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Original Article

Individual Characteristics, Workload, Shift Work, and Work Fatigue among Stevedores at Ahmad Yani Port Ternate

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ABSTRACT
Background: Work fatigue is an important occupational health and safety issue in port activities because stevedoring involves manual material handling, irregular schedules, and sustained physical effort. This study aimed to identify factors associated with work fatigue among local stevedores at Ahmad Yani Port, Ternate.
Methods: This analytic observational study used a cross-sectional design. The population comprised all 110 local stevedores at Ahmad Yani Port, and all were included using total sampling. Work fatigue was measured using a structured questionnaire based on the Industrial Fatigue Research Committee (IFRC) instrument. The dependent variable was work fatigue; the independent variables were age, length of employment, nutritional status, physical workload, and work shift. Data were analyzed using IBM SPSS version 27. Univariate analysis described frequency distributions, and bivariate analysis used the chi-square test or Fisher's exact test when assumptions were unmet, with a significance level of 0.05.
Results: Most respondents were older (70.0%), had long employment duration (84.5%), had normal nutritional status (95.5%), had a light physical workload (57.3%), and experienced work fatigue (79.1%). Age (p = 0.004) and shift work (p = 0.004) were significantly associated with work fatigue, which was more frequent among older and night-shift workers. Length of employment (p = 0.972), nutritional status (p = 0.280), and physical workload (p = 0.529) were not significant.
Conclusion: Age and shift work were the main factors associated with work fatigue. Prevention should prioritize age-sensitive job allocation, safer shift rotation, limiting consecutive night shifts, adequate rest, periodic health monitoring, and education.

INTRODUCTION

Occupational safety and health are fundamental components of decent work because unsafe working conditions can reduce productivity, increase injury risk, and create wider economic and social losses. In Indonesia, the burden of occupational accidents remains high. The Ministry of Manpower recorded 370,747 occupational accident cases in 2023 and 462,241 cases in 2024, indicating the need for stronger prevention strategies across high-risk sectors, including transportation, logistics, and port operations (Kementerian Ketenagakerjaan Republik Indonesia, 2024, 2025). At the global level, the World Health Organization and the International Labor Organization estimated that almost 1.9 million deaths in 2016 were attributable to work-related diseases and injuries, with long working hours being one of the largest contributors to the occupational burden of disease (World Health Organization & International Labour Organization, 2021).

Work fatigue is a decline in physical or mental capacity that reduces alertness, endurance, reaction time, and work efficiency. Fatigue is not merely a temporary feeling of tiredness; it can increase unsafe behavior, reduce concentration, and contribute to accidents, especially in jobs requiring continuous attention and physical strength (Cunningham et al., 2022; Moreira & de Lucca, 2025). Current evidence emphasizes that nonstandard schedules, long work hours, and inadequate recovery are important hazards for worker fatigue and require organizational-level control. Epidemiological evidence also links excessive working hours with cardiovascular outcomes, including ischemic heart disease and stroke (Descatha et al., 2020; Li et al., 2020; Pega et al., 2021).

Port stevedores are exposed to multiple fatigue-related demands. Their tasks include lifting, carrying, holding, and moving goods during stevedoring, cargodoring, receiving, and delivery activities. These tasks combine manual material handling with time pressure, environmental exposure, noise, heat, and shift-based operations. In port areas, this burden may be compounded by exposure to vessel exhaust, cargo dust, diesel-powered cargo-handling equipment, and heavy-vehicle emissions, which can contribute to particulate matter exposure, including PM2.5 and PM10 (International Maritime Organization & International Association of Ports and Harbors, 2018; Mueller et al., 2011). Recent Indonesian evidence among stevedoring workers at Tanjung Priok also highlights PM2.5 as a relevant occupational and environmental health concern in port settings (Irfandi et al., 2025). Although air pollutants were not measured in the present study, this environmental context strengthens the rationale for examining fatigue among stevedores because respiratory and cardiovascular strain may increase the physiological burden of physically demanding port work.

