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Analysis of Factors causing Work Accidents in the Production Process at the Blitar Plywood Factory

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Abstract
This study analyses the factors causing work accidents of 89 workers in the production process of the Plywood factory. Using a quantitative, analytical observational study with a cross-sectional approach. The study revealed a significant relationship between knowledge of PPE and workplace accidents in plywood factories (ρ = 0.027). Meanwhile, other variables like education level, age, gender, and length of service did not have a significant relationship with workplace accidents. This study was focused on worker behaviour, so it did not examine environmental and equipment factors. The results of this study can be used to improve the socialisation of using PPE.

Keywords: Accident, Factors, Plywood, Factory,

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1.0 Introduction

Occupational safety and health (OSH) are an effort undertaken by the workplace to protect workers from the risk of injury, occupational illness, and even death. Implementing OSH in the manufacturing industry is not only a moral and ethical obligation for workers but also crucial to the success and sustainability of the company, including improving productivity and quality (Pulungan & Hasibuan, 2024).

In the wood processing industry, particularly plywood factories, the risk of occupational accidents is relatively high due to the work environment involving heavy machinery, rotating cutting tools such as rotary machines, the use of sharp objects, exposure to noise from machinery, dust, and chemicals (Rezkyana et al., 2024).

Based on data on work accidents and occupational diseases reported by BPJS Ketenagakerjaan, it is known that the number of work accident cases has increased, namely 210,789 cases in 2019, then to 221,740 cases in 2020, increasing to 234,370 cases in 2021, then 297,725 in 2022, and to 360,635 in 2023 (Saputra, 2024). As for the distribution of work accident data based on the type of

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business sector, the business sector that most frequently experienced work accidents in 2019-2021 was the miscellaneous industry business sector (22.3%), followed by four other business sectors such as trade and services (21.4%), agriculture, fisheries, plantations, forestry (17.3%), consumer goods industry 15.5%, and the basic and chemical industry business sector (12.1%) (Kementerian Ketenagakerjaan Republik Indonesia, 2022). Plywood factories are one part of the wood processing industry that can be classified as a miscellaneous business sector. Based on a study conducted on the wood processing industry in Poland, it was found that the prevalence of work accident cases was highest in industries with a micro and small business scale (71.7%) rather than medium and large business scale (40.8%) (Nowakowska & Pajęcki, 2024). Some types of injuries that commonly occur in workers in the wood processing industry include loss of fingers and toes, dislocations, sprains, and strains of the lower limbs (Thi & Van, 2025). The cause of accidents is related to worker behaviour in the workplace, including workers who do not carry out work under SOPs, workers who do not use PPE, and workers who have never attended training activities on safety at work and occupational accident prevention (Thi & Van, 2025).

In Blitar City, the wood processing industry plays a significant role in the local economy and employs a significant workforce. However, the high number of workplace accidents in the production process indicates weaknesses in implementing occupational safety and health standards. Interviews with a Plywood company revealed that workplace accidents occur almost monthly in the company's area. In 2023, several accidents occurred during the morning shift, resulting in workers being struck by objects and having their right hands trapped. The most common type of accident was a cutter scratch on the repair core. Initial observations indicated that several causes of accidents were workers' lack of knowledge of using PPE, resulting in many workers not using PPE according to existing regulations and inadequate PPE supplies. Based on this background, the researcher was interested in conducting a study on "analysis of factors causing workplace accidents in the production process at the Plywood Factory in Blitar City." This study aims to analyse the causes of workplace accidents at the Plywood Factory in Blitar City using a systematic approach based on risk analysis. The purpose of this paper is to present the results of research that has been conducted. The study results are expected to provide innovative input in designing occupational safety interventions and contribute to strengthening public health policies for workers in the plywood industry.

2.0 Literature Review

2.1 Plywood

Plywood is a wood-based building product commonly used in commercial and residential construction (Jia et al., 2019). Plywood has become an important material in everyday life, so it is widely used in various fields such as construction (building materials), furniture (furniture making), flooring, window and door production, and interior and exterior home applications (Krišťák & Réh, 2021). Plywood manufacturing requires several stages to ensure high-quality plywood. The stages of plywood manufacturing include Raw Material Preparation, Veneer Treatment, Adhesive Preparation, Veneer Assembly, Heat Pressing, Cooling and Finishing, and Quality Control (Bekhta et al., 2020).

