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KELAIKAN ETIK

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after reviewing the research protocol, herewith to certify
setelah menilai dokumen protokol penelitian yang diajukan, dengan ini menyatakan

that the research protocol titled:
bahwa protokol penelitian dengan judul :

Pengaruh Paparan Debu Lingkungan Kerja terhadap Gangguan Fungsi Paru Obstruktif, Restriktif dan *Mixed* pada Pekerja Bagian Pemintalan PT Kusumaputra Santosa Karanganyar

Protocol ID **Nomor Protokol**	**: 01/18/08/183**
Principal Investigator **Peneliti Utama**	**: Aditama Putra Nugraha** **: NIM. R0214004**

is Ethically Approved.
dinyatakan Laik etik.

***Issued on* : 23 July 2018**

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The Determinant Of Lung Function Dissorders Of The Textile Industry Spinning Section

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Submission date: 23-Jun-2020 11:52AM (UTC+0700)
Submission ID: 1348416009
File name: Kemas_Unnes-Iwan_Suryadi.docx (92.34K)
Word count: 4849
Character count: 26537

The Determinant Of Lung Function Dissorders Of The Textile Industry Spinning Section

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ABSTRACT: Many factors affect lung function capacity in textile industry workers. This research aims to determine the factors that affect the vital role of pulmonary spinning workers in the textile industry. This research used an analytic observational research design with a cross-sectional approach. Sampling technique used total sampling and get the sample was 96 people, and measurement of lung vital capacity used spirometry. The Low Volume Sampler was applied to measure dust concentration, and the questionnaire was used to assess the individual characteristics. Bivariate analysis of the variables is the working environment dust, exercise habits, smoking behavior, and gender are significant. The result of multivariate analysis of dust is the most significant to the lung vital capacity. Conclusion, dust concentrations is classified above the Threshold Limit Value (TLV), so the company should to control the source of dust exposure.

***Keywords**: lung function dissorders*

Introduction

Occupational respiratory disease is a major global public health problem that accounts for up to 30% of all occupational diseases. Besides, 10-20% of deaths caused by respiratory problems (Gizaw, Yifred and Tadesse, 2016). Exposure to dust in textile industry workers can be at risk of causing lung function disorders. Health effects in the form of impaired lung function have been documented in workers exposed to dust in both small, medium, and large industries (In and Surfactant, 2002; Subbarao, Mandhane and Sears, 2009). Occupational Lung Disease (OLD) is a pulmonary disease arising from prolonged or repeated exposure that causes toxic effects, both acute and chronic (Stobnicka and Górny, 2015). Occupational diseases are caused by pathological responses from patients to their working environment (Qian *et al*., 2016). There is a growing consensus on the adverse impact of organic dust on the symptoms and respiratory function of industrial workers, one of which is impaired lung function (Khodadadi *et al*., 2011).

ILO shows that every year, there are more than 250 million accidents at workplaces, and 160 million workers become sick because of hazards that exist in the workplaces. Also, around 1.2 million workers die due to accidents and occupational diseases. New materials for the production process are distributed annually in the workplaces, and many of them cause lung disease (ILO, 2013).

Indonesia is one of the developing countries that have many companies produce dust from the production process. OLD is a group of occupational diseases in which the target organ of the disease in the lung (Sumakmur P.K, 2014).

The textile industry is one of the many vital sectors in Indonesia, especially in Surakarta Raya region. Workers can be exposed to a variety of different environmental factors, especially from the spinning and weaving processes (Daba Wami *et al*., 2018). Those processes in the textile industry produce large amounts of cotton dust (Tagiyeva *et al*., 2017). The dust consists of various sizes and types of particles, such as plant materials, fibers, bacteria, fungi, soil, pesticides, non-cotton materials, and other contaminants (Wu *et al*., 2019). Research on respiratory disturbances and impaired lung function in cotton spinning in Egypt shows a significant relationship in the group exposed to dust (Tageldin, Gomaa and Hegazy, 2017; Daba Wami *et al*., 2018).

The results of the initial survey conducted at 3 points in the production area of the spinning / spinning industry of the textile industry showed the highest levels of work environment dust of 0.24 mg / m3 and the lowest 0.19 mg / m3 with an average of 0.21 mg / m3. This figure is included above the Threshold Value (NAV) of working environment dust with the type of cotton at work that is equal to 0.2 mg / m3. The purpose of this study is to determine the determinants of the vital capacity of the lung of spinning textile industry workers.

