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Factors Associated with Impaired Lung Vital Capacity in Cutting and Sewing Unit Workers Pt. Daiwabo Garment Indonesia

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ABSTRACT

Occupational diseases (ODs) are one of the leading causes of workplace deaths, second only to occupational accidents. According to a 2023 report by the International Labour Organization (ILO), approximately 2.6 million work-related deaths were caused by occupational diseases. At PT. Daiwabo Garment Indonesia, the predominant occupational disease identified is impaired lung vital capacity, affecting 65% of the respondents. This condition is often accompanied by common symptoms experienced by workers, such as coughing and shortness of breath. The aim of this study is to identify the factors associated with impaired lung vital capacity among workers in the cutting and sewing units at PT. Daiwabo Garment Indonesia. This research is a quantitative study using a cross-sectional method, involving a total of 40 respondents. Multivariate analysis using logistic regression revealed that length of employment (p: 0,011), compliance with the use of Personal Protective Equipment (PPE) (p: 0,017), and age (p: 0,42) are significantly associated with impaired lung vital capacity among workers in the cutting and sewing units at PT. Daiwabo Garment Indonesia.

INTRODUCTION

Occupational health issues are still a major challenge in the world of labor, especially in the industrial sector. Data from the International Labor Organization (ILO) in 2023 showed that of the 2.93 million work-related deaths, around 2.6 million of them were caused by occupational diseases, far exceeding the number of deaths due to work accidents of 330,000 cases. One of the most common forms of occupational diseases is respiratory system disorders, especially those caused by dust exposure in industrial work environments, such as those in the garment industry . Based on a literature study conducted by (1) there are relevant findings from a review of 17 identified studies revealing that these garment workers experience mental illness, respiratory and cardiovascular diseases, and MSDs (musculoskeletal disorders). According to the Workplace Safety and Health Institute (WSH) in 2015 there was an increase of more than 0.4 million occupational diseases compared to 2011 and more than 70% of them were caused by respiratory diseases. Respiratory disease is the 3rd largest occupational disease after blood circulation disease and malignant neoplasm (2).

Vital Lung Capacity (VLC) is the total volume of air a person can exhale after a full inspiration. The normal threshold for human vital lung capacity is more than 80%. According to a study published in the American Journal of Respiratory and Critical Care Medicine, the global prevalence of Chronic Obstructive Pulmonary Disease (COPD)—a major factor contributing to decreased lung function—was estimated at 10.7% in 2016, with the highest prevalence observed in developing countries (3).

A review of previous literature identified that occupational lung disorders are closely correlated with exposure to dust particles, especially in work environments with high dust concentrations (4). Several studies have also highlighted that the vital capacity of the lungs (KVP) as an important indicator in assessing lung function of workers is often decreased due to long-term exposure to industrial dust (5). This is caused by a decrease in lung elasticity, resulting in symptoms of shortness of breath, chest heaviness and watery eyes (6). In addition to environmental factors, a number of studies have also underlined the importance of paying attention to internal factors such as age, gender, smoking habits, tenure, and compliance with the use of personal protective equipment (PPE) (7). However, most previous studies have not specifically highlighted the issue of impaired lung vital capacity in the context of the garment industry in Indonesia.

Based on the results of observations and initial interviews at PT Daiwabo Garment Indonesia, it was found that the cutting and sewing work unit has the potential for high dust exposure, but there has never been a systematic examination of lung function. This is also in accordance with the results of the Hazard Identification and Health Risk Assessment (HIRA) method analysis conducted by (8) and states that the cutting and sewing production process at PT Daiwabo Garment Indonesia has a risk of dust exposure that can be harmful to the vital health of workers' lungs. This indicates a gap in occupational health monitoring practices that can have an impact on reducing worker productivity and welfare.

The scientific novelty of this study lies in its comprehensive risk factor analysis approach to impaired lung vital capacity associated with working conditions in the national garment industry, with a particular focus on the most at-risk work units. In addition, this study also integrates internal and external factors simultaneously and prioritizes risks based on comprehensive analysis as a basis for evidence-based risk control recommendations.

