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DEHYDRATION LEVELS AND DRINKING WATER CONSUMPTION ON WORK FATIGUE AT PT. PAL INDONESIA

TINGKAT DEHIDRASI DAN KONSUMSI AIR MINUM TERHADAP KELELAHAN KERJA DI PT. PAL INDONESIA

Original Research Article
Penelitian

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A B S T R A C T

Background: *Work fatigue among PT. PAL Indonesia workers occurs due to several factors, such as working under high temperatures and sunlight without the aid of temperature reducing equipment and the lack of easily accessible drinking water around the workplace, which can trigger dehydration in workers.* ***Purpose:*** *This study aims to analyze the strength of the relationship between drinking water consumption and dehydration on work fatigue in floating and digging dock workers at PT. PAL Indonesia.* ***Method:*** *This research is an observational study with a cross-sectional approach, involving a sample of 26 dock workers from the Harkan Division at PT. PAL Indonesia. Data collection was conducted through measuring work fatigue using a reaction timer, questionnaires, interviews, and observations.* ***Result:*** *The analysis between variables shows a strong relationship between dehydration and work fatigue of 0.606 and a very weak relationship between drinking water consumption and the incidence of work fatigue of 0.135.* ***Conclusion:*** *It is suggested that the company should regularly provide drinking water supplies for workers and place them in locations that are easily accessible. Apart from that, the company should encourage workers to consume more water instead of other drinks to protect them from possible diseases beyond work fatigue.*

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A B S T R A K

Latar belakang: Kelelahan kerja pada pekerja PT. PAL Indonesia terjadi karena beberapa faktor, seperti bekerja dibawah suhu dan sinar matahari yang tinggi tanpa adanya bantuan alat penurun suhu dan tidak adanya akses air minum yang mudah dijangkau di sekitar tempat kerja, yang dapat memicu terjadinya dehidrasi pada pekerja. **Tujuan:** Penelitian ini bertujuan untuk menganalisis kekuatan hubungan antara konsumsi air minum dan dehidrasi terhadap kelelahan kerja pada pekerja dock apung dan gali di PT. PAL Indonesia. **Metode:** Penelitian ini merupakan penelitian observasional dengan pendekatan *cross-sectional* yang melibatkan sampel sebanyak 26 pekerja dock dari divisi harkan di PT. PAL Indonesia. Pengumpulan data dilakukan melalui pengukuran kelelahan kerja menggunakan alat pengukur reaksi, kuesioner, wawancara, dan observasi. **Hasil:** Analisis antar variabel menunjukkan adanya hubungan yang kuat antara dehidrasi dengan kelelahan kerja sebesar 0.606, dan hubungan yang sangat lemah antara konsumsi air minum dengan kejadian kelelahan kerja sebesar 0.135. **Kesimpulan:** Disarankan agar perusahaan secara teratur menyediakan suplai air minum bagi pekerja dan menempatkannya pada tempat yang mudah diakses bagi pekerja. Selain itu, perusahaan sebaiknya menghimbau kepada para pekerja untuk memperbanyak konsumsi air putih dibanding konsumsi minuman lain guna menjaga pekerja dari kemungkinan penyakit lain selain kelelahan kerja.

Kata kunci:
Tingkat dehidrasi, Konsumsi air minum, Kelelahan kerja

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INTRODUCTION

Work fatigue is the level of fatigue felt by a person, characterized by symptoms of feeling tired (mental fatigue) and physiological changes in the body (physical fatigue), which result in a decrease in vitality and productivity (Tasyrifah, 2017). The factors causing fatigue in the industry vary greatly, and to maintain health and efficiency, the refreshment process must be carried out to alleviate stress. Refreshment primarily occurs during nighttime sleep, but rest periods and downtime can also provide refreshments (Fahmi, 2020).

Work fatigue is a serious problem that requires special attention. As such, work fatigue is one of the highlights that companies need to address. Work fatigue can increase the risk of work accidents (Tarwaka, 2014). This is supported by data from the International Labor Organization (ILO) in 2018, which stated that nearly two million workers die each year due to work accidents related to work fatigue. Fatigue is a common experience for many individuals. Headaches, tension, joint pain, and bad mood are some of the symptoms experienced when fatigue occurs (Hijah *et al*., 2021).