Materials And Methods

Study Site and Period

This study uses an observational analytic design with a cross-sectional study design that explains the differences between the variables through testing previously formulated hypothesis. This research approach uses a cross sectional approach in which cause / risk and causal / causal variables are measured or collected at the same time and carried out at the same time. The study was conducted in the range of November 2017 to July 2018 on the spinning labor section in the textile industry.

Population and sampling size

This study uses a total sampling technique where all workers in the spinning section are assigned to be the research sample. The research sample of 96 workers.

Independent and dependent variable

The independent variables in this study were environmental dust and individual characteristics including age, sex, years of service, exercise habits and smoking behavior, while the dependent variable was vital lung capacity.

Dust collection methods

The measurement of dust levels in the work environment is carried out at 6 points of the spinning area measured using a Low Volume Sampler (LVS) tool. To get the concentration of dust by using a sample filter before and after being entered into the LVS, the results of the

dust content from the LVS tool are then weighed again with analytical scales to obtain the difference in dust after and before measurement. Procedure for measuring environmental dust based on SNI 16-7058-2004 regarding measurement of total dust, other variables such as age, sex, years of service, exercise habits and smoking behavior were assessed by questionnaire

Lung functional test

Pulmonary function tests were carried out on a total of 96 workers in the textile industry spinning section of PT X. Measurements using spirometry are a tool used to determine the percentage of Forced Vital Capacity (FVC) and Forced Expiratory Volume / Forced Expiratory Volume / forced volume in the first second (FEV1) .

The vital lung capacity is classified into four namely normal, obstructive, restrictive and mixed. based on the% FVC and% FEV1 measured using a spirometer which is a tool used to find out the percentage of Forced Vital Capacity (FVC) and Forced Expiratory Volume / Forced Expiratory Volume / forced volume in the first second (FEV1). Pulmonary function is normal if% FVC ≥ 80% and% FEV1 ≥ 70% and obstructive disorders if% FVC> 80% and% FEV1 <70%, restrictive disorders if% FVC <80% and% FEV1 ≥ 70%, mixed disorders if % FVC <80% and% FEV1 <70%.

Statistic analysis

This analysis is used to see the description and characteristics of each independent variable and the dependent variable. The variables of this study were analyzed using the frequency distribution of SPSS version 23 data tendencies to describe the characteristics of each study variable. Bivariate analysis is used on two variables that are thought to have a relationship or mutual correlation. Bivariate analysis uses the Spearman correlation test for work environment dust variables with obstructive, restrictive and mixed pulmonary function disturbances because the independent variable uses a numerical data scale (ratio) while the dependent variable has a categorical (ordinal) data scale.

The strength of the relationship of a variable obtained from the direction of the correlation that has positive (+) and negative (-) values. A positive value (+) means that the greater the value of one variable, the greater the value of other variables. Conversely, for negative values (-), if the greater the value of one variable, the other variables will be smaller. suggests that the correlation strength number (r) is divided into: 1) 0.00 - 0.199: very weak, (2) 0.20 - 0.399: Weak, (3) 0.40 - 0.599: (4) Medium 0.60 - 0.799: (5) Strong 0.80 - 1,000: the significance value of p is as follows: a) If p value <0.05, the test results have a significant correlation. b) If the p value is 0.05, the test results have no significant correlation. and multivariate analysis to find out which variables are the most

influential among the variables that have a P-value <0.25.

Results

PT X textile industry is located on Jalan Raya Solo-Karanganyar km. 9.5, Surakarta, Central Java. The industry has a spinning production unit that produces yarn as a primary material for making fabrics.

Table 1. Variable Characteristics with Lung vital capacity.

