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DETERMINANT FACTOR OF PULMONARY FUNCTION IMPAIRMENT ON RICE MILL WORKERS

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Abstract

Introduction: *Exposure to organic dust in the agricultural industry can cause pulmonary function problems for workers. This study aims to know the determinant of pulmonary function impairment on rice mill workers in Ujung Pangkah, Gresik, East Java.* ***Method:*** *This study was an analytical observational study using a cross-sectional design. This study's population were all rice mill workers in Ketapang and Glatik Villages, Ujung Pangkah, Gresik, East Java there were 25 people. The sample of this study was 16 people. The independent variable in this study was the sex, working period, smoking, and using a mask, while the dependent variable was the pulmonary function status of workers. The data respondent obtained a questionnaire, observations, and measurement of workers' pulmonary function using a spirometer. Data analysis was performed in analytic descriptive with the Spearman correlation test.* ***Result and Discussion:*** *The Spearman test results are known that the working period (r = -0.022) and smoking (r = -0.160) were very weak and an inverse correlation with pulmonary function status. In comparison, the use of masks (r = 0.462) was adequate and directly correlated with pulmonary function status. Smoking and working period will describe the length of exposure to rice dust, affecting the pulmonary function status. The obedience of using masks to workers will reduce the risk of pulmonary function impairment.* ***Conclusion:*** *Working period, smoking, and using mask are determinants of pulmonary function impairment on rice mill workers in Ujung Pangkah, Gresik, East Java.*

INTRODUCTION

The existence of fast-growing industries has a positive impact on the country's socio-economic development. However, it can not be separated from the negative impacts that may occur as the impact of the physical condition and the environment (1). The exposure that occurs in the workplace has the potential to cause occupational diseases. Such exposure can contribute to a condition and even worsen a pre-existing condition (2). Vapors, gases, dust, and smoke are identified as exposures that can cause public health problems in the workplace. The exposure of small particle size can enter through the respiratory system, which is the main port of entry for exposure to the body so that the entry of these particles can affect the sensitivity and cause symptoms (3). The particles that enter the body can cause various pulmonary diseases such as chronic obstructive pulmonary disease (COPD) and interstitial pulmonary disease (4).

Organic dust exposure in the agricultural industry is a significant cause of inflammation of workers' respiratory tract and pulmonary impairment (5). The threshold values of dust content related to safety and healthy working environment regulated in the Regulation of the Ministry of Manpower of the Republic Indonesia Number 05 of 2018 are equal to 10 mg/m3 (6). Exposure to dust, fumes, gas, and smoke correlates with COPD. Therefore, inhalation of dust in rice mills is known to harm pulmonary function, indicating a pattern of obstructive disease (7). When associated with COPD, organic dust has a higher risk than mineral dust (8). Besides being caused by exposure to high levels of dust, pulmonary function impairments in rice mill workers can be influenced by worker characteristics factors including age, smoking habits, history of pulmonary disease, nutritional status, physical activity, the period of work, and use of personal protective equipment (PPE) in the form of a mask (9).

Pneumoconiosis is one of the occupational diseases that frequently occur in industrial workers. Pneumoconiosis occurs when there is no prevention of dust accumulation in the lungs, leading to blockage and damage to lung tissue. Epidemiological studies conducted in developing countries showed that between 30% and 50% of industrial workers have a high risk of experiencing silicosis and pneumoconiosis (10-11). According to global estimates in 2015, one of the leading causes of death due to occupational diseases was a respiratory disease at 17%, including COPD and asthma (12). It has been noted that about 15% of asthma occurs in adults, and 15% of COPD is caused by hazardous occupational exposure (13). However, exposure to dust, organic and inorganic chemical agents, and smoke as a risk factor for COPD is often less attention. Air pollution's role in the prevalence of COPD appears to be relatively smaller than the role of smoking. The prevalence of COPD is projected to increase for several the coming decades because of the exposure sustained against risk factors of COPD and the increasing age of the population in the world. The increase in the prevalence of COPD is due to age; more increase will show long-term effects of exposure to COPD risk (14).

The rice equivalent to rice in Gresik Regency in 2018 amounted to 208,093 tons with a harvested area of 362,252 ha (15). The condition then demanded a rice mill's availability as a tool to process the community's rice production. The largest rice mills in Ujung Pangkah District are in Ketapang Lor Village and Glatik Village. The rice mill employs a significant number of workers. Based on a preliminary survey conducted in the rice mill in Ujung Pangkah District, many of the rice mill workers did not use PPE. Based on interviews, workers experiencing health complaints, including cough, shortness of breath, itchy skin, sore on the eyes, and other health impairments.

