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Analysis of the Effect of Work Shift and Fatigue on Unsafe Action Cause of Workplace Accidents in Technical Workers of PT. X

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ABSTRACT

An uncontrolled or unplanned event caused by human, situational, or environmental factors that disrupts the work process with or without resulting in injury, illness, death, or damage to work property. This study aims to determine the effect of work shifts and work fatigue on work accidents with unsafe actions as an intervening variable in engineering workers at PT. X. This study is an analytical observational study using a cross-sectional research design. The population in this study is the total number of engineering workers. The sample in this study amounted to 65 workers determined using the total sampling method where all members of the population were used as samples. The collected data were analyzed using the chi-squared test for bivariate and path analysis for multivariate. The results of the path analysis showed that the work shift variable was not affected by work accidents (p = 0.333), work fatigue had an effect on work accidents (p = 0.029), work shift had an effect on unsafe action (p = 0.002), there was an effect of work fatigue on unsafe action (p = 0.000), there was an effect of unsafe action on work accidents (p = 0.000). Based on the intervening test of work shifts on work accidents with unsafe action, significant results were obtained (p = 0.011) and work fatigue on work accidents with unsafe action obtained significant results (p = 0.006). It can be concluded that the unsafe action variable is an intervening variable in the influence of work shifts, work fatigue, on work accidents. It is hoped that future researchers will expand the population and number of samples to obtain better research results.

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INTRODUCTION

A work accident is an unexpected event that causes losses, both to workers, the production process, and assets or property in the industrial work environment. This incident generally occurs due to a series of previous factors or events, so that if one of the causal factors can be eliminated, the accident can be prevented. Broadly speaking, the factors causing work accidents are categorized into two, namely unsafe actions and unsafe conditions [1].

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According to data from 11 member countries of the World Health Organization (WHO) in the South and Southeast Asia regions with a total population of around 1.5 billion people, 22.5 million cases of work accidents and occupational diseases were recorded with 699,000 deaths triggered by various risk factors in the workplace. In detail, every year around 5 million accident cases occur, or the equivalent of 36 cases every minute, 90,000 fatal accidents per year, and 300 deaths every day. Overall, the death rate due to work accidents reaches 1.1 million people per year [2].

Research results [3] show that approximately 80%–85% of workplace accidents are caused by human factors, particularly negligence or errors in work. Unsafe actions are behaviors that have the potential to endanger workers or others, thus causing accidents. These include not using personal protective equipment, ignoring work procedures, violating safety regulations, and working carelessly. Theoretically, for every 300 unsafe actions, at least one accident will occur, resulting in lost workdays. Some examples of unsafe actions frequently encountered in the workplace include not wearing personal protective equipment, operating machinery without authorization, and ignoring safety warnings.

In addition, work accidents are also influenced by environmental and human factors. Environmental factors include policies, work area conditions, equipment availability, and occupational safety and health (K3) procedures. Meanwhile, human factors include unsafe work behavior or habits [4]. Furthermore, the causes of accidents are not only limited to unsafe actions and unsafe conditions, but are also influenced by individual characteristics (such as length of service, age, knowledge, gender, education, working hours or shifts, skills, physical condition, behavior, and attitudes), management factors (for example, K3 socialization, policies, Standard Operating Procedures, and training), as well as work environment factors (such as ventilation, noise, lighting, layout/housekeeping, color, and warning labels) [5].

According to a survey conducted by Smith et al., the impact of work shifts on occupational health and safety shows that the highest number of work accidents occurs at the end of the night shift rotation, with an average of 0.69% per worker. However, not all studies find an increase in industrial accidents during the night shift [6]. Fatigue itself is a common complaint that has a significant impact on worker performance, where around 20% of the workforce experiences symptoms of fatigue. Factors that influence fatigue include physical and psychological aspects, especially work shifts and work stress. From research it is known that psychological factors contribute 64% to the onset of fatigue, even more than half of fatigue cases are caused by this factor [7].

