The Influence of Age, Working Hours, and Use of Personal Protective Equipment on the Risk of Work Accidents: A Case Study at the TKBM Cooperative Work Groups 1 and 2, Sorong Port

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ARTICLE INFO	ABSTRACT
	This study aims to examine the influence of age, working hours, and the use of personal protective equipment (PPE) on the risk of occupational accidents among port workers, particularly in Work Groups 1 and 2 of the TKBM Cooperative at Sorong Port, Indonesia. Given the high number of reported accidents 40 cases in the last two years. This study highlights a critical safety issue in the maritime logistics sector. A quantitative approach with a descriptive method was employed. Data were collected from 50 dockworkers through a closed-ended Likert-scale questionnaire and direct observation. The analysis was conducted using multiple linear regression with SPSS version 27. The results indicated that age (p = 0.085) and working hours (p = 0.340) did not have a significant effect on the risk of work accidents when considered individually. In contrast, PPE usage showed a significant impact (p = 0.008), and all three variables together had a statistically significant combined effect (p = 0.001). These findings underscore the importance of consistent PPE usage in preventing occupational accidents and suggest that integrated safety management strategies should be prioritized, especially in physically demanding work environments such as ports. This study contributes to the occupational health and safety literature by addressing a research gap in high-risk labor sectors and offers practical insights for improving policy and training programs in port labor management.

1. Introduction

Workplace accidents are a critical issue in the labor sector, particularly in high-risk environments such as stevedoring (TKBM) operations at ports. This type of work involves the "3Ds"(dangerous, dirty, and difficult) which directly increase the likelihood of occupational accidents. Data from the TKBM Cooperative at Sorong Port show that over the past two years (2022–2023), there were 40 recorded work-related accidents within Work Groups 1 and 2, resulting in 26 minor injuries and 14 serious injuries. According to company policy, workers involved in accidents receive compensation. The compensation includes benefits from the national employment insurance program (BPJS Ketenagakerjaan) under the Occupational Accident Insurance (JKK) scheme, BPJS Health coverage, and monetary compensation of IDR

1,000,000 (approximately one million rupiah) for minor injuries and more than IDR 2,000,000 for serious injuries.

Theoretically, workplace accidents do not occur randomly. Heinrich's Domino Theory (1931) and the Three Main Factor Theory emphasize that human factors, environmental conditions, and equipment are the primary causes of accidents. In the context of TKBM workers, variables such as worker age, long and irregular working hours, and non-compliance with the use of Personal Protective Equipment (PPE) are considered major contributors to the increased risk of occupational accidents.

1.1 Background

Incidents commonly occurring during loading and unloading activities such as slipping in the ship's hold, being struck by heavy loads while carrying cargo at the port, getting crushed by transported goods, or falling while jumping between vessels significantly increase the risk of work-related accidents during operations. These recurring incidents highlight the urgent need for research, as such accidents not only jeopardize the health and safety of workers but also disrupt the smooth operation of port activities.

This research is supported by previous empirical studies. Suak et al., (2018) demonstrated that incomplete use of Personal Protective Equipment (PPE) significantly increases the risk of workplace accidents. Similarly, Sudarta (2022) found an inverse relationship between PPE usage and accident rates. Meanwhile, a study by Mulyadi et al., (2022) showed that age does not always correlate with occupational accidents, emphasizing the need for further investigation depending on job context and type. Research by Sitanggang et al., (2024) also indicated that shift work schedules contribute to worker fatigue, although age was not found to have a significant impact.

Although previous studies have examined factors influencing workplace accidents, there remains a research gap in the specific context of the TKBM Cooperative in Sorong, particularly among stevedores. Moreover, limited attention has been given to the combined relationship between age, working hours, and PPE usage in determining accident risk. Much of the prior research has focused on environmental and physical workplace conditions, with little emphasis on individual factors such as age, the duration of working hours, and PPE compliance. Therefore, this study seeks to fill this gap by thoroughly investigating how variables such as age, working hours, and PPE usage contribute to the incidence of

occupational accidents among TKBM workers.