Variable	Lung Vital Capacity				Total	r	p-value
	Normal	Restriktif	Obstruktive	Mixed			
Dust						-0,390	0,000
Age (year)							
17-40	8	0	0	0	8	-0,110	0,285
>40-60	69	15	2	2	88		
Body Mask Index							
Thin	6	2	0	0	8	0,185	0,072
Normal	49	8	2	0	59		
Overweight	14	0	0	0	14		
Obesitas	8	5	0	2	15		
Employment Period (year)							
<10	4	0	2	0	6	0,236	0,020
≥10	73	15	0	2	90		
Gender							
Male	30	11	2	2	45	0,319	0,002
Female	47	4	0	0	51		
Smoking Behavior							
Yes	31	12	2	2	47	0,350	0,000
Not	46	3	0	0	49		
Sport Habits							
Routine	64	5	0	2	71	0,420	0,000
Not Routine	13	10	2	0	25		

Sumber: Primary Data, 2018

Table 1 shows the relationship between respondent characteristics and lung vital capacity. In the age variable, it shows that age >40 years old has obstructive pulmonary function disorder, restrictive, and mixed. In the BMI variable, the majority of lung function disorders in respondents with healthy BMI. From the working period, the variable is known that the working period >10 years mostly experience obstructive and mixed lung function disorders. In gender variables, lung function disorders experienced mainly by men. For the smoking behavior variables, the majority of diseases are the smokers, and for the exercise habits variables, the conditions are

mostly experienced by respondents who do not routinely exercise. Correlations between independent variable and dependent the age and BMI variables do not significantly affect the lung vital capacity, while other variables significantly influence the lung vital capacity. The obstructive, restrictive, and mixed pulmonary vital capacity are theoretically incorporated into disorders pulmonary function.

If we analyze the table for workers> 40 years have experienced many lung function disorders, in BMI, workers in the normal and obese categories have lung function disorders, then the working period that workers who have worked ≥ 10 years experience more lung function disorders than workers who worked <10 years. Female workers have fewer lung function disorders than male workers, smoking habits, and exercise habits according to table 1 shows that smokers and workers who rarely exercise suffer from obstructive, restrictive, and mixed lung function.

Variables, which include in the multivariate analysis, are variables that have a *p*-value <0.25. In table 2, the variable that mostly influences lung vital capacity is gender, where the four variables above can affect lung vital capacity 38.4%, and 52.6% explained by other variables not examined.

Table 2.Variables that most influence the vital capacity of the lungs.

Varibel	Koefisien β	*P-Value*	Adjusted R^2
Dust	-0.290	0.001	
BMI	-0.348	0.000	
Gender	-0.409	0.000	0.384
Sport Habits	-0.175	0.040	

Discussion

Particles that are toxic to magrofag can be stimulating the formation of new magrofags. The formation and destruction of magrophages that continue to play an important role in the formation of collagen connective tissue and the deposition of hyaline in the connective tissue that forms fibrosis. This fibrosis occurs in the lung parenchyma that is the alveoli and wall intertestial connective tissue. As a result of pulmonary fibrosis will decrease lung tissue elasticity (shifting lung tissue) and give rise to impaired lung development, namely restriction. Obstruction disorder is a pulmonary disorder characterized by barriers to airflow in the respiratory tract that are irreversible. In this study, there were 3 respondents (6%) who experienced obstruction. Narrowing of the airways and disruption in airflow therein will affect the work of breathing. FEV1 will always be reduced in respondents who experience obstruction and can be a deep large amount, whereas FVC can not be reduced. A mixture of restrictions and obstruction occurs due to pathological processes which reduce lung volume, capacity and flow, and presence narrowing of the respiratory tract and the presence of landfill breathing by particulates.

Measurement of work environment dust at 6 points at PT X Karanganyar, Indonesia Textile Industry obtains an average 0.395 mg/m^3. The results of analyses in all aspects are above the Threshold Limit Value (TLV) 0.2 mg/m^3 every eight working hours per day for the type of cotton dust based on Permenaker RI No.5, 2018 concerning occupational safety

and health work environment appendix 3 TLV Chemical Factors (Republic of Indonesia Ministry of Manpower, 2018). Research by Mwinykione et al also shows that dust exposure above the threshold value has a risk of decreased lung function (Mwinykione Mwinyihija,Ken Killham,Ovidiu Rotariu, 2005). The workers in the textile industry have the risk of being affected by LFD from exposure to cotton dust so that they can cause the risk of disease. From 96 total samples of workers, 77 workers have normal conditions, and 19 workers experience lung dysfunction (22.86%). Most lung function disorders are the restrictive type, with a total of 15 respondents. The mechanism of dust accumulation in the lung begin by breathing in, then the air containing dust entering the lungs. Dust that is between 5-10 microns will be retained by the upper respiratory tract, while the middle of the respiratory tract will retain the 3-5 microns. Particles with a size between 1 and 3 microns will be placed directly on the surface of the pulmonary alveoli. The particles with a magnitude 0.1 microns do not so quickly settle on the surface of the alveoli. The mass of dust which less than 0.1-micron particles is too small so that it does not end on the surface of the alveoli or lender membrane, because of Brown's movement, it causes such dust to move out of the alveoli. The impaired pulmonary function in the spinning section also caused by inhalation of cotton fibers and dust in the working environment (Mahmoud and El-Megeed, 2004). This Is Also Consistent With Research By The Sultan That There Was A Decrease In Lung Function Against Prolonged Dust Exposure In Wood Industry Workers (Sultan A., 2007)

