and restrictive state, FVC tends to decrease or much lower than VC. Normal lung function could be detected with FVC values nilai 80% prediction, FEV1 ≥ 80% prediction, FEV1%> 70%, and FVC% ≥ 80%, obstructive pulmonary function when FVC values ≥ 80% prediction, FEV1 <80% prediction, FEV1 % <70%, restrictive pulmonary function if FVC value ≥ 80% prediction, FEV1 normal or <80% prediction, FEV1%> 70%, and FVC% <80%, and impaired combined pulmonary function if FVC value <80% prediction, FEV1 <80% prediction, FEV1% <70%. Dust in the factory was mostly cement dust which was very delicate and does not dissolve in water, making it difficult to be removed by mucus (mucus) in the airways that causes precipitation in the alveoli, this would cause the lungs could not develop fully due to sediment dust, causing impaired pulmonary function. In some individuals, with maximum effort, air could enter the lungs and develop the lungs, but the air that had already entered the alveoli would be blocked by dust deposition that the more the greater the barriers to air expenditure which also cause obstructive pulmonary function disorders. Inhalation of dust could cause lung function and capacity abnormalities due to damage to lung tissue. The results of this study were also in line with research by Sihombing (2013), which

states that workers who inhale dust mostly suffer from restrictive lung function disorders. The dust could damage lung tissue and make the airway become congested.

Effect of Age on Lung Function

The results showed that the age of the youngest respondents was 26 years and the oldest was 45 years with an average of 32 years and a standard deviation of 3.82. Age significantly influences lung function in PT Cement Puger Jaya Raya Sentosa workers. Age had historically been one of the main factors in evaluating lung function. Lung maturity reaches around 20-25 years, after which lung function begins to progressively decline. The variables most affected were forced vital capacity (FVC) and forced expiratory volume in 1 second (FEV1); this decrease with increasing age due to decreased ability to expand the chest wall, loss of expiratory muscle strength, and a tendency to increase the smaller airways to be closed during forced expiration. FEV1 decreases around 20 ml/year between the ages of 25 and 39 years, a level that gradually increases to reach 35 ml/year after age 65 (8). This was in accordance with research conducted by (12) in Sragen Regency showing there was a relationship between age and the pulmonary function of UD furniture workers. Indri Jati and UD Wanna Jati ($p = 0.021$).

According to the researchers, the results of this study were in accordance with the theory that age factors affect lung function including FVC and FEV1. The results showed that with age, the lung function also decreased. This was due to the decreased elasticity of the lungs so that the ability of the lungs to expand and deflate was not as good as at a young time, this causes lung function disorders. Lung function which was strongly influenced by age was FVC and FEV1 where both of these functions were parameters of lung function disorders, decreasing FVC and FEV1 values cause both restrictive and obstructive.

Effect of Height on Lung Function

The results of research at PT Cement Puger Jaya Raya Sentosa Jember could be seen that a minimum height of 160 cm and a height of 187 cm with an average of 168 cm and a standard deviation of 6.77. Height does not affect overall lung function because the pvalue> 0.05. Some parameters, such as TLC, VC, RV, FVC and FEV1, were affected by height, because they were proportional to body size. This meant that in tall individuals, which correspond to greater lung capacity, lung volume would decrease at a greater rate for shorter individuals as they get older (8).

According to researchers, in general height might affect lung function, but in certain cases, height effect was not too significant, especially if the respondent was often exposed to dust or other micro particles that could settle in the lungs and cause lung function disorders. Height could affect lung function under normal circumstances, meaning that it distinguishes the magnitude of the lung capacity between tall people and those who were shorter in normal circumstances without any other knowing factors, therefore, in this study the results obtained were not related, due to predicting impaired function Lung was obtained from the ratio of FVC and FEV1, not the value of pure FVC and FEV1, so that tall people who had FVC and FEV1 greater than shorter people would still get almost the same ratio as shorter people.

Effect of Weight on Lung Function

The results of research at PT Cement Puger Jaya Raya Sentosa Jember could be seen that a minimum body weight of 47 kg and a maximum of 102 kg with an average of 65 kg and a standard deviation of 11.22. Body weight did not affect lung function in cement factory

workers at PT Cement Puger Jaya Raya Sentosa Jember, as evidenced by pvalue> 0.05. TLC decreases when body mass index (BMI) increases, although the decrease was not significant, even in unnatural obesity. The preservation of TLC and VC was caused by the effect of IC compensation, which increases with obesity. This increase in IC and the corresponding decrease in RV was due to the transfer of the diaphragm to the chest cavity as a result of mechanical pressure exerted by excess fat. As a result, tidal volume (VT) at rest and during physical exercise tends to decrease, resulting in smaller expiratory flow (Barosso et al, 2018).