The analysis using VOSviewer software reveals that, although the variables of age and working hours have been widely studied over the past five years, research specifically focusing on the TKBM (port stevedore) population remains very limited. Meanwhile, the variable of PPE usage has rarely been the primary focus of previous studies. Therefore, the novelty of this research lies in its comprehensive approach, which not only examines the individual effects of each variable but also considers the integration of three key variables age, working hours, and personal protective equipment (PPE) usage in analyzing the risk of occupational accidents among TKBM workers. By referencing real-world phenomena, addressing research gaps in prior literature, and applying a comprehensive analytical framework, this study aims to contribute both practically and theoretically to efforts in improving occupational safety within the port stevedoring sector.

1.2 Problem Statement

Based on the background described, the following research questions are formulated to define the scope of the study:

1. Does the age of workers have a significant effect on the risk of occupational accidents among TKBM workers in Work Groups 1 and 2 of the TKBM Cooperative at Sorong Port?
2. Do working hours affect the risk of occupational accidents among TKBM workers in Work Groups 1 and 2 of the TKBM Cooperative at Sorong Port?
3. Does the use of personal protective equipment (PPE) have a significant effect on the risk of occupational accidents among TKBM workers in Work Groups 1 and 2 of the TKBM Cooperative at Sorong Port?
4. Do age, working hours, and the use of personal protective equipment collectively have a significant effect on the risk of occupational accidents among TKBM workers in Work Groups 1 and 2 of the TKBM Cooperative at Sorong Port?

1.3 Objectives and Scope
Objectives
This study aims to investigate the influence of individual and combined factors namely age,

working hours, and the use of personal protective equipment (PPE) on the risk of occupational accidents among port stevedores. The specific objectives are as follows:

1. To examine the significant effect of workers' age on the risk of occupational accidents among TKBM workers in Work Groups 1 and 2 of the TKBM Cooperative at Sorong Port.

2. To assess the significant effect of working hours on the risk of occupational accidents among TKBM workers in Work Groups 1 and 2 of the TKBM Cooperative at Sorong Port.

3. To analyze the significant effect of personal protective equipment (PPE) usage on the risk of occupational accidents among TKBM workers in Work Groups 1 and 2 of the TKBM Cooperative at Sorong Port.

4. To evaluate the combined effect of age, working hours, and PPE usage on the risk of occupational accidents among TKBM workers in Work Groups 1 and 2 of the TKBM Cooperative at Sorong Port.

Scope

Based on the research problems and objectives, the scope of this study is limited to examining the influence of age, working hours, and the use of personal protective equipment on the risk of occupational accidents (A Case Study at the TKBM Cooperative Work Groups 1 and 2 at Sorong Port).

2. Literature Review

This study builds upon established theories and empirical studies related to occupational accidents, particularly within high-risk labor sectors. Heinrich's Domino Theory (1931) and the Three Main Factor Theory provide a theoretical framework by emphasizing that work-related accidents result from human, environmental, and equipment factors. In the context of TKBM workers, these factors are reflected in age, irregular working hours, and compliance with PPE use.

2.1 Related Work

Several previous studies offer valuable insight for this research. Suak et al. (2018) reported that incomplete use of personal protective equipment (PPE) significantly increases the likelihood of occupational accidents. Sudarta (2022) found an inverse relationship between PPE usage and accident rates. Mulyadi et al. (2022) noted that age was not

significantly correlated with accident risk, suggesting that its impact varies depending on job type and context. Additionally, Sitanggang et al. (2024) found that shift work schedules contribute to worker fatigue, although age had no significant influence.

These studies share a common approach: the use of quantitative methods to examine relationships between occupational safety variables. However, most were conducted in sectors such as construction, manufacturing, or mining, and did not specifically focus on TKBM port workers.

2.2 Research Gap

Although the variables of age, working hours, and PPE usage have been widely studied, research specifically targeting stevedores (TKBM workers) in port environments remains scarce. VOSviewer analysis also reveals that PPE usage has seldom been the central focus of research. Moreover, prior studies tend to analyze these variables independently rather than examining their combined effects.

This study addresses the gap by integrating all three variables—age, working hours, and PPE usageinto a single analytical model to assess their collective impact on occupational accident risk, specifically among workers of the TKBM Cooperative at Sorong Port.

