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The Causes Analysis of Pulmonary Function Disorders at Semen X Company

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Abstract

Abstract. The cement industry is the largest manufacturing industry, vital for sustainable development, and very risky for workers to be exposed to dust in various processes, including production. Continuous exposure to dust can cause pulmonary function disorders. This study aimed to analyze the relationship between dust exposure, age, length of work, working period, use of PPE (masks), smoking habits, and pulmonary function disorders in labor. This research used an observational method with a cross-sectional approach. The research sample was a total population of 38 male workers at Semen X company, engaged in the cement bagging industry as business activities. Data collection was by interviewing respondents, measuring the level of inhaled dust with a personal dust sampler, and checking the lung capacity with a spirometer. Data analysis was performed bivariate with the chi-square test. The results showed that there was a relationship between the use of PPE (mask) (p = 0.006) with pulmonary function disorders.

Introduction

The industrial sector rapidly grows and changes the pattern of disease in society, including among workers. Many workers spend their time daily at work and have health risks and occupational diseases from work exposures and activities (Sunaryo, 2020). An occupational disease is a disease caused by the effect of activities in the work environment and caused by physical, biological, psychosocial, and biological risk factors (Salawati, 2015). Respiratory disease caused by work activities is a global disease that is a health problem that contributes to as much as 30% of occupational diseases. In addition, 10-20% of death, are caused by respiratory matters (Gizaw et al., 2016). According to (Habybabady et al., 2018), when carrying out work activities, workers are vulnerable to being exposed to hazards or risks.

One of the hazards or risks that can affect the health of workers is dust. When dust enters the human body through the respiratory tract, it will cause harmful effects, especially it can cause health problems (Oktaviani & Prasasti, 2015). Dust is a small solid particle having a diameter of about 1 to 100 μm suspended in the air resulting from drilling, sifting, crushing, grinding, and blasting activities (WHO, 2014). There are various types of dust. After all, cotton dust, asbestos, wood, cement, coal, and others. The dust has the property of being able to settle because it is influenced by the force of gravity, forming lumps because the surface is constantly wet due to being coated with water and can catch the opposite particles (Tureková et al., 2019). Long-term dust exposure causes respiratory health problems (Fallahian, 2019). According to (WHO, 2017), the number three cause of death related to work is a respiratory disease, which is 21%.

The health risks caused by inhaled dust particles are affected by the exposure time and the biological response caused by the dust particles (Yang et al., 2020). The cement industry sector is the largest manufacturing industry required for sustainable development.

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In addition, the cement industry sector also causes environmental pollution at all stages of the process, including production. The environmental pollution generated from the cement industry sector is air pollution in the form of gases, noise, vibrations, and dust. The cement industry is related to dust exposure which contributes to silicosis, bronchitis, and pulmonary function disorders (Sana et al., 2013). Lung function disorders are occupational respiratory disorders that often occur in workers exposed to dust in the industrial sector, including the cement industry (Zeleke et al., 2010). In addition to disturbances in the respiratory system, dust pollution can cause cardiovascular disorders (Manisalidis et al., 2020). This study aims to analyze the relationship between dust exposure, age, work duration, length of service, use of PPE (masks), smoking habits, and pulmonary function disorders in labor.

Method

The research design was cross-sectional, measuring exposure to cement dust, age, length of work, working period, use of PPE, smoking habits, and associated pulmonary function disorders. Where these variables are examined at the same time to determine the relationship between these variables. This research took place at the Semen X Company, Mempawah Regency, West Kalimantan Province. It was engaged in the Cement Packaging industry as a business activity. The impact of cement bagging production activities was air pollution from cement dust. The types of activities carried out were receiving materials from the docks and shelters, as well as the process of packaging/bagging cement powder in bags and distributing them to distributors. The results of field observations in the factory area were visible flying dust, not only seen in the cement bagging production area but also in the raw material storage area, the factory machine area, and the road where factory vehicles pass. Cement dust particles have the highest level of toxicity compared to other air pollutants, so they are the most dangerous for health. The bagged cement production capacity was 600,000 tons/year. The raw material comes from the parent company of the cement factory in Tabalong Regency, South Kalimantan. Production materials are transported to Pontianak by cement Bulk ship, cement bag packaging was 40 kg and 50 kg by refer to market developments.

