

Correlation between the factors of unsafe acts and unsafe conditions and the occurrence of work accidents among construction workers (a case study of PT X at Hospital Y project)

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ABSTRACT

Backgrounds: Generally speaking, unsafe acts and unsafe conditions are the causes of work accidents. Based on the HSE reports, the cases of occupational accidents in the Hospital Y project in the last 7 months until October 2021 had amounted to 20. The correlation between the unsafe acts as well as unsafe conditions and the occurrence of work accidents constitutes the basis and objectives of this study.

Methods: This study is quantitative in nature, with analytical observation implementing cross sectional approach. It involved 63 out of 130 workers (consisting of staff, supervisors, and subcontractor workers) who were selected using purposive sampling technique. Instruments in the forms of questionnaires, observations, and documentary studies were implemented. The data were further analyzed using chi-square test, fisher test, and cell pooling.

Results: It was shown from the statistics that the Occupational Safety and Health (OSH) Knowledge gained the score of ($p=0,066$; $PR=1,368$; $95\%CI=0,995-1,879$), Load of Work ($p=0,010$; $PR=0,647$; $95\%CI=0,457-0,916$), OSH Training ($p=0,029$; $PR=1,833$; $95\%CI=0,873-3,848$), Equipment Safety Gear ($p=0,005$; $PR=1,682$; $95\%CI=1,102-2,567$), and Operational Procedures ($p<0,0001$; $PR=1,934$; $95\% CI=1,251-2,991$).

Conclusions: It is found that no correlation was existent between OHS Knowledge occurrence of work accidents. However, there was a correlation between work load, OSH training, and equipment safety gear and the occurrence of work accidents.



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1. Introduction

Construction services in Indonesia can be said to have developed, progressed, and gained attention comparable to other industrial sectors. Such development should be supported by competent human resources and sophisticated equipment. However, there are still a large number of construction companies and employees who are not aware of the importance of Occupational Safety and Health so that many employees work under hazardous or unsafe conditions (Khairiah & Widajati, 2017). A work accident is an unplanned and uncontrolled occurrence which is caused by environmental conditions, humans, or combination of various factors resulting in the disturbance in the work process. A study by Everett and Frank (1996) concludes that the total cost of construction accidents contributes to 7.0-15% of the total cost of a project.

The most recent data issued by the International Labour Organization (ILO) (2018), estimated that around 2.78 million workers died every year due to work accidents and work-related diseases. About 2.4 million (86.3%) of the deaths were caused by work-related diseases and more than 380,000 (13.7%) by work accidents. Meanwhile, the ILO (2018) data also mentioned that the number of work accidents in the construction sector has contributed the largest number compared to other sectors. Around 45% of workers in the construction sector stated that their jobs had a negative impact on their health (Panuwatwanich, 2020). In Indonesia itself, there is an annual average of 90.000 work accident cases and the Social Security Agency (BPJS) handles an average of 130,000 work accident cases per year, ranging from light cases to fatalities (Kemenkes RI, 2018). In addition, the number of work accidents in the construction sector as recorded by BPJS Ketenagakerjaan (BPJS of Employment) through 2018 amounted to 173.105 cases with 36 cases (95%) occurring in building constructions. These accidents were surely caused by the lack of awareness in the importance of OSH implementation among the workforce. OSH implementation has so far been considered as a cost, not as an investment to prevent the occurrence of work accidents (BPJS, 2019).

The report for the Quarter II of 2020 showed that Banten was recorded as one of the provinces with the highest number of work accidents. Banten ranked the second after West Java Province with a total of 838 cases. Such an increase was due to the fact that, in 2020, work accidents from the time the workers departed for work to the time they departed from the workplace were incorporated into the calculation. During 2019, there were 300 cases of work accidents and only 70% of the workforce were covered by work accident security programs (Disnakertrans, 2020). Tangerang Regency is one of the most populous areas of Banten Province and is indisputably one of the biggest contributors of work accident cases for the province. The data from the Manpower and Transmigration Office of Tangerang Regency showed that during 2019 as many as 2 (two) construction workers lost their lives every day due to workplace accidents. A study by Deswyta showed that, during 2020, construction was the industrial sector which contributed the highest number of work accidents with roughly 1,500 workers per year and 200 fatalities due to work accidents (Deswyta, 2020).