Suma'mur explains that continuous exposure to cotton dust for years irritates the upper respiratory tract of the bronchus. If the exposure continues, it will happen chronic obstructive pulmonary disease, which can be interpreted that the more extended working period, there will be more cotton dust that settles in the respiratory tract, the more severe the disease suffered byssinosis. Small invisible cotton dust particles enter the alveoli of the lungs through inhalation and accumulate in the lymph cause damage to the alveoli and reduce the capacity to retain oxygen. When cotton dust builds up, workers can suffer from byssinosis (Su *et al*., 2003). Dust can cause lung disease and fibrosis if inhaled during continuous work. If the alveoli harden, it reduces elasticity in accommodating the volume of air, so that the oxygen binding ability decreases. The results of the analysis show that the effect of occupational dust exposure significantly to the lung vital capacity with a *p*-value 0.000. It is in line with research on work environment dust against pulmonary dysfunction (Qian *et al*., 2016). These results are also in line with Qian's, which shows that there is a relationship between dust exposure and lung function disorder (Su *et al*., 2003).

Exposure to dust can reduce lung function. The result of this study shows that there is a significant relationship between dust exposure with reduced lung function. It is followed by research; there is a meaningful relationship between workers exposed to dust with lung function disorders where workers exposed to dust have a higher

risk than those who do not (Khan, Moshammer and Kundi, 2015; Said, AbdelFattah and Almawardi, 2017). Lung function will decrease as people get older. Age is related to the aging process or increasing age where the older a person is, the higher the likelihood of lung function capacity. The age of 20-40 years is the maximum muscle strength in a person and will be reduced by 20% after the age of 40 years. The older a person is, the risk of impaired lung function is also high (Schachter *et al*., 2009).

The longer a person is at work, the more he has been exposed to the dangers posed by the work environment, including exposure to cotton dust. Chronic disorders occur due to occupational dust exposure which is quite high and for an extended period which is usually annual and not infrequently the symptoms of lung function appear after more than ten years of exposure (Boschetto *et al*., 2006; Daba Wami *et al*., 2018). Work period is the length of time worked (years) in a Company environment. The longer a person works on dusty environment, it will further reduce capacity vital lung. Where every additional work period in one year a decrease in lung capacity of 35.3907 ml will occur (Sumakmur P.K, 2014). Research on Lung Morbidity of Traffic Wardens Exposure to Cronic Vehicular Pollution in Lahore Pakistan, at 500 respondents at the city of Lahore, Pakistan concluded that the lung capacity of traffic officers are reduced because of chronic exposure to vehicle emissions (Shelly *et al*., 2019).

The lung capacity of traffic officers who have a minimum working period of 10 years is moderately affected by 25% of officers and 2.5% of officers who experience a serious impact on the vital capacity of their lungs. The volume and capacity of the entire lung in women is approximately 20 up to 25 percent smaller than men, and even greater to athleticists and bigger people than people who are small and astenis. Gender affects lung function disorders. Several pieces of research in the textile industry show that men have a higher risk of lung function disorders than women (Camp, Dimich-Ward and Kennedy, 2004; Schachter *et al*., 2009). Other studies have also found that women aged> 50 years are at risk of developing acute respiratory problems due to particulates (Chen and Wu, 2018). Smoking can cause changes in structure and function respiratory tract and lung tissue. In the respiratory tract large, enlarged mucosal cells (hypertrophy) and mucous glands multiply. In the small respiratory tract, inflammation occurs mild to narrowing due to increased cells and mucus buildup. In the lung tissue an increase in the amount inflammation cells and alveoli damage. As a result of changes in the anatomy of the channel breath, in smokers changes in lung function and everything kinds of clinical changes (Jaén *et al*., 2006; KC *et al*., 2018). This is the main basis for this chronic obstructive disease. Smoking can accelerate the decline in pulmonary physiology.It may also be caused by male smoking behavior which makes them easier to experience lung function disorders (Jaén *et al*., 2006; Bakhsh *et al*., 2016).

