Journal of Neonatal Surgery
ISSN(Online): 2226-0439
Vol. 14, Issue 32s (2025)
https://www.jneonatalsurg.com

OPEN ACCESS

Factors Associated with Respiratory Complaints in Mill Concentrating Workers Pt. Leighton Contractor Indonesia Site Pt. Freeport Indonesia

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Cite this paper as: Shofiyyah, Yahya Thamrin, Atjo Wahyu, (2025) Factors Associated with Respiratory Complaints in Mill Concentrating Workers Pt. Leighton Contractor Indonesia Site Pt. Freeport Indonesia. *Journal of Neonatal Surgery*, 14 (32s), 4382-4391.

ABSTRACT

Background: Respiratory complaints, such as coughing, phlegm, dyspnea, wheezing, and chest pain, can be an early sign of lung damage and are one of the occupational diseases caused by exposure to pollutants in the workplace environment.

Objective: This study aims to analyze the factors associated with respiratory complaints in workers in the concentrating mill factory.

Method: This study employed a cross-sectional analytic design. The sampling method used was total sampling, involving all 62 workers from the population. Data were analyzed using the chi-square test with the help of the SPSS software.

Results: There is a relationship between working period (P = 0.002), length of work (P = 0.000), use of PPE (P = 0.000), and smoking status (P = 0.002) and respiratory complaints in workers in the mill concentrating, while there is no relationship between age (P = 0.136) and nutritional status (P = 0.115) and respiratory complaints in workers in the mill concentrating/

Conclusion: Respiratory complaints in workers may result from prolonged work duration, substandard PPE use, and smoking habits. While age and nutrition show little effect, maintaining regular nutritional intake supports overall health.

Keywords: *Respiratory Complaints, PPE Use, Workers, Occupational Diseases.*

1. INTRODUCTION

Respiratory complaints are disorders of the respiratory tract due to constant exposure to air pollutants. The risk of respiratory complaints will increase with the length of time individuals are exposed to air pollutants. Respiratory complaints experienced by a person, such as coughing, phlegm, coughing up phlegm, shortness of breath, wheezing, and chest disease, can be an early sign of lung damage. Coughing and shortness of breath are the most common respiratory complaints(1).

According to the International Labor Organization (ILO), in 2017, there were 860,000 workers experiencing accidents and diseases due to work worldwide every day. As many as 6,400 workers die every day due to occupational accidents and diseases. The causes of work-related deaths were 34% cancer, 25% accidents, 21% respiratory diseases, 15% cardiovascular diseases, and 5% caused by other factors. Respiratory diseases due to work, according to the results of the Surveillance of Work Related and Occupational Respiratory Disease (SWORD) research conducted in the UK, found 3,300 new cases of work-related lung disease.

Occupational diseases are diseases caused by work and or the work environment. Occupational diseases occur due to exposure to physical, chemical, biological, or psychological factors in the workplace. Data from the International Labor Organization (ILO) in 2018 states that 270 million workers experience occupational accidents every year, and 160 million are affected by occupational diseases. The number of work-related deaths in the world each year is 2.78 million. In the Asia-Pacific region alone, 1.8 million work-related deaths occur each year(2).

Dust is one of the particles that float in the air. In the event of air pollution, both inside and ambient air (Indoor and Outdoor Pollution). Dust is a parameter that is used as an indicator of pollution that states the level of danger both to the environment and to occupational health and safety. Respiratory disease is one of the occupational diseases caused by exposure to dust in

the workplace environment. One of the chemical factors that is often present and dangerous in the workplace is dust. Based on Permenakertrans RI No.13 of 2011 concerning Threshold Values for Physical and Chemical Factors in the workplace that the maximum dust level in the workplace is 3 mg/m3(3).

Based on 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 value for exposure to respirable silica dust is 3 mg/m3. In Indonesia, occupational lung diseases or disorders caused by dust are estimated to be quite numerous. Based on research by Handari et al. (2018), most workers experienced impaired lung function capacity, namely 54.5% and 45.5% did not experience interference. PERMENAKERTRANS RI Number Per.08/VII/2010 article 6 point 1 states that workers and other people who enter the workplace are required to wear or use PPE by potential hazards and risks.