Based on these problems, this research is directed at the question: "what factors are associated with impaired lung vital capacity in cutting and sewing unit workers at PT Daiwabo Garment Indonesia?". Thus, the purpose of this study is to determine and analyze the factors associated with impaired lung vital capacity in cutting and sewing unit workers at PT Daiwabo Garment Indonesia, and provide recommendations for appropriate risk control to improve worker health protection.

METHODS

This research was a quantitative analytical survey with a cross-sectional approach. Primary data were collected through interviews using a questionnaire containing a list of questions regarding factors associated with an increased risk of impaired lung vital capacity. This research was also supported by observations of the conditions at the study site.

The variables in this study consisted of independent and dependent variables. The dependent variable was impaired lung vital capacity. The independent variables included age, dust levels, smoking habits, compliance with PPE use, and length of service. Additionally, confounding variables included gender, history of lung disease, and exercise habits. The population was all 372 workers in the cutting and sewing units of PT Daiwabo Garment Indonesia. However, the company only permitted researchers to sample 40 workers in the morning shifts of the cutting (Line A and B) and sewing (Line A and B) units. Therefore, the researchers used a total sampling method, with 40 respondents. The instruments used to collect data included spirometry, an air quality detector, and observation sheets.

RESULTS

Table 1 Frequency Distribution Based on Respondent Characteristics

Respondent Characteristics	Category	Total Number	
		N	%
Gender	Male	5	12
	Female	35	87
History of Lung Disease	Yes	0	0
	No	40	100
Exercise Habit	Yes	19	47
	No	21	52
Production Unit	Cutting	20	50
	Sewing	20	50
Vital Lung Capacity	Normal	14	35

	Abnormal	26	65

Table 1 shows that the total number of respondents in this study was 40 respondents. Based on the gender of the respondents, there were 5 male respondents (25%) and 35 female respondents (87.5%). Thus, the number of female respondents is greater than the number of male respondents. This is also in accordance with the reality of the number of workers who are predominantly female, which is a ratio of 1:7. The distribution of respondents based on a history of lung disease has two categories, namely having a history and not. All respondents were declared not to have a history of lung disease, so the respondents fit the inclusion criteria in the study. Meanwhile, the distribution of respondents based on exercise habits was 19 respondents (47.5%) who had exercise habits, and 21 respondents (52.5%) who did not have exercise habits. This shows that awareness about the importance of exercise is still low. As for the production unit, respondents are divided into two categories, namely cutting and sewing. Respondents from the cutting production unit were 20 respondents (50%) and sewing were 20 respondents (50%). Based on spirometry examination of lung vital capacity, 14 respondents (35%) were classified as normal, and 26 respondents (65%) were classified as abnormal.

Table 2 Frequency Distribution Based on Variables

Variable	Category	Frequency (n)	Precentage (%)
Dust Level	Abnormal	0	0
	Normal	26	100
Age	≥25 Years	29	72
	<25 Years	11	27
Smoking Habit	Yes	5	12
	No	35	87
PPE-Use Compliance	No	31	77
	Yes	9	22
Working Period	>5 Years	9	22
	<5 Years	31	77

According to the Regulation of the Minister of Manpower of the Republic of Indonesia Number 5 of 2018 concerning Occupational Safety and Health in the Work Environment, the Threshold Limit Value (TLV) refers to the standard level of hazardous exposure in the workplace. It is defined as the average concentration or intensity of a hazardous agent, measured as a time-weighted average (TWA), that can be tolerated by workers without causing health problems, assuming an exposure duration not exceeding 8 hours per day or 40 hours per week (9).

Based on (Table 2), dust levels at 26 points in the cutting and sewing unit production room at PT Daiwabo Garment Indonesia are categorized as normal (100%) because they are < Threshold Value (NAB). Thus, this company has normal dust levels. The threshold value for dust levels in the workplace is 10 mg/m3. Thus, in this study dust levels do not have a significant relationship with impaired lung vital capacity. Based on the results of researcher observations by conducting interviews with HSE Compliance, it was found that ventilation at PT

Daiwabo Garment Indonesia uses a type of mechanical ventilation in the form of a Fan.

