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Characteristics of Respiration Symptoms and Lung Function of Rice Milling Workers In Suwug Village, Sawan District, Buleleng Regency

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ABSTRACT

Background: Rice milling is an important industry in the agricultural sector, but during the process can affect the health of workers. ***Method:*** This research is an observational analytical study using a cross-sectional design, which was conducted in Suwug Village, Sawan District, Buleleng Regency in August 2023. ***Results:*** There were 106 samples that met the inclusion criteria. Cough is the dominant respiratory symptom found in rice mill workers. The average FEV1 was 1.59 ± 0.64 liters and 74.34 ±24.21%, the average FVC was 2.04 ± 0.73 and 77.82 ± 38.73%, the median FEV1/FVC value was 76.59 (22.25) and the median FEF25-75 was 68.11 (58.50). Cough was found to be more common in female samples (p = 0.048). Wheezing was found more in samples that did not use PPE (p = 0.026). FEV1/FVC values were lower in active smokers 71.80 ± 16.33 (p = 0.043). FEV1(%), FEV1/FVC (%), and FEF25-75 were significantly lower in more than 20 years old workers with values respectively 64.06±24.42; 67.93±15.44; and 46.65 ± 31.73 (p = 0.00). The mean FEF25-75 was lower in samples <63.94 years old (p = 0.028). Airway obstruction was predominantly in workers for more than 20 years. ***Conclusion:*** There was no correlation between all respiratory symptoms including coughing, hemoptysis, shortness of breath, chest pain, sputum, purulent sputum, and wheezing based on age, smoking status, and length of work. There were no significant differences in spirometry results based on age, gender, smoking status, and use of PPE.

Keywords: rice mill workers; respiratory symptoms; lung function

INTRODUCTION

Agriculture is the most essential sector in the structure of the growth of the Indonesian economy, which is an agricultural country and is the main focus of continuous development. Not only the harvest process, but the post-harvest process is also important in the agricultural production process.

Rice milling is one of the stages where grain is harvested from rice fields into rice that can be consumed by the community [1]. According to the results of PIPA12, there are 182,199 rice milling industry companies throughout Indonesia. A total of 95,762 companies (52.56 percent) are on Java Island, 35,450 companies (19.46 percent) on Sumatra Island, 23,873 companies (13.10 percent) on Sulawesi Island, 17,248 companies (9.47 percent) on Kalimantan Island, 9,307 companies on the islands of Bali and Nusa Tenggara, and 559 companies (0.31 percent) in Maluku and Papua.

In the process, rice mills produce organic dust which can affect the health of workers. Based on statistics from the International Labor Organization (ILO), around 2.78 million workers per year died as a result of work accidents and work-related diseases in 2018. In 2010, China recorded a total of 27,240 cases of work-related diseases. There are 32,812 of them caused by exposure to dust in the workplace. The main composition of rice dust consists of silicate, cellulose, and lignin which can be inhaled by rice mill workers. Several previous studies have shown that the dust content of rice milling exceeds the highest permitted limit value stated in the Regulation of the Minister of the Republic of Indonesia Number 5 of 2018 with a value of > 3mg/m^3.

This dust has the potential to irritate the upper respiratory tract and in the long term can significantly reduce the average value of the lung function index.[2]

Suwug is a village in Sawan District, Buleleng Regency. More than half of the area is used as agricultural land. The rice milling business is an important industrial sector for the people of Suwug Village and its surroundings. Most of the population has their main livelihood in this field so exposure to organic dust among rice mill workers is inevitable.

Therefore, the researchers wanted to assess the symptoms and lung function of rice mill workers in Suwug Village, Sawan District, Buleleng Regency, and the association between the characteristics of rice mill workers with respiratory symptoms and spirometry results.

METHOD

This study was an observational analytic study using a cross-sectional study design. The research was conducted at the Suwug village, Sawan District, Buleleng Regency on August 2023. Samples were taken using total sampling techniques, which are all rice mill workers in Suwug Village. The sample was determined by consecutive sampling, where taken by determining subjects who were suitable for inclusion and exclusion until the specified time limit was reached. The inclusion criteria in this study are: 1) Cooperative, 2) Willing to be a research subject. The exclusion criteria in this study are having contraindications for spirometry. Data analysis in this study consisted of descriptive statistical analysis, distribution differentiation analysis, and multivariate logistic regression test.