The study was conducted to determine the determinants of pulmonary function impairment, the strength, and direction of the correlation between these determinants, and pulmonary function status in rice mill workers in Ujung Pangkah District, Gresik Regency, East Java.

METHOD

Observational analytic was chosen as the basis of this research. This research was also conducted with a cross-sectional approach. This study's population was 25 workers in the villages of Ketapang and Glatik, Ujung Pangkah District, Gresik Regency, East Java. However, when the research was conducted, two workers were sick, one worker did not fulfill the research criteria, one worker was unwilling to be a respondent, and five other workers were absent. Thus, the sample of this research was 16 workers. In this research, the inclusion criteria were rice mill workers in Ketapang and Glatik Villages, Ujung Pangkah District, Gresik Regency, East Java, who were more than 20 years old and willing to be the research sample. The characteristics and behavior of workers were the independent variables in this research. Worker characteristics included sex and working period, while worker behavior included smoking and using masks.

Meanwhile, pulmonary function status was the dependent variable. The research location was conducted in the rice mills of Ketapang and Glatik

Villages, Ujung Pangkah District, Gresik Regency, East Java. This research was conducted from December 2018 to August 2019.

Primary data collection in this research was conducted through interviews with questionnaires, observation, and pulmonary function status measurement. Primary data collection was performed using interviews guided by questionnaires to determine the length of service, smoking habits, and use of masks of rice mill workers in Ketapang and Glatik Villages, Ujung Pangkah District, Gresik Regency, East Java.

Observations were undertaken on smoking habits, and the use of masks on rice mill workers who were working in rice mills started from the drying process to the milling process. Spirometer was a tool used to measure pulmonary function status and was undertaken by K3 expert staff from UPT K3 Surabaya. The measurement of these workers' pulmonary function status was undertaken one hour before working time at 7 AM, and the second measurement was undertaken after work at 4 PM. The determination of the rice mill workers' pulmonary function status in this research was based on the measurement results in the afternoon after the workers have finished working at 4 PM. Meanwhile, secondary data collection was undertaken to describe the rice mills in Ujung Pangkah District, Gresik Regency, East Java, in general. The data analysis in the study was undertaken in a descriptive-analytical using the Spearman correlation test. Descriptive analytic data analysis was undertaken to determine the significance and direction of the correlation of working period, smoking habits, and using masks on the rice mill worker's pulmonary function status. This research has been declared to have passed an ethical review and have acquired a certificate of ethical clearance from the Faculty of Dentistry, Universitas Airlangga, with number 277 / HRECC.FODM / V / 2019.

RESULT

Table 1 shows respondents' frequency distribution based on the characteristics, behavior, and pulmonary function status of rice mill workers in Ujung Pangkah District, Gresik Regency, East Java. A male dominates rice mill workers as many as 13 workers (81.25%). Also, most workers had a work period of more than five years, namely 11 people (68.75%).

Behaviors of respondents are described through the habit of smoking and using masks. In this study, the distribution behavior of smoking was done by half of the respondents, as many as eight workers (50.00%), while most respondents have done the use of masks as many as 12 workers (75.00%).

The pulmonary function status of respondents presented in Table 1 shows that as many as three workers (18.75%) have abnormal pulmonary function status with most was a restriction that is as much as two workers (12.50%) and one worker (6.25%) others have obstruction.

Table 1. Distribution of Respondents

Variable	Workers	
	n	%
Characteristics		
Sex		
Male	13	81.25
Female	3	18.75
Total	16	100.00
Working period		
<5 years	5	31.25
≥5 years	11	68.75
Total	16	100.00
Behavior		
Smoking		
Do not smoke	8	50.00
Smoke	8	50.00
Total	16	100.00
Using of masks		
Do not use	4	25.00
Use	12	75.00
Total	16	100.00
Pulmonary Function Status		
Normal	13	81.25
Restriction	2	12.50
Obstruction	1	6.25
Total	16	100.00

Description of the correlation between working period, smoking and using a mask with pulmonary function status on rice mill workers in the District Ujung Pangkah, Gresik Regency, East Java in gain from the results of cross-tabulations. From Table 2 can be known that most of the respondents with a work period of more than five years having the status of pulmonary normal with a total of 9 workers (56.25%), but respondents who have the abnormal pulmonary function status also dominated by the respondents with a work period of more than five years which is as many as two workers (12.50%).