In general, work accidents are caused by unsafe acts and unsafe conditions. Heinrich (2018) states that 80-85% of work accidents are caused by human ignorance or errors, while 15-20% of them by unsafe conditions. This is also supported by a research conducted by the National Safety Council (NSC) in 2017 (Affandhy, 2017) stating that work accidents were caused by unsafe acts with 88%, unsafe conditions with 10%, and unknown causes with 2%.

Unsafe acts are defined as human failure in complying with work procedures which deviate them from the correct and mutually agreed operating procedures resulting in the occurrence of work accidents. The factors affecting unsafe acts can be grouped into 8 (eight) categories, i.e individual, work group, supervision, contractor, workplace condition, project management, organization, and community.

Whereas, unsafe conditions refer to conditions which are hazardous to workers. According to Matondang, work accidents are caused by two main factors, where an unsafe condition is one of them. The factors affecting unsafe conditions can be grouped into 7 (seven) categories, i.e equipment and tools, work environment, material, nature of work, work process, and work procedures (Berek & Suwandi, 2019).

A study entitled Relationship Between Unsafe Acts Condition and Accidents in Construction Company in Nigeria stated that the unsafe acts which led to as many as 26 work accidents were the workers' failure in wearing Personal Protective Equipment while working in heights resulting in a number of falling down. Unsafe conditions also contributed to the occurrence of work accidents, where as many as 20 cases were caused by the absence of Danger Signs which led to the workers' ignorance of the environment when they were entering and exiting the workplaces (Nkem et.al., 2015). A study by Digma Primadianto et al, regarding the impacts of unsafe acts and unsafe conditions on the occurrence of work accidents in construction works has resulted in the conclusion that unsafe acts and unsafe conditions have impacts on the work accidents in construction areas. The frequent unsafe act made by the workers is their failure in wearing Personal Protective Equipment (PPE). Whereas, the frequent unsafe condition is the hazardous condition related to the models of the buildings or hazardous work areas (Primadianto et.al., 2018).

PT X is one of the private companies in building engineering and construction. The works done by this company include the constructions of storey buildings such as factories, hospitals, schools, shopping centers, and offices where hazards are existent ranging from the low to high levels. Annually, PT X is engaged in the construction projects of between 10 and 15 buildings. One of the projects by PT X to be studied is the construction of Hospital Y in Sepatan, Tangereang, Banten. The protection and implementation of Occupational Safety and Health in the construction of Hospital Y have been carried out by the HSE division of the project in the form of company OSH programs. The programs included safety induction, safety talk (coordination meeting), toolbox meeting, general cleaning, daily inspection, safety patrol, and distribution of vitamin C.

This study is aimed at identifying the correlation between unsafe acts and unsafe condition factors and the occurrence of work accidents in the Hospital Y Construction Project. Based on the monthly, weekly, and daily OSH reports, it was found that there had been 20 cases of work accidents in the last 7 months ending in October 2021. There was an occurrence of as many as 17 minor accidents which required the workers to get the first aid treatment. Whereas, there were 3 medium work accidents which led the workers to be provided with Medical Treatment Case (MTC). The minor accidents included such cases as nail punctures, scratch by sharp materials, stumbles, and slips. Whereas, the medium accidents included cases like hands got splashed with gutter water, feet got slash-cut by sharp materials, and eyes inserted by debris of corroded irons. Based on the on-site findings obtained through the safety patrols, it was known that a number of issues were existent with regard to the workers' unsafe acts and unsafe conditions in the workplace. The findings of unsafe acts included working at dangerous speed, using unsafe tools, kidding or playing during work, smoking during work, littering, and wearing no PPE. Meanwhile, the findings of unsafe conditions included extensive working hours, incorrect work procedures or positions, sub-standard workplace (tools scattered, absence of cleaning facilities), and inappropriate or incomplete Personal Protective Equipment.

