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## ORIGINAL

# OCCUPATIONAL AND NON-OCCUPATIONAL FACTORS RELATED TO FATIGUE AMONG LIGHT VEHICLE DRIVERS AT PT CIPTA KRIDATAMA, SOUTH KALIMANTAN

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## ABSTRACT

Fatigue is a major occupational health issue that reduces performance, concentration, and safety, especially among mining drivers exposed to long hours, irregular schedules, and high demands. This study analyzed the effects of work stress, working hours, rest duration, and sleep quality on fatigue among Light Vehicle (LV) drivers at PT Cipta Kridatama, BIB Site, South Kalimantan. An analytical observational design with a cross-sectional approach was applied, involving 76 LV drivers selected through proportional total sampling. Data were collected using questionnaires and analyzed with chi-square tests and logistic regression. Results showed that work stress ( $p=0.000$ ), working hours ( $p=0.046$ ), rest duration ( $p=0.009$ ), and sleep quality ( $p=0.037$ ) were significantly associated with fatigue, while work shift was not ( $p=0.393$ ). Logistic regression identified work stress as the strongest predictor ( $p=0.013$ ; OR=8.80), indicating that highly stressed drivers were nearly nine times more likely to experience fatigue. Rest duration also had a protective effect ( $p=0.019$ ; OR=0.117). Although not statistically significant, longer working hours and poor sleep quality showed a tendency to increase fatigue risk. In conclusion, occupational fatigue among LV drivers is mainly influenced by stress and insufficient rest, highlighting the need for stress management, adequate breaks,

and better sleep quality.

**KEYWORDS** Occupational Fatigue, Work Stress, Sleep Quality, Light Vehicle Driver

## 1. INTRODUCTION

Health is a critical determinant of workforce quality and productivity. Optimal health enables workers to meet high productivity demands, while poor health such as fatigue can significantly reduce performance and increase the risk of errors or injury. To maintain a healthy and productive workforce, regular health screenings and preventive measures are essential (Suma'mur, 2013). According to the International Labour Organization in 2018, approximately two million workers die annually from work-related accidents linked to fatigue. Among 58,115 samples, 32.8% (18,828) experienced fatigue (Organization, 2018). In Indonesia, occupational accidents have shown a consistent annual increase. In 2019, there were 210,789 cases, rising to 221,740 in 2020 and 234,370 in 2021 an annual increase of approximately 5–6% (Kementerian Ketenagakerjaan, 2022). Data from the Social Security Agency for Employment reported 234,270 cases in 2021, including 93 mining accidents, 11 of which were fatal. In 2018, 147,000 occupational accidents were recorded, with 4,678 cases leading to disability and 2,575 resulting in death. On average, 12 workers become disabled and 7 workers die each day due to workplace accidents. One significant contributing factor to this high accident rate is fatigue, which can reduce alertness and substantially increase the risk of incidents (Ketenagakerjaan, 2021). The mining industry is among the sectors with the highest risk of occupational accidents (Rofi'i & Tejamaya, 2022). Despite technological advancements improving efficiency and productivity, workers still face potential hazards that may threaten their safety and health (Lestari et al., 2023). Mining, while economically important, poses hazards such as fatigue from irregular schedules, which increases human error, a major cause of accidents. KNKT data show human factors dominate traffic accidents. At PTFI, there have been about 330 light vehicle incidents annually over the past decade, with 345 in 2023, mostly from speeding, aggressive driving, and fatigue. Managing fatigue and promoting safe driving are vital to reduce these risks (Widijanto et al., 2024). Driver fatigue is a significant risk factor in transportation accidents, leading to reduced concentration, drowsiness, slower reaction times, eye strain, boredom, inattention, microsleep, and loss of focus (Birana et al., 2019). Aggressive driving behaviors, such as continuous braking after high-speed driving, can overheat brakes and cause tire deflation or brake failure. Time pressures to meet delivery deadlines often push truck drivers to exceed speed limits and engage in risky maneuvers, such as frequent overtaking. Fatigue remains one of the primary causes of truck-related accidents, making fatigue management and adherence to safe driving practices essential for accident prevention (Selvia & Erlina, 2022). South Kalimantan, in southeastern