According to researchers, as explained in the theory above, that the decrease in lung function due to weight gain was not too significant, so that it could cause a very small effect of body weight, especially if the respondent had a height in accordance with body weight or in other words had a BMI normal, then body weight had no effect on lung function. Similar to height, people who weigh more than others would not had a significant effect on lung function because lung function here was obtained from the ratio of FVC and FEV1. Based on the above theory it was also mentioned that the affected lung function tends to be on TLC (total lung capacity/total lung capacity), vital capacity (VC), not on the value of FVC and FEV1.

Effect of Smoking Habits on Lung Function

The results of research at PT Cement Puger Jaya Raya Sentosa Jember could be seen that 67.5% of respondents smoke, and 32.5% of respondents did not smoke. Smoking had a significant effect on the lung function of workers at PT Cement Puger Jaya Raya Sentosa Jember. Cigarette smoke that was inhaled contains chemicals that could stimulate respiratory tract cells, resulting in accumulation of mucus or phlegm. A smoker experiences paralysis of the vibrating hair. Vibrating fur found in the respiratory tract that functions as a cough reflex was largely paralyzed by cigarette smoke so that phlegm or phlegm cannot be completely removed. Long mucus that was retained in the respiratory tract would cause the development of bacteria that would cause chronic bronchitis. This was different from when you catch a cold, because the flu was caused by the stimulation of dust, viruses or bacteria so that the sputum from the flu virus would be pushed out by vibrating hairs by stimulating cough reflexes. Tar particles contained in cigarette smoke would settle in the mucus that was long enough in the respiratory tract so that there would be chronic stimulation of tar that causes changes in the shape of the lung cells (13).

The results of this study were supported by research conducted by (12) in Sragen Regency which suggested that there was a relationship between the use of PPE and the pulmonary function capacity of UD furniture workers. Indri Jati and UD. Wanna Jati (p = 0.019).

According to researchers, the influence of smoking habits on lung function was due to the many other factors that cause lung function decline. Cigarettes themselves contain various kinds of substances that could settle in the lungs such as nicotine and tar, the more cigarettes smoked every day, the more chemical deposits in the lungs, which when added to inhaled dust, would worsen lung function disorders, alveoli would had difficulty catching air, because the room in the alveoli had been filled with cigarette chemicals and dust deposition. As a result the lungs would find it difficult to expand and deflate which causes obstructive and restrictive pulmonary disorders. Workers who smoke and were in a dusty work environment tend to experience lung function disorders compared to workers who were in a dusty environment but did not smoke. Respondents who had the habit of smoking could affect the capacity of lung function, in addition, it was worsened by the presence of active dust levels which allows respondents to be affected by lung function disorders.

Effect of Work Space on Lung Function

The results of research at PT Cement Puger Jaya Raya Sentosa Jember showed that most 67.5% of respondents work in open spaces, and 32.5% of respondents work in closed spaces. The workspace influences lung function especially tidal volume, FEV1, MVV and impaired lung function in workers at PT Cement Puger Jaya Raya Sentosa Jember. Dust and smoke, including pollutants that could pollute the air in the production room. Indoor air pollution was more dangerous for its occupants than outdoor air pollution because it had greater levels and was 1000 times more able to reach the lungs (14). Pollutants could increase from outside the room, from smoking and also could not come out freely into the ambient air because it was not supported by good ventilation (Mukono, 2011).

The greater the level of dust in the work area, it would also increase the risk of pulmonary physiology due to high dust exposure. The level of dust contained in the air causes more dust to be contained in the lungs so that it could more quickly and easily make the condition of lung function decrease and the individual was susceptible to disease, especially respiratory disease. This study was in line with research conducted by Ardam (2015) which states that there was a significant relationship between dust exposure and pulmonary physiology. The higher the level of dust exposure in the power plant overhaul, the higher the likelihood of workers experiencing pulmonary physiology.