Ventilation in this company has not fully met the standards of SNI 03-6572-2001 and PERMENAKER No. 5 of 2018. This is because PERMENAKER No. 5 of 2018 in article (41) paragraph (3) states that ventilation must be cleaned periodically at least 3 (three) months or in accordance with statutory provisions, while in reality PT Daiwabo Garment Indonesia only carries out ventilation cleaning once every 6 (six) months. However, based on the researcher's observation, the installation of ventilation in the production room has met the SNI 03-6572-2001 standard, which is not located >3.6 m above the floor. The ventilation height in this company is 2 meters from the floor surface. Ventilation consists of two fan units and has a size of 1m x 1m, so the total ventilation area is 2 m2. When compared to the area of the cutting and sewing rooms of 1,104 m2 each, the ventilation ratio is 18.12%. Quantitatively, this figure shows a considerable proportion of ventilation. However, since mechanical ventilation is used, the evaluation of ventilation effectiveness should consider the air flow rate. Therefore, this calculation only gives a general idea of the proportion of ventilation to the room area.

Based on (Table 2), respondents aged ≥25 years were 29 respondents (72.5%), and those aged <25 years were 11 respondents (27.5). In addition, there were 29 respondents aged ≥25 years, while there were 11 respondents aged <25 years. The frequency of respondents based on smoking habits is respondents who have smoking habits as many as 5 respondents (87.5%), while those who do not have smoking habits are 35 respondents (12.5%). The frequency of research respondents who complied with the use of PPE was 9 respondents (22.5%), while 31 respondents (77.5%) did not comply. Then, respondents who had a working period of >5 years were 9 respondents (22.5%), while those <5 years were 31 respondents (77.5%).

Table 3. Relationship between Age, Smoking Habit, PPE Use Compliance, and Working Period

Variable	Vital Lung Capacity				Total		CC	*P Value*
	Abnormal		Normal					
	N	%	N	%	N	%		
Age								
≥25 Years	23	79	6	21	29	100	0,438	0,002
<25 Years	3	27	8	73	11	100		
Smoking Habit								
Yes	5	100	0	0	5	100	0,267	0,079
No	21	60	14	40	35	100		
PPE Use Compliance								
Yes	23	74	8	26	31	100	0,337	0,024
No	3	33	6	67	9	100		
Working Period								
>5 Years	25	81	6	19	31	100	0,520	0,000

<5 Years	1	11	8	89	9	100		

Based on bivariate analysis with the Chi-Square test, it shows that age has a significant relationship with impaired lung vital capacity of cutting and sewing unit workers at PT Daiwabo Garment Indonesia. This is obtained from bivariate analysis with the chi square test which shows a p value of 0.002 (<0.05). Based on the Contingency Coefficient (CC), the variables of age and impaired lung vital capacity have a moderate relationship. The smoking habit variable does not have a significant relationship with impaired lung vital capacity of cutting and sewing unit workers at PT Daiwabo Garment Indonesia (p=0.079) > 0.05). Based on the Contingency Coefficient (CC) value, the variable of smoking habits and impaired lung vital capacity has a low relationship. The results of the bivariate analysis of the PPE use compliance variable with the Chi-Square test obtained a p value of 0.024 <0.05, which means that there is a significant relationship between compliance with PPE use and impaired lung vital capacity in the cutting and sewing unit of PT Daiwabo Garment Indonesia with a CC value = 0.337, which means that compliance with PPE use has a low relationship. Meanwhile, the working period variable obtained a p value of 0.000 <0.05, meaning that the working period has a significant relationship with impaired lung capacity of cutting and sewing unit workers at PT Daiwabo Garment Indonesia with a CC value = 0.520, meaning that this variable has a strong relationship.