RESULT

In this study, there were 104 rice mill workers, mostly women (65.4%) with an average age of 63.94 years and a Body Mass Index (BMI) of 23.06 kg/m^2. Fifty-one (49%) had a working period of more than 20 years. Eighty-nine (85.6%) had a working duration of less than 9 hours. The sample consisted of 7 (6.7%) people in the drying section, 43 (41.3%) in the milling section, and 10 (9.6%) in other sections, such as administration, storage, and distribution. Thirty-four (32.7%) people were active smokers. During work, only 28 (26.9%) rice mill workers used personal protective equipment (PPE).

Overall, the average of FEV1 was 1.59 ± 0.64 liters and 74.34 ± 24.21%. Meanwhile, the average FVC was 2.04 ± 0.73 and 77.82 ± 38.73%. The median FEV1/FVC was 76.59 (22.25) and the median FEF25-75 was 68.11 (58.50). The dominant respiratory symptom was cough which was found in 44 (42.3%) people, followed by shortness of breath in 34 (32.7%) peoples, wheezing in 28 (26.9%) peoples, chest pain and sputum in 20 (19.2%) peoples, purulent sputum in 15 (14.4%) peoples, and hemoptysis in 8 (7.7%) peoples. Fifty-three peoples (50.9%) had comorbidities while the remaining 51 (49%) had no comorbidities. Details are listed in Table 1.

There were no significant differences in all respiratory symptoms including cough, hemoptysis, shortness of breath, chest pain, sputum, purulent sputum, and wheezing in aged <63.94 years and aged >63.94 years. Meanwhile, cough symptoms were found more frequently in the females (57.9%) compared to men (42.1%) (p = 0.048). There were no differences in other respiratory symptoms, like hemoptysis, shortness of breath, chest pain, sputum, purulent sputum, and wheezing between male and female workers. Based on smoking status, there were no significant differences in respiratory symptoms in all samples. Cough complaints were more common in workers using PPE. Meanwhile, wheezing was found more in workers who did not use PPE (p = 0.026). Based on the work period, there were no significant differences in all respiratory symptoms in the sample. The association between respiratory symptoms and age, gender, smoking status, use of PPE, and years of work can be seen in Table 2.

The mean FEF25-75 was lower in aged <63.94 years (57.31 ± 31.28) compared to aged >63.94 years (76.36 ± 41.98) (p = 0.028). Lower FEV1/FVC was found in active smokers (p = 0.043). Based on work experience, FEV1(%), FEV1/FVC (%), and FEF25-75 were significantly lower in people with work experience of more than 20 years (p = 0.00). Differences in average spirometry based on age, gender, smoking status, use of PPE, and years of work can be seen in Table 3. There were no significant differences in spirometry results based on age, gender, smoking status, and use of PPE which can be seen in Table 4. Small airway obstruction was dominant in workers that had a working period of more than 20 years compared to less than 20 years (p=0.00).

TABLE 1: Demographic characteristics of study subjects.

Characteristics	Frequency (%)	Mean/Median
Gender		
Male	36 (34.6%)	
Female	68 (65.4%)	
BMI (kg/m^2)		23.06
Age (years)		63.94
Length of work		
>20 years	51 (49%)	
<20 years	53 (51%)	
Duration of work		
>9 hours	15 (14.4%)	
<9 hours	89 (85.6%)	
Workplace		
Drying	7 (6.7%)	
Milling	43 (41.3%)	
Packaging	10 (9.6%)	
Others	44 (42.3%)	
Smoking status		
Smoker	34 (32.7%)	
Passive smoker	47 (45.19%)	
Non-smoker	23 (22.11%)	
Use of PPE		
Yes	28 (26.9%)	
No	76 (73.1%)	
Lung function		
FEV1 (liter)	1.59 ± 0.64	
FEV1 (%)	74.34 ± 24.21	
FVC (liter)	2.04 ± 0.73	
FVC (%)	77.82 ± 38.73	
FEV1/FVC (%)	76.59 (22.25)	
FEF25-75	68.11 (58.50)	
Respiratory symptoms		
Cough	44 (42.3%)	
Hemoptysis	8 (7.7%)	
Shortness of breath	34 (32.7%)	
Chest pain	20 (19.2%)	
Sputum	20 (19.2%)	
Purulent sputum	15 (14.4%)	
Wheezing	28 (26.9%)	
Comorbid		
With comorbid	53 (50.9%)	
Without comorbid	51 (49%)	

TABLE 2: Association between respiratory symptoms and age, gender, smoking status, use of PPE, and length of work.

