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Research Article

Factors Associated with Work Fatigue among Firefighters and Rescue Personnel in Jambi City, 2025

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A B S T R A C T

Background: Work fatigue is a commonly reported feeling of tiredness, characterized by decreased activity and motivation, which can affect physical condition and reduce workers' ability to perform optimally. According to data from the International Labour Organization (ILO), approximately 32% of workers worldwide experience work fatigue Work fatigue is influenced by both internal and external factors. This study aims to examine the relationship between age, nutritional status, years of service, physical workload, and stress and work fatigue among personnel at the Fire and Rescue Department of Jambi City.
Method: This study used a quantitative method with an analytical observational approach and a cross-sectional design. The population in this study consisted of 180 personnel. The minimum sample size required to represent the study population was 78 respondents. Sampling was carried out using probability sampling with the Proportionate Stratified Random Sampling technique. This study uses chi-square test.
Results: The results of the chi square statistical test showed that there was a relationship between age (p-value = 0,005), length of service (p-value = 0,000), and physical workload (p-value = 0,000) with work fatigue. There was no relationship between nutritional status (p-value = 0,978) and stress (p-value = 0,154) with work fatigue.
Conclusion: There is a relationship between age, length of service, and physical workload with work fatigue among personnel at the Fire Fighter and Rescue Department of Jambi City. Then there is no relationship between nutritional status and stress with work fatigue among personnel at the Fire Fighter and Rescue Department of Jambi City.

INTRODUCTION

Globally, work fatigue is an important occupational health issue, as it affects productivity, safety, and worker well-being. Work fatigue is a frequently reported feeling of tiredness, characterised by a decrease in activity and motivation, which can affect physical condition to the extent that workers are unable to return to work optimally. According to data from the International Labour Organisation (ILO), around 32% of workers worldwide experience work fatigue. Based on data from the National Fire Protection Association (NFPA) in 2021, 40 out of 70 firefighters (57%) died in the United States due to stress and work fatigue. According to a report by the Ministry of Manpower and Transmigration, an average of 414 workplace accidents occur every day in Indonesia. Of these, 27.8% are caused by work fatigue, while around 9.5% or 39 people suffer disabilities as a result of workplace accidents. (Monoarfa & Miolo, 2022), (Wurarah et al., 2020), (U.S. Fire Administration, 2021), (ILO, 2016), (Rahmawati et al., 2024)

At the regional level, the province of Jambi itself, based on data from the Jambi Employment Social Security Agency, shows that there were 343 reports of workplace accidents in 2016, increasing to 629 cases in 2017, then reaching 714 cases in 2018, and 640 cases in 2019, some of which were caused by work fatigue. Based on research in the city of Jambi, conducted by Ihza (2021), it was found that of the 77 fire department officers, 25 people (32.5%) experienced moderate work fatigue, while 52 people (67.5%) experienced high work fatigue. (Rini & Aswin, 2021), (Ihza, 2021)

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Age, length of service, nutritional status, physical workload, and exposure to stress are factors that influence work fatigue. As we age, our bodily functions decline due to changes in the cardiovascular and hormonal systems, reducing the body's ability to adapt to the demands of work. The longer a person works, the greater the accumulation of physical and mental stress they experience. This condition can increase the risk of work fatigue, burnout, decreased endurance, and decreased concentration due to continuous and prolonged exposure to work activities. In addition, good nutritional status supports energy, endurance, and concentration, while poor nutrition can decrease stamina and accelerate fatigue. On the other hand, high physical workloads and demanding activities deplete the body's energy reserves, while chronic stress exposure causes physiological and psychological reactions that slow down recovery. Stress can cause work fatigue because it is influenced not only by physical factors but also mental and psychological factors. Continuous stress can deplete energy, reduce endurance, and hinder recovery, thereby accelerating the onset of work fatigue. Thus, the combination of these factors increases the risk of work fatigue, making understanding and management important for maintaining worker health and performance. (Baharuddin et al., 2023), (Wulandari, 2022), (Kacandra et al., 2024), (Oktariani et al., 2022)

This study differs from previous studies conducted on firefighters, because previous studies generally focused only on certain factors related to work fatigue, whereas this study examines multiple physical and psychological risk factors simultaneously, including age, nutritional status, years of service, physical workload, and work stress in relation to work fatigue among firefighting and rescue officers in Jambi City in 2025. The novelty of this study lies in the integration of physical and psychological factors in a single analysis, particularly the measurement of physical workload using the Cardiovascular Load (CVL) method and work stress using the DASS questionnaire, as well as the use of the SOFI instrument to assess multidimensional work fatigue. In addition, studies that comprehensively analyze these variables among firefighters in Indonesia are still limited, especially in the context of firefighting and rescue officers in Jambi City.

