



Assessment of Elements Contributing Work Accidents in Construction Projects

Octavia Rahayu✉, Evi Widowati
Universitas Negeri Semarang Indonesia;

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Abstract

Background: In 2019, the number of work accidents in the construction sector in Indonesia was still relatively high, with a total of 130,923 accidents. Education is one of the main factors influencing work accidents, with 16 people (61.5%) at risk of experiencing work accidents and 60 (60.6%) accidents due to non-compliance in using Personal Protective Equipment. In this research project, a work accident occurred, but the company still needs to record all of them entirely. This research aims to determine the relationship between education and the use of personal protective equipment with work accidents on the project.

Methods: The design of this research is an observational analytic study with a cross-sectional design. The sample taken in the study was 123 workers, who were obtained using the Slovin formula and adding a minimum of 5% of the research sample size. Data analysis in this study used the chi-square test.

Results: This study showed that there was a relationship between education and work accidents ($p=0.004$), and there was a relationship between the use of personal protective equipment such as safety helmets ($p=0.000$) and safety shoes ($p=0.000$) with work accidents on the project.

Conclusion: Education and compliance in using safety helmets and safety shoes had a significant relationship with work accidents on the project.

✉ Correspondence Address:
Email : octaviarahayu@students.unnes.ac.id

INTRODUCTION

Work accidents are unexpected and unwanted events or events that can disrupt the workflow (Oktavianus et al., 2022). Work accidents can cause losses to humans in the form of injuries, damages, loss of property, and other losses (Sriwahyuni et al., 2020). Other factors associated with workers such as worker awareness, low knowledge, and safe conditions in the workplace (Berek et al., 2022).

Based on data from the Ministry of Public Works and Spatial Planning (PUPR), the number of work accidents in the construction sector in Indonesia is still high; there are 130,923 cases of work accidents (Ihsan et al., 2020). In addition, from statistical data, the International Labour Organization (ILO) reported a significant number of deaths and occupational accidents occurred in 2018; as many as 380,000 workers, or equivalent to 13.7% of 2.78 million workers, lost their lives due to occupational accidents and 2.4 million died due to occupational diseases (Muhraza Siddique et al., 2020). 2021 there were 11,000 fatal work accidents (Keumala Muda et al., 2022).

According to research Ruan et al., (2021) from the data of the last few years, Indonesia has a problem with the number of work accidents. Data in 2018 showed that the number of work accidents reached 173,105 cases. (Same et al., 2021). In 2019, it decreased to 114,235 cases; in 2020, it increased by 55.2% to 177,161 cases. (Zaelani Adnan et al., 2022). Then, in 2021, the number of work accidents in Indonesia was 234,270 cases. (Saliano et al., 2022). Based on data on the number of work accidents in Central Java Province in 2018, around 2,329 cases (Utami & Sugiharto, 2020). Then it decreased by 48% to 1,468 cases in 2019 (Rahmawati et al., 2022). In 2020, the number of work accidents in Central Java increased by 221,740; in 2021, it rose to 234,270 cases. (Bayu, 2022).

According to Heinrich, 80-85% of accidents are caused by unsafe actions (unsafe actions), while 15-20% are due to unsafe conditions (unsafe conditions) due to the employee's negligence or fault. (Uyun & Widowati, 2022). Meanwhile, research by the National Safety Council (NSC) shows that

unsafe actions cause 88% of work accidents, unsafe conditions cause 10%, and 2% are of unknown cause. (Sobya et al., 2018).

By The National Institute for Occupational Safety and Health (NIOSH), Construction is one of the most dangerous jobs; construction work accounts for the highest number of deaths among other sectors. (Azil & Jabar, 2021). According to data from the Ministry of PUPR in 2017, the construction sector is the most significant contributor to accidents in Indonesia at 32% yearly (Augustian et al., 2020). The development of construction projects in Indonesia has increased, as seen from each region's many high-level development processes. (Nurjaman et al., 2018). The construction sector is closely related to various accidents and fatal injuries (Ayob et al., 2018). Work accidents occur due to changes in human behavior and environmental conditions (Scarcity et al., 2019). A good work environment has a positive, conducive impact, both physical and non-physical (Zaelani Adnan et al., 2022). However, if the work environment is not good, it can take longer and not support an efficient work plan. (Arilaha et al., 2018). Then, various kinds of potential dangers, namely, falling from above, falling from a height, falling, inhaling materials or materials that have harmful chemical content, biological hazards, and physical hazards due to sharp object materials (Hansen, 2022). Next danger can be caused by a lack of awareness of the use of Personal Protective Equipment (PPE) (Fairyo & Wahyuningsih, 2018). The leading cause of work accidents comes from the characteristics of construction projects (Wahyuni, 2017).

