

Original Research Report

PHYSICAL WORKLOAD AND WORK FATIGUE AMONG TANK CAR DRIVERS AT SURABAYA INTEGRATED TERMINALTasya Endah Milinia¹, Dani Nasirul Haqi² , Siti Arum Alia³ ¹Public Health Bachelor Program, Faculty of Public Health, Universitas Airlangga, Surabaya, Indonesia²Department of Occupational Health and Safety, Faculty of Public Health, Universitas Airlangga, Surabaya, Indonesia³Area Manager Medical, PT Pertamina Patra Niaga Regional Jatimbalinus, Surabaya, Indonesia**ABSTRACT**

Every year, there are nearly a thousand times more of non-fatal accidents than fatal accidents. In Indonesia, Java Island has the highest number of traffic accidents. Work accidents have three main factors, i.e. worker factors, labor factors, and environmental factors. Fatigue is one of the conditions called silent killer. The aim of this research was to analyze the correlation of physical workload with work fatigue in tank car drivers at Surabaya Integrated Terminal. This research was an observational cross-sectional study. The sample were 205 tank car drivers fulfilling the inclusion criteria as fuel tank car drivers and willing to participate in this research. The independent variable in the study was physical workload, while the dependent variable was subjective work fatigue. Data were collected using the IFRC questionnaire. The Spearman's correlation test revealed the value of Sig. (2-tailed)=0.437, indicating no significant correlation between physical workload and subjective work fatigue. The results showed that the physical workload had no correlation with work fatigue. Fatigue found among the drivers are probably induced by other factors not analyzed in this study. Companies and tank car drivers are advised to carry out work fatigue management by, for example, drinking water regularly, carrying out light exercise, and fulfilling nutritional intake.

Keywords: Physical workload; work fatigue; work accidents; traffic accidents; public health

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H i j n i j t u r

1. Physical workload had no correlation with work fatigue among tank car drivers.
2. Companies and tank car drivers are advised to carry out work fatigue management by exercising lightly and fulfilling nutritional and water intake.

INTRODUCTION

The International Labor Organization (ILO) estimates that 2.78 million workers die each year as a result of occupational accidents and diseases. About 2.4 million (86.3%) of these deaths were caused by occupational diseases, and more than 380,000 (13.7%) were caused by work accidents. Every year, there are nearly a thousand times more of non-fatal accidents than fatal accidents. An estimated number of 374 million workers are affected by non-fatal accidents each year, many of which have serious consequences for workers' earning capacity (Hämäläinen et al. 2017).

Based on the investigation of the National Transportation Safety Committee (KNKT) in 2007-2016, the highest numbers of road traffic accidents involving motorized vehicles happen in Java. West Java Province has the highest accident rate in Java with 22 accident cases. The reason is the geographical conditions, which mostly consist of hilly and mountainous areas with geometric ascents, descents, and bends. East Java Province has the second highest traffic accident rate with 13 accident cases. Central Java Province has the third highest traffic accident rate with 6 accident cases. Meanwhile, North Sumatra Province has the highest traffic accident rate in Sumatra with 5 accident cases (Saputra 2018).

The ILO states that work accidents have three main factors, i.e. worker factors (including age, education level, and work experience), labor factors (including shift work, type or work unit), and environmental factors (including physical, chemical, and biological factors) (Djarmiko 2016). The results of previous studies showed that there was a correlation between fatigue and work accidents (Tanriono et al. 2019). The results of a research by Zhang et al. (2016) showed a significant correlation between fatigue and accidents in bus drivers, and that fatigue is one of the conditions known as the silent killer.

The Surabaya Integrated Terminal, included in the work area of PT Pertamina Patra Niaga in the Jatimbalinus Region, is responsible in distributing fuel oil to all business areas in East Java, so it has a risk of tank car traffic accidents. Based on data obtained from the Surabaya Integrated Terminal, accidents occurred until November 2021 included 14 tanker truck accidents, 9 of which were active accidents. On the other hand, the number of tanker truck accidents in the Pertamina Patraniaga area throughout East Java is 27 accidents.

Based on this background, the purpose of this study was to analyze the correlation between physical workload and work fatigue in tank car drivers at the Surabaya Integrated Terminal.

MATERIALS AND METHODS

This research was an observational descriptive cross-sectional study. The aim of this study was to provide an overview of the state of the object and analyze the problems studied. This research was conducted on tanker car drivers at the Surabaya Integrated Terminal. The population in this study were 420 workers with inclusion criteria as fuel tank car drivers who were willing to participate in this research. The sample in this study were 205 people with the determination of the sample size using the Slovin formula with a degree of error of 5%. Sampling was conducted using simple random sampling technique. The use of this method provides an equal opportunity in a population to be taken as sample.