Based on preliminary surveys through observation and interviews at the Jambi City Fire and Rescue Service, officers are divided into eight teams spread across eight posts in Jambi City. They work on a three-day rotation system: 24 hours on duty at the post, 24 hours off, and 24 hours on standby from home. During working days, officers must be ready to respond to emergencies at any time, while standby days allow for on-call duty in the event of a fire or other emergency. Working hours may be extended as needed to handle fires, so that the total weekly working hours may exceed the ideal limit of 40 hours as stipulated in the Minister of Manpower and Transmigration Regulation. These conditions require a high level of physical and mental preparedness, which has the potential to increase the risk of work fatigue, especially if the frequency of tasks is high. Based on these conditions, the researchers were encouraged to conduct further analysis of the factors related to work fatigue among Jambi City Fire and Rescue Service officers in 2025.

LITERATUR REVIEW

Work Fatigue

Fatigue is a condition in which the body's physical strength to perform repetitive activities decreases, resulting in a decline in work performance efficiency and effectiveness. In general, fatigue is characterised by tiredness, slowed physical reactions, difficulty in decision-making, and a decline in individual motivation to perform activities. This condition varies from person to person, but generally begins with a decline in the body's ability and capacity to maintain activity, both physical and mental. Work fatigue is a form of fatigue that arises from continuous work activities without sufficient recovery, both physically and psychologically. Generally, work fatigue is characterised by weakened physical endurance, decreased work capacity, and an increased risk of errors and work incidents. Fatigue in workers can be divided into muscle fatigue and general fatigue. Muscle fatigue occurs as a result of intense and continuous muscle contractions until energy is depleted, thereby reducing performance and increasing the risk of work errors. Meanwhile, general fatigue encompasses a comprehensive decrease in bodily energy, including physical, mental, sensory, and chronic fatigue, influenced by work duration, health conditions, nutritional status, and the nature of the work. (Safira et al., 2020), (Santriyana et al., 2023)

Age

According to Tarwaka (2016), a person's age plays an important role in determining their physical condition. Younger individuals generally have better ability to perform heavy work, while in older age, this capacity tends to decline. Older workers tend to have a higher risk of fatigue and lower mobility in performing activities, which can ultimately affect a decline in work performance. As age increases, an individual's physical abilities also decline, leading to an increased risk of work fatigue. According to Tarwaka (2016), workers over the age of 35 tend to be more susceptible to fatigue than

workers under the age of 35. These findings are indicated by the results of Baharuddin's (2023) study, which revealed a significant relationship between worker age and the level of work fatigue. Furthermore, Korwa's (2024) research also states that there is a significant relationship between age and work fatigue. (Tarwaka & Bakri, 2016), (Baharuddin et al., 2023), (Korwa & Widowati, 2024)

Nutritional Status

According to Tarwaka (2016), nutritional status is an important factor that plays a role in determining productivity and work efficiency. Good nutritional status reflects a balance between energy intake and the body's needs in carrying out activities. Meanwhile, suboptimal nutritional status can be one of the factors that trigger work fatigue. Work nutrition plays an important role because nutritional status reflects the physical quality and endurance of workers. In addition to serving as a source of nutrients and energy that help the body recover when experiencing fatigue, this statement is in line with the results of Rahmawati's (2023) research, which revealed a significant relationship between nutritional status and the level of work fatigue. Furthermore, Kamila's (2025) research showed that there is a significant relationship between nutritional status and work fatigue. (Farha et al., 2022), (Rahmawati et al., 2024), (Kamila et al., 2025)

Length of Service

According to Suma'mur (2014) as cited in Moh. Rivandi Dengo (2023), working life is the period of time or length of time from when a person enters the workforce until the time of a study, where working life is the total time spent in that profession. Workers with long working periods tend to be more prone to fatigue because their bodies have been exposed to physical and mental workloads for a long period of time. This condition can cause a decrease in physical endurance, increased fatigue, and decreased work efficiency. As the length of service increases, physical strength and endurance tend to decline, which can exacerbate fatigue. These findings are in line with the results of a study by Gunadarma (2024), which revealed that there is a significant relationship between length of service and the level of work fatigue. Additionally, the results of Rusila's (2022) research show that there is a significant relationship between length of service and work fatigue. (Firmansyah et al., 2024), (Wayan Bennardy Gunadarma et al., 2024), (Rusila & Edward, 2022