2. Materials and Method

This study falls in the category of quantitative study which is analytical observational in nature with cross sectional approaches. The population included all the 130 employees (consisting of field staff of the main contractor PT X, supervisory personnel of the main contractor PT X, and the subcontractors) who worked in the Hospital Y Project, with a sample of 63 people. Purposive sampling techniques were implemented in this study for the sample taking. Questionnaires, observation sheets, and documentation study sheets were used in the collection of primary data, whereas the general profile of PT X, general profile of Hospital Y, and literature studies were used as the secondary data. The data were processed using SPSS software through the processes of editing, coding, scoring, tabulation, and entries. Univariate and bivariate analyses were implemented to analyze the data of this study.

3. Results and Discussion

This section may be divided by subheadings. It should provide a concise and precise description of the experimental results, their interpretation as well as the experimental conclusions that can be drawn.

3.1. Findings

Results of the study were obtained through the univariate and bivariate analyses as presented in the following table:

Table 1. Sample Distribution based on the OSH Knowledge

OSH Knowledge	Frequency	
	N	%
Low	36	57,1
Medium	20	31,7
High	7	11,1
Total	63	100

It was found that, based on the OSH Knowledge variable, most of the respondents had a low level of knowledge, i.e. as many as 36 people (57.1%). Whereas, those with the high level of knowledge were 7 respondents.

Table 2. Sample Distribution Based on Workload

Workload	Frequency	
	N	%
Low	6	9,5
Medium	20	31,7
High	37	58,7
Total	63	100

Based on the workload variable (Table 2), it was found that most of the respondents or as many as 37 (58.7%) had a high level of workload. Whereas, as many as 6 respondents (9.5%) were in the low level of workload.

Table 3. Sample Distribution Based on OSH Training

OSH Training	Frequency	
	N	%
Never	54	85,7
Ever	9	14,3
Total	63	100

Based on the OSH training variable, it was found that as many as 54 respondents (85.7%) had never attended training on Occupational Safety and Health (OSH), while as many as 9 respondents (14.3%) had ever attended OSH training.

Table 4. Sample Distribution Based on the Machine Safety Gear

Machine Safety Gear	Frequency	
	N	%
Absent	42	66,7
Present	21	33,3
Total	63	100

Based on the variable of machine safety gear (Table 4), it was found that as many as 42 respondents (66.7%) had working tools or machines which were not equipped with the safety gears. Whereas, as many as 21 respondents (33.3%) had working tools or machines with safety gears.

Table 5. Sample Distribution Based on Work Procedures

Work Procedures	Frequency	
	N	%
Inappropriate	40	63,5
Appropriate	23	36,5
Total	63	100

Based on the variable of work procedure, most of the respondents or as many as 40 people (63.5%) worked with inappropriate procedures, while as many as 23 respondents (36.5%) did the job with appropriate procedures.

Table 6. Results of Bivariate Analysis

Variable	Work Accident				Total		p value
	Never		Ever		N	%	
	N	%	N	%			
OSH Knowledge							
Low	31	86,1	5	13,9	36	100	0,066
Medium – High	17	63	10	37	27	100	
Total	48	76,2	15	23,8	63	100	
Workload							
Low – Medium	15	57,7	11	42,3	26	100	0,010
High	33	89,2	4	10,8	37	100	
Total	48	76,2	15	23,8	63	100	
OSH Training							
Never	44	81,5	10	18,5	54	100	0,029
Ever	4	44,4	5	55,6	9	100	
Total	48	76,2	15	23,8	63	100	
Machine Safety Gear							
Absent	37	88,1	5	11,9	42	100	0,005
Present	11	52,4	10	47,6	21	100	
Total	48	76,2	15	23,8	63	100	
Work Procedure							
Inappropriate	37	93,5	3	7,5	40	100	<0,0001
Appropriate	11	47,8	12	52,2	23	100	
Total	48	76,2	15	23,8	63	100	

The results of bivariate analysis (Table 6) showed that the OSH knowledge variable had no correlation with the occurrence of work accidents (p value > 0.05). Whereas, the workload, OSH training, machine safety gear, and work procedure variables were correlated with the occurrence of work accidents in the construction project (p value < 0.050). The results of the computation were tested with chi square test, while those which did not fulfill the requirement were tested using cell pooling method and fisher test.