Variables determined by researchers to be candidates for multivariate models are independent variables with a p value <0.25 in bivariate analysis. Variables that were included in the multivariate model included age, smoking habits, length of service and compliance with PPE use. Then, logistic regression analysis was carried out using the Enter method, which included all independent variables in the model. Variables that can be included in the logistic regression model are variables that have a p value <0.25 and <0.05. Therefore, the logistic regression results can be seen in the following table:

Table 4. Multivariate Analysis Results

Variable	*P Value*	Result
Working Period	0,011	Significant
PPE Use Compliance	0,017	Significant
Age	0,042	Significant
Smoking Habit	0,999	Not Significant

The working period variable has a p value of 0.011 (<0.05), which means that there is a significant relationship between working period and impaired lung vital capacity in cutting and sewing unit workers at PT Daiwabo Garment Indonesia. The PPE use compliance variable has a p value of 0.017 (<0.05), which means that there is a significant relationship between compliance with PPE use and impaired lung vital capacity. The working period variable has a p value of 0.042 (>0.05) which means that there is a significant relationship between age and impaired lung vital capacity. The smoking habit variable has a p value of 0.999 (>0.05) which means that there is no significant relationship between smoking habits and impaired lung vital capacity.

DISCUSSION

Dust Levels

The measurement of dust levels in the cutting and sewing production room of PT Daiwabo Garment Indonesia shows that dust levels are normal because they are still below the Threshold Value (<NAB). Thus, in this study dust levels do not have a significant relationship with impaired lung vital capacity.

The condition of dust levels in this company proves that ventilation as an effort to control dust works well. Respiratory disorders in workers will increase if the workplace does not have sufficient ventilation and inadequate room area which causes reduced air circulation, and higher dust accumulation (10). The ventilation used by this company is a type of mechanical ventilation in the form of a fan. However, based on the researcher's observation, the installation of ventilation in the production room has met the SNI 03-6572-2001 standard, which is not located >3.6 m above the floor (11). The ventilation height in this company is 2 meters from the floor surface. The following is a picture of ventilation in the cutting and sewing room:

Gambar 5. 1 Ventilasi di Ruang Produksi
PT. Daiwabo Garment Indonesia

Ventilation in the production room is categorized as not meeting the standards of PERMENAKER No. 5 of 2018 (12). Article (41) paragraph (3) states that ventilation must be cleaned periodically at least once every 3 (three) months or in accordance with statutory provisions, while in reality PT Daiwabo Garment Indonesia only carries out ventilation cleaning once every 6 (six) months. This can certainly cause dust to be trapped and accumulate longer in the ventilation.

When cleaning the company's ventilation, it has also not been carried out by K3 personnel in the field of work environment who are competent and certified. Although the dust levels in the cutting and sewing rooms are normal (<NAB), if the ventilation cleaning is not up to standard, the dust is still at risk of increasing the incidence of impaired lung capacity, supported by the factor that the majority of workers have worked for >5 years and have not fully complied with the use of PPE, so that dust will more easily accumulate in the lungs of

workers longer and begin to give mild symptoms such as coughing and shortness of breath. This is in accordance with the condition of the respondents, the majority of whom experienced symptoms of respiratory distress and on spirometry examination it was also found that 65% of respondents had abnormal lung vital capacity.

Age

This study shows that age has a significant relationship and is the second factor for impaired pulmonary vital capacity of cutting and sewing unit workers at PT Daiwabo Garment Indonesia. This was obtained from bivariate analysis with the chi square test which showed a p value of 0.002 (<0.05). Based on research by (13) at the age of 25 years, humans experience a decrease in large and small airway function, then accelerated decline occurs at the age of 50 years. This is in accordance with the results of the study which states that there is a relationship between age and impaired lung vital capacity, especially at the age of ≥25 years.