Borneo, has varied terrains from lowlands and coasts to the Meratus Mountains where mining faces extreme road and weather conditions. Shifts between highland and lowland sites, combined with unsafe driving, significantly increase the risk of light vehicle accidents (Widijanto et al., 2024). To reduce risks, companies use technologies such as the Driving Monitoring System (DMS) to track driver behavior and prevent unsafe actions (Djunaidi, 2022). However, driver fatigue remains a major cause of accidents, leading to reduced focus, slower reactions, and risky driving such as speeding or aggressive overtaking (Birana et al., 2019). Light Vehicle (LV) drivers in mining are especially vulnerable, making fatigue risk assessment essential for prevention (APSIL et al., 2023). This study analyzes the relationship between work and non-work factors and work-related fatigue among LV drivers at PT Cipta Kridatama, BIB Site, South Kalimantan, in 2025.

## 2. Methods

This study employed an analytical observational design with a cross-sectional approach to examine the relationship between work and non-work factors and work-related fatigue among LV drivers at PT Cipta Kridatama, BIB Jobsite, Angsana, South Kalimantan. In a cross-sectional study, data on risk factors and outcomes are collected simultaneously at a single point in time. The research was conducted at PT Cipta Kridatama, BIB Jobsite, Angsana, South Kalimantan, from January to February 2025. The study population comprised all 76 registered LV drivers at the site. The sample included all members of this population, selected using proportional total sampling. This study was approved by the Health Research Ethics Committee of Hasanuddin University, Indonesia (No. 3617/UN4.14.1/TP.01.02/2024) with protocol number 161224062391. The study protocol, titled “Work Fatigue Management Study on Light Vehicle (LV) Drivers at PT Cipta Kridatama, BIB Site, South Kalimantan”, was reviewed under the expedited category and granted approval on 23 December 2024, valid until 23 December 2025. All participants were informed about the purpose, procedures, potential risks, and benefits of the study, and provided written informed consent prior to participation.

## 3. Result

**Table 1: (a)** Distribution of Respondent Characteristics by Work Tenure, Age, and Education Level among Light Vehicle Drivers at PT Cipta Kridatama, BIB Site

CHARACTERISTIC	SAMPLE SIZE	
	f	%
<b>AGE</b>		
<b>17-25</b>	8	10,5
<b>26-35</b>	36	47,7
<b>36-45</b>	29	38,2
<b>46-55</b>	3	3,9

**Table 1: (b)** Distribution of Respondent Characteristics by Work Tenure, Age, and Education Level among Light Vehicle Drivers at PT Cipta Kridatama, BIB Site

<b>WORK TENURE</b>		
<b>&lt;1 YEAR</b>	9	11,8
<b>1 YEAR</b>	29	38,2
<b>2 YEARS</b>	17	22,4
<b>3 YEARS</b>	12	15,8
<b>4 YEARS</b>	1	1,3
<b>&gt;5 YEARS</b>	8	10,6
<b>EDUCATION LEVEL</b>		
<b>MASTER'S DEGREE</b>	1	1,3
<b>BACHELOR'S DEGREE</b>	28	36,8
<b>SENIOR HIGH SCHOOL</b>	46	60,5
<b>JUNIOR HIGH SCHOOL</b>	1	1,3

As shown in Table 1., the majority of the 76 respondents were in the 26–35 years age group (47.7%), followed by those aged 36–45 years (38.2%). Smaller proportions were observed among respondents aged 17–25 years (10.5%) and 46–55 years (3.9%). In terms of work tenure, most respondents had been employed for one year (38.2%), with smaller proportions having worked for two years (22.4%), three years (15.8%), and less than one year (11.8%). Only 10.6% had more than five years of service, and the smallest group, comprising 1.3% of respondents, had four years of tenure. Regarding education level, the majority had completed senior high school (60.5%), followed by those holding a bachelor's degree (36.8%). Master's degree holders and junior high school graduates each accounted for only 1.3% of the sample.