3. Methodology

This study employed a quantitative approach with a descriptive research design. This method was chosen to align with the study's objectives, which are to analyze the influence of age, working hours, and the use of personal protective equipment (PPE) on the risk of occupational accidents among TKBM workers at Sorong Port. The quantitative approach allows for the measurement of variable relationships through numerical data and statistical analysis.

3.1 Data Collection

Data were collected through the distribution of closed-ended questionnaires using a Likert scale to 50 respondents, all of whom were active stevedores in Work Groups 1 and 2 of the TKBM Cooperative at Sorong Port. The sampling technique employed was total sampling (census sampling), in which the entire population was taken as the sample due to its relatively small and accessible size. In addition to the questionnaire, direct field observations

were also conducted to gather supplementary information related to working conditions and compliance with the use of personal protective equipment (PPE).

3.2 Analysis Techniques

The collected data were analyzed using multiple linear regression with the help of SPSS version 27. This model was chosen to assess the individual and simultaneous effects of the independent variables (age, working hours, PPE usage) on the dependent variable (occupational accident risk). Classical assumption tests were also conducted to validate the regression model.

3.3 Validation

To ensure the validity and reliability of the data, both validity and reliability tests were conducted on the research instrument. The validity test aimed to assess the extent to which the questionnaire items accurately represented the constructs being measured. Reliability testing was performed using Cronbach's Alpha, where a value above 0.60 was considered acceptable. Furthermore, several classical assumption tests were carried out, including tests for normality, multicollinearity, linearity, and heteroscedasticity, to confirm that the data met the requirements for multiple linear regression analysis. The analysis was then followed by hypothesis testing using t-tests and F-tests, as well as the calculation of the coefficient of determination (R^2) to evaluate the explanatory power of the independent variables on the dependent variable.

4. Results and Discussion

Instrumen Testing

1. **Validity Test**

   The validity test is used to measure whether a questionnaire used in the research is valid or not (Aldo & Sunardi, 2022). The criteria for assessing validity are as follows: if the calculated r-value (r count) is greater than the r-table value, the item is considered valid; conversely, if the calculated r-value is less than the r-table value, the item is considered invalid.

Table Validity Test Results of Research Variables

Item Statement	r Count	r Table	Description
Age (X1)			
X1.1	0.252	0.235	VALID
X1.2	0.252	0.235	VALID
X1.3	0.248	0.235	VALID
X1.4	.283*	0.235	VALID
X1.5	0.237	0.235	VALID
X1.6	.353*	0.235	VALID
X1.7	.353*	0.235	VALID
Working Hours (X2)			
X2.1	.343*	0.235	VALID
X2.2	.310*	0.235	VALID
X2.3	-.862**	0.235	VALID
X2.4	.284*	0.235	VALID
X2.5	.317*	0.235	VALID
X2.6	.309*	0.235	VALID
X2.7	0.241	0.235	VALID
X2.8	0.250	0.235	VALID
Use of Personal Protective Equipment (X3)			
X3.1	.311*	0.235	VALID
X3.2	0.250	0.235	VALID
X3.3	0.250	0.235	VALID
X3.4	0.250	0.235	VALID
X3.5	0.261	0.235	VALID
X3.6	.297*	0.235	VALID
X3.7	0.255	0.235	VALID
X3.8	0.252	0.235	VALID
X3.9	.400**	0.235	VALID
X3.10	0.254	0.235	VALID
X3.11	.334*	0.235	VALID
X3.12	.319*	0.235	VALID
Occupational Accidents (Y)			
Y1	0.249	0.235	VALID
Y2	0.236	0.235	VALID
Y3	0.244	0.235	VALID

Y4	0.255	0.235	VALID
Y5	.313*	0.235	VALID
Y6	0.254	0.235	VALID
Y7	0.252	0.235	VALID
Y8	0.271	0.235	VALID
Y9	.335*	0.235	VALID

Source: SPSS 27 Output

Based on the table, the data show that the r-count values for all questionnaire items distributed to 50 respondents are greater than the r-table value of 0.235, indicating that the instrument is valid and the research can proceed to the next stage.

2. Reliability Test

The reliability test is a tool used to measure the consistency of a questionnaire that serves as an indicator of a variable. A questionnaire is considered reliable if the Cronbach's Alpha (α) coefficient is greater than 0.60, indicating that the data are reliable. Conversely, if the Cronbach's Alpha (α) coefficient is less than 0.60, the data are considered unreliable (Aldo & Sunardi, 2022).