RESEARCH METHODS

This research is a quantitative study with an analytical observational design using a cross-sectional study approach. The quantitative method was chosen to test the theory objectively by examining the relationship between variables. The purpose of this study is to analyze the indirect relationship between the independent variable (work fatigue) and the dependent variable (work accidents) through an intervening variable, namely unsafe actions, in

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engineering workers at PT. X. The study was conducted at PT. X from June to December 2024.

The research population included all 65 engineering workers at PT. X. Due to the relatively small population, a saturated or census sampling technique was used, resulting in a total of 65 respondents being used as the research sample. Data collection was conducted through two sources: primary and secondary data. Primary data were obtained through observation, interviews with engineering workers using questionnaires, and blood sugar level measurements using a glucometer. Meanwhile, secondary data were collected from the personnel department of PT. X and literature studies in the form of journals, scientific papers, and literature relevant to the research topic. Data analysis in this study used a path analysis model.

RESULTS

Based on data obtained from the data collection and processing carried out, the results obtained are as follows

Table 1. Respondent characteristics are the innate characteristics of the respondents. Age, length of service, and blood sugar are the respondent characteristics used in the study.

Respondent Characteristics	Frequency	
	n	%
Age Group		
21-30 years old	13	20.0
31-40 years	22	33.8
41-50 years	22	33.8
>50 years	8	12.3
Years of service		
1-5 years	47	72.3
6-10 years	14	21.5
>10 years	4	6.2
Gender		
Man	62	95.4
Woman	3	4.6
Blood sugar		
<70 mg/dl	7	10.8
71-120 mg/dl	43	66.2
>120 mg/dl	15	23.1

Source: Primary data (2024).

Table 1 The results of the study on the characteristics of the respondents showed that most were in the age range of 31–40 years and 41–50 years, with 22 respondents (33.8%) respectively. Physiologically, age affects muscle work capacity, where as age increases, individuals tend to experience fatigue and health problems more quickly. Based on gender distribution, the majority of respondents were male, namely 62 people (95.4%), while only 3

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respondents were female. Gender differences affect physical abilities, where men generally have stronger body size and endurance in completing heavy work, while women do more work that requires manual skills with lighter physical demands.

In terms of length of service, the majority of respondents (72.3%, or 47 people) had between 1 and 5 years of work experience. Meanwhile, blood sugar levels showed that the majority of respondents were in the normal range (71–120 mg/dl), namely 43 respondents, or 66.2%.

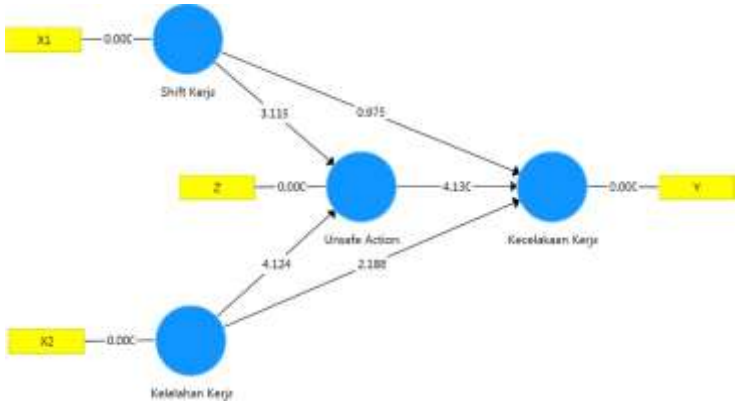

Figure 1. Path Analysis Results

Table 2. Direct Influence Between Variables

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
Work Shift -> Unsafe Action	0.313	0.307	0.100	3,119	0.002
Work Fatigue -> Unsafe Action	0.444	0.448	0.108	4,124	0,000
Work Shift -> Accident Work	0.093	0.091	0.095	0.975	0.330
Work Fatigue -> Work accident	0.249	0.261	0.114	2,188	0.029
Unsafe Action -> Work accident	0.526	0.514	0.127	4,130	0,000