According to the Environmental Protection Agency (EPA) (2018), particulate matter (PM) is particles that float in the air for long periods or particles found in the air, including dust, dirt, soot, and smoke. Particles less than 2.5 μm in size (PM2.5) are referred to as fine particles and are believed to pose the greatest health risk due to their small size (about 1/30 the width of an average human hair), allowing them to enter the lungs. The Environmental Protection Agency (EPA) categorizes dust particles by size into two categories: dust particles ≤ 10 μm and dust particles ≤ 2.5 μm.

The International Labor Organization (ILO) revealed that the causes of worker-related deaths were 34% due to cancer, 25% due to accidents, 21% respiratory diseases, 15% cardiovascular diseases, and 5% caused to other factors. Worker deaths due to respiratory tracts rank 3rd after work accidents[2]. Based on research conducted by the Directorate General of PPM & PL, in Indonesia Chronic Obstructive Pulmonary Disease (COPD) ranks first as a contributor to morbidity by (35%), followed by bronchial asthma by (33%), lung cancer by (30%), and others by (2%)(4).

Abnormalities and disorders in the respiratory system can be caused by two things, namely, interference with the oxygen binding process and abnormalities in the respiratory tract that interfere with air flow. Disruption of the oxygen binding process occurs due to competition between oxygen and other substances that can bind to hemoglobin. An example is carbon monoxide gas poisoning. Carbon monoxide binds to hemoglobin more easily than oxygen. This causes hemoglobin to bind to carbon monoxide instead of oxygen. If most of the blood binds to carbon monoxide, the tissues in the body will lack oxygen. One of the respiratory disorders is ARI (Respiratory Tract Infection).

Indonesia, as one of the countries in Asia that is developing into a new industrial country, also faces the problem of air pollution, which is most often caused by motor vehicles and factory dust. The level of air pollution, especially in big cities in Indonesia, has increased from year to year, causing health problems, especially those related to respiratory problems, to increase(3).

The workplace can be exposed to substances that can make the respiratory tract more sensitive; some of the causes include spray paint, certain vehicles, flour dust, wood dust, metalworking fluids, and cleaning agents. Other risks from air pollution in the workplace include asbestos fibers, welding fumes, and silica dust. Silica dust can also be harmful and is found in products such as bricks and concrete. Welding is a common industrial process that releases fine particulate matter and toxic gases. If working as a cleaner, workers will also be exposed to Volatile Organic Compounds (VOCs). Women who work as cleaners have increased lung function decline.

Lack of control of dust factors in the work environment can make dust exposed to easily enter the body and affect the health of workers. High risk scores also indicate increasing severity for workers. The entry of dust into the respiratory tract triggers non-specific immune reactions such as sneezing, coughing, mucociliary transport disorders, and phagocytosis by macrophages. The use of PPE in the form of masks can protect breathing from gases, vapors, dust, or air that is exposed to dirt from the work area or causes irritation.

PT Leighton Contractors Indonesia is a company engaged in various fields of general construction and mining services. The company specializes in all aspects of civil engineering and infrastructure, industrial buildings and camp accommodation, contract mining, mine infrastructure, marine machinery, telecommunications, railroads, and process engineering. PT Leighton Contractors Indonesia, in its operation, does not escape the problems faced, such as occupational accidents, occupational diseases, and the negative impact of industry on the surrounding environment, so the level of human work safety as a production factor is needed so that optimal productivity can be achieved.

Based on preliminary observations made by researchers in the Mill Concentrating 74 factory section of PT Leighton Contractor Indonesia, located at PT Freeport Indonesia that the factory workers work for an average of 8 hours/day for 6 days. The results of observations made by researchers found that the work environment in the Mill Concentrating 74 factory section of PT Leighton Contractor Indonesia, located at PT Freeport Indonesia, is less healthy, as evidenced by the amount of dust produced due to the production or processing process. In addition, there are still some workers who do not use Personal Protective Equipment (PPE) when working, which is very risky for workers caused to exposure to dust. A safe working environment can affect workers' health, especially respiratory problems.