Table Reliability Test Results of Research Variables

Variable	Cronbach's Alpha	Role of Thumb	Description
Age (X1)	0.648	0.60	*Reliabel*
Working Hours (X2)	0.621	0.60	*Reliabel*
Use of Personal Protective Equipment (X3)	0.659	0.60	*Reliabel*
Occupational Accidents (Y)	0.681	0.60	*Reliabel*

Source: SPSS 27 Output

Based on the table above, it can be seen that the variables Age, Working Hours, Use of Personal Protective Equipment, and Occupational Accidents have reliable data, as indicated by Cronbach's Alpha values greater than 0.60. This suggests that the questionnaire items produced consistent and stable responses over time. Therefore, it can be concluded that the research is reliable and can proceed to the next stage.

Classical Assumption Test

1. **Normality Test**

    This test uses the One-Sample Kolmogorov-Smirnov method. The testing criteria are as follows: If the significance value (Asymp. Sig. 2-tailed) > 0.05, the data are normally distributed, If the significance value (Asymp. Sig. 2-tailed) < 0.05, the data are not normally distributed. (Hafni, 2022)

Table Normality Test Results Kolmogorov-Smirnov

One-Sample Kolmogorov-Smirnov Test			
			Unstandardized Predicted Value
N			50
Normal Parameters[a,b]	Mean		40.8000000
	Std. Deviation		0.88812141
Most Extreme Differences	Absolute		0.104
	Positive		0.104
	Negative		-0.103
Test Statistic			0.104
Asymp. Sig. (2-tailed)[c]			.200[d]
Monte Carlo Sig. (2-tailed)[e]	Sig.		0.184
	99% Confidence Interval	Lower Bound	0.174
		Upper Bound	0.194
a. Test distribution is Normal.			
b. Calculated from data.			
c. Lilliefors Significance Correction.			
d. This is a lower bound of the true significance.			

Source: SPSS 27 Output

Based on the Kolmogorov-Smirnov test results, it was found that the unstandardized residual had an Asymp. Sig. value of 0.200, which is greater than 0.05. This indicates that the data are normally distributed.

2. **Linearity Test**

    The decision-making basis for the linearity test using SPSS is at a significance level of 0.05. If the significance value (Linearity) is less than 0.05, it indicates a linear relationship between the independent variable (X) and the dependent variable (Y) (Muhammad Zakiy, S.E.I., 2021).
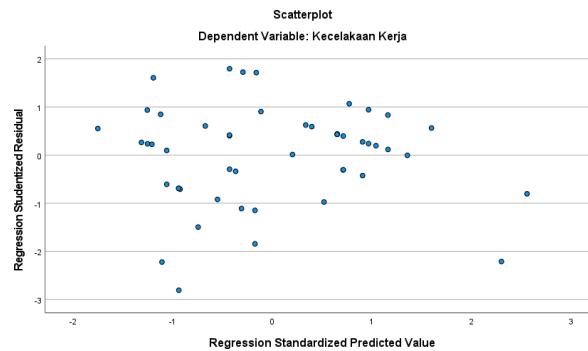
Tabel Linearity Test Results

ANOVA Table			Sum of Squares	df	Mean Square	F	Sig.
Kecelakaan Kerja * Usia	Between Groups	(Combined)	34.940	7	4.991	2.074	0.068
		Linearity	18.062	1	18.062	7.506	0.009
		Deviation from Linearity	16.879	6	2.813	1.169	0.341
	Within Groups		101.060	42	2.406		
	Total		136.000	49			

ANOVA Table			Sum of Squares	df	Mean Square	F	Sig.
Kecelakaan Kerja * Jam Kerja	Between Groups	(Combined)	31.368	5	6.274	2.638	0.036
		Linearity	6.202	1	6.202	2.608	0.046
		Deviation from Linearity	25.166	4	6.292	2.646	0.113
	Within Groups		104.632	44	2.378		
	Total		136.000	49			

