

The Relationship between Physical Environment (Temperature and Noise) and Work Fatigue in Gas Station Operators in Pontianak City

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Abstract

Work fatigue is a condition that decreases a person's efficiency and endurance at work. It is caused by many individual and external factors, such as the physical work environment, namely temperature and noise. This study aims to analyze the relationship between the physical environment (temperature and noise) and work fatigue among gas station operator workers in Pontianak City. This research is an analytical observational research with a cross-sectional approach. The population in this study was 147 gas station operator workers in Pontianak City, and the total sample was 60 respondents. The data analysis techniques used are univariate and bivariate analysis, and the Chi-Square statistical test was used for bivariate analysis. The research results show the relationship between temperature and work fatigue in gas station operator workers, with a value of $p=0.003$ and $OR=10.286$ ($CI=1.940-54.527$). There is also a relationship between noise and work fatigue in gas station operator workers, with a value of $p=0.042$ and $OR=6.750$ ($CI=1.227-37.142$). The conclusion is a relationship exists between temperature and noise and work fatigue among gas station operator workers in Pontianak City. This research advises that gas station operator workers are expected to consume sufficient drinking water while working, at least one glass of 250ml every 20-30 minutes or 2.8 liters/day, and can add a little salt to drinking water to avoid harmful effects such as dehydration. To reduce noise, you should use ear PPE, such as earplugs.

Keywords: Gas Station Operators, Noise, Physical Environment, Temperature, Work Fatigue.

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1. INTRODUCTION

The implementation of occupational safety and health needs to be implemented in every work environment to support optimal work productivity (Ndjoulou et al., 2015). Public Fuel Filling Stations (SPBU) are a type of public infrastructure provided to meet the fuel needs of motor vehicles. Gas station operator workers generally work in a perform tasks while standing for extended periods causing work fatigue. Work fatigue is a common problem experienced by gas station operator workers in Pontianak City (Vos et al., 2012).

The work activities carried out by gas station operators, apart from standing for a long time, are opening and closing the fuel tank on the consumer's vehicle before and after refueling, lifting and then inserting the fuel nozzle into the consumer's vehicle tank, regulating the amount of fuel flowing into the consumer's vehicle through the fuel nozzle. burn. During work activities, gas station operators are in awkward positions such as twisting, bending, standing for a long time during 8 hours of work (Henny et al., 2012).

Based on the results of initial observations obtained by researchers, fatigue is a common problem experienced by gas station operator workers. Fatigue can reduce the productivity of gas station operator workers in Pontianak City (Juliana et al., 2018). Workers who experience work fatigue can reduce the effectiveness of the performance process and physical stability to continue their activities and have an impact on reducing the level of comfort at work, inhibiting communication, contributing to errors at work and reducing work productivity (Usmawati et al., 2021). According to Rahmawan et al., 2023 there is a relationship between work fatigue and work productivity, work fatigue is a combination of decreased physical and mental performance which results in decreased work enthusiasm and work productivity.

Continuous standing during refueling duties among gas station operators in Pontianak City may lead to work fatigue, diminishing their focus and efficiency (Suma'mur, 2017). Apart from fatigue, the problems that often occur in gas station operators are musculoskeletal problems because they have to repeatedly open and close the vehicle's fuel tank, lift and insert the fuel nozzle into the vehicle's fuel tank, regulate the fuel flow through the nozzle, replace the fuel nozzle and lock and close it. vehicle fuel tank after filling. Apart from gas station operator workers having to stand for hours, the work positions they do include bending, twisting, and standing repeatedly in awkward positions. This activity is carried out by serving several vehicles to be filled with fuel during working hours. This repetitive activity increases work on the ligaments and muscles. Public Fuel Filling Stations or commonly known as gas stations are public infrastructure provided by PT. Pertamina (Persero) for the wider community throughout Indonesia to meet vehicle fuel needs. Gas stations are a business activity that operates and carries out service processes 24 hours a day. Based on observations, operator workers at gas stations work continuously standing and making repetitive movements to refuel consumers' vehicles, making it possible for work fatigue to occur (Tarwaka et al., 2017).

