Correlation with dust exposure rice milling worker’s lung function capacity in Sub-District Kerjo

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Abstract. Workers in the rice mill in Kerjo Subdistrict are at risk of lung function disorders due to dust exposure from milling activities. Dust exposure is a risk factor for impaired lung function. This study aims to see the correlation between environmental dust exposure and mill workers’ pulmonary function capacity. The study was conducted with rice milling workers in Sub District Kerjo. The research method was observational and crossed sectional. The total sampling technique was used to calculate the number of samples. Measuring dust with a high volume sampler is based on the guidelines from SNI 16-7058-2004. Lung function capacity was measured by spirometry, and the questionnaire assessed other variables. The results showed a significant relationship between dust exposure (p = 0.001; r = -0.648) on lung function capacity, where dust exposure had a strong correlation and had a negative direction. Workers should use PPE during work to minimize the risk of exposure.

1. Introduction
Exposure to airborne particulates is a major occupational hazard, especially in small-scale milling enterprises where exposure levels may be unacceptably high. The risk of exposure is higher in small-scale milling enterprises than large-scale industrial milling enterprises because of older technology, poor working environment, lack of awareness of potential health hazards associated with exposure to airborne particulates, and lack of use of personal protective measures. An estimated 12% mortality from chronic obstructive pulmonary diseases was attributed to occupational exposure to airborne particulates [1].

Rice milling production activities start from the harvested grain. After going through the drying process, the dry unhulled rice goes into a milling process so that the skins come off and become rice. Milling activities have factors and potential hazards that are at risk of causing occupational accidents and occupational diseases. A dusty work environment needs attention from rice milling business actors because rice milling activities that cause dust can decrease lung function capacity.

Report from the Global Burden of Disease Study, the prevalence of obstructive pulmonary disease globally reached 251 million cases in 2015. An estimated 5% or 3.17 million deaths occurred in 2015 due to this disease, and more than 90% of deaths due to restrictive lung disease occurred in developing countries [2]. The prevalence of Chronic Restricted Lung Disease (COPD) in Indonesia is 3.7%, with
the highest prevalence in the province of East Nusa Tenggara at 10%, while Central Java at 3.4% [3].

It is estimated that there are quite a lot of workers suffering from lung function problems in Indonesia. Based on previous research, the prevalence of decreased lung function caused by dust exposure in rice mill workers in Sidrap Regency was 56.8% [5].

Flour dust varies in size, with aerodynamic sizes ranging from 4 to 30 mm [6]. In dusty areas, up to 20% of the flour dust particles have smaller aerodynamic sizes [7]; hence, they can easily enter the exposed person's respiratory tract and cause or aggravate pulmonary and respiratory diseases among exposed workers. Waugh et al. [8] reported a reduced lung efficiency of flour mill workers in India because of excessive exposure to fine organic dust prevalent in the workplace environment.

Kerjo Subdistrict Karanganyar Regency is one of the areas with the mainstay commodity in agriculture in rice. Rice mills in Kerjo District have different layouts, ventilation and light intensity. The rice mill in Kerjo Subdistrict is one of the workplaces with high dust exposure for 8 hours of work/day, which operates on Monday-Saturday. Rice Milling is one of the places with a high emission load from the vehicle that exits every day. The milling machine's grain dust produces a high concentration of dust pollutants from milling activities.

2. Methodology

2.1. Design study
The research design used in this study was an observational study design with a cross-sectional approach, namely to see cases and effects at the same time.

2.2. Population, sample and sampling method
The research was conducted in November 2019 - June 2020 in all rice mills in Kerjo District. The number of mills is 25 mills, with 50 respondents who are then used as research samples based on the total sampling method.

2.3. Data collection method
Measurement of work environment dust is carried out at work, between 08.00-12.00 hours using a high volume sampler (HVAS). This measurement is based on the SNI 16-7058-2004 guidelines. To measure lung function capacity using spirometry, which is done to determine the lungs' ability to accommodate air during breathing, breathing oxygen from the outside air into the respiratory tract and blood. Spirometry is used to assess vital lung capacity in the normal category if% FVC ≥ 80% and% FEV1 ≥ 70%, have obstructive dysfunction if% FVC < 80% and% FEV1 <70%, restrictive disorders if% FVC <80% and% FEV1 ≥ 70%, mixed disorders if% FVC <80% and% FEV1 <70%.

2.4. Analysis of data
Univariate analysis to explain each research variable's characteristics and produce a frequency distribution and percentage of each variable and bivariate analysis to determine the relationship between the independent and dependent variables and to see the strength of the correlation based on the Spearman rank test.