Physical Workload

According to Tarwaka (2016), workload encompasses all tasks that must be completed by workers and can be categorised into physical workload, which relies on muscular energy, and mental workload. The workload assigned to workers has a significant impact on their productivity, efficiency, and occupational safety and health aspects. Excessive workload has the potential to cause both physical and mental fatigue. The higher the intensity of the workload, the more energy is required. Jobs with a high level of difficulty require more frequent breaks and shorter working hours. If working hours are extended beyond the capacity of the workforce, this can cause fatigue. Workload can be measured by taking the pulse rate during work activities. Heart rate frequency is closely related to human physical performance. According to the Ministry of Health of the Republic of Indonesia, heart rate can be measured using a pulse oximeter. One method that can be used is to calculate physical workload based on heart rate using the Cardiovascular Load (%CVL) method. The results of the
%CVL is then compared with the established classification as follows: (Subekti et al., 2024), (Sari et al., 2022), (Simanullang et al., 2025)
<30% = No Fatigue Occurred
30 to <60% = Improvement Required
60 to <80% = Immediate Action Required
80 to <100% = Immediate Action Required
>100% = Not permitted to engage in activities

Stress

According to Tarwaka (2016) stress is a condition that arises as an individual's response to demands or pressures, whether from the work environment or from within, which are perceived to exceed a person's ability to cope. Stress is not only related to physical aspects, but also involves psychological and emotional aspects, such as feelings of anxiety, tension, and fatigue. Continuous stress can affect a person's physical and mental condition, contributing to work fatigue. If stress persists for a long time and is not managed properly, it can have a negative impact on physical and mental health, reduce a person's quality of life and performance, and even increase the risk of work errors. Stress can be measured using a research instrument in the form of the Depression, Anxiety, and Stress Scales (DASS-42) questionnaire developed by Lovibond and Lovibond (1995), one of which is to measure stress levels in individuals. These findings are in line with research conducted by Septiani et al. (2025), which indicates a significant relationship between work stress and work

fatigue. Additionally, research by Kusuma et al. (2025) indicates that there is a significant relationship between stress and work fatigue. (Tarwaka & Bakri, 2016), (Septiani et al., 2025), (Kusuma et al., 2025).

METHODOLOGY

This study utilised a quantitative method with an analytical observational approach designed as a cross-sectional study. The research was conducted at the Jambi City Fire and Rescue Service. The study was planned to commence in November–December 2025. The population in this study consisted of 180 firefighting and rescue officers at the Jambi City Fire and Rescue Service in 2025. The minimum total sample required to represent the population in this study was 78 respondents. Sampling in this study was obtained through the Probability Sampling technique, which is a method that gives each member of the population an equal chance of being selected as a sample. The sampling technique applied was Proportionate Stratified Random Sampling, in which a heterogeneous population was divided into several strata, then samples were taken proportionally from each stratum. The work fatigue variable in this study was measured using the Swedish Occupational Fatigue Index (SOFI) questionnaire. The rating scale used was 0–6, where 0 indicates no fatigue and 6 indicates very high fatigue. The scores obtained from the SOFI questionnaire are then based on the established assessment guidelines, as follows:

Table 1. Interpretation of work fatigue scores

No	Category	Rating Fatigue
1	<1.13	Low
2	1,13-4,87	Medium
3	>4,87	High

Source: Ashbeng, 2000.

Meanwhile, the stress variable in this study was measured using the Depression, Anxiety, and Stress Scales (DASS-42) questionnaire. The rating scale used was 0–3, with the following provisions:
0 = Not at all
1 = Sometimes
2 = Often
3 = Almost every day.
The scores obtained from the DASS-42 questionnaire are then based on the established assessment guidelines, as follows:

Table 2. Interpretation of stress scores

Stress Level Categories	Stress Scores
Normal	0-14
Mild Stressful	15-18
Moderate Stressful	19-25
Severe Stressful	26-33
Very Severe Stressful Stres	≥34

Source: Lovibond, 1995.

The SOFI and DASS-42 questionnaires are standardized instruments that have been tested for validity and reliability. Data collection was carried out using primary data obtained through interviews with respondents and secondary data obtained from available sources or from trusted official institutions. This study uses chi-square test.

RESULTS AND DISCUSSION

Respondent Characteristics

Table 3. Frequency Distribution of Respondent based on Firefighter Characteristic

Characteristics	Frequency	Percentage(%)
Highest Level of Education		
High School/MA	37	47,4

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Graduate D3/D4/S1	41	52,6
Marital Status		
Married	62	79,5
Not Married	16	20,5

Source: Processed Primary Data, 2026

Based on Table 3, the distribution of respondent characteristics shows that the majority of Fire Department officers have a final education level of D3/D4/S1, namely 41 people (52.6%), while respondents with a final education level of SMA/MA number 37 people (47.4%). In terms of marital status, most respondents were married, namely 62 people (79.5%), while 16 respondents (20.5%) were unmarried.