3.2. Discussions

3.2.1. Correlation between OSH Knowledge and Occurrence of Work Accidents among Construction Workers in Hospital Y Project

Based on the statistical results of the OSH knowledge variable (Table 6), it was found that most of the samples with low level of OSH knowledge had experienced work accidents. Whereas, the samples with medium-high level of OSH knowledge also tended to ever experience work accidents. Analyses using the Chi-square test had resulted in the value of $p=0.066$. As such, it was concluded that there was no significant correlation between OSH knowledge and the occurrence of work accidents among the construction workers in the Hospital Y project.

These results are in line with a study by (Putri et al., 2017) stating that no significant correlation is existent between the knowledge of OSH and occurrence of work accidents with the p -value of 0.529 ($p>0.05$). In addition, a study by (Hardiyana et al., 2021) mentions that there is no correlation between OSH knowledge and occurrence of work accidents with a p -value of 0.233 ($p>0.05$). To minimize the occurrence of work accidents, OSH knowledge is required in order that the workers have the ability to identify the actions to be taken so that occupational safety and health runs in a favorable manner.

According to (Notoadmodjo, 2010), knowledge is the result of knowing after someone carries out sensing processes towards an object which he or she observes. A person's behavior which is based on knowledge would be longer-lasting in nature compared to the one which is not based on knowledge. The more positive the behavior, the greater would be the ability of the person to avoid unexpected experiences. Basically, when someone has a lack of knowledge, he would be ignorant of the surrounding hazard, would do the jobs without the determined regulation, and be unaware of the possible risks. On the contrary, someone with good knowledge would always perform the jobs in

good manner and could be prevented from work accidents. Such a knowledgeable worker would have better awareness of the way to always be in safe conditions while performing the jobs and would be more aware of the possible risks if a job is performed not in accordance with the predetermined procedures (Syaputra, 2017).

Knowledge improvement needs to be made in order that workers are able to understand and manage the risks. Education might be given to the workers with the presentation materials related to OSH which would be the basis for knowledge improvement through OSH programs such as toolbox meeting or safety morning, routine safety talk, and OSH socialization using media before a work is started. In addition, efforts should be made to prepare the workers by providing them with OSH training to improve knowledge on the importance of safe working practice modeling. All of these should be supported by the project managers, supervisors, as well as the company management to solve the problems and to improve the quality of OSH in the workplace.

3.2.2. Correlation between Workload and Occurrence of Work Accidents among Construction Workers in Hospital Y Project

Based on the statistical test on the workload variable (Table 6), it was found that most of the workers with a high level of workload had experienced work accidents. On the other hand, the samples with low-medium level of workload also tended to ever experience work accidents. The Chi-square analysis resulted in the value of $p=0.010$, leading to a conclusion that there is a significant correlation between the workload and the occurrence of work accidents among the construction workers at the Hospital Y project.

Based on the study, most of the workers had a high level of workload. The workers with a higher level of workload had experienced more work accidents than those with low-medium level of workload. These results are in line with the study by (Wardhani, 2020) stating that the chi-square statistical tests have resulted in the p -value of 0.000 ($p<0.05$), which means that there is a significant correlation between the workload and the work accidents among the construction workers in the project of PT Wijaya Karya (the Section 1 of Jakarta-Bandung High Speed Railway Project). Workload is defined as physical capability in accepting a work. The workload of a person should be appropriate and balanced. An excessively high level of workload would require a worker to use the energy excessively and lead to an overstress condition (Dwiyanti & Mustofani, 2019). On the contrary, workload which is too low would cause a worker to experience boredom or understress condition (Batubara et.al., 2021).

Workload might be affected by physical ability, age, nutrition intake, work activities, and weight of load. When the required energy is insufficient, a worker might experience fatigue, difficulties in concentration, and less energy for the muscles to make contractions. When muscles lose their ability to withstand a load, then a worker would not be able to lift the load in such a way that it might fall down and cause work accidents (Narpati et al., 2019).