There were 38 workers in the cement packing/packing production division. The characteristics of male workers, aged 20 to 54 years (most of them are 20-30 years old), working hours start at 8 am – 4 pm (8 hours), maximum working hours were three years (the new company operating in 2017). Workers used PPE in the form of cloth masks. Most of the workers have smoking behavior. The research sample was the total population, which was 38 male workers. Data collection in this study was by interviewing about age, length of work, working period, use of PPE, smoking habits, and data on workers' lung function measured using a spirometer. Measurement of the inhaled dust level using a personal dust sampler. Then the data from observations, measurements, and research interviews were analyzed bivariate with statistical tests using the chi-square test at the 95% confidence level to find the relationship between the research variables. The test was at the significance level ($\alpha = 5\%$). If $p \leq 0.05$, the test results were significant. This research was conducted under the Helsinki declaration guidelines. The research design was explained to the participating workers. Written consent was obtained from all workers who participated in the study.

Result and Discussion

The Semen X company was engaged in the cement industry. The activities are receiving, holding, and the packing or packing cement powder into bags to be distributed to the distributor. It was founded in 2017 and started production activities in 2018. Its type and production capacity is divided into two products. Namely cement in bags and bulk cement. The number of workers is 38 men, with the age range of 20-40 years. The standard working hour schedule starts from 8 am- 4 pm, working time is 8 hours/day and 40 hours/week.

TABLE 1. The Variable Frequency Distribution for Workers of *Semen* X Company, Mempawah Regency in 2020

Variable	Category	N	(%)
Dust inhaled	>1,0 mg/m^3	10	26,3
	≤ 1,0 mg/m^3	28	73,7
Age	20-40 years	33	86,8
	>40 years	5	13,2
Length of Working	> 8 hour/day	22	57,9
	≤ 8 hour/day	16	42,1
Working Period	2-3 years	35	92,1
	≤1 year	3	7,9
Use of PPE	Do not use PPE	14	36,8
	Use PPE	24	63,2
Smoking Habit	Smoking	32	84,2
	Do not smoking	6	15,8
Pulmonary Function Disorders	Distraction	9	23,7
	Normal	29	76,3

Source: Primary Data, 2020

Table 1 shows that inhaled dust levels > 1.0 mg/m3 were experienced by 26.3% of workers. Workers aged > 40 years are (13.2%). Length of working hours, 57.9% is > 8 hours/day. Most of the workers (92.1%) have worked 2-3 years. 36.8% of workers do not use PPE. Workers who have a smoking habit are 84.2%. Workers who experience lung function disorders are 23.7%.

TABLE 2. The Analysis of Inhaled Dust Levels (Respirable) with Pulmonary Function Disorders in Workers at *Semen X* Company Mempawah Regency in 2020

No	Dust Inhaled	Pulmonary Function Disorders				Total		*p value*[a]	OR
		Distraction		Normal		N	%		
		n	%	n	%				
1	**>1,0 mg/m^3**	4	40,0	6	60,0	10	26,3		
2	**≤ 1,0 mg/m^3**	5	17,9	23	82,1	28	73,7	0,205*	3,067
Total		9	23,7	29	76,3	38	100		

Source: Primary Data, 2020

[a] Chi Square, α = 5%; *Significance p ≤ 0.05

Based on statistical test results between the variable levels of inhaled dust and pulmonary function disorders, obtained p value = 0.205, it can be concluded that there was no significant relationship between inhaled dust levels and pulmonary function disorders among workers. However, workers with inhaled dust levels > 1.0 mg/m3 tend to have a greater risk of experiencing lung function disorders 3.067 times greater than workers with dust levels <1.0 mg/m3. The inhaled dust level was one of the causes of pulmonary dysfunction, as cement dust was inhaled and enters through the nose, throat, and lungs. Dust build-up in the lungs can occur when inhaled with a size of 1-3 μ (respirable dust). If the respiratory dust accumulates in the lungs and exceeds the threshold value, it can cause pneumoconiosis (Nafisa et al., 2016). To minimize lung dysfunction due to inhaled cement dust, workers must undergo periodic medical examinations and regular work rotation changes (Shanshal & Al-Qazaz, 2020).