Based on research conducted Aryantiningsih & Husmaryuli (2016), a person with low education is at risk of a work accident in as many as 16 respondents (61.5%). In the research conducted Runtuwarow et al (2020) The results showed that 54 respondents (54.5%) obeyed the use of personal protective equipment, while 45 respondents (45.5%) did not comply with the rule. Furthermore, this study also shows that out of 99 respondents, as many as 60 (60.6%) have experienced work accidents.

One of the efforts that can be made to control the high number of work accidents

is to increase the use of personal protective equipment that can be done to reduce work accidents (Runtuwarow et al., 2020). Personal protective equipment is a set of safety equipment that protects all or part of the worker's body (Nafista et al., 2022). Personal protective equipment for the construction project includes a safety helmet, safety shoes, and safety gloves. Using personal protective equipment in the workplace has become necessary, but workers' awareness and discipline are weak (Azzahri & Ikhwan, 2019). The occupational safety and health program aims to create a safe and comfortable working environment and achieve a company goal (Cykura & Fabrianto, 2021). The program can reduce the number of work accidents (Silva et al., 2019).

This research was carried out in the flood control and rob project of the Loji River - Banger Pekalongan City, which is a construction work for installing parapets, pump houses, and mooring ponds. This project is temporary and has the characteristics of workers who do not settle in one job and have the characteristics of workers with low education (SD-SMP) as many as 70 respondents (56.9%), then those with higher education as many as 53 respondents (43.1%). Based on a preliminary study, in the observation of 10 parapet construction project workers, three workers (3%) did not comply with using PPE safety helmets. The results of an interview with an HSE supervisor and the number of work accidents in this project from October 2021 to November 2022 show that several workers experienced minor accidents. The minor accidents include being scratched by iron. In addition, in this project, there have been work accidents, but in the implementation, the company has not fully recorded those work accidents. This study aims to determine whether there is a relationship between education, the use of personal protective equipment, and the occurrence of work accidents in the project.

METHODS

This quantitative study uses observational analytical methods and a cross-sectional study design. The researcher used the design because of the analysis of data in the form of numbers and the simultaneous collection of data. The independent variables in this study

were age, education, and compliance with personal protective equipment in the form of safety helmets, safety shoes, and safety gloves. The dependent variable in this study was the occurrence of work accidents.

The population of this study was all project workers, totaling 165 workers. The study sample consisted of 123 workers, obtained using the Slovin formula and a minimum addition of 5% of the research sample. The study sample met the criteria for inclusion and exclusion. The inclusion criteria were registered as project workers, workers present during the study, and workers willing to be respondents. Meanwhile, the exclusion criteria were employees who are on vacation, day workers, and employees who are not ready. The instrument in this study uses a checklist questionnaire sheet. The research was carried out from December 2022 to January 2023 in the Loji River - Banger Pekalongan City flood control and rob project. The data source used was a combination of primary data and secondary data. Primary data collection was obtained through questionnaires and direct observation in the field. Secondary data sources were obtained from the companies involved in the project.

Data collection techniques in this study were observation, questionnaire sheets, checklists, and taking pictures as documentation by the principles of research ethics. The data was processed by computer, taking questionnaire data and providing coding, scoring, and entry. The data was accessible to summarize and arrange, making it easy to analyze. Then, the final processing stage tabulates and groups data in the form of a table according to the purpose of this study. The first univariate analysis aims to explain and describe the characteristics of each variable. A second bivariate analysis was conducted to determine the relationship between the two variables. The statistical test in this study uses the chi-square with the SPSS application—test chi-square using a level of significance of 95%. If the $p\text{-value} \leq 0.005$, there was a relationship between the independent and bound variables. If the $p\text{-value} > 0.005$, the statistical calculation shows no significant relationship between the independent and dependent variables. The operational definition in this study is handy for researchers to identify

the criteria that can be researched easily. The operational definition includes the last education owned by the workforce (Kristian & Abdullah, 2020). The level of education is divided into two categories: a) Elementary and junior high school education with a score of 1, and b) High school education with a score of 2 (Son et al., 2013). Furthermore, in the compliance category for the use of personal protective equipment, the compliance score is divided into 2, namely: a) Not compliant if the score is 0-6, b) Compliant if the respondent answers with a score of 7-12 that has been summed up from the questions (Bawihu et al., 2017). In addition, the work accident category contains about five work accidents with a score of 1 and never 2 (Antari, 2021).