Workers who are exposed to heat stress cause the body to respond by producing a lot of sweat to cool the body temperature. This leads to changes in the sweat glands, which increase their secretion, resulting in excessive sweating. If this sweating is not balanced by adequate fluid intake or replacement, it can lead to dehydration (Suma'mur, 2014). The situation worsens if an individual does not consume enough fluids and experiences a decrease in the amount of body fluids of up to 10%, which can result in serious health consequences or even death (Budiono, 2003).

In a hot work environment, heat stress can arise due to exposure to extremely high temperatures originating from certain equipment or work locations (Suryaningtyas, 2017). The occurrence of heat stress is influenced by factors such as the temperature in the work environment, body metabolic temperature, physical activity and workload, as well as wind speed and humidity (Susetyo *et al*., 2012). One of the causes of fatigue is an extreme work environment. Fatigue is a protective mechanism for the body to avoid further damage so that recovery occurs after rest (Kuswadji, 1997).

Fatigue is centrally regulated by the brain. In the central nervous system, there is a balance between sympathetic activity and parasympathetic inhibition (Tarwaka, 2016). The term fatigue usually indicates different conditions for each individual, but it generally leads to a loss of efficiency and decreased work capacity and body endurance (Maftuh *et al*., 2021). Fatigue resulting from work is often interpreted as a process of decreased efficiency, reduced work performance, and decreased physical strength or endurance, which affects the ability to continuously perform required activities (Subaris, 2008).

Research by Entianopa *et al*. (2020) shows that there is a significant influence of a hot work climate on the work fatigue of steam operators at PT. XYZ Boyolali. It also reported that factors related to the incidence of fatigue among PT. Angkasa Raya Djambi Dryer workers in 2020 included a hot work climate, physical activity, and water consumption. According to the ILO (2013), up to two million workers die each year due to work accidents caused by fatigue. Other research also reported that out of 58.115 samples, 32.8% of them experienced fatigue, if workers experienced work accidents caused by fatigue, this would have a direct impact on their work productivity levels (Pabumbun *et al*., 2022).

PT. PAL Indonesia is one of the strategic industries owned by state-owned enterprises (BUMN) that produces the main equipment for the Indonesian defense system, especially for maritime dimensions. Its existence certainly has an important and strategic role in supporting the development of the national maritime industry. The role of PT. PAL Indonesia became stronger after the issuance of Law No. 16 of 2012 concerning the defense industry, which granted strategic BUMN a broader role. Based on this law, PT. PAL Indonesia professionally carries out the mandate as well as the obligation to play an active role in supporting the fulfillment of the needs for marine defense equipment and acts as the main guide (lead integrator) of marine dimensions.

The initial goal of being established as a center of excellence for the national maritime industry, PT. PAL Indonesia has proven its reputation as a major force in the development of the national maritime industry to strengthen the foundation for the development of the maritime industry. However, this company has a high risk of occupational fatigue due to hot working climate and the high possibility of dehydration at work. This reason, it is important to measure the possibility of work fatigue caused by the work climate and the incidence of dehydration in the workplace, as reported by Huda and Suwandi (2018). This can be done to prevent work accidents related to the variables to be studied. Therefore, the researchers are interested in studying this topic to examine the issues at PT. PAL Indonesia related to dehydration and water consumption in relation to work fatigue.

MATERIAL AND METHOD

This research has been ethically tested and received an ethical certificate from the Ethics Commission of the Faculty of Public Health, Universitas Airlangga No: 172/EA/KEPK/2023 issued on 14th August 2023. This research employed a quantitative approach method. The design was observational with descriptive analysis. This research used a cross-sectional approach with data collected at one time within the company, including

measurements of work fatigue, dehydration levels, and drinking water consumption, as well as observations. This research was carried out at PT. PAL Indonesia in May 2023. The sample comprised dock workers from the Harkan Division at PT. PAL Indonesia, totaling 26 workers.

The data collection technique of this research involved primary and secondary data. Primary data were collected through work fatigue measurement using a reaction timer, dehydration measurement using urine color indicators, drinking water consumption using questionnaires, and respondent characteristics gathered through questionnaires and observations. Meanwhile, secondary data included profiles and accident data at PT. PAL Indonesia.