Based on the theory of Loss Causation Model, workload is one of the factors which causes work accidents. Physical activities consume more muscle power in such a way that in their movements the muscles require oxygen which is transported by the blood to the muscles to burn substances to generate the energy. It can be said that the harder the work, then the more amount of energy is utilized (Tarwaka & Bakri, 2004). The levels of workloads of a worker can be used to determine how long the worker can do the activities in accordance with the worker's capacity. This means that a higher level of workload would lead to the shorter length of time which the worker can withstand to do the work without significant fatigue and physiological problems.

3.2.3. Correlation between OSH Training and Occurrence of Work Accidents among the Construction Workers in the Hospital Y Project

Based on the statistical tests on the OSH training variable (Table 6), it is known that most of the samples who never attended OSH training had experienced work accidents. Whereas, those with a record of OSH training attendance tended to have no experience of work accidents. The analyses using Fisher test have resulted in the value of $p=0.029$ which leads to a conclusion that a significant correlation is existent between the OSH training and the occurrence of work accidents among the construction workers in the Hospital Y project.

These results are in accordance with a study by (Aryanto et al., 2016) stating that the chi-square statistical analyses had resulted in a p-value of 0.000 ($p < 0.05$) meaning that there was a significant correlation between the OSH training and the occurrence of work accidents in the platform installation of the Well Connection Project at the TOTAL E&P INDONESIA Turu Field of the Mahakam Block. Based on these data, it can be said that work accidents occur frequently among workers with minimum training, i.e the newly additional recruits with less than one-year working term and minimum work experience. OSH training would bring the benefit in terms of the incorporation of safe habits and safe behaviors among workers in doing their jobs. Such habits would be adopted consistently so that they could support the efforts to prevent the occurrence of work accidents and be useful in identifying unsafe habits and acts which are usually practiced without awareness. It is not an easy job to prevent work accidents which are caused by the ignorance by the workers as well as the company management. Hence, execution of OSH training by the company would be the most appropriate policy. The execution of OSH training is aimed at minimizing the occurrence of work accidents and damage as well as improving the maintenance of equipment.

Occupational Safety and Health training is an activity by the workers to obtain knowledge of the dangers of work accidents, acquire new skills, and get educated in the anticipation of hazards so that they can act safely and be concerned with safety in their workplace (Statt, 2002). The parties in charge of the Hospital Y project had never provided their field workers (such as supervisors and construction laborers) with OSH training. This study also found that most of the workers never attended training in Occupational Safety and Health.

The occurrence of work accidents might be caused by the workers' as well as the company management's ignorance. Hence, when such occurrences are frequent, the necessary action to be taken by the management is to improve themselves by organizing OSH training for the whole on-going projects. The organizing of OSH training is aimed at maintaining work equipment as well as improving other aspects. According to (Halimah) in a study by (Dzulfikri & Fitri, 2019), OSH training would be beneficial to the workers, especially the newly-recruited workers in a project, in terms of incorporation of safe habits and behaviors at work. Whereas, such training is also beneficial to the longer-serving workers who are transferred to other projects or are assigned with new types of jobs to be implemented in identifying unsafe habits and behaviors which are sometimes out of their unawareness. Hence, unfavorable behaviors could be stopped or be replaced with the habit of safe behaviors.

3.2.4. Correlation between Machine Safety Gear and Occurrence of Work Accidents among the Construction Workers of Hospital Y Project

Results of the statistical tests on the machine safety gear (Table 6) showed that most of the samples who had working tools without safety gear were found to have experienced work accidents. Whereas, those with tools with safety gears also had the tendency to ever and never experience work accidents. The Chi-Square analyses have resulted in the value of $p = 0.005$. This leads to a conclusion that there is a significant correlation between machine safety gears and the occurrence of work accidents among the construction workers in the Hospital Y project.