Based on the explanation above, the researcher is interested in researching “Analysis of factors associated with respiratory complaints in workers in the Concentrating Mill factory section 74 PT. Leighton Contractor Indonesia Site PT. Freeport

Indonesia Year 2023".

This study aims to determine the factors associated with respiratory complaints in workers at the Mill Concentrating 74 PT Leighton Contractor Indonesia Site PT Freeport Indonesia. Specifically, this study aims to determine the relationship between work period, length of work, age, use of PPE, nutritional status, and smoking status with respiratory complaints in workers at the Mill Concentrating 74 PT Leighton Contractor Indonesia Site PT Freeport Indonesia.

2. PARTICIPANTS & METHODS

The research design used is a cross-sectional analytic research method, which is a risk and effect study, involving observation or data collection at one specific point in time. In this study, researchers aimed to identify factors associated with complaints of respiratory problems among workers in the Concentrating Mill factory section of PT Leighton Contractor Indonesia Site PT Freeport Indonesia. This research was conducted from October to November 2023. The study population consisted of 62 workers at PT. Leighton Contractor Indonesia Site PT Freeport Indonesia. The sampling technique employed was a saturated sample technique, in which all members of the population, totaling 62 factory workers at PT Leighton Contractor Indonesia, were included. The inclusion criteria required participants to be factory workers at PT Leighton Contractor Indonesia and to provide consent by signing an informed consent form.

Independent variables are variables that affect or cause changes or the emergence of dependent variables (bound). The independent variables used in this study are length of service, age of workers, length of work, use of PPE, smoking status, and nutritional status. The dependent variable is the variable that is influenced or that becomes the result, because of the independent variable (free). The dependent variable used in this study is respiratory complaints.

Data collection was done by observation, interview, questionnaire, and documentation. Univariate analysis is an analysis conducted for each variable from the research results. The analysis was carried out by describing each research variable to get an overview and see the frequency distribution of the research variables in the form of frequency distribution tables and narratives. Then tested applying the chi-square test with the SPSS application.

3. FINDINGS

The characteristics of respondents in the workers of the Concentrating Mill Factory section 74 PT Leighton Contractor Indonesia Site PT Freeport Indonesia Year 2023, as follows:

Table 1. Frequency Distribution Based on Respondent Characteristics Among Workers in the Mill Concentrating 74 Division of PT. Leighton Contractor Indonesia Site PT. Freeport Indonesia in 2023

Respondent Characteristics	Total	Percentage (%)
Age		
Early Adult ≤ 30 years old	45	72,6
Late Adult > 30 years old	17	27,4
Gender		
Male	36	58,1
Female	26	41,9

Source: Primary Data, 2024

Based on Table 1 shows that the majority of respondents in this study are early adults ≤ 30 years old, namely 45 (72.6%), while those who are late adults > 30 years are 17 (27.4%). Furthermore, the majority of respondents in this study were male, namely 36 (58.1%), while only 26 (41.9%) were female.

The distribution of respondents in the workers of the Concentrating Mill Factory section 74 PT Leighton Contractor Indonesia Site PT Freeport Indonesia Year 2023, as follows:

Table 2. Distribution of Respondents Based on Variables Studied Among Workers in the Mill Concentrating 74 Division of PT. Leighton Contractor Indonesia Site PT. Freeport Indonesia

Variables	Total	Percentage (%)
Length of Service		
At Risk	28	45,2
Not at Risk	34	54,8
Length of Service		
At Risk	21	33,9
Not at Risk	41	66,1
Use of PPE		
At Risk	14	22,6
Not at Risk	48	77,4
Nutrition Status		
Overweight	2	3,2
Normal	12	16,4
Underweight	48	77,4
Smoking Status		
Heavy	7	11,3
Moderate	21	33,9
Not smoking	34	54,8
Respiratory Complaints		
Experience	17	27,4
Not Experienced	45	72,6

Source: Primary Data, 2024

Based on Table 2 shows that most respondents have a working period that is not at risk, namely 34 (54.8%). Most respondents in this study had a duration or length of work that was not at risk, namely 41 (66.1%). Most of the respondents who used PPE were not at risk, namely 48 (77.4%). Most of the respondents had poor nutritional status, namely 48 (77.4%). Most respondents who have non-smoking habits are 34 (54.8%), and most respondents do not experience respiratory complaints as many as 45 (72.6%).