2.2 Types of Work Accidents in Plywood Factories

A workplace accident is an undesired event that can result in material and non-material losses. The following are some of the most common types of accidents that occur to workers in plywood.

A. Wounds and cuts: Workers risk injury from sharp tools and machinery used in plywood production, especially during cutting (Rezkyana et al., 2024).
B. Crushing injuries: Fingers, toes, hands, and feet can be crushed or broken by heavy materials or machinery (Ro'In et al., 2023).
C. Eye injury: Wood dust and chips can cause eye damage and irritation (Ro'In et al., 2023).
D. Respiratory problems: Exposure to wood dust can cause respiratory problems and irritation (Ro'In et al., 2023).
E. Falls and slips: Slippery floors due to dust and wood chips increase the risk of falls (Truong Thi, 2022).
F. Musculoskeletal injuries: Lifting heavy materials can cause injuries that affect hand and leg movement (Truong Thi, 2022).
G. Chemical exposure: Workers may experience skin irritation or respiratory problems due to the chemicals used in the finishing process (Zahra et al., 2024).
H. Hearing damage: Loud engine noise has the potential to cause hearing loss (Zahra et al., 2024).
I. Electric shock: Unsafe cables pose a risk of electric shock (Zahra et al., 2024)

2.3 Three Main Factor Theory

The Three Main factors Theory of Accidents are human factors, equipment, and environment. This theory suggests that accidents are caused by the interaction of these three elements, encompassing aspects like a worker's behaviour or knowledge, the condition of machinery, and the physical workspace itself (Nur et al., 2022).

1. Human factors

a. Unsafe Acts and Conditions

Unsafe acts by workers and unsafe conditions in the workplace are major contributors to accidents in the plywood industry (Manalu et al., 2023). Unsafe acts include not using personal protective equipment (PPE) properly, while unsafe conditions include hazards in the work environment, such as the smell of glue and putty paint and hazards associated with work tools and machines (Rezkyana et al., 2024).

b. Personal Protective Equipment (PPE)

Lack of proper use of PPE is a common factor in workplace accidents. Workers often neglect to wear PPE due to discomfort, increasing the risk of injury (Manalu et al., 2023)

c. Worker Characteristics

Age, length of work experience, and knowledge of occupational safety and health can influence the likelihood of an accident. Workers with less experience or inadequate safety knowledge may be more susceptible to accidents (Irkas et al., 2020).

d. Working hours

Extended working hours can contribute to an increased risk of accidents. Some workers in the plywood industry work up to 10 hours or more per day, which can lead to fatigue and reduced alertness (Manalu et al., 2023).

2. Equipment such as Machine condition: How well a machine is maintained and whether it is functioning correctly. Tools and machinery: Proper training on how to use equipment, including safety procedures. Personal Protective Equipment (PPE): Whether it is available and used correctly.

3. Environment, such as Physical workspace, Workplace hazards, and Organisational factors. The work environment plays a significant role in accidents. Factors such as noise, poor lighting, and a cluttered workspace can increase the risk of accidents. In some cases, workers rely solely on natural light, which may be inadequate (Manalu et al., 2023).

3.0 Methodology

This research is an observational, analytical, quantitative study with a *cross-sectional approach*. This research was conducted at the Plywood Factory in Blitar City from May to August 2024. The independent variables in this study were age, education level, gender, length of service, and knowledge of Personal Protective Equipment (PPE).

The population in this study were workers involved in the production process, such as workers in the hotpress, repair face back, repair core, press core, rotary, sizer, barker, and other sections, totalling 812 workers. The sampling technique used was *simple random sampling.* Using the Slovin formula, a sample of 89 people was obtained. The sample determination used the *simple random sampling method,* with all workers in the production process area having the same opportunity to become samples.

The data source in this study comes from primary data collected using a questionnaire instrument that has been tested for validity and reliability. The secondary data in this study consists of data regarding the history of work accidents in a plywood factory. Furthermore, the data obtained will be processed and analysed using the chi-square statistical test with an error rate of $\alpha = 0.05$. This study has received an ethical certificate from the Ethics Unit of the Ministry of Health Polytechnic of Malang with number DP.04.03 / F.XXI.31 / 01005 / 2024. This study focuses only on worker behaviour and does not examine work equipment and the work environment.