A person's nutritional status affects the body's immune system to maintain personal health from various diseases, such as coughing, colds, diarrhea. Besides, the

immune system influences the body's ability to detoxify foreign objects, such as dust that enters the body, which will automatically affect the function and performance of the lungs. A person's nutritional status affects the body's immune system to maintain personal health from various diseases such as coughing, colds, diarrhea and also the body's ability to detoxify foreign objects such as dust that enters the body. As a result, the function and performance of the lungs also interfere. Besides the results of research on obesity and mortality, explained that obesity can reduce a person's age. Even obese non-smokers who live healthier lives have a higher risk of premature death than thinner people. One of the assessments of a person's nutritional status is also disturbed by calculating the Body Mass Index (BMI) (Dangi and Bhise, 2017). Lung capacity can be affected by a person's habit of running sports. Exercising can increase blood flow through the lungs so that many causes all pulmonary capillaries to get maximum perfusion. This causes oxygen to diffuse into the pulmonary capillaries with a greater volume or maximum. Sports has ten main elements of physical fitness, one of these elements is the function of breathing. Exercise should be done at least three times a week, people who are athletic and have a large body capacity and greater lung volume. good exercise can be done at least three times a week. explains that the duration for daily exercise is 20-60 minutes. Lung capacity can be influenced by a person's habit of running sports. Having regular exercises can increase blood flow through the lungs, which will make the pulmonary capillaries to get maximum perfusion so that oxygen can diffuse into the capillaries to the maximum (Mohammadien, Hussein and El-Sokkary, 2013; KC *et al*., 2018).

Prevention of the risk of decreased lung function can be done by controlling techniques, treatment and management aspects. Control techniques by adding ventilation to the work area, covering the risk of dust exposure, using personal protective equipment, in the aspect of treatment carried out with the company providing health facilities and doctors, spirometry examination. As for management aspects, it is work rotation and the existence of clear operational standard procedures related to the prevention of occupational diseases (Boschetto *et al*., 2006; Portnoy *et al*., 2016) .

Conclusion

There is an influence between exposure to work environment dust with obstructive, restrictive and mixed lung function in the spinning workers of PT Kusumaputra Santosa Karanganyar. Overall the level of dust in the work environment at PT Kusumaputra Santosa Karanganyar is above the threshold value (NAV) of cotton dust of 0.2 mg / m3 based on the Republic of Indonesia Ministerial Regulation No. 5 of 2018 with an average of 0.395 mg / m3 conducted at 6 measurement points, where the higher the dust exposure the more the risk of lung function disorders. Most of the workforce of PT Kusumaputra Santosa Karanganyar's spinning section did not experience lung function disorders, namely 69 respondents, 15 workers (22.86%) experienced restrictive function disorders, 2 respondents experienced obstructive and mixed lung function disorders.

in addition, individual characteristics affect the disruption of lung function. body mass index, length of service, sex, exercise habits and smoking behavior have a significant effect on impaired lung function. age more than 40 years at risk of developing restrictive pulmonary function impairment, working period of more than 10 years is also at risk of experiencing lung dysfunction, men, smokers and not accustomed to exercise are also at risk of developing lung function disorders. Suggestion : In this study the researchers gave the following suggestions: For further research, it is better to do the measurement use the Personal Dust Sampler so that the measurement results of dust are more specific namely respirable / respirable dust (1-10 microns). For PT Kusumaputra Santosa Karanganyar, the company can take several steps in dealing with the source of dust exposure in the company by controlling in the form of routine socialization about the dangers of cotton dust exposure to health, so that workers are aware of the importance of maintaining personal hygiene pre and after work and more obedient to use a mask. Carry out medical check-ups on personnel on a regular basis at a minimum once a year to find out the health conditions of the workforce especially the condition of the lungs. Promotive steps in the form of slogans, prohibitions and appeals by installing mmt at several points in the company. Work rotation is performed on workers so as not to be exposed to dust the same size continuously. Perform routine maintenance of dust blowers in every area of the company. Provision of N95 type masks that have a dust prevention density of 1-10 microns in size according to respected dust.

Conflicts of Interest: The authors declare no conflict of interest

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