Risk Analysis of Wood Dust Exposure for Respiratory Health of Workers in The Chip and Wood Department of a Pulp Industry PT. X

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Abstract. The aim of this study is to analyse the risk of exposure to wood dust on the respiratory system of workers in the chip and wood department. The study was conducted in March 2021 at PT. X South Sumatra. The research sampleconsisted of 100 workers in PT. X and 20 sampling sites. This study used quantitative methods with a cross-sectional design The American Thoracic Society (ATS) Standardised Respiratory Questionnaire was used for data collection and the IOM dust sampler was used to measure dust in the work area. Based on the NIOSH recommendation, the sampling point for measuring inhalable dust at each sampling point was 6m x 6m. The results showed that wood dust exposure ranged from 0.240 mg/m3 to 1,431 mg/m3, with an average of 0.62 mg/m3. The result of the statistical analysis using the chi-square test indicated a significant relationship between the duration of work and the impaired lung function of the workers (prevalence ratio = 1.2). Analysis of the age variable showed that older respondents had a 1.12-fold higher risk of impaired lung function. Dust exposure as a confounding variable influenced lung function impairment with a prevalence ratio of 1.893. In other words, exposure to wood dust was likely to cause lung function impairment. The most risky workplace in the chip and wood department was debarking.

Keyword: Risk Analysis, Wood Dust Exposure, Respiratory Health of Workers, The Chip and Wood Department

1. Introduction

Indonesia is the world's largest exporter and producer of timber, with annual increases in logs, sawnwood, plywood and LVL, crisps, veneer and pulp. The wood processing industry is one of the dynamic sectors of the economy that contributes to labour absorption. However, it also poses risks to workers' health. Pulp production generates dust that pollutes the air and triggers acute respiratory and lung health problems.[1]

Pulp is a paper making material, while paper is a cellulose compression material containing cellulose and hemicellulose. Pt. X is one of the pulp industries that has been using acacia wood (Acacia Mangium) as raw material since 2000. The main production process of this company consists of raw material preparation, wood chip maturation, washing and screening, delignification

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with oxygen, bleaching and pulp shaping, while chemical recovery process, chemical treatment for bleaching process and raw water treatment to produce clean water for process and household use are the supporting processes.

The production process, especially the preparation of the wood and wood crisps, is one of the processes that generates the most wood dust this process aims to prepare the raw materials (wood crisps), which are then cooked in the fermenter unit (debarking), formation of wood crisps (shredding), screening of the wood crisps and storage and recovery of the wood chips [2].The workforce is an important asset for the companies and special attention must be paid to their health and safety. Companies must create a safe and pleasant working environment by implementing physical, chemical, biological, ergonomic and psychosocial risk controls for their workers.2 In certain departments such as the Chip and Wood In certain departments such as the Chip and Wood Department (CWD), workers are likely to be directly exposed to wood dust during the debarking, chipping and screening of crisps. Based on these explanations, the author is of the opinion that it is necessary to conduct a study on the risk analysis of wood dust exposure to the respiratory health of workers in the Wood Crisps and Wood Department of PT. X.

2. Methodology

A quantitative method with a cross-sectional design was used in this study. For data collection, the StandardisedRespiratory Questionnaire of theAmerican Thoracic Society (ATS), and the IOM dust sampler was used to measure dust in the workplace. Wood dust concentration was measured using the standard method of the NMAM-0500 from NIOSH. The sampling point for the inhalable dust measurement was 6m x 6m. This sampling was done at the source of exposure based on the recommendation of the National Instite of Occupational Safety and Health(NIOSH).

In analysing the data, this study used univariate analysis to obtain a picture of the individual independent and dependent variables. The author also investigated the best variable for predicting dependent variables by performing a multiple logistic regression analysis. Analysis with $p < 0.25$. At the end of the analysis, the most related variable was determined based on the largest OR value in the final modelling.

3. Result and Discussion

Based on the univariate analysis, out of 100 male respondents (100%), 36 people (36%) work in WHP department, 13 people (13%) work in debarking department, 12 people (12%) work in inchipping department, 10 people (10%) work in screening department and 29 people (29%) work in other departments.

For the age variable, the median was 29.9 (95% CI: 28.46 - 31.36), the youngest member was ten years old and the oldestmember was 53 years old. With a 95% confidence interval, the result of the analysis shows that older workers are1.12 times more likely to have impaired lung function, and that the risk increases 1.05 to 1.20 times with age. The analysis result of a simple logistic regression test showed a P-value of 0.001, indicating a significant correlation between age and

impaired lung function. For the height variable, the P-value was 0.391, indicating that there was no significant correlation between height and impaired lung function. For the weight variable, the P-value was 0.410, showing no significant correlation between weight and impaired lung function.

Thus, the results of this study show a significant correlation between age and impaired lung function. The results of this study are consistent with previous related studies reported by [3] , which mention that chi-square analysis shows a significant correlation between age and lung function. A study by [4] also showed a correlation between age and the condition of the lungs, such as a decrease in lung elasticity. After a person reaches 35 years of age, lung function decreases with age. This can lead to breathing becoming a little more difficult than usual [1].