Source: Primary Data, 2024

Table 2 Based on the analysis results in Table 2, it is known that the Work Shift variable (X1) has a significant effect on Unsafe Action (Z), with a p value = 0.002 (<0.05). Similarly, the Work Fatigue variable (X2) also shows a significant effect on Unsafe Action (Z), with a p value = 0.000 (<0.05). Meanwhile, Work Shift (X1) does not have a significant effect on Work Accidents (Y), indicated by a p value = 0.330 (>0.05). On the other hand,

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Work Fatigue (X2) has a significant effect on Work Accidents (Y) with a p value = 0.029 (<0.05). In addition, the Unsafe Action variable (Z) is proven to have a significant effect on Work Accidents (Y), with a p value = 0.000 (<0.05).

The results in table 2 were subjected to bivariate and multivariate analysis to determine the relationship between the independent and dependent variables using the Chi Square test in a 2x2 tabulation table and regression analysis logistics.

Table 3. Intervening Test Analysis Results

Intervening Test Results	T Statistics (|O/STDEV|)	P Values
Work Shift -> Unsafe Action -> Work Accident	2,550	0.011
Work Fatigue -> Unsafe Action -> Work accident	2,787	0.006

Source: Primary Data, 2024

Table 3 The analysis results in Table 3 show that Work Shift (X1) has an indirect effect on Work Accidents (Y) through Unsafe Action (Z), with a p value = 0.011 (<0.05). This indicates a significant indirect relationship between Work Shift and Work Accidents through the intermediary of Unsafe Action. Similarly, Work Fatigue (X2) also has an indirect effect on Work Accidents (Y) through Unsafe Action (Z), with a p value = 0.006 (<0.05), which means there is a significant influence on this path.

The magnitude of the indirect influence contribution can be seen from the T Statistics value. The variable of Work Shift on Work Accidents through Unsafe Action obtained a T-Statistics value of 2.550. This indicates a significant indirect effect, although it is still largely influenced by other factors or indicators. Meanwhile, the variable of Work Fatigue on Work Accidents through Unsafe Action obtained a T-Statistics value of 2.787. This finding also indicates a significant indirect effect, with the remaining contribution influenced by other indicators.

Discussion

This study aims to determine the effect of work shifts and work fatigue on work accidents with unsafe actions among workers at PT. X. The discussion of the results of the analysis of the research variables is narrated as follows.

Work Shifts on Work Accidents

Shift work is a division of working hours determined by a company for workers to complete tasks, usually divided into morning, afternoon, and night shifts. As investment in the use of production machines that must be operated continuously increases, the proportion of shift workers also increases. This condition requires workers to work both day and night, which ultimately causes various problems, especially for those who have difficulty adjusting to work patterns outside of normal hours [4]. Long shift work hours not only reduce productivity but also increase the risk of work accidents. Research [8] reports that shift workers have a 2.7 times higher risk of experiencing work injuries than non-shift workers.

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The results of a study conducted on engineering workers at PT. X showed that there was no significant relationship between work shifts and work accidents (p = 0.975). This can be explained because the scheduled shift system allows workers to adapt to their sleep patterns, so that it does not cause significant disruption. According to Rudin [9], workers who are accustomed to scheduled shifts are able to adjust their sleep patterns, so that it does not affect performance or increase the risk of accidents. The implementation of the work shift system itself can also function as a control effort, because a structured work pattern can reduce excessive workloads and prevent overtime which has the potential to cause accidents.

However, this finding differs from Ratih's [10] research, which stated a significant relationship between work shifts and workplace accidents (p = 0.014). She explained that a shift system with only two monotonous time patterns can trigger fatigue, reduce performance, and increase the risk of accidents. Thus, workplace accidents are closely related to fatigue, shifts, and work duration, which have been the focus of various studies to explain their impact on workplace safety.

