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Factors Associated With Work Fatigue Among Tank Truck Crew at Fuel Terminal Biak

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ABSTRACT

Background & Objective: Work-related fatigue remains a significant concern in occupational health and safety, particularly in roles that demand high levels of physical exertion, such as fuel transportation. This study seeks to compare factors contributing to fatigue among fuel truck operators at Fuel Terminal Biak with findings from two prior investigations: one involving waste collectors in Kendari, and another examining lifting equipment operators at PT Pelindo IV Kendari Branch. The analysis focuses on three primary variables: workload, employment duration (tenure), and working hours or shift patterns. **Method:** All three studies applied a quantitative method with a cross-sectional design and utilized chi-square tests for statistical analysis. **Result:** The findings suggest that workload and job tenure consistently exhibit a significant correlation with fatigue across all occupational groups examined. In contrast, the impact of work hours appears inconsistent, with notable influence from contextual factors such as sleep quality and the implementation of night shifts. **Conclusion:** These results highlight the need for customized work scheduling and comprehensive fatigue management. The study underscores the importance of targeted interventions by employers and policymakers through strategies such as balanced workload distribution, structured rest periods, and ergonomic support. Such efforts are particularly critical in physically demanding and high-risk industries like fuel distribution, where fatigue poses direct threats to safety and operational efficiency.

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Introduction

Work fatigue is a crucial issue in the field of Occupational Health and Safety (OHS) due to its widespread impact on individual productivity, operational safety, and the physical and mental well-being of workers (Hidayat et al., 2021; Tarwaka, 2014). This condition is complex and multidimensional, encompassing physical exhaustion, emotional stress, and mental fatigue resulting from continuous work demands without adequate recovery time (Permatasari & Mulyono, 2020). The issue tends to worsen in work environments that require high physical activity, long working hours, limited rest periods, and lifestyle-related factors such as alcohol consumption.

The World Health Organization (WHO) has identified occupational fatigue as a major factor contributing to the global decline in productivity and has linked it to serious psychological disorders such as prolonged stress and burnout (WHO, 2021). This aligns with the burnout concept proposed by Maslach and Jackson (1981), which describes a state of emotional and physical exhaustion due to prolonged work-related pressure. Furthermore, the International Labour Organization (ILO) reported that approximately 2.78 million workers die annually from occupational diseases and accidents, many of which are triggered by early, undetected fatigue (ILO, 2019; Widiyanti et al., 2020).

One occupational group at high risk of experiencing fatigue is fuel truck drivers, such as those working at the Fuel Terminal Biak. Their responsibilities include safely transporting hazardous and flammable materials while facing demanding working conditions, including long hours, high delivery frequencies (ritase), and insufficient rest time. When compounded by unhealthy lifestyle habits, such as alcohol consumption, the risk of fatigue increases significantly (Suma'mur, 2009).

Objective

To gain a broader understanding of this issue, the present study compares work-related fatigue levels among three groups of physically demanding workers in different sectors: fuel truck drivers, waste collectors in Kendari, and lifting equipment operators at PT Pelindo IV Kendari Branch. Waste collectors typically begin their work early in the morning, manually handle large volumes of waste, and often operate without optimal OHS support. This study aims to analyze the level of work fatigue among fuel truck drivers at Fuel Terminal Biak by focusing on six main variables suspected to contribute to fatigue: age, working hours, length of employment, workload (daily delivery frequency), rest or sleep patterns, and alcohol consumption.

Each variable is believed to contribute differently to the level of fatigue. Age influences physical capacity and work endurance. Long working hours tend to increase physical burden and reduce recovery time. Long durations of employment without task variation may cause cumulative fatigue. High workload—such as more than four deliveries per day—adds significant physical strain. Lack of adequate sleep (<8 hours per day) can impair cognitive function and concentration. Meanwhile, alcohol consumption can deteriorate physiological health and accelerate fatigue, especially over the long term.

By investigating the relationship between these variables and work fatigue levels, this study aims to provide a deeper understanding of the dominant factors contributing to fatigue. The findings are expected to inform the development of more

effective OHS policies, particularly for high-risk and physically demanding occupations such as fuel transport.

Method

This study is a comparative analysis that examines three previous studies using an analytical observational approach with a cross-sectional design. This design was chosen because all studies aimed to evaluate the relationship between several independent variables and work-related fatigue within a specific time frame, without any intervention or treatment applied to the research subjects (Notoadmodjo, 2012; Sudijono, 2011).

The primary study was conducted on fuel tank truck workers at Fuel Terminal Biak, involving 44 respondents. The entire population that met the inclusion criteria was included through a total sampling method. The data collection instrument used was a questionnaire developed by the Industrial Fatigue Research Committee (IFRC), which has been validated to measure work fatigue based on three main aspects: physical, psychological, and behavioral. The assessments were conducted subjectively by each respondent.