Univariate Analysis

Table 4. Univariate Analysis

Characteristic	Frequency	Percentage (%)
Work Fatigue		
High Fatigue	9	11,5
Moderate Fatgue	38	48,7
Mild Fatigue	31	39,7
Age		
At Risk	44	56,4
Not at Risk	34	43,6
Nutritional Status		
Abnormal	19	24,4
Normal	59	75,6
Length of Service		
Long	52	66,7
Short	26	33,3
Physical Workload		
Heavy	47	60,3
Light	31	39,7
Stress		
Mild Stress	29	37,2
Normal	49	62,8

Source: Processed Primary Data, 2026

Based on Table 4, regarding the frequency distribution of officers at the Jambi City Fire and Rescue Service. The univariate analysis results show that the majority of respondents experienced moderate work fatigue, namely 38 people (48.7%). Based on age characteristics, most respondents were in the at-risk age category (≥35 years), namely 44 people (56.4%). In terms of nutritional status, the majority of respondents had a normal nutritional status, namely 59 people (75.6%). Furthermore, based on length of service, most respondents were in the long service category (>5 years), namely 52 people (66.7%). Based on physical workload, the majority of respondents were in the heavy workload category, namely 47 people (60.3%).

Bivariate Analysis

Table 5. Bivariate Analysis

Variabel	Kategori	Work Fatigue				Total	PR	(95% CI)	P-Value
		High		Low					
		n	%	n	%				
Age	At Risk	33	75	11	25	44	1, 821	1,17-2,81	0,005
	Not at Risk	14	41,2	20	58,8	14			
Nutritional Status	Abnormal	12	63,2	7	36,8	12	63,2	0,71-1,59	0,978
	Normal	35	59,3	24	40,7				

Length of Service	Long	45	86,5	7	13,5	52	11,25	2,95-42,78	0,000
	Short	2	7,7	24	92,3	26			
Physical Workload	Heavy	45	95,7	2	4,3	47	14,48	3,87-56,77	0,000
	Light	2	6,5	29	93,5	31			
Stress	Stress	14	48,3	15	51,7	29	0,717	0,46-1,09	0,154
	Normal	33	67,3	16	32,7	49			

Source: Processed Primary Data, 2026

Based on Table 3, the results of the bivariate analysis show that there is a significant relationship between age and work fatigue among Fire Department officers (p-value = 0.005). Officers in the at-risk age group (≥35 years) are more likely to experience work fatigue than officers in the non-at-risk age group (<35 years), with a PR value of 1.821 and a 95% confidence interval (CI: 1.172– 2.81). Regarding nutritional status, the analysis showed no significant relationship with work fatigue (p-value = 0.978), with a PR value of 0.772 and a 95% CI (0.71–1.59). Furthermore, for the variable of length of service, there was a significant relationship between length of service and work fatigue (p-value = 0.000), where officers with long service (>5 years) had a higher chance of experiencing work fatigue compared to officers with short service (≤5 years), with a PR value of 11.252 and a 95% CI (2.95–42.78). For the variable of physical workload, the analysis results showed a significant relationship with work fatigue (p-value = 0.000), where officers with heavy physical workloads were 14.48 times more likely to experience work fatigue than officers with light physical workloads, with a 95% CI (3.87–56.77). Meanwhile, for the work stress variable, the analysis results showed no significant relationship with work fatigue (p-value = 0.154), with a PR value of 0.717 and a 95% CI (0.46–1.09).

Discussion

Based on the findings of this study, there is a significant relationship between age and work fatigue among officers at the Jambi City Fire and Rescue Service in 2025. The analysis results show a *p-value* of 0.005 (p < 0.05) with a 95% CI range (1.17-2.81), indicating that the relationship is statistically significant. It also shows that the PR value is 1.821, which means that officers aged ≥35 years have a 1.821 times greater chance of experiencing work fatigue than officers aged <35 years. Based on Tarwaka's (2016) theory, it explains that younger individuals generally have better abilities in performing heavy work, while in older age, this capacity tends to decline. The results of this study are also in line with the research by Viona Mona et al. (2024) on employees at the Semarang City Disaster Management Agency, which showed a significant relationship between age and work fatigue with a p-value of 0.000. Based on field conditions, all firefighters, both young and older, have the same responsibilities and workload in handling fires and emergencies. This situation means that older personnel must expend more energy to complete the same tasks as younger personnel. As a result, older personnel tend to experience fatigue more quickly due to a decline in muscle strength, physical endurance, and physical work capacity. [7,22]