Shift work is especially relevant in port settings because operational activities may run beyond standard daytime hours. Shift work can disturb circadian rhythm, shorten sleep, reduce recovery time, and increase physical and mental fatigue (Khosravipour et al., 2021; Mohd Azmi et al., 2020; Moreira & de Lucca, 2025; Sweileh, 2022). Indonesian studies have also shown that shift work is associated with fatigue in several work settings, including industrial, hospital, and transportation workers (Jannah & Tualeka, 2022; Labaran et al., 2024; Maulani et al., 2020; Mustain et al., 2022). However, evidence specific to local stevedores in eastern Indonesia remains limited.

Ahmad Yani Port in Ternate is an important logistics node in North Maluku. Local stevedores play a critical role in maintaining the flow of goods in an open port environment, where loading and unloading activities occur near vessels, cargo piles, trucks, and warehouses under variable outdoor conditions. This combination distinguishes port stevedoring from many indoor industrial jobs because workers may experience simultaneous ergonomic, scheduling, and environmental exposures. Understanding the factors associated with fatigue in this workforce is important for designing practical occupational health interventions. Therefore, this study aimed to analyze the association between individual characteristics, physical workload, shift work, and work fatigue among local stevedores at Ahmad Yani Port, Ternate.

METHODS

This study used an analytic, observational, cross-sectional design. The design was selected because the study aimed to assess the association between independent variables and work fatigue at a single point in time. The study was conducted among local stevedores at Ahmad Yani Port, Ternate, North Maluku, Indonesia. The month and year of data collection should be inserted by the authors before final submission because this information was not available in the reviewed manuscript file.

The population consisted of all 110 local stevedores working at Ahmad Yani Port. The study used total sampling, meaning that all members of the population were included as respondents. The dependent variable was work fatigue. The independent variables were age, length of employment, nutritional status (body mass index category), physical workload, and work shift. Age was categorized as younger (≤35 years) and older (>35 years), while length of employment was categorized as new (≤5 years) and long (>5 years). These cut-off points were determined before analysis to distinguish workers with lower and higher cumulative occupational exposure.

Nutritional status was categorized as normal or abnormal based on body mass index. Physical workload was categorized as light or heavy according to the questionnaire scoring guide, and work shift was categorized as morning, evening, or night.

Data were collected using a structured questionnaire on respondent characteristics, physical workload, and work fatigue. Work fatigue was assessed using an IFRC-based questionnaire consisting of subjective fatigue symptoms related to reduced activity, reduced motivation/concentration, and physical complaints. The Indonesian version of the IFRC/JIFRC fatigue questionnaire has been reported to have satisfactory psychometric properties for assessing occupational fatigue, and validity is commonly evaluated through item-total correlation, while reliability is evaluated using Cronbach's alpha (Ramdan, 2019). The physical-workload questionnaire was reviewed for content and face validity before use, and internal consistency was evaluated using Cronbach's alpha; values of 0.70 or higher were considered acceptable. Data processing included editing, coding, data entry, and tabulation. Data analysis was performed using IBM SPSS version 27. Univariate analysis was used to describe the distribution of each variable as frequencies and percentages. Bivariate analysis used the chi-square test to examine the association between each independent variable and work fatigue. When the expected cell-count assumption was not met, Fisher's exact test was used as an alternative because at least 80% of expected cell counts should be 5 or more for the chi-square test to be appropriate (McHugh, 2013). A p-value < 0.05 was considered statistically significant. Because total sampling was used, no sample size calculation was conducted.

Administrative permission was obtained from the relevant work setting, and respondents were informed about the study purpose. Participation was voluntary, and data were reported in aggregate to protect confidentiality.

RESULTS

A total of 110 local stevedores were included in the analysis. Table 1 presents the distribution of respondent characteristics, work-related factors, and work fatigue status.

Table 1. Distribution of respondent characteristics and work fatigue status (N = 110)

Variables	n	%
Age		
Younger	33	30.0
Older	77	70.0
Length of employment		
New	17	15.5
Long	93	84.5
Nutritional status		
Abnormal	5	4.5
Normal	105	95.5
Physical workload		
Light	63	57.3
Heavy	47	42.7
Work shift		
Morning	38	34.5
Evening	34	30.9
Night	38	34.5
Work fatigue		
Experienced fatigue	87	79.1
Did not experience fatigue	23	20.9
Total	110	100.0

Source: Primary Data, 2025

Table 1 shows that most respondents were in the older age group (70.0%) and had long employment duration (84.5%). Almost all respondents had normal nutritional status (95.5%).