ANOVA Table			Sum of Squares	df	Mean Square	F	Sig.
Kecelakaan Kerja * Penggunaan Alat Perlindungan Diri	Between Groups	(Combined)	51.908	10	5.191	2.407	0.024
		Linearity	29.728	1	29.728	13.787	0.001
		Deviation from Linearity	22.180	9	2.464	1.143	0.357
	Within Groups		84.092	39	2.156		
	Total		136.000	49			

Source: SPSS 27 Output

The results of the linearity test in the table show that the age variable has a significance value of 0.009 < 0.05, the working hours variable has a significance value of 0.046 < 0.05, and the PPE usage variable has a significance value of 0.001 < 0.05. These findings indicate that all three independent variables (X_1, X_2, X_3) and the dependent variable (Y) have significance values below 0.05, which means there is a linear relationship among them.

3. Heteroscedasticity Test

Source: SPSS 27 Output

Based on the scatterplot generated from the heteroscedasticity test, the graph shows that the points are randomly dispersed and spread both above and below the value of 0 on the Y-axis. This indicates that there is no heteroscedasticity in the regression model.

4. Multicollinearity Test

Multicollinearity can be detected by examining the values of the Variance Inflation Factor (VIF) and Tolerance. If the VIF value is less than 10 and the Tolerance value is greater than 0.1, it indicates that there is no multicollinearity.

Table Multicollinearity Test Results

		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
Model		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	12.062	7.857		1.535	0.132		
	Usia	0.227	0.129	0.232	1.762	0.085	0.894	1.118
	Jam Kerja	0.172	0.179	0.122	0.963	0.340	0.965	1.036
	Penggunaan Alat Perlindungan Diri	0.280	0.101	0.371	2.780	0.008	0.875	1.143

a. Dependent Variable: Kecelakaan Kerja

Source: SPSS 27 Output

Based on the table of multicollinearity test results, it is shown that the Tolerance values are greater than 0.1 and the VIF values are less than 10. Specifically, the VIF value for the age variable is 1.118 < 10 with a Tolerance value of 0.894 > 0.1; the VIF for the working hours variable is 1.036 < 10 with a Tolerance of 0.965 > 0.1; and the VIF for the PPE usage variable is 1.143 < 10 with a Tolerance of 0.875 > 0.1. Therefore, it can be concluded that there is no multicollinearity among the three independent variables.

Multiple Linear Regression Test

Table Results of the Multiple Linear Regression Test

	Coefficients[a]					
		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	12.062	7.857		1.535	0.132
	Usia	0.227	0.129	0.232	1.762	0.085
	Jam Kerja	0.172	0.179	0.122	0.963	0.340
	Penggunaan Alat Perlindungan Diri	0.280	0.101	0.371	2.780	0.008
a. Dependent Variable: Kecelakaan Kerja						

Source: SPSS 27 Output

Based on the table above, the linear regression equation that reflects the relationship between the variables in this study is as follows:

$Y = 12.062 + 0.227X_1 + 0.172X_2 + 0.280X_3$

The interpretation of the regression equation is as follows:

1. The constant value $a = 12.062$ means that if there is no change in the independent variables (X_1, X_2, and $X_3 = 0$), the value of the dependent variable (Y) is 12.062.

2. The regression coefficient for the age variable (X_1) is 0.227, which is positive. This indicates that for every 1-unit increase in age, the occupational accident score increases by 0.227.

3. The regression coefficient for the working hours variable (X_2) is 0.172, which is also positive. This means that for every 1-unit increase in working hours, the occupational accident score

increases by 0.172.

4. The regression coefficient for the use of personal protective equipment variable (X_3) is 0.280, a positive value, indicating that a 1-unit increase in PPE usage leads to an increase of 0.280 in the occupational accident score.

Hypothesis Testing

1. Partial Test (t-Test)

Table Results of Partial (t-Test) Analysis

Coefficients[a]					
	Unstandardized Coefficients		Standardized Coefficients		
Model	B	Std. Error	Beta	t	Sig.
1 (Constant)	12.062	7.857		1.535	0.132
Usia	0.227	0.129	0.232	1.762	0.085
Jam Kerja	0.172	0.179	0.122	0.963	0.340
Penggunaan Alat Perlindungan Diri	0.280	0.101	0.371	2.780	0.008
a. Dependent Variable: Kecelakaan Kerja					

Source: SPSS 27 Output

Based on the table, the hypothesis testing results are as follows:

1. Effect of X_1 on Y

   The significance value is $0.085 > 0.05$ and the t-count is $1.762 < 2.012$. Therefore, H_0 is accepted and H_1 is rejected, indicating that there is no significant effect of variable X_1 (Age) on variable Y (Occupational Accidents).