TABLE 3. Analysis of Age, Working Period and Length of Work with Pulmonary Function Disorders in Workers at *Semen* X Company, Mempawah Regency in 2020

Variable	Category	Pulmonary Function Disorders				Total		p value [a]	OR
		Distraction		Normal		N	%		
		n	%	n	%				
Age	>40 years	1	20	4	80	5	13,2		
	20-30 years	8	24,4	25	75,8	33	86,8	1,000*	0,781
Total		9	23,7	29	76,3	38	100		
Working	>8 hours/day	4	18,2	18	81,8	22	57,9		
Length/day	≤ 8 hours/day	5	31,3	11	68,8	16	42,1	0,450*	0,489
Total		9	23,7	29	76,3	38	100		
Working	2-3 years	9	25,7	26	74,3	35	92,1		
Period	≤1 year	0	0	3	100	3	7,9	1,000*	0
Total		9	23,7	29	76,3	38	100,0		

Source: Primary Data,2020

[a] Chi Square, α = 5%; *Significance p ≤ 0.05

Based on the statistical test results between the variable age and lung function disorders, the results obtained a p-value = 1,000. So there is no significant relationship between age and lung function disorders. It was in line with research (Qian et al., 2016), because age was not a crucial factor that can cause pulmonary function disorders in workers. But age can also be a risk factor for decreased lung function leading to function disorder (Meo et al., 2013). Pulmonary Function Disorders of workers were affected by age factors because the older a person was, the more susceptible to health risks (Hasan & Maranatha, 2019). The age factor was a factor that can also affect the condition of a person's lungs. The older a person was, the performance and function of body organs decrease, which causes changes in bone tissue, muscles, nervous system, and organs including the lungs, causing a decrease in the immune system and susceptibility to disease (Pinugroho & Kusumawati, 2017). Decreased lung function can cause lung function disorders caused by damage to the elastic tissue of the lung due to age (Kumari Prasad et al., 2019).

Furthermore, statistical tests result between the variable length of work and pulmonary function disorders, the results obtained p-value = 0.450, it can be concluded that there was no significant relationship between the work duration and lung function disorders, aligned with the results of the study (Irjayanti et al., 2012) found no significant relationship between them in workers because the length of work did not guarantee that exposure to inhaled dust causes lung function disorders was also getting severe. After all, the exposures number for each person was different.

The working period was related to the duration of the worker starting at the place calculated in the annual period (Fatimah et al., 2018). Based on the results of statistical tests using the chi-square test at the 95% confidence level, the results obtained a p-value = 1,000 indicate no significant relationship between tenure and lung function. This case is in line with the previous research (Yuvaraj et al., 2016) that tenure or working period was not related to pulmonary function disorders in workers. It was because all respondents have a working period of (less than) < 10 years, as shown in table 1. Occupational diseases such as pulmonary function disorders appear with an average period of > 10 years. Based on research in China, a group of workers who had a service period of (more than) > 10 years, experience lung function disorders with a p-value of < 0.05 (Bian et al., 2015). The working period was related to a decrease in lung function capacity because the longer the worker work in a risky place (exposure to dust) will impact health problem, especially those related to respiratory disorders (Thomas et al., 2018).