4.0 Results

The frequency distribution of the research variables can be seen in the following table:-

Table 4.1. Frequency distribution of research variables

Variables	Frequency (N)	Percentage (%)
Work accident		
Once	46	51.7
Never	43	48.3
PPE Knowledge Level		
Good	83	93.3
Not enough	6	6.7
Level of education		
JUNIOR HIGH SCHOOL	7	7.9
Senior HIGH SCHOOL	72	80.9
College	10	11.2
Age		
≤30 years (Early Adulthood)	81	91
>30 years (Late Adulthood)	8	9
Gender		
Man	57	64
Woman	32	36
Years of service		
≤5 years (New)	84	94.4
>5 years (Old)	5	5.6

Source: Primary Data

Based on Table 4.1, it is known that the frequency distribution of respondents regarding workplace accidents observed from 89 people shows that 51.7% of respondents (46 people) have experienced a workplace accident. The types of accidents that frequently occur in plywood factories are cuts, falls, and being hit by objects. Based on the interview results, most accidents occur during the afternoon and night shifts, and the impact does not result in fatalities.

Most people (93.3%) had a good level of knowledge of PPE, and 80.9% had completed senior high school. Most respondents (91%) were ≤30 years old in the early adult category, 94% were male, and the most 94,4% had a new work period. The results of the bivariate analysis using the chi-square test can be seen in the following table:

Table 4.2 Analysis Study of each variable

Variables	Work accident				Total		p-value
	Once		Never				
	N	%	N	%	N	%	
PPE Knowledge Level							
Good	40	44.9	43	48.3	83	93.3	0.027
Not enough	6	6.7	0	0	6	6.7	
Level of education							
JUNIOR HIGH SCHOOL	4	4.5	3	3.4	7	7.9	0.802
SENIOR HIGH SCHOOL	36	40.4	36	40.4	72	80.9	
College	6	6.7	4	4.5	10	11.2	
Age							
≤30 years (Early Adulthood)	40	44.9	41	46.1	81	91.0	0.268
>30 years (Late Adulthood)	6	6.7	2	2.2	8	9.0	
Gender							
Man	29	32.6	28	31.5	57	64.0	0.839
Woman	17	19.1	15	16.9	32	36.0	
Years of service							
≤5 years (New)	43	48.3	41	46.1	84	94.4	0.532
>5 years (Old)	3	3.4	2	2.2	5	5.6	

Source: Primary Data

Based on Table 4.2, it is known that the variable related (p-*value* > 0.005) to the occurrence of work accidents in the plywood factory in Blitar City is knowledge of using PPE (p-value = 0.028). Meanwhile, other variables such as education level, age, gender, and length of service do not have a significant relationship to the accidents in the plywood factory in Blitar City.

5.0 Discussion

5.1 The relationship between the level of knowledge of PPE and the occurrence of accidents

Based on the hypothesis test results using the chi-square test, the Asymp.sig value was 0.027 (p < 0.05), indicating a significant relationship between the level of PPE knowledge and workplace accidents. Several studies have found a significant relationship between workers' knowledge of occupational health and safety, including the use of PPE, and the occurrence of accidents in the workplace (Anasti & Harahap, 2024).

The analysis results show that most respondents (48.3%) had good knowledge of PPE and had never experienced a work accident. Workers with good knowledge and never experienced a work accident because they truly understand the importance of using PPE and the risks of not using PPE in the workplace. Better knowledge of PPE tends to lead to increased compliance with PPE use. Workers with good knowledge of PPE are more likely to use it correctly, which helps prevent accidents (Putri & Syarvina, 2022). While increased knowledge generally leads to better use of PPE, some studies note that knowledge alone does not always result in behavioural change (Putri & Syarvina, 2022). Attitudes, supervision, and workplace culture are important in PPE compliance and accident prevention (Putri & Syarvina, 2022). Providing workers with information about the importance of PPE and proper usage techniques can improve compliance and reduce accidents (Aini Fatimah et al., 2023).

5.2 The relationship between education level and work accidents

Based on the hypothesis test results using the chi-square test, the Asymp.sig value was 0.802 (p-value > 0.05), indicating a significant relationship between education level and occupational accidents among workers in plywood factories. It aligns with research on sugar factory workers at PG Poerwodadie, which found no relationship between respondents' education level and non-compliance with personal protective equipment (PPE) (Roosyanto P, 2022).