Respiratory symptoms by age			
	<63.94	**>63.94**	**P-value**
Cough	9 (47.4%)	10 (52.6%)	0.159
Hemoptysis	3 (37.5%)	5 (62.5%)	0.517
Shortness of breath	16 (47.1%)	18 (52.9%)	0.296
Chest pain	8 (40.0%)	12 (60.05)	0.108
Sputum	10 (50%)	10 (50%)	0.457
Purulent sputum	6 (40%)	9 (60.9%)	0.076
Wheezing	16 (57.1%)	12 (42.9%)	0.083
Respiratory symptoms by gender			
	Male	**Female**	**P-value**
Cough	8 (42.1%)	11 (57.9%)	0.048
Hemoptysis	3 (37.5%)	5 (62.5%)	0.568
Shortness of breath	12 (35.3%)	22 (64.7%)	0.919
Chest pain	9 (45%)	11 (55%)	0.277
Sputum	7 (35%)	10 (50%)	0.968
Purulent sputum	7 (46.7%)	13 (65%)	0.289
Wheezing	10 (35.7%)	8 (53.3%)	0.886
Respiratory symptoms by smoking status			
	Active smoker	**Non-active smoker**	**P-value**
Cough	6 (31.6%)	13 (68.4%)	0.909
Hemoptysis	3 (37.5%)	5 (62.5%)	0.520
Shortness of breath	11 (32.4%)	23 (67.6%)	0.959
Chest pain	7 (35%)	13 (65%)	0.807
Sputum	4 (20%)	16 (80%)	0.178
Purulent sputum	6 (40%)	9 (60%)	0.514
Wheezing	9 (32.1%)	19 (67.9%)	0.942
Respiratory symptoms by use of PPE			
	Use PPE	**Did not use PPE**	**P-value**
Cough	10 (52.6%)	9 (47.4%)	0.005
Hemoptysis	2 (25%)	6 (75%)	0.632
Shortness of breath	11 (32.4%)	23 (67.5%)	0.384
Chest pain	6 (30%)	14 (70%)	0.730
Sputum	8 (40.0%)	12 (60%)	0.142
Purulent sputum	7 (46.7%)	8 (53.3%)	0.062
Wheezing	12 (42.9%)	16 (57.1%)	0.026
Respiratory symptoms by length of work			
	>20 years	**<20 years**	**P-value**
Cough	9 (47.4%)	10 (52.6%)	0.872
Hemoptysis	5 (62.5%)	3 (37.5%)	0.336
Shortness of breath	17 (50%)	17 (50%)	0.891
Chest pain	8 (40%)	12 (60%)	0.368
Sputum	11 (55%)	9 (45%)	0.553
Purulent sputum	6 (40%)	9 (60%)	0.449

TABLE 3: Average differences in spirometry results based on age, gender, smoking status, use of PPE, and length of work.

Spirometry results by age			
	<63.94	**>63.94**	**P-value**
FVC (%)	78.4 ± 19.8	77.37 ± 19.86	0.795
FEV1 (%)	70.99 ± 23.61	76.90 ± 24.54	0.219
FEV1/FVC (%)	73.98 ± 14.80	78.58 ± 15.15	0.089
FEF25-75	57.31 ± 31.28	76.36 ± 41.98	0.028
Spirometry results by gender			
	Male	**Female**	**P-value**
FVC (%)	81.67 ± 20.91	75.78 ± 18.95	0.246
FEV1 (%)	78.14 ± 26.09	72.33 ± 23.09	0.149
FEV1/FVC (%)	75.08 ± 15.74	77.39 ± 14.81	0.601
FEF25-75	78.27 ± 40.04	62.73 ± 37.1	0.053
Spirometry results by smoking status			
	Active smoker	**Non-active smoker**	**P-value**
FVC (%)	76.51 ± 22.44	78.45 ± 18.45	0.642
FEV1 (%)	69.34 ± 26.83	76.77 ± 22.63	0.143
FEV1/FVC (%)	71.80 ± 16.33	78.92 ± 14.01	0.043
FEF25-75	65.56 ± 40.89	69.35 ± 37.88	0.473
Spirometry results by use of PPE			
	Use PPE	**Did not use PPE**	**P-value**
FVC (%)	81.57 ± 17.36	76.43 ± 20.50	0.242
FEV1 (%)	77.02 ± 23.21	73.35 ± 24.64	0.495
FEV1/FVC (%)	76.45 ± 15.65	76.64 ± 15.00	0.936
FEF25-75	78.55 ± 64.26	64.26 ± 36.49	0.138
Spirometry results by use of PPE			
	Use PPE	**Did not use PPE**	**P-value**
FVC (%)	81.57 ± 17.36	76.43 ± 20.50	0.242
FEV1 (%)	77.02 ± 23.21	73.35 ± 24.64	0.495
FEV1/FVC (%)	76.45 ± 15.65	76.64 ± 15.00	0.936
FEF25-75	78.55 ± 64.26	64.26 ± 36.49	0.138
Spirometry results by length of work			
	>20 years	**<20 years**	**P-value**
FVC (%)	74.90 ± 20.74	80.62 ± 18.52	0.141
FEV1 (%)	64.06 ± 24.42	84.23 ± 19.58	0.00
FEV1/FVC (%)	67.93 ± 15.44	84.93 ± 8.85	0.00
FEF25-75	46.65 ± 31.73	88.76 ± 33.42	0.00