2. Effect of X_2 on Y

   The significance value is $0.340 > 0.05$ and the t-count is $0.963 < 2.012$. Thus, H_0 is accepted and H_2 is rejected, meaning there is no significant effect of variable X_2 (Working Hours) on variable Y.

3. Effect of X_3 on Y

   The significance value is $0.008 < 0.05$ and the t-count is $2.780 > 2.012$. Therefore, H_0 is rejected and H_3 is accepted, indicating that there is a significant effect of variable X_3 (Use of Personal Protective Equipment) on variable Y.

2. Simultaneous Test (F-Test)

Table Simultaneous Test (F-Test) Results

ANOVAᵃ

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	38.649	3	12.883	6.087	.001ᵇ
	Residual	97.351	46	2.116		
	Total	136.000	49			

a. Dependent Variable: Kecelakaan Kerja

b. Predictors: (Constant), Penggunaan Alat Perlindungan Diri, Jam Kerja, Usia

Source: SPSS 27 Output

Based on the F-table formula (k; n – k – 1), the Ftable value is 2.80. Referring to the table above, the Fcount is 6.087 and the significance value is 0.001. Since Fcount > Ftable (6.087 > 2.80) and the Sig. value is less than 0.05 (0.001 < 0.05), it can be concluded that H_0 is rejected and H_4 is accepted. This means that the variables age, working hours, and PPE usage collectively (simultaneously) have a significant effect on the occupational accidents of TKBM workers.

Coefficient of Determination Test

The criterion for this test is that the closer the R^2 value is to 100%, the greater the influence of all independent variables on the dependent variable (Hafni, 2022).

Table Coefficient of Determination Test Results

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.533ᵃ	0.284	0.238	1.45476

a. Predictors: (Constant), Penggunaan Alat Perlindungan Diri, Jam Kerja, Usia

Source: SPSS 27 Output

Based on the table above, the R Square value is 0.284 or 28.4%, indicating that there is a simultaneous influence of the variables Age, Working Hours, and Use of Personal

Protective Equipment on the variable Occupational Accidents by 28.4%. The remaining 71.6% (100% – 28.4%) is influenced by other factors or variables that are not included in this analysis.

4.1 Key Findings

The key findings of this study, based on multiple linear regression analysis conducted on 50 TKBM workers from Work Groups 1 and 2 at Sorong Port, are as follows:

1. Age (X_1) does not have a statistically significant effect on occupational accident risk, as indicated by a p-value of 0.085 (> 0.05) and a t-value of 1.762 (< t-table = 2.012).

2. Working Hours (X_2) also do not have a significant individual effect on accident risk, with a p-value of 0.340 (> 0.05) and a t-value of 0.963 (< t-table = 2.012).

3. Use of Personal Protective Equipment (X_3) has a significant effect on occupational accident risk, as shown by a p-value of 0.008 (< 0.05) and a t-value of 2.780 (> t-table = 2.012).

4. Simultaneously, all three variables age, working hours, and PPE usage have a statistically significant influence on the risk of occupational accidents, with a p-value of 0.001 (< 0.05) and an F-value of 6.087 (> F-table = 2.80).

5. The coefficient of determination (R^2) is 0.284, meaning that 28.4% of the variation in occupational accident risk can be explained by the three independent variables studied, while the remaining 71.6% is influenced by other factors not covered in this research.

4.2 Interpretation of Results

The findings of this study provide valuable insight into the factors influencing occupational accidents among TKBM workers at Sorong Port. Among the three independent variables analyzed—age, working hours, and PPE usage—only the use of personal protective equipment (PPE) was found to have a significant individual effect on accident risk. This supports previous studies (e.g., Suak et al., 2018; Sudarta, 2022) which emphasized that consistent PPE usage is critical in minimizing workplace hazards.