Work fatigue towards work accidents

Workplace accidents in workers can be triggered by various factors, such as lack of experience, minimal training, limited recognition of the work environment, non-compliance with procedures, and low awareness of safe behavior in completing work [11]. The results of research on engineering workers at PT. X showed a significant relationship between work fatigue and work accidents, with a p value = 0.029. This finding is consistent with Aulia's (2018) research which also found a similar relationship with a p value = 0.000. Workplace accidents caused by Fatigue is closely related to human factors, where fatigue can trigger unsafe work behaviors, increasing the risk of accidents. Workers in sectors with heavy workloads, such as shipyards, are more susceptible to fatigue, which leads to an increased potential for workplace accidents.

Work Shifts against Unsafe Action

The level of work fatigue on the morning shift is lower than the night shift. Workers on The level of work fatigue on the morning shift tends to be lower than the night shift. Workers who work on the night shift have a risk of approximately 28% higher for experiencing injury or accidents. Fatigue experienced by workers is one of the triggering factors for the emergence of unsafe actions, which then contribute to the occurrence of work accidents [12]. The results of research on engineering workers at PT. X showed a significant relationship between work shifts and unsafe actions, with a p value = 0.002. From the results of observations it was found that in each work shift, there were still workers who carried out unsafe actions, such as not using Personal Protective Equipment (PPE). This is contrary to the Minister of Manpower and Transmigration Regulation [13] Article 6 concerning PPE, which requires all workers and other people in the work area to use PPE according to potential hazards and risks.

This finding is in line with research [14] regarding differences in unsafe actions between shifts in the threading section of production unit I of PT. Y in Surabaya in 2019. The results of this study showed significant differences in unsafe action behavior in the

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morning, afternoon, and night shifts. The frequency of low category unsafe actions decreased in the afternoon shift compared to the morning shift, and decreased again in the night shift. However, high category unsafe actions were also found in the night shift, which were not found in the morning or afternoon shifts.

Work Fatigue due to Unsafe Action

The relationship between work fatigue and unsafe acts aligns with the International Loss Control Institute (ILCI) theory, which states that unsafe behavior is triggered by underlying causes, one of which is human factors in the form of physical and physiological stress. Fatigue can vary from person to person, but generally results in decreased concentration at work. Decreased concentration leads to decreased alertness, which increases the potential for errors in decision-making during work.

The results of research on engineering workers at PT. X showed a significant relationship between work fatigue and unsafe actions, with a p value = 0.000. This finding indicates that workers with high levels of fatigue tend to have a greater likelihood of committing unsafe acts in the workplace. Similar results were also reported by Ramadhany [15] in his research on production workers at PT. Lestari Banten Energi, where the Chi-Square test produced a p value = 0.008 (<0.05), so there is a significant relationship between work fatigue and unsafe behavior.

*Unsafe Action*against Work Accidents

Some unsafe actions or mistakes by workers that result in injuries include working not in accordance with occupational health management standards and safety procedures, not using PPE (personal protective equipment) such as gloves, rushing when working so as not to pay attention to caution which results in injuries such as slipping, being cut or even being hit by objects, incorrectly placing or storing work tools carelessly, and workers who are less skilled.[16]

Based on the results of research conducted on engineering workers at PT. X, the results obtained were: that there is a significant relationship between unsafe actions and the occurrence of work accidents in workers where the statistical test results obtained p (0.000). Most engineering workers at PT. X experience work accidents due to unsafe actions due to a lack of caution in working and lack of concentration while working. This is in line with research conducted by (Ani, 2018) which states that there is a relationship between unsafe behavior and work accidents with a p value (0.024). This is because the company does not consider the work schedule that can affect the progress of work and also the lack of implementation of worker supervision in the field. Unsafe behavior is also greatly influenced by perception factors, work experience and work shifts.

Unsafe acts can be interpreted as all actions carried out by a person who ignores safety factors, where these actions can endanger himself, other people, equipment and the surrounding environment. Based on various literature, the human error factor is placed as the core of the problem of work accidents. 88% of work accidents are caused by unsafe acts, 10% by unsafe conditions and 2% by other causes.[17]

The results of this study are not in line with the research conducted by Orialny [18] regarding the relationship between unsafe worker behavior and work accidents at PT.