This research had received an ethics certificate from the Health Research Ethics Committee of Medicine Faculty, valid since December 13, 2022, Number 567/KEPK/

EC/2022.

RESULTS AND DISCUSSION

Based on research carried out in the flood control and tidal control project of the Loji - Banger River, Pekalongan City, it plays a role in controlling tidal floods in Pekalongan City, which was targeted to be completed in October 2023. The types of work contained in the project were divided into several parts, namely: iron frame installation work, casting work, Corrugated Concrete Sheet Pile (CCSP) piling work, Steel Sheet Pile (SSP) piling work, welding work, formwork installation work, formwork dismantling work, and excavation work. This project has implemented occupational safety and health programs, including Safety Morning, Toolbox Meeting, Safety Talk, Safety Patrol, and Safety Induction. The program serves to support knowledge and safety for the workforce.

Table 1. Distribution of Respondent Frequency by Age, Education, Compliance with PPE Use (*safety helmet, safety shoes, and safety gloves*), and Work Accidents in Construction Projects.

	Variable	F(n)	(%)
Age	Young 17-35 Years	51	41.5
	Older $\leq$ 36 – 53 Years	72	58.5
	Total	123	100
Education	Low	70	56.9
	Tall	53	43.1
	Total	123	100
PPE Usage Compliance			
<i>Safety helmet</i>	Non-Compliance	43	34.1
	Obedient	81	65.9
	Total	123	100
<i>Safety shoes</i>	Non-Compliance	49	39.8
	Obedient	74	60.2
	Total	123	100
<i>Safety gloves</i>	Non-Compliance	44	35.8
	Obedient	79	64.2
	Total	123	100
Occurrence of Work Accidents			
	Ever	59	48
	Never	64	52
	Total	123	100

Univariate Analysis

The results of the table above show that most of the respondents are in the age range of ≤ 36 years, as much as 58.5%, and the respondents are young, from 17 to 35 years old, as much as 41.5%.

According to the research results, education is divided into primary education (elementary and junior high school) and higher education (high school). Then, from the statements on the questionnaire sheet, the respondents' education had different results from those in Table 1. The characteristics of the respondents were that out of 123 workers, 70 respondents (56.9%) had low education, and 53 respondents (43.1%) had higher education.

Compliance with the use of Personal Protective Equipment (PPE) (safety helmet, safety shoes, and safety gloves)

Based on the findings of the study on the level of compliance with the use of PPE, which includes (safety helmets, safety shoes, and safety gloves) from the number of respondents, as many as 42 respondents (34.1%) did not comply with the use of PPE in the form of safety helmets. The other 81 respondents (65.9%) used the PPE compliantly. Based on the results of a questionnaire containing four questions regarding safety helmet compliance, 42 workers scored 1-6, and as many as 81 workers had a total score of 7-12.

Compliance with the use of PPE in the form of safety shoes was known that 49 respondents (39.8%) who do not comply use PPE safety shoes, while 74 respondents (60.2%) were compliant. Based on the questionnaire's four questions regarding safety shoe compliance, 49 respondents scored 1-6, and as many as 74 respondents had a total score of 7-12. Furthermore, the results showed that of the total respondents, 44 respondents

(35.8%) did not comply with using PPE in the form of safety gloves, while 79 respondents (64.2%) complied with using PPE. Based on the results of a questionnaire containing four questions regarding safety gloves compliance, 44 respondents scored 1-6, and as many as 79 respondents had a total score of 7-12.