Bivariate analysis aims to determine the significance of whether or not there is a relationship between the independent variables.

Table 3. Relationship between Research Variables and Respiratory Complaints Among Workers in the Mill Concentrating 74 Division of PT. Leighton Contractor Indonesia at the PT. Freeport Indonesia Site in 2023

Variables	Respiratory Complaints						P-Value
	Experience		Not Experienced		Total		
	n	%	n	%	n	%	
Length of Service							
At Risk	13	46,4	15	53,6	28	100	0,002
Not at Risk	4	11,8	30	88,2	34	100	
Length of Service							0,000

At Risk	12	57,1	9	42,9	21	100	
Not at Risk	5	12,2	36	87,8	41	100	
Use of PPE							
At Risk	7	41,2	10	58,8	17	100	0,136
Not at Risk	10	22,2	35	77,8	45	100	
Nutrition Status							
Overweight	11	78,6	3	21,4	14	100	0,000
Normal	6	12,5	42	87,5	48	100	
Underweight							
Smoking Status							
Heavy	0	0,00	2	100	2	100	0,115
Moderate	6	50,0	6	50,0	12	100	
Not smoking	11	22,9	37	77,1	48	100	
Respiratory Complaints							
Experience	5	71,4	2	28,6	7	100	0,002
Not Experienced	8	38,1	13	61,9	21	100	
	4	11,8	30	88,2	34	100	

Source: Primary Data, 2024

Based on table 3 shows that respondents who have a risky work period and experience respiratory complaints are 13 (46.6%). The results of the chi-square test obtained a p value (0.002 <0.05), which shows that there is a relationship between work period and respiratory complaints. Respondents who have a duration or length of work are at risk of experiencing respiratory complaints as many as 12 (57.1%). The results of the chi-square test obtained a p-value (0.002 <0.05), which shows that there is a relationship between the length of work and respiratory complaints.

Table 3 shows that respondents who are > 30 years old who experience respiratory complaints are 7 (41.2%). The results of the chi-square test obtained a p value (0.136>0.05), which indicates there is no relationship between age and respiratory complaints. The table also shows that respondents who use risky PPE and experience respiratory complaints are 11 (78.6%). The results of the chi-square test obtained a p-value (0.002 <0.05), which indicates that there is a relationship between the use of PPE and respiratory complaints.

The table above also shows that respondents who have a normal nutritional status and experience respiratory complaints are 6 (50.0%). The results of the chi-square test obtained a p-value (0.115>0.05), which indicates that there is no relationship between nutritional status and respiratory complaints. Respondents who have a heavy smoking status who experience respiratory complaints are 5 (71.4%). The results of the chi-square test obtained a p value (0.002 <0.05), which indicates that there is a relationship between smoking status and respiratory complaints.

4. DISCUSSION

This study found that of the 6 variables studied, 4 variables were associated with respiratory complaints. These variables are length of work, tenure, smoking status, and use of PPE. The variables that are not associated with respiratory complaints are age and nutritional status.

a. Relationship between length of service and respiratory complaints

Period of employment is the time when individuals work, which is calculated from the beginning of employment until the time of the study. This working period shows the length of time individuals are exposed to the workplace until the research is conducted. The longer the working period, the longer the worker is exposed to the workplace, which can affect the occurrence of an increased risk of occupational diseases.

Based on the results obtained, the respondents in this study mostly had a risky work period with respiratory complaints, as many as 13 (46.4%), while the work period that was not at risk and experienced respiratory complaints was only 4 (11.8%). This indicates that the working period in workers causes many health problems caused by the environment or work materials that are exposed and accumulated long enough. Someone who works for a long time will also be exposed to hazards in their work environment. This is also related to the time of exposure to substances or exposure to dust in the work environment;

the longer the duration of exposure, the higher the person's health complaints, especially respiratory complaints.