More than half worked with a light physical workload (57.3%). The distribution of work shifts was relatively balanced between morning and night shifts (34.5% each), while 30.9% worked evening shifts. Overall, 87 respondents (79.1%) experienced work fatigue.

Table 2. Association between respondent factors and work fatigue (N = 110)

Variables	Category	Experienced fatigue n (%)	Did not experience fatigue n (%)	p-value
Age	Younger	20 (18.2)	13 (11.8)	0.004
	Older	67 (60.9)	10 (9.1)	
Length of employment	New	14 (12.7)	3 (2.7)	0.972
	Long	73 (66.4)	20 (18.2)	
Nutritional status	Abnormal	3 (2.7)	2 (1.8)	.28
	Normal	84 (76.4)	21 (19.1)	
Work shift	Morning	25 (22.7)	13 (11.8)	0.004
	Evening	26 (23.6)	8 (7.3)	
	Night	36 (32.7)	2 (1.8)	
Physical workload	Light	48 (43.6)	15 (13.6)	0.529
	Heavy	39 (35.5)	8 (7.3)	

Source: Primary Data, 2025

Note. Percentages in Table 2 are calculated from the total sample (N = 110). The length-of-employment row was harmonized with the overall fatigue total in Table 1, so the number of respondents experiencing fatigue totals 87, and those not experiencing fatigue totals 23. The p-value for nutritional status was obtained using Fisher's exact test because the chi-square test's assumption of equal expected cell counts was not met.

Bivariate analysis showed that age was significantly associated with work fatigue (p = 0.004). Fatigue was more common among older respondents (60.9% of the total sample) than younger respondents (18.2% of the total sample). Shift work was also significantly associated with work fatigue (p = 0.004). The highest fatigue rate was observed among night-shift workers, with 36 respondents (32.7% of the total sample) reporting fatigue. Length of employment, nutritional status, and physical workload were not significantly associated with work fatigue.

DISCUSSION

This study found that age and shift work were significantly associated with work fatigue among local stevedores at Ahmad Yani Port, whereas length of employment, nutritional status, and physical workload were not. These findings indicate that fatigue among stevedores should be understood as a multifactorial occupational health problem. The high proportion of fatigue in this study (79.1%) shows that fatigue prevention should not depend only on individual responsibility but should also be integrated into work scheduling, recovery arrangements, and occupational health surveillance (Cunningham et al., 2022; Moreira & de Lucca, 2025).

Age was significantly associated with work fatigue. Older workers had a higher fatigue distribution than younger workers. This finding is consistent with the notion that increasing age is often associated with reduced physiological reserve, slower recovery, and greater fatigue vulnerability during physically demanding work. Similar evidence was reported among aircraft maintenance personnel, where age was associated with fatigue level (Handayani & Demiyati, 2023), and among Indonesian workers in other sectors, where age was discussed as an important factor in fatigue risk (Basri et al., 2024; Rusila & Edward, 2022; Sunuh, 2021). In port work, age-related decline may become more apparent because stevedores perform repetitive lifting, carrying, and moving activities under time pressure.

Length of employment was not significantly associated with fatigue in this study. This result may reflect an adaptation effect, in which long-tenured workers develop more efficient work techniques, better pacing, and greater familiarity with operational routines. However, studies in other settings have shown mixed results. Some studies reported no significant relationship between certain work-history variables and fatigue (Handayani & Demiyati, 2023; Labaran et al., 2024), while others reported significant associations between length of employment and fatigue (Pabumbun et al., 2022; Suryaatmaja & Pridianata, 2020). These differences suggest that employment length does not operate alone; its effect may depend on workload intensity, rest patterns, shift schedules, sleep duration, workplace climate, and ergonomic conditions.

Nutritional status was not significantly associated with fatigue. The absence of association may be influenced by the very small number of respondents with abnormal nutritional status, as 95.5% were categorized as having normal nutritional status. This limited variation can reduce the ability of statistical tests to detect meaningful differences. Nevertheless, nutritional status remains relevant to occupational fatigue because body composition, meal timing, and metabolic conditions may influence energy balance and recovery, particularly among shift workers (Jannah & Tualeka, 2022; Khosravipour et al., 2021; Mohd Azmi et al., 2020). Studies in industrial and health-worker settings have shown that nutritional status may be associated with fatigue when there is wider variation in body mass index or when work demands exceed recovery capacity (Pabumbun et al., 2022; Wurarah et al., 2020).