All three studies analyzed the data using chi-square (χ^2) statistical tests, aimed at identifying the relationships between independent variables (age, working hours, length of employment, workload, rest/sleep patterns, and alcohol consumption) and the dependent variable of work-related fatigue levels. The chi-square test was selected as it is suitable for categorical data and effective for determining whether significant associations exist between groups during a single observation period. The results were presented in the form of frequency distributions, cross-tabulations, and significance values (p-values) as the basis for drawing conclusions.

The similarities in study design, sampling techniques, and analytical methods allow for this comparative study to be conducted in a valid and reliable manner. By comparing these three studies, which involve different types of physical work yet exhibit similar risks of fatigue, this study aims to gain a deeper understanding of the patterns and relationships between key variables and work-related fatigue.

Results and Discussion

Table 1. Distribution of Respondents by Age

No	Age (Years)	Frequency (n)	Percentage (%)
1	> 45 years	6	13.6
2	30 – 45 years	18	40.9
3	< 30 years	20	45.5
	Total	**44**	**100**

Source: Primary Data, 2025

Table 1 shows that the majority of the 44 respondents were under 30 years old (45.5%), while only 13.6% were over 45 years. Although age can affect physical endurance, this study did not find a direct correlation between age and fatigue levels, suggesting that fatigue is more influenced by other occupational factors(Dina et al., 2024).

Working Hours and Shift System

Table 2. Distribution of Respondents by Daily Working Hours

No	Working Hours (per Day)	Frequency (n)	Percentage (%)
1	> 8 hours	32	72.7
2	≤ 8 hours	12	27.3
	Total	**44**	**100**

Source: Primary Data, 2025

Most respondents (72.7%) worked more than 8 hours per day. However, no significant correlation was found between daily working hours and fatigue in this study. This is consistent with Pasenggong et al. (2024), although most of their respondents worked 6–9 hours daily. This may reflect physical adaptation to routine or the dominant influence of other variables such as workload and work duration (Kurniawan & Rizki, 2022).

In contrast, Widiyanti et al. (2020) reported significant findings: night shift workers experienced higher fatigue levels than morning shift workers ($p = 0.009$). This is due to circadian rhythm disruption, where working at night contradicts the body's natural biological cycle, impairing sleep quality and energy recovery.

Additionally, poor sleep quality also significantly correlated with fatigue ($p = 0.011$). Workers with poor sleep reported higher fatigue levels regardless of working hours, indicating that rest quality is more crucial than work duration alone.

Table 3. Comparison of the Impact of Working Hours/Shift on Fatigue

No	Author & Year	Population	Sample Size	Variable Examined	Fatigue Outcome & Significance
1	Rahmi Apriani (2025)	Fuel Truck Drivers – Fuel Terminal Biak	44	Daily work duration	Not significant
2	Pasenggong et al. (2024)	Waste Collectors – Kendari City	211	Working hours (6–9 hrs)	Not significant
3	Widiyanti et al. (2020)	Heavy Equipment Operators – PT Pelindo IV	35	Shift & sleep quality	Shift $p = 0.009$; sleep $p = 0.011$

Years of Service

Table 4. Distribution of Respondents by Years of Service

No	Years of Service	Frequency (n)	Percentage (%)
1	< 1 year	20	45.5
2	> 1 year	24	54.5
	Total	**44**	**100**

Source: Primary Data, 2025

More than half of the respondents had worked for more than a year. Workers with ≥4 years of experience tended to show higher fatigue levels, supporting the cumulative fatigue theory (Grandjean, 1988). Routine tasks such as long-distance driving, supervising fuel unloading, and handling hazardous materials daily contribute to chronic physical and psychological stress.

Similar results were reported by Pasenggong et al. (2024), where workers with ≥4 years of experience had significantly higher fatigue levels ($p = 0.000$). Monotonous

and physically demanding work, combined with harsh environmental conditions (heat, odors, and heavy loads), led to mental fatigue and job burnout.

However, Widiyanti et al. (2020) found no significant relationship between work duration and fatigue (p = 0.807). This might be due to a more structured work system with shift rotation, technological support, and balanced work-rest schedules. Confounding variables such as age could also influence results; in their study, some new workers were older than long-serving ones, indicating that physical capacity and age may matter more than duration alone.