In the reaction timer test, a stimulus in the form of a flashing light was used, and the time needed for workers to respond to this stimulus was recorded. This test is used to measure work fatigue because the test is objective and easy to do. Reaction time measurements were carried out five times; the results were summed, and the average value was calculated. These measurements were then compared with fatigue measurement standards.

Dehydration was measured using urine color indicator cards to determine the worker's dehydration status. This type of urine looks normal in the morning during urination; therefore, in this study the right time for urine examination to be carried out was when workers were resting or after finishing work. Drinking water consumption was measured using a questionnaire to find out whether workers' water intake met the recommended 2.8 liters per day in a hot working environment. The urine color scale, developed by Armstrong (2005), ranges from clear to concentrated, with a scale from 1 to 8 (Iksani, 2005), as shown in Figure 1.

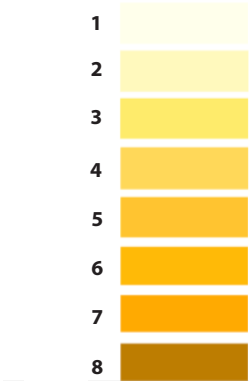

Figure 1. Urine color scale indicator

Primary data collection regarding the characteristics of respondents was carried out through interviews using questionnaires and observations to determine the characteristics of respondents, namely age, length of work, and duration of work.

Data analysis was performed descriptively and presented in the form of cross-tabulations. Statistical analysis used the contingency coefficient test. The contingency coefficient test is used to measure the strength and direction of the relationship between two categorical variables, specifically here to determine the relationship between drinking water consumption and dehydration on work fatigue. Statistical methods were employed to test hypotheses and identify relationships or patterns in the data. Techniques such as regression analysis, correlation analysis, or other statistical tests were used depending on the type of data and research objectives (Sugiyono, 2016). The contingency coefficient test scores are interpreted as follows: 0.00 to 0.19 indicates a very weak relationship, 0.20 to 0.39 indicates a weak relationship, 0.40 to 0.59 indicates a medium relationship, 0.60 to 0.79 indicates a strong relationship, and 0.80 to 1.00 indicates a very strong relationship (Supranto, 2009).

RESULT

The individual characteristic variables examined in this study include age, length of service, and working hours of the respondents as shown in Table 1. Based on the research results, respondents were aged between 26 and 55 years and had a working period of 6 to 10 years. The measurement of individual characteristics aims to describe the profiles of workers in the Harkan Division of PT. PAL Indonesia Surabaya. The majority of respondents are early adults (26 - 35 years), namely 11 people (42.3%). The majority of respondents have a new work period (<6 years), with 15 people (57.7%), and the majority of respondents have worked (≤8 hours), namely 24 people (92.3%).

The dehydration variable describes the level of fluid loss due to excessive sweating from prolonged exposure to heat. The results, based on primary data obtained from measurements using a urine color indicator card, are presented in the form of a variable frequency distribution table. According to Table 2, it is known that the majority of respondents experienced moderate dehydration, namely 13 people (50%).

Drinking water consumption was measured to describe the amount of drinking water consumed by workers in the Harkan Division of PT. PAL Indonesia Surabaya. The results of the frequency distribution are based on primary data obtained from measurements using a questionnaire and are presented in the form of a frequency distribution table. Based on Table 3, it is known that the majority of respondents' drinking water consumption is in the adequate category, with 14 people (53.8%) meeting the recommended intake. Conversely, 12 workers did not meet the recommended daily intake of 2.8 liters of water.

The fatigue variable describes the state of weakening of the physical strength of the worker's body as seen from the slowdown in the process of nerve and muscle fauna characterized by lengthening the response time. The results of the frequency distribution of variables in this study are based on primary data obtained from measurements using a reaction timer. The reaction timer results categorize fatigue as follows: normal (150 - 240 milliseconds), mild fatigue (240 - 410 milliseconds), moderate fatigue (410 - 580 milliseconds), and severe fatigue (≥580 milliseconds) (Suma'mur, 2014). Based on Table 4, it is known that the majority of respondents experienced mild fatigue, namely 18 people (69.2%).

The cross-tabulation results in Table 5 show that moderate dehydration tends to be associated with mild fatigue. However, the data also reveal that some respondents with mild fatigue did not experience dehydration (hydrated), while some with normal fatigue experienced moderate dehydration. The test results indicate a strong relationship between dehydration and the incidence of work fatigue, with a coefficient of 0.606.