This study aims to analyze the relationship between the physical environment (temperature and noise) and work fatigue among gas station operator workers in Pontianak City.

2. RESEARCH METHOD

This study employs an analytical observational design with a cross-sectional approach. The population under investigation comprises all operator workers stationed at 11 gas stations in Pontianak City. The number of respondents in this study was 147 gas station operator workers. The sampling technique used in this study was Simple Random Sampling. The number of samples to be used as respondents was calculated using the Slovin formula.

$$\begin{aligned}
 n &= \frac{N}{1 + N(e)^2} \\
 &= \frac{147}{1 + 147(0.10)^2} \\
 &= \frac{147}{1 + 1.47} \\
 &= \frac{147}{2.47} \\
 &= 59.5
 \end{aligned}$$

The research was conducted from March to July 2022. The inclusion criteria in this study were gas station operator workers in Pontianak City who were willing to be respondents during the time this research was carried out and gas station operator workers aged <55 years, while the exclusion criteria were gas station operator workers who were not willing to be respondents during The research was carried out and gas station operator workers aged ≥ 55 years.

Secondary data collection techniques were carried out by interviews using questionnaires and looking at reports from gas stations in Pontianak City. Primary data, namely respondent characteristics such as name, age, highest level of education, marital status, length of work and working hours per day, and work fatigue were obtained by interview using a questionnaire. Data on subjective work fatigue levels were collected using the Industrial Fatigue Research Committee (IFRC) questionnaire.

The IFRC questionnaire contains 30 questions which are divided into 3 parts, namely the first ten questions indicate the weakening of activities experienced by workers, the second ten questions indicate reduced work motivation felt by workers and the last ten questions indicate physical fatigue felt by workers. After conducting interviews and filling out the work fatigue questionnaire, the next step is to calculate the total individual score from the 30 questions that have been asked and then classify them into 4 categories, namely: 30-52: low work fatigue; 53-75: moderate work fatigue; 76-98: high work fatigue; 99-120: very high work fatigue.

This data is collected after workers have finished working so as not to disturb them while working hours are in progress. Physical work environment data such as temperature and noise were obtained from direct measurements at the research location using a Thermo Hygrometer and Sound Level Meter. Physical environmental data collection is carried out when gas station operator workers are working. Data collection officers have been trained during temperature and noise checks.

Data analysis and management uses a statistical analysis program to see the relationship between the independent variables of the physical environment (temperature and noise) and the dependent variable of work fatigue. Data testing was carried out using the Chi-Square statistical test with a confidence level of 95% ($\alpha = 5\%$).

3. RESULTS AND DISCUSSION

Table 1. Distribution of Gas Station Operator Workers in Pontianak City

Variable	Category	n	%
Age	20-23 Years	15	25
	24-27 Years	16	26.7
	28-31 Years	11	18.3
	32-35 Years	8	13.3
	36-39 Years	1	1.7
	40-43 Years	7	11.7
	44-47 Years	2	3.3
Education	Junior High School	4	6.7

	Senior High School	42	
	Vocational School	10	16.6
	Bachelor	4	6.7
Marital Status	Married	26	43.3
	Single	34	56.7
Length of Work	≥ 3 years	25	41.7
	< 3 years	35	58.3
Temperatures	Not eligible	50	83.3
	Qualify	10	16.7
Noise	≥ threshold value	52	86.7
	< threshold value	8	13.3
Work Fatigue	High Work Fatigue	38	63.3
	Low Work Fatigue	22	36.7