The results of the cross-tabulation between smoking and pulmonary function status in Table 2 show that most of the respondents who had normal pulmonary function status were non-smoking workers, as many as seven workers (43.75%), while workers with abnormal pulmonary function status were dominated by workers who smoke is from 2 people workers (12.50%).

The results of the cross-tabulation between using of masks and pulmonary function status in Table 2 show that the normal pulmonary function status is dominated by workers who use masks, namely 11 workers (68.75%), and most of the respondents who have an abnormal pulmonary function are workers who do not use masks, namely two workers (12.50%).

Table 2. Cross Tabulation of Working Period, Smoking, Using of Masks with Pulmonary Function Status

Variable	Pulmonary Function Status				Total		*r*
	Normal	%	Abnormal	%	n	%	
Working period							
<5 years	4	25.00	1	6.25	5	31.25	-0.022
≥5 years	9	56.25	2	12.50	11	68.75	
Total	13	81.25	3	18.75	16	100.00	
Smoking							
Do not smoke	7	43.75	1	6.25	8	50.00	-0.160
Smoke	6	37.50	2	12.50	8	50.00	
Total	13	81.25	3	18.75	16	100.00	
Using of masks							
Use	11	68.75	1	6.25	12	75.00	0.462
Do not use	2	12.50	2	12.50	4	25.00	
Total	13	81.25	3	18.75	16	100.00	

Correlation results from the Spearman test were conducted to determine the correlation between working period, smoking, and mask with pulmonary function status. The results of the strong correlation test are presented in Table 2. The correlation coefficient r obtains the correlation between the working period and pulmonary function status is -0.022 so that 0 <0.022 ≤ 0.25, which means that the correlation is very weak in the table. The correlation direction between the working period and pulmonary function status has an inverse correlation based on the negative correlation coefficient. This shows that the longer the working period, the pulmonary function status will decrease.

Correlation results from the spearman test between smoking and pulmonary function status in Table 2 show that the smoking habit with pulmonary function status has the value of the correlation coefficient r is – 0.160 so that 0 <0.160 ≤ 0.25, which means that the correlation is very weak. Based on the negative correlation coefficient, the correlation between smoking and pulmonary function status has an inverse correlation. This shows that the higher the smoking habit, the lower the pulmonary function status will be.

Correlation results from Spearman test between using a mask and pulmonary function status presented in Table 2 show correlation coefficient r are 0.462 so that 0.25 <0.462 ≤ 0.5, which means the correlation is adequate. Based on the positive correlation coefficient, the direction of the correlation between using a mask and pulmonary function status has a direct correlation. This shows that the better the use of masks, the better the pulmonary function status will be.

DISCUSSION

Rice milling is post-harvest rice processing; there is a process of separating the skin covering the grains into the rice. Traditional rice milling is one of the agro-industries that produces organic dust contamination (16). Rice dust is a product of the rice milling process. The main composition of rice dust consists of silicate, cellulose, and lignin—the dust produced during the rice milling process that workers can inhale (17). Dust with a diameter of more than 10 microns has the potential to irritate the upper respiratory tract (18). Wind speed can be one of the causes of high dust levels in the workplace (19). The high dust content in the air then becomes one of the factors in environmental pollution. Exposure to dust in the workplace then decreases the pulmonary function's value and the appearance of respiratory symptoms when workers breathe in the dust for a long time. The emergence of health problems in the respiratory tract is a pulmonary response resulting from inhaling harmful substances in the workplace. So, exposure to dust in the workplace can significantly decrease the average value of the pulmonary function index, which includes the first second forced expiratory volume, forced vital capacity, peak respiratory flow rate, and maximal voluntary ventilation (MVV) (20-21). Therefore, it is necessary to have a good ventilation system to maintain the workplace's air quality. The ventilation system that is applied can be in the form of natural ventilation, artificial ventilation, or both. If using an artificial ventilation system, it is necessary to clean the ventilation every three months (6).