Although age and working hours did not show significant effects when analyzed independently, their simultaneous effect with PPE usage proved to be statistically significant. This indicates that occupational safety is a multidimensional issue, where personal factors (such as age), workload (working hours), and behavioral safety practices (PPE usage) interact to influence accident outcomes.

The results align well with the research objectives, which aimed to assess the individual and combined effects of these variables on accident risk. The study highlights the need for integrated safety strategies that do not solely rely on equipment but also consider worker profiles and work duration. Therefore, this research contributes not only empirically but also practically in supporting the implementation of holistic safety programs within high-risk port environments.

5. Discussion

The Influence of Age on Occupational Accidents

The hypothesis testing results for the age variable show a significance value of 0.085, which is greater than the threshold of 0.05. Additionally, the calculated t-value is 1.762, which is less than the t-table value of 2.012. Therefore, it can be concluded that H_0 is accepted and H_1 is rejected, indicating that there is no significant effect of the age variable on occupational accidents.

Based on this analysis, it can be stated that the age of TKBM workers does not significantly affect the level of occupational accidents they experience. Age is not a primary determinant of whether a worker is more or less vulnerable to workplace accidents. Theoretically, age is often associated with accident risk, where younger workers are considered more prone to accidents due to a lack of experience, while older workers may be at higher risk due to physical decline. However, in the context of TKBM workers at Sorong Port, age does not appear to play a major role in determining accident risk.

Accordingly, the first hypothesis is rejected. One possible explanation for this finding is the presence of other, more dominant factors influencing occupational accidents, such as working environment conditions, adherence to safety procedures, levels of fatigue, and workload intensity.

The Influence of Working Hours on Occupational Accidents

The hypothesis testing for the working hours variable shows a significance value of 0.340, which is greater than the threshold of 0.05. Additionally, the calculated t-value is 0.963, which is less than the t-table value of 2.012. Therefore, it can be concluded that H_0 is accepted and H_2 is rejected, meaning that there is no significant effect of the working hours variable on occupational accidents. Based on this analysis, it can be stated that the duration of working hours among TKBM workers at Sorong Port does not significantly influence the level of

occupational accidents they experience. Whether the working hours are long or short does not appear to be a determining factor in whether a worker is more prone to accidents.

Accordingly, the second hypothesis is rejected. One possible explanation for this result is the presence of other factors apart from working hours that may play a more critical role in causing occupational accidents in the TKBM environment at Sorong Port. Since no previous studies were found to support this particular outcome, this finding may represent a new contribution to the research literature regarding the relationship between working hours and occupational accidents specifically in the context of stevedore workers under the TKBM Cooperative at Sorong Port.

The Influence of Personal Protective Equipment (PPE) Usage on Occupational Accidents

The hypothesis test for the PPE usage variable shows a significance value of 0.008, which is less than 0.05. Additionally, the calculated t-value is 2.780, which is greater than the t-table value of 2.012. Therefore, it can be concluded that H_0 is rejected and H_3 is accepted, meaning that there is a significant effect of PPE usage on occupational accidents.

Based on the analysis, it can be stated that the use of PPE by TKBM workers at Sorong Port has a significant impact on the level of occupational accidents they experience. Thus, the third hypothesis is accepted, indicating that the better or more consistent the use of personal protective equipment, the lower the incidence of workplace accidents, and vice versa. This result is supported by the findings of Sudarta (2022), which concluded that PPE usage significantly affects the occurrence of occupational accidents among marble craftsmen in Gamping Village, Tulungagung Regency.

The Influence of Age, Working Hours, and PPE Usage on Occupational Accidents

Based on the results of the simultaneous test (F-test), the calculated F-value was 6.087 with a significance value of 0.001. This significance value is less than 0.05, and the F-count (6.087) is greater than the F-table value (2.80). Therefore, it can be concluded that H_0 is rejected and H_4 is accepted, indicating that the variables age, working hours, and PPE usage have a simultaneous and significant effect on occupational accidents among TKBM workers at Sorong Port.

Additionally, the R Square value obtained in this study was 0.284 or 28.4%, which means that the combination of age, working hours, and PPE usage contributes 28.4% to the variation in occupational accidents. The remaining 71.6% is influenced by other factors not examined in this study.