Although there was no significant correlation between body size and impaired lung function, body size was a contributory variable influencing impaired lung function in PT. X workers. The study of [5] described that height was significantly correlated with workers' FEV 1 lung function, with an 8%contribution value. The regression coefficient for worker height was positive. Thus, the taller the workers, the higher the FEV 1 score One of the symptoms of respiratory disease is shortness of breath. The manufacturing industry has the potential to cause wood dust exposure in the workplace. The result of the pre-survey [6] at April 2015 showed that eight out of 10 workers suffered from health problems such as coughing and respiratory symptoms. These respiratory symptoms could possibly be due to occupational diseases of the respiratory system(9)when the body ingests chemicals, they can cause headaches, weight loss, shortness of breath, dizziness, cramps and irregular heartbeat [7].

The univariate result of work duration variable described that 13 respondents (18%) have been working in the company for < = 3 years while 82 respondents (82%) have been working in thecompany for > 3 years. The bivariate results showed an association between work duration and lung disease, but this variable was excluded fromthe multivariate modelling because there was inflation against prevalence risk, which biassed it. Therefore, the author assumed that job duration and lung function impairment were not correlated. This is consistent with the study [8], which found a pValue of 0.573 (> 0.05) using Fisher's Exact Test

Exact Test yielded a value of 0.573 (0.05) and indicated no correlation between duration of work and impaired lung function. Another related study also stated that there was no significant correlation between length of weekly work, impaired lung function and respiratory symptoms. There was also no correlation between the duration of work and spirometry parameters.[7]

Further statistical analysis showed that there was no correlation between dust exposure and the worker's lung function. However, dust exposure was a variable that contributed to the impairment of lung function in PT X workers. The bivariate prevalence risk was 1.893, which means that workers exposed to dust above the threshold have a 1.8-fold higher risk of suffering from impaired lung function. A related study (3) describes that dust exposure does not correlate with workers' lung function. However, several previous studies [2] show the opposite, demonstrating a correlation between dust exposure and lung function.

4. Conclusion and Suggestion

Based on the results of the respiratory health study of workers exposed to wood dust in the chip and wood department of PT. X, exposure to wood dust ranged from 0.240 mg/m3 to 1.431

mg/m3and the average was 0.62 mg/m3according to the Regulation of the Minister of Labour of the Republic of Indonesia No. 052018, the limit value for inhalable dust is 1 mg/m3. 20% of the data is above the limit set by the Government of Indonesia

Government of Indonesia. The higher dust content in the wood crisps and wood department occurs in the debarking department. Statistically, there is no correlation between dust exposure and impairment of workers' lung function. However, the variable is a contributory variable affecting the impairment of lung function of PT X workers. This study suggests that the company provide personal protective equipment. Provide protective equipment that meets the respiratory protection standard and complies with the OSHA recommended APR (Air Purifying Respirator) to protect workers' respiratory health from exposure to wood dust.

In addition, the company must provide training on the use of PPE and conduct regular respiratory health checks on workers as an early detection measure. Finally, the company should encourage workers to use PPE properly through rewards and punishments.

Reference

[1] A. Nabuasa, D.J., Berek, N.C. and Setyobudi, "Factors Related to Lung Function In Wood Furniture Workers In Oesapa Village, Kelapa Lima Sub District Kupang City," *Timorese J. Public Heal. 2(2), pp.64–72.*, vol. 2, no. 2, pp. 64–72, 2020.

[2] E. Andersson, G. Sällsten, S. Lohman, R. Neitzel, and K. Torén, "Lung function and paper dust exposure among workers in a soft tissue paper mill," *Int. Arch. Occup. Environ. Health*, vol. 93, no. 1, pp. 105–110, 2020, doi: 10.1007/s00420-019-01469-6.

[3] N. M. Alfisyah, " Studi Evaluasi Paparan Debu PM 2 , 5 Terhadap Gangguan Fungsi Paru Pekerja PT X," 2020.

[4] S. Agita Oviera, Siswi Jayanti, "Faktor-Faktor Yang Berhubungan Dengan Kapasitas Vital Paru Pada Pekerja Industri," *Kesehat. Masy.*, vol. 4, pp. 267–276, 2016.

[5] D. Armaidi, "Penyakit Sistem Respirasi Akibat Kerja Armaidi Darmawan," *Ilmu Kesehat. Univ. Jambi*, vol. 1, no. 1, pp. 68–83, 2013.

[6] S. Melissa, "CORRELATION BETWEEN PHYSICAL ACTIVITY AND LENGTH OF WORK WITH LUNG FUNCTION DISTURBANCE ON CRUSHER SECTION WORKERS IN COAL MINING IN PT. X KUTAI KARTANEGARA," *Bitkom Res.*, vol. 63, no. 2, pp. 1–3, 2018.

[7] P. S. Ramadhany, F. Yunus, and A. D. Susanto, "Lung Function and Respiratory Symptoms of Petrol Station Attendants in Central and North Jakarta and Its Contributing Factors," *Respir. Sci.*, vol. 1, no. 1, pp. 46–60, 2020, doi: 10.36497/respirsci.v1i1.7.

[8] R. Yuliawati, R. A. Lintar, A. Rachman, and M. Wahyuni, "Analysis of factors related to lung dysfunction among coal mining workers in coal processing plant," *J. Public Health Africa*, vol. 10, no. S1, pp. 90–92, 2019, doi: 10.4081/jphia.2019.1195.