Based on the analysis, it was found that 40.4% of respondents with high school degrees experienced workplace accidents. Observations indicate no relationship between education level and workplace accidents in plywood factories because most workers are high school graduates. Interviews revealed that companies do not require workers with higher education, but workers with skills appropriate to the production process. Workers with any educational background can acquire knowledge and experience related to occupational safety. Formal education may not directly translate into job-specific safety knowledge. The lack of a relationship between education and accidents may result from inadequate safety training. Many workers, regardless of their education level, may not receive adequate training in occupational health and safety (Tanaya et al., 2020).

5.3 Relationship between age and work accidents

Based on hypothesis test results using the chi-square test, the Asymp. Fisher's exact test sig value was 0.268 (p-value> 0.05), indicating no significant relationship between age and work accidents. Several studies also state no significant relationship between work accidents and age (Irkas et al., 2020; Maulana & Nugroho, 2023). Statistical data shows no increase in work accidents caused by age. In fact, in the study, several respondents stated that groups of workers aged over 55 years were less likely to experience accidents than younger workers (Araújo-Vila et al., 2022).

Based on the chi-square crosstab analysis results, 2.2% of respondents aged >30 years had never experienced a work accident. It is because workers have not experienced a decline in physiological function and are still physically strong to perform their work. Results from field observations indicate that the workers' age does not cause the occurrence of work accidents in plywood factories. Younger workers (≤45 years) are twice as likely to experience a work accident compared to older workers (Ulumuddin et al., 2019). Meanwhile, older workers tend to be more careful and have more experience, which can offset the potential for physical decline. Their accumulated knowledge and caution can help prevent accidents (Araújo-Vila et al., 2022). Other factors that may be related to work accidents include unsafe conditions and actions, length of work, knowledge of OHS, workload, fatigue, and not wearing PPE (Irkas et al., 2020; Kedang et al., 2020).

5.3 Relationship between gender and work accidents

Based on the hypothesis test results using the chi-square test, the Asymp.sig value was 0.839 (p>0.05), indicating no significant relationship between gender and work accidents. This study aligns with Kedang et al. (2020), where the results showed that gender did not contribute to accidents.

Based on field observations, it was found that men and women have the same risk of workplace accidents. The same risk for women and men is due to the clear division of work types in the plywood factory according to worker capacity. In the factory, male workers are placed in the putty, rotary, hot press, and barker sections, while women are placed in the core repair, core press, F/B setting, inspection, and 2-ply repair sections. The work sections are differentiated between men and women because men have the muscle strength and ability to perform heavy work. Therefore, men are more often involved in heavier tasks and use potentially dangerous machines, while women often do simpler and more creative jobs that require less machine use (Truong Thi, 2022). This condition may increase the risk of accidents for male workers compared to female workers.

5.4 Relationship between length of service and work accidents

Based on the hypothesis test results using the chi-square test, the Asymp.sig Fisher's exact test value was 0.532 (p>0.05), indicating no significant relationship between work period and work accidents. Several studies have shown that work periods do not significantly influence work accidents. A study of furniture workers in Tembalang, Semarang City stated that work period was unrelated to work accidents, with a p-value of 0.522 (Maulana & Nugroho, 2023).

Based on the analysis, 46.1% of respondents with less than 5 years of service had never experienced a work accident. Interviews indicated that workers in production areas experience high turnover due to monotonous, repetitive work and shift work. Occupational accidents may depend more on individual behavior and workplace conditions than length of service (Tanaya et al., 2020). Even workers with shorter service periods may be at risk if exposed to hazardous conditions for extended periods daily (Ida et al., 2019).

6.0 Conclusion & Recommendations

The analysis found that the factor associated with workplace accidents among workers in plywood factories was the level of knowledge of PPE (p-value <0.005). Meanwhile, education level, age, gender, and length of service did not have a significant relationship with workplace accidents among workers in Plywood factories in Blitar City. The company should increase the frequency of training and outreach regarding the importance of PPE use in preventing workplace accidents in plywood factories. Further research is needed to analyse environmental factors and equipment that can cause workplace accidents in plywood factories.

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Paper Contribution to Related Field of Study

This research can add information regarding human factors that cause work accidents in plywood factories.

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