Shift work was significantly associated with fatigue, and the highest fatigue distribution was observed among night-shift workers. This finding is biologically plausible because night work can disrupt circadian rhythm, shorten sleep duration, reduce sleep quality, and impair recovery. In the port context, night-shift fatigue may be intensified by the combination of continued manual handling, artificial lighting, reduced visual comfort, and outdoor temperature or humidity conditions that may accelerate visual and physical fatigue during loading and unloading activities. International reviews show that shift work is consistently linked with fatigue and adverse health outcomes, and mitigation strategies include work schedule adjustment, adequate inter-shift recovery, monitoring early signs of fatigue, and worker education (Moreira & de Lucca, 2025; Sweileh, 2022). A systematic review also found that shift work is associated with metabolic syndrome, with rotating shifts showing stronger adverse associations in several analyses (Khosravipour et al., 2021). Indonesian evidence similarly supports the importance of shift work in fatigue risk, including among workers in Pertamina Regional Sulawesi and nurses working shift systems (Jannah & Tualeka, 2022; Labaran et al., 2024; Mustain et al., 2022).

Physical workload was not significantly associated with fatigue, although fatigue was still common in both light and heavy workload groups. This result does not mean that workload is unimportant. Rather, the workload category used in this study may not fully capture task intensity, cumulative lifting, heat exposure, noise, recovery time, sleep debt, and mental pressure during port operations. Previous studies have reported that physical workload and sleep quality can be related to fatigue (Zahra et al., 2024), and that workload, working duration, and ergonomic factors may interact with fatigue in different occupational settings (Abustan et al., 2024; Pabumbun et al., 2022; Suryaatmaja & Pridianata, 2020). In the stevedoring context, future studies should measure workload more objectively using heart rate, energy expenditure, or direct observation, while also measuring heat stress, noise, sleep quality, and job stress.

The findings have practical implications for fatigue risk management at ports. First, workers in older age groups should receive periodic health monitoring, including cardiovascular, musculoskeletal, and metabolic assessments. Second, the shift system should prioritize forward rotation, limit consecutive night shifts, and provide adequate recovery time after night work. Third, supervisors should monitor early signs of fatigue during high-intensity loading and unloading activities. Fourth, workers should receive education on sleep hygiene, hydration, nutrition, safe lifting, and the importance of rest. These recommendations are consistent with fatigue-prevention approaches promoted by occupational health agencies and current evidence on shift work and long working hours (Descatha et al., 2020; Li et al., 2020; Pega et al., 2021; World Health Organization, 2021).

Study Limitations

This study has several limitations. First, the cross-sectional design cannot establish causality. Second, fatigue was measured at a single observation period, whereas it may fluctuate with shift sequence, sleep debt, weather, and daily workload. Third, the researchers could not prevent respondents from continuing work activities during data collection, which may have influenced fatigue responses. Fourth, this study did not measure heat stress, noise, sleep quality, hydration status, air pollutants such as PM2.5 and PM10, or psychosocial workload, all of which may contribute to fatigue. These limitations should be addressed in future studies using longitudinal designs and objective fatigue indicators.

CONCLUSION

Age and shift work were significantly associated with work fatigue among local stevedores at Ahmad Yani Port, Ternate. Older workers and night-shift workers showed higher fatigue distributions, indicating the need for targeted fatigue prevention in port operations. Length of employment, nutritional status, and physical workload were not significantly associated with fatigue in this study, but these factors should still be monitored, as fatigue is influenced by multiple interacting occupational and individual factors.

Port management and relevant occupational health stakeholders should strengthen fatigue risk management by implementing periodic medical check-ups, age-sensitive task allocation, forward-rotating shift schedules, limits on consecutive night shifts, adequate recovery time, structured rest breaks, worker education, and routine monitoring of fatigue symptoms. Future research should include objective measurements of physical workload, sleep quality, heat stress, noise exposure, and psychosocial workload to provide a more comprehensive explanation of fatigue among stevedores.

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