Table 1 presents the research results, the majority of gas station operator workers are 24-27 years old, 16 respondents (26.7%), and at least 1 respondent (1.7%) aged 36-39 years. According to (Basri et al., 2021), age influences work fatigue because it greatly influences a worker's ability and productivity. The physique of workers who are of productive age is stronger than workers who are not of productive age because the higher the age level of a worker, the less productive they are and this can trigger work fatigue (Kusgiyanto et al., 2017). At gas stations in Pontianak City, workers are 20 to 47 years old. The operating hours for gas stations in Pontianak City are eight working hours. Most petrol station operator workers have a high school education, 42 respondents (70%). The majority of gas station operator workers are not married, namely 34 respondents (56.7%). The working period of most gas station operator workers was <3 years, namely 35 respondents (58.3%). Based on research results, gas station operator workers experience work fatigue due to the many consumers who must be served. The gas stations are in the middle of urban areas, and some are on protocol roads. Based on the data obtained, most gas station operator workers in Pontianak City have a working period of < 3 years. The working period can affect the mechanical system in the body (Basri et al., 2021). The duration of work can impact the onset of work fatigue, as prolonged hours spent at a workplace tend to exacerbate the degree of fatigue experienced by workers (Maulinda et al., 2017). Internal factors that can influence work fatigue in gas station operator workers in this study were not explicitly researched and analyzed, so a more comprehensive study is needed to determine which factors are most related to fatigue in gas station operator workers. The majority of gas station operator workers work at environmental temperatures that do not meet the requirements, namely 50 workers (83.3%). Gas station operator workers in Pontianak City work at noise levels that exceed the NAB, namely 52 workers (86.7%). most of the gas station operator workers in Pontianak City experienced high levels of fatigue, namely 38 workers (63.3%). Work fatigue is a crucial problem that must be addressed because it will have an impact on workers' health and can cause work accidents. Work fatigue is a decline in physical condition, body condition, and work motivation (Ningsih & Nilamsari, 2018). Work fatigue can reduce work concentration and worker performance. Work fatigue will get worse if it is not treated further (Bidjuni et al., 2018).

Table 2. Results of Analysis of the Relationship between Physical Environment (Temperature and Noise) and Work Fatigue among Gas Station Operator Workers in Pontianak City.

Variable	Category	Work Fatigue				Total	p-Value	OR	
		High Work Fatigue		Low Work Fatigue					
		n	%	n	%				
Temperature	Not eligible	36	72	14	28	50	100	0.003	10.286

	<u>Qualify</u>	2	20	8	80	10	100		
Noise	\geq Threshold value	36	69.2	16	30.8	52	100		
	$<$ Threshold value	2	25	6	75	8	100	0.042	6.750

Table 2 shows that respondents who work at work environment temperatures that do not meet the requirements tend to experience higher work fatigue, namely 72%, compared to respondents who work at work environment temperatures that meet the requirements, namely 20%. The statistical results show a value of $p=0.003$, where it can be concluded that there is a relationship between temperature and work fatigue in gas station operator workers in Pontianak City. The OR value obtained = 10.286 (95% CI = 1.940-54.527), so it can be stated that environmental temperature that does not meet the requirements is a risk factor with a 10.286 chance of causing high fatigue in gas station operator workers in Pontianak City. This is by various studies, including research (Zulkarnain et al., 2020) and (Wardani et al., 2023) High temperatures increase the risk of work fatigue in workers.