3. Results and discussion
Kerjo Subdistrict Karanganyar Regency is one of the areas with the mainstay commodity in agriculture in rice. Rice milling is a home business that processes rice to become rice. There are 25 rice milling units in Kerjo District, the operation of the 25 rice milling units is actively carried out every Monday to Saturday for 8 hours/day from 07.00 -16.00 GMT+7 with 1 hour rest time from 12.00-13.00 GMT+7.

Judging from its location, this rice mill is located in the middle of residential areas and is close to rice fields. The rice milling section workers are all male, with a total of 50 workers from the 25 rice
mills. Each rice mill’s environmental conditions can be seen in plain view of dust flying in the milling room.

Each rice mill has two milling machines, namely a skin breaking and whitening machine, concerning a building perspective. The ventilation used in each rice mill only comes from the main door and small holes from the dividing wall so that air circulation is not good.

The respondents’ age characteristics were divided based on the Ministry of Health in 2009 with early adulthood, late adult, early elderly, and late elderly. The late adolescent category is not included because the respondent’s age is at least in the early adulthood range, as shown in table 1. This table also shows the distribution of each category of vital lung capacity to distribute restrictive, obstructive and mixed lung function disorders.

| Age Category     | Normal | Restrictive | Obstructive | Mixed | N  |
|------------------|--------|-------------|-------------|-------|----|
| Early adulthood  | 4      | 2           | 0           | 0     | 6  |
| late adulthood   | 3      | 12          | 1           | 0     | 16 |
| early elderly    | 3      | 19          | 1           | 1     | 24 |
| Late Elderly     | 0      | 4           | 0           | 0     | 4  |
| N                | 10     | 37          | 2           | 1     | 50 |

Table 2. Bivariate analysis between the independent variable and the dependent variable.

| Variable Independent | Variable Dependent  | r      | p-value |
|----------------------|---------------------|--------|---------|
| Dust Content         | Lung Function Capacity | 0.493  | 0.000   |

The results of statistical analysis between work environment dust and lung vital capacity as in table 2 show that there is a significant relationship between dust exposure and lung vital capacity with p value = 0.000 and r = 0.493 in a positive direction, which means that the higher the dust concentration, the more risky workers are. Affected by pulmonary function disorders.

Rice mill workers in Kerjo Subdistrict have the lowest age of 28 years and the highest 57 years with an average age of 45.66 years workers. According to these data, the majority of rice mill workers belong to the early elderly age group. Restriction disorders are experienced by early adulthood, late adult, early elderly and late elderly groups. Obstructive disorders are experienced by late adulthood, and the early elderly age group experiences early elderly groups and combined disorders. The early adult age group ranges from 25-35 years, late adults with an age range of 36-45 years, early seniors with an age range of 46-55 years and late elderly with an age range of 56-65 years.

Suma'mur (2014) explained that continued exposure to dust could irritate the lower respiratory tract. Long-term exposure to dust, more precisely than grain dust, can cause chronic effects such as obstructive pulmonary disease and increase the risk of bisinosis [9].

Workers who breathe in dust for a long time while working are at risk of developing lung damage and pulmonary fibrosis. If this happens, the alveoli will harden and reduce the alveoli's elasticity to accommodate air [10].

According to the minister of manpower regulation (Permenaker) No. 5/2018 concerning Occupational Safety and Health, the Work Environment, the Threshold Value (TLV) of grain dust is 4 mg/m³. Measurement of working environment dust at 25 rice mills resulted in 20 mills above TLV and five mills below TLV. Environmental conditions with the majority of work environment dust above TLV can increase lung function disorders.

Dust particles can cause various types of respiratory diseases and air pollution. This study found a link between dust exposure and impaired lung function supported by the research of Mohammadein and Said et al. (2013), where workers exposed to dust have a risk of developing lung function problems compared to those who are not exposed [11].
Increasing age will also affect decreased lung function, the study found that at the elderly, the majority of workers have experienced lung function disorders [12-14]. Lung disease due to exposure to toxic substances can cause acute or chronic diseases. Pathological responses in their bodies cause occupational diseases, and industrial workers can cause various health problems, especially lung function disorders [15]. Work environment design factors also affect dust concentration, lack of ventilation or no effect on increasing dust concentration [16].

4. Conclusions
There is an influence between the level of work environment dust with pulmonary function disorders in Rice Milling workers with an average dust level of 0.7335 mg/m³ that has exceeded the NAV according to Permenaker No. 5/2018. Suggestions techniques by improving ventilation or installing exhaust fans so that air circulation in the grinding chamber is smooth and suppresses exposure to inhaled dust and for workers using PPE in the form of nose covers such as masks.

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