Table 5. Comparison of Work Duration's Impact on Fatigue in Three Studies

No	Author & Year	Population	Sample Size	Work Duration Range	Fatigue Outcome & Significance
1	Rahmi Apriani (2025)	Fuel Truck Drivers – Fuel Terminal Biak	44	< 4 years vs ≥ 4 years	Significant: ≥ 4 years → fatigue
2	Pasenggong et al. (2024)	Waste Collectors – Kendari City	211	< 4 years vs ≥ 4 years	Significant (p = 0.000)
3	Widiyanti et al. (2020)	Heavy Equipment Operators – PT Pelindo IV	35	New vs Long-term	Not significant (p = 0.807)

Workload

Workload is one of the most influential factors in occupational fatigue, especially in physically demanding jobs that require repeated muscular activity and intense physical movement. Generally, workload encompasses all job demands within a specific timeframe and condition, including physical (lifting, pushing, pulling), mental (high concentration, quick decisions), and emotional (responsibility pressure, psychological stress) tasks (Hidayat et al., 2021; Tarwaka, 2014).

Table 6. Distribution of Respondents by Workload (Fuel Trips per Day)

No	Fuel Trips per Day	Frequency (n)	Percentage (%)
1	> 4 trips	32	72.7
2	≤ 4 trips	12	27.3
	Total	**44**	**100**

Source: Primary Data, 2025

Workload was found to have a statistically significant relationship with fatigue. Tasks like fuel delivery require high concentration and responsibility due to flammable materials and are often conducted under challenging conditions.

Similar findings were reported by Pasenggong et al. (2024), where high workload was significantly associated with fatigue increase (p = 0.000). Their job involved intense manual labor, such as lifting and transferring waste without mechanical support. When the workforce is inadequate relative to the workload, fatigue accelerates.

On the other hand, Widiyanti et al. (2020) did not directly assess workload, but its indicators were inferred through shift system and sleep quality. Heavy equipment operators worked in shifts with extended hours and repetitive machine operation, causing physical and mental fatigue and resulting in poor sleep. About 51.4% of respondents reported poor sleep, significantly correlated with fatigue (p = 0.011).

Table 7. Comparison of Workload Impact on Fatigue in Three Studies

No	Author & Year	Population	Sample Size	Workload Variable	Fatigue Outcome & Significance
1	Rahmi Apriani (2025)	Fuel Truck Drivers – Fuel Terminal Biak	44	Measured (subjective)	Significant ($p < 0.05$)
2	Pasenggong et al. (2024)	Waste Collectors – Kendari City	211	Directly measured	Significant ($p = 0.000$)
3	Widiyanti et al. (2020)	Heavy Equipment Operators – PT Pelindo IV	35	Indirect indicator	Indirect ($p = 0.011$ – sleep)

Rest/Sleep Time

Table 8. Distribution of Respondents by Daily Sleep Hours

No	Sleep Hours (per Day)	Frequency (n)	Percentage (%)
1	< 8 hours	8	18.2
2	≥ 8 hours	36	81.8
	Total	**44**	**100**

Source: Primary Data, 2025

Although most respondents slept ≥8 hours per day, sleep quality remains a critical factor in preventing fatigue. Widiyanti et al. (2020) found a significant correlation between poor sleep quality and fatigue ($p = 0.011$).

Alcohol Consumption

None of the respondents consumed alcohol, so this variable could not be further analyzed. However, according to Tarwaka (2014), alcohol consumption can worsen sleep quality and increase the risk of fatigue.

Discussion

The study results indicate that workload and years of service are the primary factors significantly influencing work fatigue. These findings are consistent with previous studies such as Pasenggong et al. (2024).

Working hours alone did not show a strong relationship with fatigue. However, shift systems—particularly night shifts—had a noticeable impact. Widiyanti et al. (2020) confirmed that night shift workers experienced higher fatigue levels ($p = 0.009$), and poor sleep quality was also a contributing factor ($p = 0.011$).

Age and alcohol did not appear to influence fatigue in this study. In contrast, sleep quality and work schedules misaligned with the body's biological rhythm emerged as key contributors to chronic fatigue (Moore-Ede et al., 1982).

Table 9. Comparison of Findings in Three Studies on Fatigue Factors

No	Author & Year	Population	Dominant Variables	Findings & Significance
1	Rahmi Apriani (2025)	Fuel Truck Drivers – Fuel Terminal Biak	Workload, years of service	Significant ($p < 0.05$)
2	Pasenggong et al. (2024)	Sanitation Workers – Kendari	Workload, years of service	Highly significant ($p = 0.000$)
3	Widiyanti et al. (2020)	Heavy Equipment Operators – PT Pelindo IV	Shift, sleep quality	Significant ($p = 0.009$ and $p = 0.011$)

Conclusion

This study concludes that work fatigue among fuel truck drivers is influenced by high workloads, long years of service, and poor sleep quality. Night shift schedules further exacerbate fatigue, even when daily working hours are not excessive.

To prevent chronic fatigue, organizations should manage workloads proportionally, provide adequate rest schedules, and implement adaptive training through Occupational Health and Safety (OHS) programs. In addition, work systems must align with workers' biological rhythms to maintain sleep quality and overall fitness Lerman et al. (2012).

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