The independent variable was physical workload, while the dependent variable was work fatigue. Based on sources, data in this study were primary data and secondary data. Primary data was obtained through interviews and filling out questionnaires, while secondary data was obtained through books, articles, or previous researches with appropriate or related topics.

Data on the physical workload variable were obtained from interviews about activities carried out in a day and then the physical workload was calculated by considering the calorie needs. Based on the number of calorie needs, the physical workloads were categorized into mild (<200 kcal/hour), moderate (200-350 kcal/hour), and strenuous (>350 kcal/hour) physical workloads (Indonesian Minister of Manpower and Transmigration 2011). Data on work fatigue variable were obtained through direct questionnaires filled out by the workers using the Industrial Fatigue Research Committee (IFRC) questionnaires.

The IFRC questionnaires were assessed using a Likert scale. After being filled out by the respondents, the questionnaires were assessed by adding up the total score. The total score was classified into low (0-21), medium (22-44), high (46-67), and very high (68-90) subjective work fatigue.

The data were analyzed using univariate and bivariate analyses. Univariate analysis was carried out by presenting data in tabular form and data percentages. Meanwhile, bivariate analysis was used to see whether there was a correlation between variables using the Spearman test.

RESULTS

Based on Table 1, it can be known that the majority of respondents were >35 years old with 139 people (67.8%) and have a working period of >5 years with 123 people (60%).

Table 1. Characteristics of respondents (n=205)

Characteristics of Respondents	Total	Percentage
Age		
≤35 years old	66	32.2
>35 years old	139	67.8
Total	205	100
Working period		
≤5 years	82	40
>5 years	123	60
Total	205	100

Work fatigue can be caused by many factors, one of which is physical workload. The distribution of the workers based on the physical workload and work fatigue was as follows:

Table 2. Distribution of workers based on the physical workload

Variable	Total	Percentage
Physical Workload		
Mild	142	69.3
Moderate	63	30.7
Strenuous	0	0
Total	205	100

Based on Table 2, it can be known that the majority of respondents had mild physical workload with 142 people (69.3%). Other respondents had moderate physical workload with 63 people (30.7%).

Table 3. Distribution of workers based on the work fatigue

Variable	Total	Percentage
Work Fatigue		
Low	191	93.2
Medium	14	6.8
High	0	0
Very High	0	0
Total	205	100

Based on Table 3, it can be known that the majority of respondents experienced low subjective work fatigue with 191 people (93.2%). Other respondents had medium work fatigue with 14 people (6.8%).

Table 4. The Correlation of Physical Workload with Work Fatigue

Variable	Work Fatigue				Total		Spearman Rank
	Low		Medium		n	%	
	n	%	n	%			
Physical Workload							
Mild	131	92.2	11	7.8	142	100	0.437
Moderate	60	95.2	3	4.8	63	100	

Based on Table 4, it can be known that out of the tank car drivers with a mild physical workload at the Surabaya Integrated Terminal, 131 people (92.2%) had low work fatigue. Meanwhile, 11 people (7.8%) of the total respondents with mild physical workload had medium work fatigue. Out of the tank car drivers with a moderate physical workload, 60 people (95.2%) had low work fatigue. Meanwhile, 3 people (4.8%) of the total respondents with moderate physical workload had medium work fatigue.

Based on the results of the Spearman correlation test analysis where the value of $\alpha=0.05$ (5%), it can be known that the value of Sig. (2-tailed)=0.437. Sig value (2-tailed)=0.437 > $\alpha=0.05$. Therefore, it can be concluded that there was no significant correlation between physical workload and subjective work fatigue.

DISCUSSION

It is known that work fatigue in tanker car drivers is divided into low and moderate category. Low and moderate work fatigues that occur in tank car drivers are the results of excessive working hours. According to the Act of the Republic of Indonesia Number 13 Year 2003 concerning manpower, regulated working hours are seven hours. However, the tank car drivers' working hours are twelve hours and can even reach one full day due to the distance of fuel distribution from the Surabaya Integrated Terminal to the destinations, or due to increased orders for fuel oil. Long working hours can affect optimal work productivity and cause work fatigue (Irwanto 2020). It may increase the risk of cardiovascular disease (Kim et al. 2018).

The biggest cause of traffic accidents is human factors at 79.91% (Utomo 2019). One of the human factors is fatigue or work fatigue. Fatigue can be identified by several signs and symptoms including yawning, rubbing the eyes, dizziness, drowsiness, decreased concentration, and boredom (Caldwell et al. 2019). Fatigue can be caused by sleep factors (circadian rhythm), work factors (long working hours), and health factors (Davidović et al. 2018). Work schedule can affect work fatigue, and then work fatigue can also affect work performance (Al-Mekhlafi et al. 2021). Fatigue can lead to a decrease in productivity and affect the health of workers (Prastuti & Martiana 2017). Work fatigue can also cause work accidents due to decreased body functions while working (Fitriani et al. 2021).