The cross-tabulation results in Table 6 show that drinking water consumption that meets the requirements can still cause respondents to experience mild fatigue and some even experience severe fatigue. However, mild fatigue also occurred in respondents whose drinking water consumption did not meet the requirements. The test results show a very weak relationship between drinking water consumption and the incidence of work fatigue, with a coefficient of 0.135.

Table 1. Characteristics of individual workers in the Harkan Division of PT. PAL Indonesia

Variable	Category	Number	Percentage (%)
Age	Late teens (17 - 25 years)	3	11.5
	Early adults (26 - 35 years)	11	42.3
	Early old age (36 - 45 years)	10	38.5
	Late old age (46 - 55 years)	2	7.7
	Total	26	100.0
Length of work	New (<6 years)	15	57.7
	Moderate (6 - 10 years)	6	23.1
	Long (>10 years)	5	19.2
	Total	26	100.0
Duration of work	≤ 8 hours	24	92.3
	> 8 hours	2	7.7
	Total	26	100.0

Table 2. Dehydration levels of workers in the Harkan Division of PT. PAL Indonesia

Variable	Category	Number	Percentage (%)
Dehydration level	Hydrated	2	7.7
	Mild dehydration	6	23.1
	Moderate dehydration	13	50.0
	Severe dehydration	5	19.2
	Total	26	100.0

Table 3. Drinking water consumption of workers in the Harkan Division of PT. PAL Indonesia

Variable	Category	Number	Percentage (%)
Drinking water consumption	Adequate	14	53.8
	Inadequate	12	46.2
	Total	26	100.0

Table 4. Worker fatigue in the Harkan Division of PT. PAL Indonesia

Variable	Category	Number	Percentage (%)
Fatigue	Normal	2	7.7
	Mild Fatigue	18	69.2
	Moderate Fatigue	5	19.2
	Severe Fatigue	1	3.8
	Total	26	100.0

Table 5. Statistical test results of the relationship between dehydration and work fatigue in the Harkan Division of PT. PAL Indonesia

Dehydration level		Fatigue				Total	Coefficient contingency
		Normal	Mild	Moderate	Severe		
Hydrated	n	0	2	0	0	2	0.606
	%	0	100	0	0	100	
Mild dehydration	n	0	4	1	1	6	
	%	0	66.7	16.7	16.7	100	
Moderate dehydration	n	2	9	2	0	13	
	%	15.4	69.2	15.4	0	100	
Severe dehydration	n	0	3	2	0	5	
	%	0	60	40	0	100	
Total	n	2	18	5	1	26	
	%	7.7	69.2	19.2	3.8	100	

Table 6. Statistical test results of the relationship between drinking water consumption and work fatigue in the Harkan Division of PT. PAL Indonesia

Drinking water consumption		Fatigue				Total	Coefficient contingency
		Normal	Mild	Moderate	Severe		
Adequate	n	2	7	4	1	14	0.135
	%	14.3	50	28.6	7.1	100	
Inadequate	n	0	11	1	0	12	
	%	0	91.7	8.3	0	100	
Total	n	2	18	5	1	26	
	%	7.7	69.2	19.2	3.8	100	

DISCUSSION

Overview of dehydration in workers in the Harkan Division of PT. PAL Indonesia

Based on the research results, the majority of workers at PT. PAL Indonesia experienced moderate dehydration, namely 13 workers (50%) and only two workers (7.7%) were hydrated, while five workers experienced severe dehydration (19.2%). Dehydration is a condition where living creatures lack excessive amounts of body fluids (Ihsan and Salami, 2015). The level of worker dehydration was determined by observing the color of the workers' urine, which was matched to a urine color scale of 1 to 8. There are four categories of dehydration levels, namely hydrated (urine color scale 1 - 2), mild dehydration (urine color scale 3 - 4), moderate dehydration (urine color scale 5 - 6), and severe dehydration (urine color scale 7 - 8). According to Suma'mur (2014), when workers work in a hot work environment, they will tend to sweat more. This can cause loss of body fluids, resulting in dehydration.