According to researchers, the theory was different in context from the one at PT Cement Puger Jaya Raya Sentosa Jember, where in this study the definition of closed space was the office part that was not exposed to cement dust, air-conditioned room so that cement dust does not easily enter the room and dust levels were lower than those in open spaces such as the production department, namely packing, moci, combustion, etc. which were directly exposed to cement dust so that dust was inhaled more, deposition of more particles so that workers who work outside more rooms experience lung function disorders compared to workers who were in closed rooms. Exposure to dust in a cement plant was quite high because it exceeds the threshold allowed in industry by the Ministry of Manpower of the Republic of Indonesia. In addition, the effect of smoking was also not significant because some workers who were diligent in exercising or had a high activity so that their lungs were also trained which causes smoking to not affect the lung function of cement factory workers.

Effect of Sports Habits on Lung Function

The results of research at PT Cement Puger Jaya Raya Sentosa Jember showed that 52.5% of respondents did not routinely did sports, while those who routinely did sports were only 17.5%. Exercise habits had no effect on the lung function of PT Cement Puger Jaya Raya Sentosa Jember workers as evidenced by pvalue> 0.05. Exercise could increase blood flow to the lungs so that oxygen could diffuse into the capillaries of the lungs with a larger or maximum volume. Athletes usually had a greater lung vital capacity than people who had never exercised. Exercise habits could increase lung capacity by 30-40%. In sports there was one important element that was important in physical fitness, namely the function of breathing. Regular exercise could increase blood flow through the lungs which would cause the pulmonary capillaries to get maximum perfusion, so that O2 could diffuse into the lung capillaries with a greater or maximum volume. Sports should be done at least three times a week (9).

According to researchers, exercise was very good for health, but that does not mean people who were diligent in sports would not be able to experience impaired lung function because the cause of impaired lung function was influenced by many factors. Exercise

facilitates blood and oxygen flow throughout the body, this could occur in normal conditions or exposed to dust in a threshold that could be tolerated by the body and could be removed from the lungs by cilia, but it was different if workers experience exposure to dust that exceeds the body's ability threshold to remove dust so that dust that enters the lungs in high levels would cause sedimentation in the lungs so that respondents could experience lung function disorders, in addition, if the respondent also smokes would increase the number of particles that settle in the lungs, causing lung function disorders.

Effect of PPE Use on Lung Function

The results of research at PT Cement Puger Jaya Raya Sentosa showed that the use of PPE was known that 57.5% of respondents wore masks and 42.5% of respondents did not use PPE. The use of PPE had no effect on the lung function of workers at PT Cement Puger Jaya Raya Sentosa Jember, especially FEV1 and impaired lung function. Respiratory protection had a function to filter out chemical contaminants, dust particles, microorganisms, smoke, steam, aerosols, or other impurities that pollute the air that was inhaled but could only filter particles in large sizes and visible to the eye (ILO, 2013).

This was supported by research which suggested that there was no relationship between the use of personal protective equipment (PPE) with impaired pulmonary function with a p value = 0,250 (15).

According to researchers, personal protective equipment, especially respiratory protective equipment was very important in protecting the lungs from dust exposure, but not all masks could protect lungs from dust exposure, because some fine particles could pass through the sidelines of the mask and enter the lungs to disrupt lung function . Workers who did not use standard masks would increase the risk of lung function disorders. Although some respondents already use PPE, but some were still affected by lung function disorders. Impaired lung function could occur due to dusty work environment, age of the respondent, smoking habits. Personal protective equipment used by workers measured in this study was the use of masks. The use of PPE was simply a set of tools used by workers to protect part or all of their bodies from potential hazards or work accidents. PPE does not perfectly protect the body, but could reduce the severity that might occur. Respondents whose activities were exposed to dust particles need protective equipment such as masks to reduce the number of particles that could be inhaled. Compliant respondents who wear masks when working in dusty areas would minimize the amount of exposure to dust particles that could be inhaled. In addition to the amount of exposure, the particle size that might escape the mask becomes small

CONCLUSION

Based on the results of the study it could be concluded that the description of the characteristics of workers at PT Cement Puger Jaya Raya Sentosa Jember were the average age of respondents 32 years, average height 168 cm, average weight 65 kg, smoking habits were mostly smoking, some Most respondents work in open spaces, most respondents did not routinely did sports, and most respondents use PPE. There was an influence of dust concentration on lung function in workers at PT Cement Puger Jaya Raya Sentosa Jember.

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