Smoking Habits

The results of this study indicate that smoking habits do not have a significant relationship with impaired lung vital capacity of cutting and sewing unit workers at PT Daiwabo Garment Indonesia. From the results of bivariate analysis with Chi-Square test obtained p value of 0.079 > 0.05. The variables in this study are not related allegedly because of the small number of samples, so the data is less varied. The results of this study were also influenced by the number of female respondents more than male respondents, while women tend not to have a smoking habit. So that the number of respondents who do not smoke is far more than the number of respondents who smoke. The results of this study are not in line with previous research by (14) which states that there is a significant relationship between smoking habits and smoking habits (p value = 0.022).

PPE Use Compliance

PPE will help individuals protect themselves from exposure to hazards such as dust and microorganisms. An example of PPE commonly used in the garment industry is masks. From the results of bivariate analysis with the Chi-Square test, a p value of 0.024 <0.05 was obtained, which means that there is a significant relationship between compliance with the use of PPE and impaired lung vital capacity in the cutting and sewing unit of PT Daiwabo Garment Indonesia. This is in line with the research of (15) which states that there is a significant relationship between the use of PPE (p=0.013) with the lung function capacity of furniture workers in Gowa Regency. Based on the results of bivariate and multivariate analysis, compliance with the use of PPE is stated to be related and is the second factor because PPE has the main function of preventing and reducing exposure to disease agents, one of which is dust. PPE used in the cutting and sewing process that is influential in increasing the risk of impaired lung vital capacity is PPE masks. If workers do not wear PPE masks, dust will easily enter the lungs through the nose or mouth of workers. Then, dust can accumulate in the lungs over time. So that workers can experience symptoms of impaired vital lung capacity such as coughing and shortness of breath.

Work Period

Based on the results of bivariate analysis with the Chi-Square test, the p value of 0.000 <0.05 was obtained, meaning that the work period has a significant relationship with impaired lung capacity of cutting and sewing unit workers at PT Daiwabo Garment Indonesia. This is in line with previous research by (14)which states that there is a significant relationship between the variable working period (p value = 0.016) with lung vital capacity. In addition, there is previous research by (16) which states that there is a significant relationship between working period (p=0.000) with complaints of respiratory problems in brick workers in Talang Belido Village, Sungai Gelam District, Muaro Jambi Regency.

Based on multivariate analysis, tenure is the main factor that can increase the risk of impaired lung vital capacity. Although the dust level in the room is categorized as normal (<NAB), the dust will still be inhaled and enter the lungs of workers. Then, supported by the number of working years of the majority of respondents is ≥5 years, the longer the dust will accumulate in the lungs of workers. Then workers will begin to feel mild symptoms such as coughing and shortness of breath. This condition causes respondents to experience symptoms of respiratory problems. This is evidenced in the spirometry examination which states that 26 (65%) respondents have abnormal lung vital capacity.

This condition is in accordance with research (14) which states that dust and gas emissions can accumulate in the lungs of workers over time. This accumulation increases every day and is directly related to the duration of a person's working life. The accumulation of dust and gas emissions in the lungs is influenced by the relatively long duration of exposure to dust, so that exposure continues to persist and accumulate in the body.

CONCLUSIONS

Based on data analysis, this study shows that factors associated with impaired lung vital capacity in cutting and sewing workers at PT Daiwabo Garment Indonesia are length of service, compliance with PPE use, and age. The longer a person's working period, the more at risk of impaired lung vital capacity. Then, this can also be supported by workers' non-compliance in wearing personal protective equipment (PPE) and the average age of workers> 25 years. Therefore, the Company needs to carry out appropriate risk control to prevent occupational diseases. The company can organize health checks for all workers on a regular basis in order to monitor workers' health conditions, especially respiratory health. In addition, the company can also educate workers about preventing occupational diseases and PPE. Then, continue with supervision and establish strict follow-up procedures for workers who do not wear PPE during work. The company can also increase the frequency of ventilation cleaning from once every 6 (six) months to once every 3 (three) months to maintain environmental health in the workplace.

ADVANCED RESEARCH

Future researchers can conduct research with other variables that have not been studied by researchers and need to prepare more respondents to support the smooth research process.

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