**Table 2: (a)** Associations between Work Shift, Daily Working Hours, Break Duration, Sleep Quality, and Occupational Stress and Work Fatigue among Light Vehicle Drivers at PT Cipta Kridatama, BIB Site

WORK SHIFT	OCCUPATIONAL FATIGUE						TOTAL		STATISTICAL TEST RESULT
	Severe		Moderate		Mild				
	n	%	n	%	n	%	n	%	
MORNING	8	14,3	44	78,6	4	7,1	56	100	p=0,393
NIGHT	2	10,0	18	90,0	0	0	20	100	
WORKING HOURS									
NORMAL	8	21,6	26	70,3	3	8,1	37	100	p=0,046
ABNORMAL	2	5,1	39	92,3	1	2,6	39	100	
BREAK DURATION									
NORMAL	2	8,3	18	75,0	4	16,7	24	100	p=0,009
ABNORMAL	8	15,4	44	84,6	0	0	52	100	

**Table 2: (b)** Associations between Work Shift, Daily Working Hours, Break Duration, Sleep Quality, and Occupational Stress and Work Fatigue among Light Vehicle Drivers at PT Cipta Kridatama, BIB Site

<b>SLEEP QUALITY</b>									
<b>GOOD</b>	4	7,4	46	85,2	4	7,4	54	100	$p=0,037$
<b>POOR</b>	6	27,3	16	72,7	0	0	22	100	
<b>WORK STRESS</b>									
<b>SEVERE</b>	2	72,2	25	92,6	0	0	27	100	$p=0,000$
<b>MODERATE</b>	2	4,3	37	80,4	7	15,2	46	100	
<b>MILD</b>	0	0	0	0	3	100	3	100	

Table 2 presents the associations between work shift, daily working hours, break duration, sleep quality, and occupational stress with occupational fatigue among 76 Light Vehicle drivers at PT Cipta Kridatama, BIB Site. Analysis of work shift indicated that among morning shift workers, 8 respondents (14.3%) experienced mild fatigue, 44 respondents (78.6%) experienced moderate fatigue, and 4 respondents (7.1%) experienced severe fatigue. In the night shift category, 2 respondents (10.0%) experienced mild fatigue and 18 respondents (90.0%) moderate fatigue, with no cases of severe fatigue. The chi-square test yielded  $p=0.393$ , indicating no significant association between work shift and occupational fatigue. Daily working hours showed a significant association with fatigue ( $p=0.046$ ). In the normal working hours group, 8 respondents (21.6%) experienced mild fatigue, 26 (70.3%) moderate fatigue, and 3 (8.1%) severe fatigue. In contrast, among those with abnormal working hours, only 2 respondents (5.1%) experienced mild fatigue, while the majority, 39 respondents (92.3%), reported moderate fatigue, and 1 respondent (2.6%) reported severe fatigue. Break duration was also significantly associated with fatigue ( $p=0.009$ ). Among drivers with normal break duration, 2 respondents (8.3%) experienced mild fatigue, 18 (75.0%) moderate fatigue, and 4 (16.7%) severe fatigue. In contrast, drivers with abnormal break duration showed higher fatigue levels, with 8 respondents (15.4%) experiencing mild fatigue, 44 (84.6%) moderate fatigue, and none experiencing severe fatigue. Sleep quality had a significant association with fatigue ( $p=0.037$ ). Respondents with good sleep quality reported 4 cases (7.4%) of mild fatigue, 46 (85.2%) moderate fatigue, and 4 (7.4%) severe fatigue. Those with poor sleep quality had 6 cases (27.3%) of mild fatigue and 16 (72.7%) moderate fatigue, with no severe cases reported. Occupational stress demonstrated the strongest association with fatigue ( $p=0.000$ ). In the severe stress category, 2 respondents (7.2%) experienced mild fatigue, 25 (92.6%) moderate fatigue, and none experienced severe fatigue. Moderate stress was associated with 7 cases (15.2%) of mild fatigue, 37 (80.4%) moderate fatigue, and 2 (4.3%) severe fatigue. Mild stress was only present in mild fatigue cases, with 3 respondents (100%) in this category.