TABLE 4: Average differences in spirometry results based on age, gender, smoking status, use of PPE, and length of work.

Spirometry results by age			
	<63.94	**>63.94**	**P-value**
Restriction	20 (37.0%)	34 (63.0%)	0.182
Obstruction	13 (41.9%)	18 (58.1%)	0.858
Small airway obstruction	25 (52.1%)	23 (47.9%)	0.093
Spirometry results by gender			
	Male	**Female**	**P-value**
Restriction	16 (29.6%)	38 (70.4%)	0.267
Obstruction	12 (38.7%)	19 (61.3%)	0.567
Small airway obstruction	13 (27.1%)	35 (72.9%)	0.135
Spirometry results by smoking status			
	Active smoker	**Non-active smoker**	**P-value**
Restriction	20 (37%)	34 (63%)	0.326
Obstruction	11 (35.5%)	20 (64.5%)	0.692
Small airway obstruction	18 (37.5%)	30 (62.5%)	0.333
Spirometry results by use of PPE			
	Use PPE	**Did not use PPE**	**P-value**
Restriction	12 (22.2%)	42 (77.8%)	0.261
Obstruction	10 (32.3%)	21 (67.7%)	0.424
Small airway obstruction	10 (20.8%)	38 (79.2%)	0.195
Spirometry results by length of work			
	<20 years	**>20 years**	**P-value**
Restriction	31 (57.4%)	23 (42.6%)	0.07
Obstruction	14 (45.2%)	17 (54.8%)	0.606
Small airway obstruction	41 (85.4%)	7 (14.6%)	0.000

DISCUSSION

In this study, there were no differences in respiratory symptoms and spirometry results based on age, but there were differences in the mean results of FEF25-75, which were lower in aged <63.94 years. FEV1 and FVC values decrease more rapidly after 60 years old and remain stable throughout the age range of 60-90 years. Aging lungs are characterized by a decrease in bronchiole density and an increase in bronchiole diameter. Aging causes loss of alveolar surface area accompanied by enlargement of the alveolar size and air spaces. The lungs gradually lose their elasticity and become stiffer, thought to be caused by changes in the expression of extracellular matrix proteins, lamin, elastin, and fibronectin [3]. Changes in lung function are also associated with comorbidities. Changes in the respiratory system caused by age in healthy individuals do not cause serious problems such as airway obstruction or parenchymal lung disease because there is still reserve lung capacity. However, for individuals who have comorbid lung disease, either because of smoking or because of a previous lung infection, this reserve is reduced and can cause abnormalities that appear more easily in the lungs [4]. Differences in results in this study may occur because other confounding variables have not been removed, such as the presence of other comorbid chronic lung diseases, determining the age cut point based on the median value of the sample, and the dominant sample being classified as old to elderly.

In this study, respiratory symptoms like cough were more common in women, this could be caused by the sample distribution which is more women than men. In addition, women have smaller respiratory tracts compared to men, making it easier to cause narrowing of the respiratory tract [5]. Meanwhile, there were no differences in lung function related to gender.

Based on smoking status, there were no significant differences in respiratory symptoms in all samples. Lower FEV1/FVC values were found in active smokers (71.80 ± 16.33), compared to non-smoking samples (78.92 ± 14.01) ($p = 0.043$). Smoking can cause chronic obstructive pulmonary disease (COPD), which is clinically known to occur in 15-20% of smokers [6].