Occurrence of Work Accidents

Based on the research, the results of the distribution of work accident incidents in the Loji - Banger River, Pekalongan City flood control and rob project. Respondents who experienced work accidents were 59 respondents (48%). Based on data from the work accident research, as many as 39 respondents (31.7%) had been (stabbed, pinched, and scratched), 16 respondents (13%) had fallen while working, 17 respondents (13.8) had been hit by an object while working, six respondents (4.9%) had been exposed to chemical splashes, and 20 respondents (16.3%) had been electrocuted while working. As many as 64 respondents had never had a work accident. The results were obtained from a questionnaire containing five questions about the occurrence of work accidents, with a score of 1 if ever and a score of 2 if never having experienced a work accident. Work accidents are still a significant problem in the workplace. (Megasari, 2022). According to research Agustian et al (2020) Work accidents tend to increase in the construction sector.

Bivariate Analysis

Using the Chi-square test, bivariate analysis was used to test the relationship between the independent and bound variables. The relationship between the level of education and compliance with the use of PPE (safety helmets, safety shoes, and safety gloves) and the incidence of work accidents in project workers can be seen in Table 2.

Table 2. Results of Bivariate Test on the Relationship between Education and the Use of PPE and the Incidence of Work Accidents in Construction Projects.

Variable		Work Accidents				Total		<i>P-value</i>	<i>PR</i>
		Ever		Never		n	%		
		F	%	F	%				
Age	Youth	22	24.5	29	26.5	51	100	0.427	-
	Older	37	34.5	35	37.5	72	100		
	Total	59	59	64	64	123	100		
Education	Low	42	60	28	40	70	100	0.004	1.875
	High	17	32.1	36	67.9	53	100		
	Total	59	47.9	64	52.1	123	100		
PPE Compliance <i>safety helmet</i>	Non-Compliance	37	88	5	12	42	100	0.000	3.247
	Obedient	22	27.1	59	72.9	81	100		
	Total	59	48	64	52	123	100		
PPE Compliance <i>safety shoes</i>	Non-Compliance	44	89.8	5	10.2	49	100	0.000	4.440
	Obedient	15	20.2	59	79.8	74	100		
	Total	59	48	64	52	123	100		
PPE Compliance <i>safety gloves</i>	Non-Compliance	24	54.5	20	45.5	44	100	0.367	-
	Obedient	35	44.3	44	55.7	79	100		
	Total	59	48	64	52	123	100		

Age relationship with the incidence of work accidents

Based on the results of the Chi-square test of the age of workers with the incidence of work accidents in project workers, it showed that out of 51 young respondents, 22 respondents (24.5%) have experienced work accidents. As many as 29 respondents (26.5%) have never experienced work accidents. As many as 37 respondents (34.5%) had experienced a work accident, and 35 respondents (37.5%) had never experienced a work accident.

Results of statistical tests using chi-square obtained 0.427 ($p < 0.05$), so the results of this study show no significant relationship between the age of the worker and the incidence of work accidents in project workers. This research is in line with the research conducted by Aryantiningsih & Husmaryuli (2016), Huda et al (2021) and Widyanti & Pertiwi (2021), which resulted in no relationship between age and the incidence of work accidents.

The relationship between education and the incidence of work accidents

Based on the Chi-square test results, it could be concluded that there was a relationship between education and the incidence of work accidents in flood control project workers and the Loji - Banger River Flood Control Project,

Pekalongan City. The results of 70 respondents with low education showed that as many as 42 respondents (60%) had experienced work accidents, while 28 respondents (40%) had never experienced work accidents.

Results of statistical tests using Chi-square obtained 0.004 ($p < 0.05$). This study's results showed a significant relationship between education level and the incidence of work accidents in project workers. The Prevalence Ratio (PR) was obtained at 1.875 ($PR > 1$), so those with low education had a 1.875 times greater risk of having a work accident than those with higher education who were not at risk. Based on research conducted Vita & Cahyani (2021), Dzulfikri & Fitri (2019) and Mulyadi et al (2022) It also shows a relationship between education and work accidents, with grades ($p < 0.05$).

The relationship between compliance with personal protective equipment (safety helmet) and the incidence of work accidents

Based on the Chi-square statistical test results, there was a relationship between using PPE safety helmets and the incidence of work accidents in project workers. The results of 42 respondents who did not comply with safety helmets were that 37 respondents (88%) had experienced work accidents, while five

respondents (12%) had never experienced work accidents. Meanwhile, of the 81 respondents who obeyed the use of safety helmets, 22 respondents (27.1%) had experienced work accidents, and 59 respondents or equivalent (72%) had never experienced work accidents.