Work fatigue can be overcome with work fatigue management which will have an impact on the prevalence of work accidents (Sieber et al. 2022). Work fatigue management programs must be carried out by companies and workers. Work fatigue management program for the tanker drivers includes knowing the signs of fatigue, light stretching, meeting daily drinking water needs, and optimizing rest time. Another way is taking time to be in nature which can reduce fatigue levels (Longman et al. 2021). Work fatigue management program provided by the company includes warming-up before starting work, providing drinking water and additional food, joint stretching program, providing a camera to record the driver, and providing rest areas. The company's intervention in providing additional food can increase the nutritional needs of workers so that they can work optimally, while the company's intervention with light exercise can make the workers' bodies healthier and reduce their sedentary lifestyle (Rachmah et al. 2022). The company's intervention in providing a camera for the drivers can record changes in facial expression, voice,

drivers can record changes in facial expression, voice, and posture (Murad et al. 2022). There are other ways to detect fatigue, i.e. recognizing biological changes through electroencephalogram (EEG) and electrocardiogram (ECG). These methods can describe the drivers' condition with high accuracy, but these methods require a tool that is attached to a certain body part, so it could interfere with the movement while working (Fan et al. 2022).

This study divided the physical workload experienced by the tank car drivers into mild and moderate categories. The majority of the tank car drivers had mild physical workload because they tended to not use a lot of energy and did not require great physical strength to carry out their activities. Although tank car drivers do not require much physical strength at work, tanker drivers may experience fatigue or back and neck pain due to the monotonous position of the drivers' body and awkward posture when driving (Sekky et al. 2021). The monotonous position and awkward posture while driving can increase the drivers' fatigue, which can have an impact on absenteeism due to illness (Bláfoss et al. 2019).

The results of the study indicated that most of the physical workload of the tank car drivers was in the mild category. The physical workload categorization based on oxygen demand through calorie needs assessment cannot explain the actual exposure of workers. Other than the difficulty of the work itself, other factors that can affect calorie needs include work environment, work style, attitude, and workplace (Tarwaka 2019).

Based on the results of the study, it was found that there was no correlation between physical workload and work fatigue. The heavier the physical workload, the higher the subjective fatigue level. As in these results, light physical workloads tended to cause low work fatigue. The results of this study are in line with a research by Saputra & Hartono (2021) that there is no significant correlation between physical workload and the incidence of work fatigue in public transport drivers in Depok City, Indonesia. A research by Maulana (et al. 2021) showed similar result that there is no significant correlation between workload and the incidence of work fatigue among intercity and interprovincial (AKAP) bus drivers in PT Eka Sari Lorena Transport Tbk, Bogor, Indonesia.

Fatigue can be caused by factors that may be work-related, non-work-related, or a combination of both, and can accumulate over time. When the body is inadequate to recover from fatigue, the fatigue can continue to accumulate (Gabriel et al. 2018). Work

fatigue is generally caused by external factors of workload, work itself, or organization (working hours, breaks, shifts, night work, etc.), work environment (physical, chemical, biological, ergonomic, and psychological), physical factors (age, gender, height, condition, nutritional status), and psychological factors (motivation, job satisfaction, desire, etc.) (Russeng in Mahardika 2017). The results showed that the physical workload variable was not related to work fatigue due to the fact that there were probably different variables that induced the drivers' fatigue to be minimum, or different variables that now have been no longer analyzed, so they could not outline the causes of the fatigue.

Strength and limitation

Therefore, the limitation of this study was the lack of other variables to study because it only examined one factor while there were many factors related to work fatigue. It is recommended for future research to examine other factors that have not been studied, such as organizational factors, physical factors, and psychological factors.

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The results of this study showed that there is no correlation between the physical workload variable work fatigue. It is due to the fact that there are probably different variables that induced the drivers' fatigue to be minimum. Another possibility of it is that there are different variables that now have been no longer analyzed. Therefore, the causes of the fatigue cannot be outlined. Variables that may have an effect but had not been researched in this study were individual characteristics, working hours, and work motivation. Companies and tank car drivers are advised to carry out work fatigue management by meeting the needs of drinking water, exercising lightly, and fulfilling nutritional intake.

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Conflict of interest

Tasya Endah Milinia and Dani Nasirul Haqi declare no conflicts of interest. Siti Arum Alia is an employee in PT Pertamina Patra Niaga Regional Jatimbalinus.

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Author Contribution

TEM wrote the manuscript with a support from DNH. SAA conceived the original idea.

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