TABEL 4. Analysis of the Use of PPE (Masks) and Smoking Habits with Pulmonary Function Disorders in Workers at *Semen* X Company, Mempawah Regency in 2020

Variable	Category	Pulmonary Function Disorders				Total		p value [a]	OR
		Distraction		Normal		N	%		
		n	%	n	%				
PPE	Do not use	7	50	7	50	14	36,8	0,006*	11
	Use	2	8,4	22	91,6	24	63,2		
Total		9	23,7	29	76,3	38	100,0		
Smoking	Smoking	7	21,9	25	78,1	32	84,2	0,613*	0,560
Habit	Do not smoking	2	33,3	4	66,7	6	15,8		
Total		9	23,7	29	76,3	38	100,00		

Source: Primary Data,2020

[a] Chi Square, α = 5%; *Significance p ≤ 0.05

Based on statistical test results using the chi-square test at a 95% confidence level, the results obtained a p-value = 0.006, which can be concluded that there was a significant relationship between the use of PPE (masks) and lung function disorders. The workers who did not use PPE tend to have a risk of experiencing lung function disorders greater than 11 times higher than workers who did it. Personal Protective Equipment (PPE) was needed to minimize exposure or hazards that result in injury or health problems in the workplace that cannot be controlled administratively or technically, it serves to protect the respiratory tract from exposure to steam, gas, or dust in the workplace, by using it, can affect the occurrence of malfunctioning lungs in workers, so dust exposure needs to be minimized (Muhith, 2018). Based on the results of observations and interviews conducted by researchers, 36.8% of workers did not use it because they thought it was not comfortable and prevented workers from doing work. It is the equipment used to protect the body from exposure to hazards in the workplace. Disciplined while using it in work activities can protect certain body parts from exposure to hazards. One of its functions to protect the respiratory tract from the risks of dust exposure was a mask functioned as a deterrent to dust exposure. It must also be appropriate and meet standards to prevent dust of any size from entering the worker's body (Fatimah et al., 2018). The use of masks can prevent and reduce the entry of dust. Although they do not protect completely, but can minimize the risk of pulmonary function disorders.

Based on statistical test results using the chi-square test at the 95% confidence level, the results obtained a p-value = 0.613, indicating no significant relationship between smoking habits and pulmonary function disorders. It was in line with research (Kumari Prasad et al., 2019) due to several factors. Namely the length of smoking, the number of cigarettes smoked per day, and others. The relationship analysis between variables obtained OR = 0.560, which meant that workers who had a smoking habit experienced a tendency of pulmonary function disorders 0.560 times greater than workers who did not. Its smoke was a mixture consisting of complex chemicals. The chemical complexity contained in cigarettes, and cigarette smoke has many effects on human health and contributes to adverse health problems such as chronic bronchitis and other respiratory symptoms (Ghanem & Hage, 2018). Smoking can cause death and health problems, including being a risk factor for lung function disorders and causing respiratory and cardiovascular disease (Tantisuwat & Thaveeratitham, 2014). A person with a smoking habit can accumulate sediment in the lungs, causing narrowing of the air in and out passages (Balkhyour et al., 2019).

Conclusion

There is a relationship between the use of PPE (masks) and lung function disorders in cement company workers with a p-value = 0.006; OR = 11. From the results of the bivariate analysis, it is also known that there is no relationship between inhaled dust levels (p-value = 0.0205; OR = 3,067), length of work (p-value = 0.450; OR = 0.489), age (p-value =

1,000; OR = 0.781), smoking habits (p-value = 0.613; OR = 0.560), and working period (p-value = 1, 000) with pulmonary function disorders in cement company workers. Based on the research results, Semen X company should be able to monitor dust levels by checking the dust levels in the area of the production unit regularly, increasing the personal awareness of workers in using PPE through organizing socialization activities with the help of related third parties regarding the importance of using PPE, conducting health checks regularly routine as an effort to prevent disruption of work functions among workers who work in the production section and improve administrative control by providing PPE in the form of masks and gloves that meet standards, conducting regular supervision to increase workers' compliance in using PPE, regulating working hours, cleaning ventilation and dust collectors where workers do work and enforcing regulations regarding occupational safety and health in the company as an effort to prevent occupational accidents and occupational diseases.