A long work period can allow the accumulation of pollutants in the lungs to also increase, because it has been breathing contaminated air for a long time, which is characteristic of respiratory complaints. According to Widi (2024), Individual characteristics that are also factors in the occurrence of respiratory complaints are the length of work and the period of exposure that is exposed every day in the work environment, especially in places that have hazardous materials, such as air pollution, that can cause respiratory complaints.

According to Nurmayanti (2022), the longer a person works, the more easily they are exposed to risks caused by the work environment. In a work environment exposed to dust, tenure can affect lung function. The longer people are exposed to dust in the workplace, the greater the chance of dust accumulating in the lungs. Workers who are in a work environment that has high dust levels and has a long period have a high risk of lung disease, which can lead to respiratory complaints such as shortness of breath, coughing, fatigue, and frequent sputum discharge[10]. According to Ambiya (2022), the working period tends to be a risk factor for the onset of restrictive or obstructive conditions in workers in dusty industries above 5 years(2).

The results of statistical tests using chi-square obtained a value of p = 0.002 <0.05, which means that there is a relationship between working period and respiratory complaints in workers in the Mill Concentrating factory section of PT Leighton Contractor Indonesia Site PT Freeport Indonesia. The results of this study are in line with research conducted by Medyati (2023) on the variable of working period with subjective symptoms of respiratory disorders, obtained p-value = 0.000 < 0.05, meaning that there is a significant relationship between working period and subjective symptoms of respiratory disorders in furniture industry workers in Abepura District. This study is also in line with research conducted by Kafit (2025) which shows the results of the chi-square statistical test obtained with a p-value of 0.027 < a = 0.05 where Ho is rejected and Ha is accepted, it can be interpreted that there is a relationship between working period and respiratory complaints in welding workers at PT X Batam City(5,6).

According to the researcher's assumption that in this study the working period is related to respiratory complaints due to a long working period, the longer the worker is exposed to substances and dust contained in the work environment, so that the greater the chance of dust accumulating in the lungs, workers who are in a work environment that has high dust levels and has a long period have a high risk of experiencing lung disease which will make respiratory complaints arise.

b. Relationship Between Long-term Employment and Respiratory Diseases

Working hours refer to the length of time an individual works in a single day. Working hours represent the amount of time spent performing a job, and in this context, the longer the working hours, the higher the risk of workers experiencing respiratory complaints in their workplace.

Based on the research findings, the majority of respondents in this study had risky work duration and experienced respiratory complaints, with 12 respondents (57.1%) falling into this category, while only 5 respondents (12.2%) had non-risky work duration and experienced respiratory complaints. The chi-square test yielded a p-value (0.000 < 0.05), indicating a significant association between work duration and respiratory complaints. This indicates that the duration or length of work is the intensity of exposure to hazardous working conditions, the amount of dust exposure from factory production activities inhaled by each worker, and workers who work >8 hours will be exposed to more dust compared to workers who work <8 hours in performing their work activities.

The daily dose received by employees in a day is determined by the duration of exposure; the longer the exposure, the greater the dose of exposure received by employees. If someone works in a location with exposure and health risks exceeding 8 hours of work, that worker may be at risk of developing respiratory disorders shortly. The optimal number of hours worked per day is typically 6–8 hours. Increasing working hours beyond capacity is not usually accompanied by increased efficiency; instead, productivity often decreases, and there is a tendency toward fatigue, illness, and injury. One potential variable that can cause respiratory dysfunction in workers is how long someone is exposed to pollutants in a particular environment.

According to Siregar (2022), workers exposed to dust for longer periods are at a higher risk of developing respiratory disorders such as impaired lung function. Additionally, working long hours can lead to fatigue. When the body is fatigued, there is a decline in bodily functions, making it more susceptible to health issues, including respiratory disorders. Working hours cause differences in the intensity of exposure and the amount of dust inhaled by each worker, so workers who have been involved in their work activities for a long time have the potential to inhale more dust compared to workers who have not been involved in their work activities for a long time(1).