The result of this study is in line with the study by (Anugrah, 2019) showing that statistical analysis using the chi-square test had resulted in the p-value of 0.007 ($p > 0.05$), meaning that there was a correlation between machine safety gear and the occurrence of work accidents among the workers of PT Todong Jaya Makmur. A study by (Pravitra & Bagyono, 2017) revealed that all of the working tools used by the workers were not equipped with machine safety gears so that no correlation analysis could be made. During the observation on the condition of the machines, all of them were not equipped with appropriate safety gear and no barrier was available between the workers and the machines. There were 19 cases of work accidents caused by the absence of the machine safety gear with such cases as hands or feet hurt by the tools.

Machine safety gears are essential for the workers to prevent them from various risks of working accidents. When the safety gears are not applied appropriately and the tools are not equipped with protective and safety gears, then the tools might cause various dangers such as burning, electric shock, explosion, wound, injuries, and others. In order to be safe for usage, the tools must be equipped with appropriate protective gears according to safety regulations. In addition, more complex

equipment must be provided with operational guidance/procedures during the usage (Suryani et al., 2013).

It was found in this study that most of the working tools were not equipped with machine safety gears, even though some were found to have ones. Appropriate safety gears must be attached to machines or tools with rotating or moving components, where unintentional contact with the operators is possible and may result in serious injuries or wounds. Actually, the presence of safety gears attached to working tools can minimize the occurrence of work accidents. However, there are some workers or operators who intentionally remove the safety protective gears for efficiency reasons with no consideration of the possible consequences.

3.2.5. Correlation between Work Procedures and the Occurrence of Work Accidents among the Construction Workers in the Hospital Y Project

The results of the statistical tests on the variable of work procedure (Table 6) showed that most of the samples who did the jobs with inappropriate procedure had experienced work accidents. Whereas, those who did the jobs with predetermined appropriate procedures tended to experience no work accidents. The Chi-square analyses have resulted in the value of $p=0.0001$, which led to the conclusion that there was a significant correlation between the work procedures and the occurrence of work accidents among the construction workers in the Hospital Y project.

A procedure is defined as the way a work is executed in correct and safe manners. A procedure is basically an explanation of the ways and techniques of work execution. A study by (Rahman et al., 2020) showed that the chi-square tests had resulted in the p-value of 0.005 ($p<0.05$), meaning that there was a correlation between the compliance with the work procedure and the occurrence of work accidents among the workers in the construction project of Bank Indonesia representative office. Workers' failure to comply with appropriate rules or procedures would result in the occurrence of work accidents, with such examples of non-compliance as taking short-cut in doing the jobs, practicing unsafe acts, and so on. This is caused by the absence of workers' awareness of hazardous conditions. The workers consider that procedures just disturb and slow down the work so that it takes longer to finish. The lack of OSH rules enforcement could lead to the worker's ignorance in complying with work procedures.

Compliance with the procedures means the workers' acts of obeying or disobeying the procedures prepared by the management of the project. Based on the questionnaire, it was shown that the workers who did not comply with the work procedures frequently did the jobs outside their expertise, continued working despite unfit condition, used working tools not according to the guidance and not by the dedicated operators, did the work in a hurry, and so on. Compliance with work procedures could be described as doing the work in careful manner, wearing Personal Protective Equipment (PPE), obeying the rules, being responsible and not playing as well as being lazy during the work, doing the jobs according the procedures, presence of OSH inspection by the safety personnel, using working tools in appropriate manners, forwarding reports to the supervisor in the presence of problems/errors, et cetera (Aisyah, 2016).

4. Conclusion

It is concluded that there was no significant difference between the OSH knowledge and the occurrence of work accidents among the construction workers in the Hospital Y project. Whereas, the factors that are correlated to the occurrence of work accidents in the Hospital Y project include workload, OSH training, machine safety gear, and work procedure. These correlating factors could be considered by the company's OSH coordinator and the Project HSE to be evaluated regularly to improve supervision, recording, and observation of Occupational Safety and Health. The management is suggested to improve information on OSH through socialization and training, give rewards to the workers who practice safe acts and punishment to those practicing unsafe acts so that their motivation to act safely at work would grow. In addition, the workers should actively develop OSH awareness.

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