References

Balkhyour, M.A., Ahmad, I., & Rehan, M., 2019. Asses Sment Of Personal Protective Equipment Use and Occupational Exposure in Small Industries in Jeddah: Health Implications for Workers. *Saudi Journal of Biological Sciences*, 26(4), pp.653–659.

Bian, L.Q., Zhang, Y., Jiang, R., & Mao, L., 2015. Impairment of Pulmonary Function and Changes in the Right Cardiac Structure of Pneumoconiotic Coal Workers in China. *International Journal of Occupational Medicine and Environmental Health*, 28(1), pp.62–70.

Fallahian, F., 2019. Respiratory Effects of Long-term Exposure to Dust Outbreaks. *Global Research Journal of Public Health and Epidemiology*, 6(11), pp.205–221.

Fatimah, C.L., Darundiati, Y.H., & Joko, T., 2018. Hubungan Kadar Debu Total Dan Masa Kerja Dengan Gangguan Fungsi Paru Pada Pedagang Kaki Lima Di Jalan Brigjen Sudiarto Kota Semarang. *Jurnal Kesehatan Masyarakat (e-Journal)*, 6(6), pp.49–60.

Ghanem, E., & Hage, R.-M., 2018. Behavior of Lung Health Parameters Among Smokers and Secondhand Smokers. *Journal of Environmental and Public Health*, 2018.

Gizaw, Z., Yifred, B., & Tadesse, T., 2016. Chronic Respiratory Symptoms and Associated Factors among Cement Factory Workers in Dejen Town, Amhara Regional State, Ethiopia, 2015. *Multidisciplinary Respiratory Medicine,* 11(1), pp.1–9.

Habybabady, R.H., Sis, H.N., Paridokht, F., Ramrudinasab, F., Behmadi, A., Khosravi, B., & Mohammadi, M., 2018. Effects of Dust Exposure on the Respiratory Health Symptoms and Pulmonary Functions of Street Sweepers. *The Malaysian Journal of Medical Sciences*, 25(6), pp.76–84.

Hasan, H., & Maranatha, R.A., 2019. Perubahan Fungsi Paru Pada Usia Tua. *Jurnal Respirasi*, 3(2), pp.52.

Irjayanti, A., Nurjazuli, & Suwondo, A., 2012. Hubungan Kadar Debu Terhirup (Respirable) Dengan Kapasitas Vital Paksa Paru Pada Pekerja Mebel Kayu di Kota Jayapura The Relationships Between Respirable Dust Levels And The Lung Forced Vital Capasity On Wood Furniture Workers In Jayapura. *Jurnal Kesehatan Lingkungan Indonesia,* 11(2), pp.182–186.

Kumari Prasad, S., Singh, S., Bose, A., Prasad, B., Banerjee, O., Bhattacharjee, A., Kumar Maji, B., Samanta, A., & Mukherjee, S., 2019. Combined Effect of Coal Dust Exposure and Smoking on the Prevalence of Respiratory Impairment Among Coal Miners of West Bengal, India. *Archives of Environmental and Occupational Health*, 74(6), pp.350–357.

Manisalidis, I., Stavropoulou, E., Stavropoulos, A., & Bezirtzoglou, E., 2020. Environmental and Health Impacts of Air Pollution: A Review. *Frontiers in Public Health*, 8.

Meo, S.A., Dress, A.M. Al, Masri, A.A., Al-Rouq, F., & Al-Azeem, M.A., 2013. Effect of Duration of Exposure to Cement Dust on Respiratory Function of Non Smoking Cement Mill Workers. *International Journal of Environmental Research and Public Health*, 16(1), pp.390–398.

Muhith, A., Hannan, M., Mawaddah, N., & Aqnata, C.A., 2018. Penggunaan Alat Pelindung Diri (APD) Masker Dengan Gangguan Saluran Pernapasan Pada Pekerja di PT. Bokormas Kota Mojokerto. *Journal of Chemical Information and Modeling*, 3(1), pp.1689–1699.