**Table 3:** Associations between Work Shift, Daily Working Hours, Break Duration, Sleep Quality, and Occupational Stress and Work Fatigue among Light Vehicle Drivers at PT Cipta Kridatama, BIB Site

VARIABLE IN THE EQUATION					
VARIABLE	Estimate	S.E.	Wald	Sig.	Exp(B)
WORK STRESS	2.175	.878	6.138	.013	8.80
BREAK DURATION	-2.146	.913	5.522	.019	.117
WORKING HOURS	1.016	.704	2.082	.149	2.76
SLEEP QUALITY	-1.505	.799	3.548	.060	.222

As shown in Table 3, occupational stress, break duration, daily working hours, and sleep quality were included in the logistic regression model to assess their influence on work fatigue among Light Vehicle drivers at PT Cipta Kridatama, BIB Site. The results indicate that work stress was a significant predictor of fatigue ( $p=0.013$ ;  $\text{Exp}(B)=8.80$ ), meaning that drivers with higher stress levels were almost nine times more likely to experience fatigue compared to those with lower stress levels. Break duration also showed a significant effect ( $p=0.019$ ;  $\text{Exp}(B)=0.117$ ), suggesting that inadequate rest periods increased the likelihood of fatigue. Meanwhile, daily working hours ( $p=0.149$ ;  $\text{Exp}(B)=2.76$ ) and sleep quality ( $p=0.060$ ;  $\text{Exp}(B)=0.222$ ) were not statistically significant but still demonstrated important tendencies. Longer working hours were associated with more than double the risk of fatigue, while poor sleep quality showed a potential relationship with higher fatigue levels. Overall, the regression model emphasizes occupational stress and insufficient rest as the most influential risk factors for work fatigue in this population.

## 4. Discussion

### 4.1 Working Hours and Occupational Fatigue

Working hours play a crucial role in determining an employee's efficiency, health, and overall productivity. Ideally, individuals are able to work optimally for 6–10 hours per day, while the remaining time is required for rest, family, and social activities. Prolonged working hours beyond this limit do not improve productivity but instead increase the risk of fatigue, health disorders, accidents, and job dissatisfaction (Suma'mur, 2014). In this study, the majority of respondents experiencing moderate fatigue were drivers with abnormal working hours. This finding aligns with previous research, which also demonstrated a significant relationship between extended working hours and work fatigue among public transport drivers in Kendari, Indonesia. The study revealed that 79.5% of drivers with abnormal working hours experienced fatigue, compared to only 20.5% of those with normal schedules. Both studies highlight that extended work duration reduces mental concentration and increases the risk of physical and mental fatigue (Majid et al., 2023). Extended working hours disrupt the body's circadian rhythm, leading to reduced alertness and the



accumulation of lactic acid, which contributes to fatigue. Consequently, ensuring adequate rest periods and limiting daily working hours to within recommended limits is essential to maintain productivity and minimize occupational risks (Suma'mur, 2014).

#### **4.2 Break Duration and Occupational Fatigue**

The results of this study demonstrate a significant relationship between rest duration and occupational fatigue among Light Vehicle drivers at PT Cipta Kridatama, BIB Site ( $p=0.009$ ). Workers with inadequate or irregular rest periods were more likely to experience moderate fatigue compared to those with sufficient rest. Rest breaks shorter than 30 minutes have been shown to increase the risk of both muscular and general fatigue, as continuous work without adequate recovery reduces physical endurance, concentration, and overall performance, while increasing the risk of workplace accidents (Zulhadi & Daniati, 2022). Similar findings were reported among lumpia skin workers in Semarang, where insufficient rest duration was significantly related to hand muscle fatigue ( $p=0.021$ ) (Zaidah et al., 2024). These results reinforce the importance of structured and adequate rest periods in preventing cumulative fatigue. Work schedules exceeding 8 hours with limited rest duration not only reduce productivity but also affect sleep quality, thereby compounding fatigue over time (Suma'mur, 2014). Adequate rest duration of 30–60 minutes after four hours of continuous work is recommended to maintain performance and prevent excessive fatigue (Law, 2003). Therefore, effective management of work and rest schedules, supported by adequate workplace facilities, is essential for minimizing fatigue risk among drivers.