Based on this analysis, it can be concluded that the combination of age, working hours, and PPE usage has a significant overall impact on the level of occupational accidents experienced by TKBM workers at the TKBM Cooperative of Sorong Port. Although age and working hours did not show significant individual effects, when considered together with PPE usage, all three variables become important factors that influence workplace safety.

5.1 Comparison with Prior Research

The results of this study reveal that the use of personal protective equipment (PPE) has a significant effect on the risk of occupational accidents, while age and working hours do not show a significant individual influence. This finding reinforces the results of Suak et al. (2018), who concluded that incomplete or inconsistent use of PPE significantly increases the likelihood of workplace accidents. Similarly, Sudarta (2022) found that higher compliance with PPE usage leads to a lower incidence of occupational accidents. Therefore, the present study provides empirical support for the argument that safety behavior—particularly in terms of PPE usage—is a critical determinant of workplace safety.

On the other hand, the age variable did not show a significant effect on accident risk in this study. This finding is in line with the research conducted by Mulyadi et al. (2022), which suggested that age does not always correlate with accident rates and that its impact may vary depending on the type of work, level of experience, and individual work habits. In physically demanding jobs such as stevedoring, age may be offset by work experience and physical conditioning, which explains its non-significant role in this context.

Similarly, working hours did not have a significant individual effect in this study. This finding contrasts with Sitanggang et al. (2024), who reported that long working hours and shift systems contribute to worker fatigue and increase the likelihood of accidents. However, differences in work systems, labor practices, and the physical resilience of workers at Sorong Port may account for the variation in results.

Despite the lack of individual effects, the simultaneous test showed that age, working hours, and PPE usage collectively have a significant effect on the risk of occupational accidents. This supports the Three Main Factor Theory and Heinrich's Domino Theory (1931), which suggest that accidents are the result of a combination of human, environmental, and equipment-related factors. Thus, this study not only confirms some previous findings but also contributes new insights within the specific context of port labor, particularly among TKBM workers at Sorong Port.

6.

6.1 Limitations

This study has several limitations. First, the sample size is relatively small (50 respondents) and limited to Work Groups 1 and 2 of the TKBM Cooperative at Sorong Port, making it difficult to generalize the results to all port workers or other sectors. Second, the study only focused on three independent variables, excluding other potentially influential factors such as work experience, safety training, environmental conditions, or supervision quality.

6.2 Future Research

Future research should involve a broader respondent base, including multiple work groups or other port locations, to enhance the representativeness of the findings. A mixed-method approach (quantitative and qualitative) is recommended to gain deeper insights into safety behavior. Additionally, incorporating variables such as safety culture, education level, and quality of supervision could enrich the analysis and strengthen the study's validity.

7. Conclusion

This study aimed to analyze the influence of age, working hours, and personal protective equipment (PPE) usage on the risk of occupational accidents among TKBM workers at the TKBM Cooperative Work Groups 1 and 2, Sorong Port. A quantitative approach with multiple linear regression analysis was used.

The findings show that only PPE usage has a significant individual effect, while age and working hours do not. However, all three variables collectively have a significant effect, accounting for 28.4% of the variation in occupational accident risk, with the remaining 71.6% influenced by other factors not examined in this study.

These results support classic occupational safety theories such as Heinrich's Domino Theory and the Three Main Factor Theory, and reinforce prior research emphasizing the importance of safe behavior, particularly consistent use of PPE. The study contributes empirical insight in a specific and under-researched context of port labor safety.

8. Recommendation

For Related Institutions:

1) The company must ensure the availability of adequate and high-quality personal protective

equipment (PPE) in accordance with safety standards, conduct regular training on the proper use, maintenance, and storage of PPE, enforce strict supervision of PPE usage, and impose firm sanctions on violators.

2) Enhance monitoring and training regarding consistent PPE usage.

3) Evaluate workload and shift duration to prevent excessive fatigue.

4) Consider workers' physical condition and age when assigning tasks.

For Future Researchers:

It is recommended that future research explore other variables that have not yet been studied, such as work experience, safety training, and organizational culture, in order to provide more comprehensive insights into efforts to reduce occupational accidents in this environment. Additionally, the use of a mixed-method approach (quantitative and qualitative) is encouraged to achieve more in-depth and comprehensive results.

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