Workers who work at a temperature of 31° C have a light workload, 28 ° C for workers with a medium workload and 25° C for workers with a heavy workload with a working duration of 8 hours a day with a rest period of 1 hour (Mujib et al., 2018). According to (Mahdavi et al., 2020). Temperatures above 28°C cause work fatigue. Workers exposed to hot temperatures also risk experiencing heat stress and fatigue, which can reduce work productivity. Exposure to heat for hours disrupts the body's balance system, where the body produces sweat as a compensation mechanism. The body's heat center is located in the part of the brain, that regulates blood flow through the skin vessels, such as dryness, and this heat center will regulate the heat balance in the body. At environmental temperatures above 25 ° C, human skin can lose heat through convection or radiation, and sweating is the only mechanism available. Losing a lot of fluids due to sweating causes fatigue; therefore, various efforts are made to prevent work fatigue caused by temperature. High levels, namely control of the work environment such as designing and building a roof to block the sun's heat, arranging rest areas for workers, work control such as work duration, rest duration and use of work uniforms that can absorb sweat, cool and wear hats, health management such as health checks for workers as well as education regarding occupational health for workers (Horie, 2023). Gas station operator workers are expected to consume enough drinking water while working, at least one glass of 250 ml every 20-30 minutes or 2.8 liters/day, and can add a little salt to drinking water to avoid harmful effects such as dehydration. Salt water functions to retain fluids in the body. Dehydration or lack of fluids can be avoided by consuming enough salt every day (Awwalina et al., 2022).

Respondents who work in work environments with noise levels that exceed the threshold value tend to experience greater work fatigue, namely 69.2%, compared to respondents who work in work environments with noise levels that do not exceed the NAB, namely 25%. The statistical results show a value of $p=0.042$, where it can be concluded that there is a relationship between noise and work fatigue in gas station operator workers in Pontianak City. The OR value obtained = 6.750 (CI 95% = 1.227-37.142), so it can be stated that noise that exceeds the NAB is a risk factor with a 6.750 times chance of causing high fatigue in gas station operator workers in Pontianak City. This is by research (Rahimimoghadam et al., 2023) and (Keron et al., 2023) that noise influences workers' level of work fatigue.

Noise that exceeds the threshold can cause fatigue because it can disrupt worker activities. Workers' concentration on their work, which has high noise exposure, can cause psychological effects and work fatigue (Keron et al., 2023). The noise threshold value for a workplace with 8 working hours is 85dB (The National Institute for Occupational Safety and Health, 2023). Various noise prevention and control efforts must be carried out through engineering controls

that involve modifying or replacing equipment or making related physical changes to noise sources to reduce noise that will be exposed to workers' ears, administrative controls to make changes in the workplace or reducing work shift schedules to reduce or eliminate worker exposure to noise (Themann & Masterson, 2019). To reduce noise at gas station workplaces, it would be best to make rules so that two-wheeled and four-wheeled vehicles turn off the engine when queuing and refilling petrol so that gas station operator workers are not exposed to noise. Final control over noise can also be done using personal protective equipment such as earplugs for gas station operator workers. In this study, data on respondents' fatigue before work was not measured. For further research, measurements related to fatigue before work and after work need to be carried out.

Preventive and protective measures must be implemented in order of priority, with PPE being the last priority for preventive and protective action for worker safety. Diverse strategies for noise prevention and control should be implemented. These include engineering measures such as modifying or replacing equipment to minimize noise emissions and physically altering noise sources. Administrative controls, such as adjusting work schedules or altering workplace arrangements, can reduce or eliminate worker exposure to excessive noise (MOHR, 2020). The most commonly used personal protective equipment for reducing noise exposure is earplugs. Earplugs are protective devices designed to reduce noise by blocking the ear canal. Some earplugs are specifically designed for certain situations, such as those with filters that allow sound to enter while reducing its intensity by 20 to 30 dB, depending on the type and material used. (Hidayat et al., 2024; Kurniawan et al., 2020; Sari et al., 2023).

4. CONCLUSION

There is a relationship between temperature and noise with work fatigue among gas station operators in Pontianak City. This study suggests that gas station operators should consume adequate drinking water while working, at least one glass (250 ml) every 20 to 30 minutes or 2.8 liters per day, and consider adding a little salt to their drinking water to avoid harmful effects such as dehydration. Gas station operators should also use hearing protection devices, such as earplugs, to reduce noise intensity. Future research should include various factors that influence fatigue among gas station operators, such as pre-work activities and ergonomic factors.

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