#### **4.3 Sleep Quality and Occupational Fatigue**

Poor sleep quality can increase the likelihood of occupational fatigue. Workers with reduced sleep quality tend to feel tired more quickly, become drowsy during tasks, and experience decreased concentration and performance. Those working night shifts or with irregular schedules are at greater risk of sleep disturbances, which contribute to increased fatigue and workplace accidents. Continuous sleep duration of less than seven hours per day is also associated with higher fatigue levels and reduced productivity (Allo & Yanti, 2022). This study demonstrated that sleep quality was significantly associated with occupational fatigue among Light Vehicle drivers at PT Cipta Kridatama, BIB Site ( $p=0.037$ ). Drivers with poor sleep quality were more likely to experience moderate levels of fatigue compared to those with good sleep quality. These findings are consistent with previous research reporting a significant relationship between poor sleep and fatigue among nurses, whereas energy intake did not show a significant association with fatigue (Munawarah & Mutthalib, 2024). Other studies have also confirmed that poor sleep quality increases fatigue and reduces concentration, leading to decreased job

performance (Hernayanti et al., 2022). Furthermore, poor sleep is not only linked to fatigue but also to broader health problems such as reduced immunity, mood disorders, and increased accident risks in the workplace (Winata et al., 2022). Sleep plays a crucial role in maintaining both physical and mental health, as it provides an opportunity for recovery, reduces stress and anxiety, and improves daily focus.

#### **4.4 Work Stress and Occupational Fatigue**

Occupational stress is recognized as one of the dominant contributors to fatigue among workers. Stressful work environments can trigger emotional responses, physiological changes, and ultimately accelerate the onset of occupational fatigue. A significant association between occupational stress and fatigue was observed in this study, indicating that higher levels of stress increased the likelihood of fatigue among Light Vehicle drivers at PT Cipta Kridatama, BIB Site. This finding is consistent with the view that psychosocial hazards, including workplace stress, remain a critical factor influencing fatigue across various occupational sectors, particularly those involving high work demands and irregular schedules (Tarwaka, 2014). Physiologically, stress may elevate cortisol levels, disrupt the nervous and musculoskeletal systems, and reduce concentration, thereby intensifying fatigue (Allo & Yanti, 2022). Such conditions not only impair performance but also increase the risk of accidents and long-term health problems. Similar findings have been reported in palm oil industry workers, where stress was significantly correlated with fatigue, suggesting that inadequate stress management contributes to both psychological and physical exhaustion (Oktariani et al., 2022). Effective management strategies, such as promoting adequate rest, optimizing sleep quality, and creating supportive work environments, are essential to mitigate stress-induced fatigue. Interventions that address mental health and recovery time not only reduce occupational fatigue but also enhance productivity, engagement, and overall worker retention (Munawarah & Mutthalib, 2024).

#### **4.5 The Effect of Work Stress, Break Duration, Working Hours, and Sleep Quality on Occupational Fatigue**

This study investigated the effects of work stress, rest duration, working hours, and sleep quality on occupational fatigue among Light Vehicle drivers at PT Cipta Kridatama, BIB Site. The analysis showed that work stress had the strongest association with fatigue, where drivers experiencing higher stress levels were substantially more likely to report fatigue compared to those with lower stress. Rest duration also demonstrated a significant relationship, indicating that insufficient or irregular rest periods increased the likelihood of fatigue. Although working hours and sleep quality did not reach statistical significance, both exhibited meaningful trends. Longer daily working hours were associated with a higher probability of fatigue, while poor sleep quality also



contributed to increased vulnerability to exhaustion. These findings align with previous studies that emphasized the multifactorial nature of occupational fatigue, where stress and recovery patterns are critical determinants. Overall, the results highlight that occupational stress and inadequate rest are the most influential factors in driving fatigue among vehicle operators in demanding work environments. This underscores the need for organizational interventions focusing on stress management, structured rest schedules, and strategies to improve sleep quality in order to reduce fatigue-related risks.

## 5. Conclusions

This study examined the relationship between occupational and non-occupational factors with work fatigue among Light Vehicle drivers at PT Cipta Kridatama, BIB Site, South Kalimantan. The findings demonstrate that occupational factors, particularly working hours and rest duration, were significantly associated with fatigue, whereas shift work did not show a meaningful effect. In addition, non-occupational factors such as work stress and sleep quality were also found to be significantly related to fatigue, with work stress emerging as the most influential determinant. These results suggest that both job-related demands and individual recovery capacity play critical roles in the development of fatigue among drivers, with stress management being a key factor in mitigating risks.

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