The results of the statistical test using the chi-square test yielded a p-value of 0.000 < 0.05, indicating a significant association between work duration and respiratory complaints among workers in the Mill Concentrating 74 department at PT. Leighton Contractor Indonesia Site PT. Freeport Indonesia. The results of this study are consistent with the research conducted by Ainurrazaq (2022), which showed a p-value of 0.001, indicating a relationship between length of employment and respiratory complaints among brick workers in Talang Belido Village, Sungai Gelam District, Muaro Jambi Regency. This study also aligns with Siregar's (2020) research, which showed a relationship between work duration and respiratory disorders among brick workers in Jati Baru (p-value = 0.004)(1,3).

According to the researcher's assumption that in this study, work duration is associated with respiratory complaints because the longer the working hours or time spent at work, the longer workers are exposed to a work environment with a high risk of dust exposure. This increases the risk of workers experiencing respiratory complaints and disorders

c. Relationship between age and respiratory complaints

Age is a characteristic that carries a high risk of lung disorders, especially in individuals aged 40 years and older. At age 29, lung quality can deteriorate rapidly. Age plays a significant role in the onset of diseases and health disorders, as various biological changes occur with increasing age and are also influenced by an individual's ability to work. Age is associated with the potential likelihood of exposure to an infection source, immunization levels, and physiological activities of various tissues that influence the course of a disease(7).

Based on the research findings, respondents aged under 30 years predominantly reported respiratory complaints, accounting for 10 (22.2%), while those aged over 30 years reported respiratory complaints in only 7 (41.2%) cases. This indicates that most respondents in the productive age group (<30 years) experienced a decline in lung function. In this study, the researchers found that age was not associated with lung capacity among workers at the Mill Concentrating 74 PT. Leighton Contractor Indonesia Site PT. Freeport Indonesia. This finding was supported by the Chi-square test, which yielded a p-value of 0.136 > 0.05.

Workers, regardless of their productive age, who are exposed to risky working environments over the long term, are likely to experience health issues such as respiratory complaints.

In general, age affects physical endurance; as one ages, stamina and physical endurance decline. However, this study does not support this theory. Age < 30 years is considered productive, during which workers are expected to perform optimally. The results of this study contradict Prasetiyawati's (2021) theory, which states that as age increases, so does susceptibility to disease, particularly respiratory disorders among workers exposed to hazardous substances in the workplace. The aging process naturally leads to a decline in organ function due to cellular degeneration, resulting in an increase in health issues as age advances(8).

In reality, changes in the anatomical structure of the respiratory system and gas exchange caused by aging are difficult to distinguish from other factors such as air pollution, smoking habits, lifestyle, and environmental exposure. In vulnerable groups, environmental exposure can trigger inflammation in the lungs and cause a decline in lung function(9).

The results of the statistical test using the chi-square test yielded a p-value of 0.136 > 0.05, indicating no significant association between age and respiratory complaints among workers in the Mill Concentrating 74 department at PT. Leighton Contractor Indonesia Site PT. Freeport Indonesia. The results of this study are consistent with the research conducted by Amalia (2023), which found no significant relationship above 0.05 between age and subjective respiratory complaints, with a p-value of 0.459(7). This study is also consistent with research conducted by Sultan (2020), which found that there is no relationship between age and lung capacity among workers in the stone carving industry at Tampung Cinae, Tanete Riaja District, Barru Regency(10).

According to the researcher's assumption, age does not affect respiratory complaints among workers in the Mill Concentrating 74 PT. Leighton Contractor Indonesia Site PT. Freeport Indonesia, because workers aged <30 years and >30 years still experience respiratory complaints. This is caused by other factors, and workers must pay attention to other risk factors besides age to minimize the impact of respiratory complaints among workers.

d. Relationship between PPE use and respiratory complaints

Personal protective equipment (PPE) is a device designed to protect the body from workplace accidents and reduce the severity of injuries that may occur. The use of PPE (masks) by workers in dusty work environments is an effort to reduce the entry of dust particles into the respiratory system. Good PPE is PPE that meets safety and comfort standards for workers.