Labor recruitment in traditional rice milling in Indonesia does not look at sex, despite the division of jobs between them. Biologically, males have greater muscle strength compared to females. This is represented through male workers who do much lifting and transport work, while many female workers do much work on the drying process. The number of female workers in the rice milling sector is also due to the family's economic demands (22).

The abnormal pulmonary function status found in rice mill workers is restriction and obstruction. Some workers undergo changes in pulmonary function status from normal to mild restriction after work. Continuous deposition of dust particles can cause fibrotic changes in the pulmonary parenchyma resulting in decreased pulmonary elasticity and decrease the value of the pulmonary forced vital capacity and cause obstructive pulmonary disorders (21). Restrictive require great elastic work to develop the lungs, making the respiration process difficult (23). There are also rice mill workers with mild obstructive. Organic dust entering through the respiratory tract can cause mechanical irritation of the respiratory tract. This is because organic dust can release histamine and allergens that can cause airway obstruction, including asthma. Air pollution by

toxins will affect immunological mechanisms that can induce asthma response, and in chronic bronchitis, the excitation flow rate will decrease and indicate obstructive pulmonary impairment (21). There is no doubt that rice mill workers have a relatively higher prevalence of respiratory impairment symptoms (24).

In this study, it was found that there were workers who have a mild restriction with the length of work on rice milling for more than five years. In rice mill workers, the working period was related to the exposure that can affect pulmonary function impairments. Rice mill workers with a long working period have the potential to inhale higher dust, both in concentration and time. This leads to a risk of respiratory impairments (25). Over a long working period, the experience will increase and can be a risk factor for the symptoms of chronic respiratory impairments (17). Rice mill workers working in environments with prolonged exposure to rice dust will decrease the value of the pulmonary forced vital capacity and the forced excitation volume of the first second. Airborne pollutants enter the lungs through the nose hair, mucous membranes lining the nasal cavity, pharynx, cilia, and alveoli. Inside the alveoli, the pollutants are trapped and cause an inflammatory response. During the inflammatory response, the enzyme elastase is released and causes the disintegration of the alveolar septum. This inflammatory response then results in impaired defense mechanisms and repair of pulmonary tissue. It can also have an impact on changes in pulmonary elasticity (26).

In the study on the correlation of smoking habits in rice mill workers with pulmonary function status, the results were very weak and inverse. Smoking habits in rice mill workers can increase the risk of pulmonary function impairments. Workers who were in restriction condition have a smoking habit. In a study with rice milling workers in Bardhaman, West Bengal, India, it was mentioned that workers who had a smoking habit were more at risk of respiratory impairment than non-smoking workers (27). The cumulative effect of exposure to rice dust and tobacco smoke will be more harmful than any of the exposures alone (26). In workers who do not have a smoking habit, it is also possible to get exposure to cigarette pollution from the workplace (28). Passive smokers exposed to cigarette smoke were more at risk of COPD than those who were not exposed to cigarette smoke (29).

About 1 billion adults in the world have a smoking habit, but only 5% try to quit smoking and succeed for six months or more. The main reason for the high number of smokers is that the brain receives good and comfortable taste stimulation derived from cigarettes' nicotine content. When nicotine levels decrease, the brain will receive stimulation and boost smoking (30). The number of cigarettes smoked per day by a person is known to have an inverse correlation with perceived stress (31). That is a person who smokes a large amount will feel the stress experienced is reduced. In this study, it is known that male workers carry out smoking habits. Sex can be a risk factor for COPD. The incidence of COPD was higher in men who had a smoking habit (32). The pulmonary function of male workers tends to be lower than female workers because there is a possibility that the pulmonary function of female workers is only affected by exposure to rice dust, while in male workers, it is affected by the combined effects of rice dust and cigarette smoke (26). Smoking can affect impaired pulmonary function because the content of chemicals in cigarettes can damage lung tissue so that pulmonary function decreases (11). The pulmonary will's vital capacity will decrease as the duration of smoking increases, and the number of cigarettes smoked per day increases. This can cause changes to the lungs' bronchi and elasticity and then lead to restrictive lung damage. Therefore, when measuring the status of pulmonary function in smokers, the average value of the measurement results is lower than that of non-smokers (33). Other factors that can affect pulmonary capacity changes include exercise habits, use of mask, and workplace (28-29).