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Tropica Cocoprima, Lelema Village, South Minahasa Regency. In this study, the results showed that there was no relationship between unsafe worker behavior and work accidents with a p value of 1,000. This occurred because in this study, the majority of workers who experienced work accidents were in the low category of unsafe actions.

Based on the results of the research and statistical tests, it can be concluded that the higher the value of the unsafe act factor (unsafe behavior) carried out by engineering workers, the higher the probability of work accidents occurring among engineering workers at PT. X.

Work Shifts Against Occurrence of Work Accidents with Unsafe Action

A work accident can be defined as an unexpected event that has the potential to cause injury, both physical and emotional. The International Labour Organization (ILO) records nearly 120 million work accidents occurring each year, with approximately 210,000 of these cases ending in death due to unsafe acts at work [19]. Factors that influence the occurrence of unsafe acts include excessive workloads, irregular shift patterns, lack of supervision, unstable physical conditions of workers, stress due to time pressure, and inadequate rest [20].

Research conducted on engineering workers at PT. X showed a significant relationship between work shifts and work accidents through unsafe actions, with a p value of 0.011. This indicates that lack of supervision in the workplace plays an important role in preventing accidents, because supervision can ensure workers carry out tasks safely, effectively, and efficiently, thus avoiding potential hazards. The results of this study are in line with the findings of Dwiseli [21], which showed that workers with low safety perceptions or limited work experience tend to experience more accidents, such as being stabbed or cut by sharp objects. In addition, workers on the day shift were also recorded to experience more accident incidents.

A similar conclusion was obtained from research [22], which found a relationship between work shifts and unsafe actions that risk causing work accidents, with a p value = 0.005. Many accident cases were reported to occur because workers did not use Personal Protective Equipment (PPE) and were in a hurry to complete the work. his job.

Work Fatigue to Work Accidents with Unsafe Action

Workplace accidents are generally related to unsafe conditions in the work environment, whether originating from physical factors—for example, an inadequate work environment—or individual factors in the form of unsafe actions, such as workers' inappropriate responses to dangerous situations [23]. These unsafe actions are the direct cause of workplace accidents, which arise from complex interactions between various aspects, including the organization, the worker's physical condition, the work situation, and the work environment [24]. The results of research conducted on engineering workers at PT. X showed a significant relationship between work fatigue and work accidents through unsafe actions, with a p value of 0.006. The majority of workers who experienced accidents were recorded as being in the high fatigue category and carrying out unsafe actions while working.

Jurnal Eduhealth
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ESSN 2808-4608 (Online)
https://ejournal.seaninstitute.or.id/index.php/healt

Fatigue itself can be defined as a physical and mental condition that impacts work capacity and endurance. Symptoms include decreased work performance, reduced motivation, and decreased physical and mental activity that can increase the risk of errors at work. This finding is in line with research on production workers at PT. Sermani Steel which also identified a significant relationship between work fatigue and unsafe actions, with a p value = 0.000 [25]. The study explains that fatigue can arise from various factors, such as insufficient calorie intake, extreme working conditions (e.g., hot temperatures), inappropriate work and rest times, and heavy physical and mental activity. These factors can reduce concentration and motivation, increase stress, and trigger errors at work that ultimately have an impact on workplace accidents.

CONCLUSION

There is no significant relationship between work shift variables and work accidents among PT engineering workers. X. There is a significant relationship between the work fatigue variable and work accidents in engineering workers at PT. X. There is a significant relationship between the work shift variable and unsafe actions in PT engineering workers. X. There is a significant relationship between work fatigue and unsafe actions in PT engineering workers. X. There is a significant relationship between the unsafe action variable and work accidents among engineering workers at PT. X. Unsafe action is a mediating or intervening variable for the influence of work shifts on work accidents among engineering workers at PT. X. Unsafe action is a mediating or intervening variable for the influence of work fatigue on work accidents among engineering workers at PT. X.

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