Based on the research findings, 11 (78.6%) of the respondents who used personal protective equipment (PPE) experienced respiratory complaints, while 6 (12.5%) of those who were not at risk experienced respiratory complaints. This indicates that the use of Personal Protective Equipment (PPE) provided by the company, particularly masks used properly, is associated with respiratory issues because it can minimize the amount of dust or harmful substances inhaled through the nose and reduce the effects of dust exposure in the workplace, thereby lowering the risk of respiratory complaints. According to Pratiwi (2024), workers in high-risk work environments with high dust levels who do not regularly use personal protective equipment are certain to be exposed and at risk of respiratory tract disorders. Not wearing a mask allows dust to be inhaled, which over time accumulates in the lungs, leading to a decline in lung function(11).

The use of protective equipment should be based on workers' awareness. Lack of awareness about the dangers caused by exposure to workplace processes makes workers reluctant to use PPE. The availability of personal protective equipment provided by the company means that workers do not need to consider personal expenses for purchasing their own PPE. According to Prasetiyawati (2021), the proper use of PPE helps reduce the risk of work-related illnesses and minimizes direct exposure to hazardous materials in the workplace. The more comprehensive the PPE used, the lower the health risks

involved(8).

The statistical test using the chi-square test yielded a p-value of 0.000 < 0.05, indicating a significant association between the use of personal protective equipment (PPE) and respiratory complaints among workers in the Mill Concentrating 74 department at PT. Leighton Contractor Indonesia Site PT. Freeport Indonesia. The results of this study align with those of Kafit (2025), who investigated the effect of PPE use on respiratory complaints among 68 workers (5). The results of that study showed that workers who regularly used PPE, such as masks, had a lower risk of experiencing respiratory complaints compared to workers who rarely used PPE (p-value < 0.05). The results of this study are also consistent with the research conducted by Praditya (2023), which showed that the statistical test of the relationship between compliance with the use of respiratory protective equipment and respiratory complaints yielded a significance value (p-value) of 0.001 < 0.05, indicating a significant relationship between compliance with the use of respiratory protective equipment and respiratory complaints(12).

According to the researcher's assumption that in this study, the use of Personal Protective Equipment (PPE) is related to respiratory complaints caused by the use of protective equipment, especially masks, which play an important role in preventing and reducing the risk of respiratory complaints among workers. The use of masks by industrial workers in workplaces exposed to substances or dust for extended periods is an effort to reduce the concentration of substances or particles entering the respiratory tract, thereby reducing exposure that can cause respiratory complaints.

e. The Relationship between the Use of Personal Protective Equipment and Work Accidents Relationship between nutritional status and respiratory complaints

Nutritional status is the condition of the body as a result of food and nutrient consumption. One of the consequences of malnutrition is a weakened immune system and reduced antibody production, making individuals more susceptible to infections such as the common cold, cough, diarrhea, and impaired ability to detoxify foreign substances like dust that enter the body.

Based on the research findings, 6 (50.0%) of the respondents in this study had normal nutritional status and did not experience respiratory complaints, while 6 (50.0%) experienced respiratory complaints. The chi-square test yielded a p-value of 0.115 (0.115 > 0.05), indicating no significant association between nutritional status and respiratory complaints. This indicates that workers with normal or poor nutritional status remain at risk of experiencing respiratory complaints if their work environment is hazardous and the use of Personal Protective Equipment (PPE) is inadequate. Additionally, the duration of exposure to hazardous substances such as dust in the work environment is a risk factor for workers experiencing respiratory complaints.

Poor nutritional status can lead to a weakened immune system, making individuals more susceptible to health issues. However, this was difficult to prove in this study, as the majority of workers were in a normal nutritional status. According to Pusparina (2022), nutritional status is the balance between nutrient intake from food and the body's metabolic needs. Nutrient requirements vary among individuals depending on age, weight, gender, activity level, and other factors. With good nutritional status, the body has sufficient capacity to defend itself against various infectious diseases. When nutritional status is poor, it leads to a decrease in immune system response. Consequently, the body's ability to defend itself diminishes(13).