Smoking and dust from mills are sources of air pollution in rice mills, and there are risk factors for respiratory impairment, such as inflammation of the lungs. Inflammation of the lungs is characterized by airway abnormalities, lung parenchymal damage, and systemic effects resulting in chronic airflow limitation (34). This limited airflow then increases the risk of developing COPD. If the limited airflow increases, the reduced respiratory reserve will be a predisposing factor for more severe COPD (35). COPD occurs due to exposure to harmful particles or gases and then causes persistent breathing and obstruction of airflow due to alveolar abnormalities. However, COPD is preventable and treatable. COPD is a result of limited airflow, which is influenced by a decrease in the first, second, forced expiratory volume, and pulmonary's forced vital capacity can be treated with a reduction in smoking (36). Efforts to reduce smoking habits require firm action from the government by increasing cigarette taxes to reduce the prevalence of smoking. Not only firm action from the government, but health workers can also participate by carrying out health promotion related to the dangers of smoking and providing support to someone who wants to quit smoking (30).

In this study, rice mill workers who used masks at work tended to have normal pulmonary function status.

The masks that were used by rice mill workers are cloth masks. Workers who do not use masks while working in rice mills have a pulmonary function impairment; that is, one person has mild restrictions, and one person has a mild obstruction. The risk of respiratory impairment among rice mill workers who do not use masks is higher than workers who use masks (27). Workers who work in an environment with exposure to rice dust should use a mask. Dust in rice mills is organic dust with a diameter (D) of 1 to 100 µm particles. Based on the diameter size, rice dust is divided into three types: respirable fraction, D = 4 µm, thoracic fraction D = 10 µm, and inhalable fraction D50 = 100 µm (16). The use of a cloth mask to reduce inhaled dust into the respiratory tract is highly recommended. The behavior of using masks on rice mill workers can reduce the potential for respiratory impairment that occur (22).

The obedience of using masks is influenced by environmental factors and workers' habits, such as complain when using PPE in hot weather because it causes discomfort when working in a rice mill (37). Based on this study's results, most workers have used masks, but it is necessary to pay attention to the type of mask used. Rice mill workers in this study are known to use the cloth as masks. It is crucial to monitor the type of mask used by workers because the type of mask has different levels of protection, and it depends on the type of dust and the mask's ability to filter the dust itself (38). Masks used to prevent exposure to particles in the workplace usually have a National Institute for Occupational Safety and Health (NIOSH) certificate. Masks in the form of respirators with a high-performance level are P100 with the type of Elastomeric Half-Mask Respirators (EHR), followed by P100 with the type of Filtering Facepiece Respirators (FFR), N95 EHR, and N95 FFR. This type of respirator provides better performance levels for nanoparticles (10-100nm) compared to larger particles (100-400nm) (39).

Based on the description above, it can be seen that the working period, smoking, and using of the mask are determinants factors of pulmonary function impairment on rice mill workers in Ujung Pangkah District, Gresik Regency, East Java. Besides the working period, smoking, and use of masks as in this study, other factors that can affect health problems in the respiratory tract of rice mill workers are age, sex, education, and the type of work performed (20). Efforts to reduce the risk due to exposure to dust particles on workers can be made by periodically rotating work activities in the rice mill. This aims to prevent workers from focusing on milling activities that have a higher concentration of dust exposure. Prevention of rice dust exposure on worker's health can be done by providing education to the managers and supervisors of the rice mills industry. Furthermore, this can be done by direct prevention to the source of the rice dust exposure by installing ventilation, screening to the workers, providing education, training, and supervision to workers, seeking advice for environmental monitoring with the control of the Central Pollution Control Board (CPCB) and conducts surveillance through periodic health checks of rice mill workers at least once a year (40).

CONCLUSION

The working period, smoking, and using masks are determinants of pulmonary function impairments in rice mill workers in Ujung Pangkah District, Gresik Regency, East Java. The longer the rice mill workers' working period, the higher they risk having pulmonary function impairments, even though the correlation is very weak, likewise for rice mill workers who have a smoking habit. Conversely, workers who use masks while working tend to have normal pulmonary function status with good correlation.

It is recommended for rice mill workers in Ujung Pangkah District, Gresik Regency, and East Java to use cloth masks. Awareness of using masks can be done by reminding each other between workers. Also, workers need to reduce smoking habits and avoids exposure to secondhand smoke. The rice mill manager can install a local exhauster so that air circulation runs optimally. It is also necessary to monitor health, especially the measurement of pulmonary function status, at least once a year.

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