Nafisa, R.S.F., Joko, T., & Setiani, O., 2016. Kerja Terhadap Gangguan Fungsi Paru Pada Pekerja di PT. Arumbai Kasembadan, Banyumas. *Jurnal Kesehatan Masyarakat Syarakat (e-Journal)*, 4(5), pp.178–186.

Oktaviani, D.A., & Prasasti, C.I., 2015. The Physical and Chemical Air Quality, Worker's Characteristics, and Respiratory Symptoms Among Printing Workers in Surabaya. *Jurnal Kesehatan Lingkungan*, 8(2), pp.195–205.

Pinugroho, B.S., & Kusumawati, Y., 2017. Hubungan Usia, Lama Paparan Debu, Penggunaan APD, Kebiasaan Merokok Dengan Gangguan Fungsi Paru Tenaga Kerja Mebel di Kec Kalijambe Sragen. *Jurnal Kesehatan*, 10(2), pp.37–46.

Qian, Q.-Z., Cao, X.-K., Qian, Q.-Q., Shen, F.-H., Wang, Q., Liu, H.-Y., & Tong, J.-W., 2016. Relationship of Cumulative Dust Exposure Dose and Cumulative Abnormal Rate of Pulmonary Function in Coal Mixture Workers. *The Kaohsiung Journal of Medical Sciences*, 32(1), pp.44–49.

Salawati, L., 2015. Penyakit Akibat Kerja dan Pencegahan. *Jurnal Kedokteran Syiah Kuala*, 15(2), pp.91–95.

Sana, S., Bhat, G.A., & Balkhi, H.M., 2013. Health Risks Associated With Workers in Cement Factories. *International Journal of Scientific and Research Publications,* 3(1), pp.2250–3153.

Shanshal, S.A., & Al-Qazaz, H.K., 2020. Consequences of Cement Dust Exposure on Pulmonary Function in Cement Factory Workers. *American Journal of Industrial Medicine*, 64(3), pp.192–197.

Sunaryo, M., 2020. the Effect of Environmental Factor and Use of Personal Protective Equipment on the Symptoms of Acute Respiratory Tract Infections in Furniture Industry Workers. *Indonesian Journal of Medical Laboratory Science and Technology,* 2(1), pp.42–49.

Tantisuwat, A., & Thaveeratitham, P., 2014. Effects of Smoking on Chest Expansion, Lung Function, and Respiratory Muscle Strength of Youths. *Journal of Physical Therapy Science*, 26(2), pp.167–170.

Thomas, E.T., Guppy, M., Straus, S.E., Bell, K.J.L., & Glaziou, P., 2018. Rate of Normal Lung Function Decline in Ageing Adults : A Systematic Review of Prospective Cohort Studies. *Respiratory Medicine Research*, 9(6).

Tureková, I., Mračková, E., & Marková, I., 2019. Determination of Waste Industrial Dust Safety Characteristics. *International Journal of Environmental Research and Public Health*, 16(12).

WHO., 2014. Hazard Prevention and Control in the Work Environment : Airborne Dust. *In World Health Organization*. https://doi.org/10.23943/princeton/9780691143620.003.0002

WHO., 2017. *The Global Occupational Health Network*. Gohnet Newsletter.

Yang, J., Kim, E.K., Park, H.J., Dowell, A.M., & Kim, Y.-K., 2020. The Impact of Bacteria-Derived Ultrafine Dust Particles on Pulmonary Diseases. *Experimental & Molecular Medicine*, 52, pp.338–347.

Yuvaraj, R., Suganya, K., & Chandrasekhar, M., 2016. Pulmonary Function Test in Coal Handling Workers. *Res J Med Allied Sci*, 1(1), pp.100–106.

Zeleke, Z.K., Moen, B.E., & Bråtveit, M., 2010. Cement Dust Exposure and Acute Lung Function: A Cross Shift Study. *BMC Pulmonary Medicine*, 10.