The chi-square test yielded a p-value of 0.115 > 0.05, indicating no significant relationship between nutritional status and respiratory complaints among workers in the Mill Concentrating 74 department at PT. Leighton Contractor Indonesia Site PT. Freeport Indonesia. The results of this study are consistent with those of Poppy (2015), where statistical tests on this variable yielded a p-value of 1.000, concluding that there is no significant association between workers' nutritional status and the onset of respiratory symptoms(14).

Based on the results of this study, the researcher concludes that the proportion of workers with poor nutritional status is too small to indicate the influence of other factors, which may have a greater impact. Therefore, this study concludes that nutritional status is not a risk factor for respiratory disorders among workers at the Mill Concentrating 74 plant of PT. Leighton Contractor Indonesia Site PT. Freeport Indonesia.

f. Relationship between smoking status and respiratory complaints

Cigarettes contain several compounds that can harm an individual's lung condition. These compounds can accumulate in the lungs and cause physiological changes in the lungs. These compounds include nicotine, tar, and carbon monoxide.

Based on the research findings, 5 respondents (71.4%) in this study had a heavy smoking habit and experienced respiratory complaints, while 8 respondents (38.1%) had a moderate smoking habit and experienced respiratory complaints. The chi-square test yielded a p-value of 0.002 (p < 0.05), indicating a significant association between smoking status and respiratory complaints. This is attributed to the respondents' habit of smoking before and during work. Smoking habits are difficult to quit among workers because they feel addicted to cigarettes and find them comforting while performing their duties.

Respiratory function disorders are more commonly experienced by smokers who work in dusty workplaces compared to workers in the same environment who do not smoke. Lung function is influenced by smoking habits and exacerbated by the presence of dust, leading to respiratory symptoms. Smoking habits accelerate the decline in lung function. According to

Raymana (2022), the annual decline in forced expiratory volume is 28.7 ml for non-smokers, 38.4 ml for former smokers, and 41.7 ml for active smokers. The effect of cigarette smoke can be greater than the effect of dust, accounting for only about one-third of the harmful effects of smoking(15).

Smoking causes changes in the structure and function of the respiratory tract and lung tissue. In the large airways, mucosal cells enlarge (hypertrophy) and mucus glands increase in number. In the small airways, mild inflammation occurs, leading to narrowing due to an increase in cells and mucus buildup. In lung tissue, there is an increase in the number of inflammatory cells and damage to alveoli. Due to anatomical changes in the respiratory tract, smokers experience changes in lung function and various clinical changes(15)

The chi-square test yielded a p-value of 0.002 ($p < 0.05$), indicating a significant association between smoking status and respiratory complaints among workers at the Mill Concentrating 74 plant of PT. Leighton Contractor Indonesia Site PT. Freeport Indonesia. The results of this study are consistent with the research conducted by Medyati (2023), which showed that the statistical test of smoking habits with subjective symptoms of respiratory disorders yielded a p-value of $0.037 > 0.05$, indicating a significant association between smoking habits and subjective symptoms of respiratory disorders among furniture industry workers in Abepura District (6). This study is also consistent with the research by Isnaeni (2023), where statistical tests yielded a p-value of 0.000, indicating a significant relationship between smoking habits and respiratory disorders among wood furniture craftsmen in Bangkinang City District in 2023 (16).

According to the researchers' assumption, in this study, smoking habits among workers associated with respiratory complaints are caused by their lung function being affected by smoking habits. This is also due to cigarette smoke altering respiratory structure and damaging lung defense mechanisms, thereby facilitating the onset of respiratory disorders among workers.

Acknowledgements : We would like to thank the Faculty of Public Health for supporting this research. We would also like to thank all the participants and workers at PT. Leighton Contractor Indonesia Site PT. Freeport Indonesia for supporting this study.

Author Contributions: Hesty Datu, Yahya Thamrin, Atjo Wahyu : Concept and design study . Hesty Datu : Collecting and processing research data. All authors: Preparation of publication manuscript.

Conflict of Interest: There is no conflict of interest in this research .

Funding: All research and publication funding is carried out independently without any financial assistance from other parties.

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