Results of statistical tests using Chi-square obtained $p=0.000$ ($p<0.05$). This study's results showed a significant relationship between compliance with the use of PPE in the form of safety helmets and work accidents that occur to project workers. Grade results Prevalence Ratio (PR) was obtained at 3,247 ($PR >1$), which shows that workers who do not comply with safety helmets are 3.347 times more likely to be affected by work accidents than workers who obey the use of safety helmets. The primary purpose of a safety helmet is to protect the worker's head to avoid the danger of falling objects and minimize the risk of injury to workers. (Wibowo & Widodo, 2022). Research conducted Hartanto (2017), and (Salmawati et al., 2020) found a relationship between usage compliance safety helmets and the occurrence of work accidents.

The relationship between compliance with personal protective equipment (safety shoes) and the incidence of work accidents

Based on Table 2, it can be concluded that there was a relationship between compliance in using PPE in the form of safety shoes and the incidence of work accidents in flood control project workers and the Loji-Banger River Flood Control Project in Pekalongan City, showing that of the 49 respondents who did not comply, 44 respondents (89.8%) had experienced work accidents and five respondents (10.2%) had never experienced work accidents. Meanwhile, of the 74 respondents who obeyed the use of safety shoes, 15 respondents (20.2%) had experienced a work accident, and 59 respondents (79.8%) had never experienced a work accident.

Results of statistical tests using Chi-square obtained 0.000 ($p < 0.05$). This study's results show a significant relationship between compliance with PPE safety shoes and the incidence of work accidents in project workers. The results of the Prevalence Ratio (PR) were obtained at 4.440 ($PR >1$), which shows that

workers who do not comply with the safety shoes are 4.440 times more likely to be affected by work accidents than workers who obey the use of safety shoes. Using safety shoes can prevent fatal work accidents. Its function is not only limited to protecting the soles of the feet but can also reduce the risk of dangerous work accidents, such as being hit by heavy objects. (Wibowo & Widodo, 2022). Usage compliance with safety shoes is significantly related to work accidents (Runtuwarow et al., 2020), Hartanto (2017) and (Yulia and Aaron, 2019).

The relationship between compliance with personal protective equipment (safety gloves) and the incidence of work accidents

Based on Table 2, it can be concluded that there was a relationship between PPE compliance safety gloves and the occurrence of work accidents among project workers. The results showed that of the 44 respondents who did not comply with Using Safety Gloves, 24 respondents (54.5%) had experienced a work accident, and 20 respondents (45.5%) had never experienced a work accident. Meanwhile, of the 79 respondents who complied, they used safety gloves. Thirty-five respondents (44.3%) had experienced a work accident, and 44 respondents (55.7%) had never experienced a work accident. For workers, gloves do feel uncomfortable when used, but these tools are essential because they can help prevent workplace accidents (Aprilliawan & Widowati, 2016). Wearing gloves protects the fingers and skin from the dangers of hot objects and exposure to electric shock, impact, and injuries (Aprilliawan & Widowati, 2016).

Results of statistical tests using Chi-square obtained $p=0.367$ ($p>0.05$). This study's results showed no significant relationship between compliance with using PPE safety gloves and the occurrence of work accidents in project workers. The results of this study were not in line with the research conducted by Runtuwarow et al (2020) and Yulia and Aaron (2019), which showed a relationship between compliance with safety gloves and the occurrence of work accidents.

CONCLUSION

Based on the results of the study, it

was concluded that there was a significant relationship between education and compliance with the use of PPE in the form of safety helmets and safety shoes with the occurrence of work accidents among workers of the Loji - Banger River flood control project and the Loji - Banger River, Pekalongan City. Meanwhile, the relationship between age and compliance with PPE safety gloves and the incidence of work accidents was unrelated.

Recommendations for companies to continually increase the use of Personal Protective Equipment (PPE) by providing regular safety talks, increasing socialization during safety morning activities about the importance of using personal protective equipment, and paying attention to the unmet needs of workers PPE. Workers should be advised to always comply with existing procedures by being disciplined using PPE to avoid work accidents.

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