Overview of drinking water consumption in the Harkan Division of PT. PAL Indonesia

Based on calculations from the questionnaire regarding the amount of drinking water consumption, the majority of PT. PAL Indonesia workers, namely 14 workers (53.8%), have sufficient drinking water consumption (≥2.8 liters), and as many as 12 workers (46.2%) have inadequate drinking water consumption (< 2.8 liters). At PT. PAL Indonesia, there is no designated place for workers to collect water for consumption. However, based on observations, the distance between the rest area for PT. PAL Indonesia workers and their respective dock workshops is quite close. However, based on information from workers, PT. PAL Indonesia has not provided a water supply for the dock workers, so the workers must provide their own water supply independently. Even though the majority of workers have adequate drinking water consumption, the drink consumed by the majority is not water but caffeinated drinks, such as coffee, which should not be consumed in excessive amounts compared to water (Buanasita *et al*., 2015).

Overview of fatigue in workers in the Harkan Division of PT. PAL Indonesia

Fatigue describes a state of weakening of a worker's physical strength as seen from a slowdown in nerve and muscle function processes which is characterized by a lengthening of response time (Answastari, 2016). Based on the research results, the majority of PT. PAL Indonesia workers experienced mild fatigue (18 workers or 69.2%) and five workers experienced moderate fatigue (19.2%). Excessive work fatigue can cause several health risks. The results of the research show that there is a relationship between the influence of a hot working climate and dehydration on fatigue among workers in the floating and digging dock section of the Harkan division at PT. PAL Indonesia, in this case because its workers are in that environment.

Heat can cause heat stress so that the body will adapt to the environment. When the environmental temperature increases, body temperature will also increase, activating the hypothalamus gland. This gland triggers the body's heat regulation mechanism to maintain constant heat by balancing the heat received from outside the body with the heat released by the body through evaporation processes, namely breathing and sweating. Most evaporation occurs through sweat. Excessive sweating can cause dehydration if fluid intake is not adequately handled. So, workers will easily experience fatigue if their body's fluid intake is not met. Risks that can arise due to fatigue include decreased work motivation, low performance, low quality of work, many errors occurring at work, low work productivity which can lead to work stress, work-related illnesses, injuries, and work accidents (Sari, 2014).

The relationship between dehydration and the occurrence of work fatigue in the Harkan Division of PT. PAL Indonesia

The results of the research showed that moderate dehydration tended to make respondents experience mild fatigue. However, based on the level of fatigue category, there were respondents with mild work fatigue who did not experience dehydration (hydrated) and there were respondents with normal fatigue who experienced moderate dehydration. Workers have the potential to experience work fatigue caused by various factors. These factors such as working under high temperatures and sunlight without temperature reduction devices, and the lack of easily accessible drinking water around the workplace, can trigger dehydration in workers. The test results show a strong relationship between dehydration and the incidence of work fatigue with a value of 0.606. Mild dehydration in individuals with heavy physical activity can lead to a decrease in performance, resulting in increased fatigue and decreased endurance. Mild dehydration also causes disturbances in mood and cognitive functions, such as concentration and alertness (Sari, 2014).

The relationship between drinking water consumption and the occurrence of work fatigue in the Harkan Division of PT. PAL Indonesia

The research results show that consuming drinking water that meets the requirements can still cause respondents to experience mild fatigue and some even experience severe fatigue. However, mild fatigue also occurred in respondents whose drinking water consumption did not meet the requirements. The test results show a very weak relationship between drinking water consumption and the incidence of work fatigue with a value of 0.135. Other research shows that work fatigue can occur with symptoms of lack of water consumption, such as feeling thirsty, yawning while working, and having a hoarse voice (Tarwaka, 2014).

CONCLUSION

The results of the analysis show a strong relationship between different variables, where the relationship between dehydration and the incidence of work fatigue is 0.606, and the relationship between drinking water consumption and the incidence of work fatigue is very weak at 0.135. This reason, it is necessary to increase fluid intake for workers according to their body fluid needs to prevent dehydration. This can be done by improving company facilities to make it easier for workers to access drinking water, for example by increasing the number of water dispensers or providing portable drinking bottles for workers.

Additionally, it is necessary to educate workers about fluid requirements for workers in hot environments with high activity levels, the signs of dehydration, the consequences of dehydration, and how to prevent it. It is also recommended that the company install blowers in every corner of the work area to ensure proper air circulation, so that heat in the workplace can flow outside smoothly.

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