The decrease in FEV1 is strongly associated with the amount of cigarette consumption and the severity of pre-existing bronchial hyperresponsiveness in smokers with COPD. The decrease in FEV1 is also related to the number of cigarettes smoked, in heavy smokers it is known that there is a greater decrease in lung function than in light smokers.

Most rice mill workers (73.1%) do not use PPE when working. Cough symptoms are more common, due to the presence of rice mill dust spread in the rice mill room due to its small size. The source of dust in the rice mill also comes from various activities carried out in the rice mill production operations. By using a mouth and nose cover or mask, you can minimize the entry of dust into the respiratory tract. The type of mask will also influence the protective impact obtained [7].

In this study, it was found cough, was the most common symptom at 44 (42.3%) then shortness of breath at 34 (32.7%), this was similar to research conducted by Rahman et. al among rice milling factory workers in Bangladesh, the most common respiratory symptom reported by workers was chronic cough (38.7%), this was because the rice milling process produced dust consisting of dry rice particles. Workers who are constantly exposed to this dust have a higher risk of experiencing irritation of the respiratory tract, which can cause coughing and other respiratory complaints. Rice dust contains bacteria, endotoxins, spores, and chemicals that can damage the respiratory tract and cause respiratory symptoms. Apart from that, symptoms can be caused by workers possibly having allergies or hypersensitivity reactions to rice dust or fungal spores that can grow on wet rice and unavoidable environmental factors, such as poor ventilation or high humidity, which can also worsen respiratory problems and increase risks, especially coughing [8]. Cough symptoms in this study were found to be more common in samples who used PPE while working (52.6%), this could occur due to other comorbidities such as chronic lung disease that had not been adjusted or the presence of respiratory symptoms of cough that preceded it, which was then followed by workers' awareness of using masks.

In rice mill workers with more than 20 years of service, spirometry results were lower for FEV1, FEV1/FVC, and FEF 25-75 ($p = 0.000$) compared to those who had worked less than 20 years. This is similar to research conducted by Lumantow et.al on rice mill workers in the East Dumoga district, which showed there was a potential decrease in FEV1 and FVC by 8 times in workers with a working period of more than 5 years compared to less than 5 years [9].

According to research by Lusno et.al, there is a relationship between lipopolysaccharide endotoxin in rice dust, where this is correlated with a decrease in FEV1 and FVC in rice mill workers who have worked for at least 2 years, and lung function and lipopolysaccharide endotoxin levels were measured using the ELISA method.

The lipopolysaccharide endotoxin contained in rice dust will cause acute and chronic inflammatory processes in the respiratory system and decreased lung function [10].

Bronchoconstriction occurs after an allergen-containing endotoxin is inhaled, macrophages will capture and present their specific antigenic properties to activated T Helper-2 (Th2) lymphocytes. Th2 that is specific to allergens will induce B lymphocytes to produce IgG and IgM to become allergen-specific immunoglobulin (IgE). IgE will then be bound by cells with IgE receptors, eosinophil cells, and macrophages such as mastocytes in tissues and basophils in the circulation. This bond will cause an influx of calcium and changes in the cells, thereby reducing cAMP levels. A decrease in cAMP levels will cause histamine-mediated cell degranulation to stimulate respiratory tract obstructions [11].

This form of hypersensitivity pneumonitis (HP) disorder can be recognized through radiographic examination by recognizing lung infiltrates, especially with chest high-resolution CT (HRCT). HRCT findings can determine the presence of fibrotic or non-fibrotic HP which is then categorized as typical, compatible, or indeterminate with HP. Typical HP is defined by the combination of interstitial fibrosis with evidence of small airway disease. Compatible with HP was defined by the presence of a combination of interstitial fibrosis with a slight appearance of small airway disease or extensive ground glass opacity (GGO) appearance with a slight appearance of fibrosis or small airway disease. Indeterminate HP is determined by the appearance of a nonspecific fibrotic interstitial pneumonia pattern, an organizing pneumonia pattern, and the absence of small airway disease.

CONCLUSIONS

Cough is the dominant respiratory symptom found in rice mill workers. There was no correlation between all respiratory symptoms including cough, hemoptysis, shortness of breath, chest pain, sputum, purulent sputum, and wheezing based on age, smoking status, and length of work. Cough was more common in workers that used PPE, while wheezing was more common in workers that did not use PPE. There were no significant differences in the spirometry results based on age, gender, smoking status, and use of PPE. Small airway obstruction was predominantly found in workers with a working period of more than 20 years.

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