This study shows no significant relationship between nutritional status and work fatigue among Jambi City Fire and Rescue Service officers in 2025. Statistical test results show a PR value of 1.065 (p < 0.05) with a *p-value* of 0.978 and a 95% CI range (0.71-1.59). This indicates that officers with abnormal nutritional status are 1.065 times more likely to experience work fatigue, but the relationship is not statistically significant. According to Tarwaka's theory (2016), nutritional status is closely related to work fatigue because it directly affects energy availability and endurance. Workers with good nutritional status generally have sufficient energy reserves, enabling them to perform work activities optimally and not easily experience fatigue. The results of this study are not in line with the research by Indah Rahmawati et al (2024) on employees at PT Japfa Makassar, which showed a significant relationship between nutritional status and work fatigue with a p-value of 0.025. The difference between the results of this study and the previous study is likely due to the fact that the majority of respondents in this study had a normal nutritional status, resulting in relatively small variations in. This condition caused the effect of nutritional status on work fatigue to be less statistically significant.

This study shows that there is a significant relationship between length of service and work fatigue among officers at the Jambi City Fire and Rescue Service in 2025. The results of the analysis show that the PR value is 11.25, which means that officers with long service (>5 years) are 11.25 times more likely to experience work fatigue than officers with short service (≤5 years). The statistical test results show a p-value of 0.000 (p<0.05) with a 95% CI range (2.95-42.78), indicating that the relationship is statistically significant. Based on Suma'mur's (2014) theory, length of service is one of

the factors that contributes to increasing the risk of work fatigue because it is related to the length of time workers are exposed to physical and mental workloads and environmental pressures. The results of this study are in line with the findings of I Wayan et al. (2024) on firefighters in Mobagu City, which showed a significant relationship between length of service and work fatigue with a p-value of 0.004. Based on field conditions, firefighters with longer service periods have generally been exposed to physical and mental workloads continuously for years. They are accustomed to handling various emergencies such as large fires, accidents, and evacuations in extreme environmental conditions and long working hours. This prolonged exposure can increase the risk of work fatigue.

This study indicates a significant relationship between physical workload and work fatigue among officers at the Jambi City Fire and Rescue Service in 2025. The analysis results show that the PR value is 14.84, which means that officers with heavy workloads are14.84 times more likely to experience work fatigue than officers with light workloads. The statistical test results show a p-value of 0.000 ($p<0.05$) with a 95% CI range (3.87-56.77), indicating that the relationship is statistically significant. Based on Tarwaka's (2016) theory, physical workload is one of the factors that play a role in increasing the risk of work fatigue because it is related to the amount of energy that must be expended by the body during work activities. The results of this study are in line with the research by Fenita Purnama Sari et al. (2022) conducted on workers at Inti Jaya Satu Petshop Ciputat, which showed a significant relationship between physical workload and work fatigue with a p-value of 0.029. Based on field conditions, firefighters often face heavy physical workloads when handling emergencies. They must perform strenuous activities such as lifting hoses and firefighting equipment, climbing ladders, breaking through access points, evacuating victims, and working in hot, smoky, and high-risk conditions. In addition, long working hours without adequate rest, especially during large fires or consecutive incidents, cause significant energy expenditure and increase physical fatigue.

Based on the results of research conducted on officers at the Jambi City Fire and Rescue Service, it was found that of the 78 respondents, 29 people (37.2%) were in the stress category and 49 people (62.8%) were in the normal category. The results of this study indicate that there is no significant relationship between work stress and work fatigue among officers at the Jambi City Fire and Rescue Service in 2025. The statistical test results show a PR value of 0.717 ($p < 0.05$) with a p-value of 0.154 and a 95% CI range (0.46-1.09). This indicates that there is no significant relationship and the hypothesis is rejected. This is in line with Tarwaka's (2016) theory that stress is one of the factors that causes work fatigue. Tarwaka states that work fatigue is not only influenced by physical factors, but also by mental and psychological factors, such as work pressure and stress. The results of this study are not in line with the research by Septiani et al. (2025) on inpatient nurses at the Bangkinang Kota Regional General Hospital, which showed a significant relationship between work stress and work fatigue with a p-value of 0.003. The difference between the results of this study and previous studies may be influenced by working conditions and respondent characteristics. Based on field conditions, most firefighters are able to manage work pressure well because they are supported by solid teamwork, clear division of tasks, and experience in handling various emergency situations. Regular training and good preparedness help officers feel more confident and calm when facing incidents, thereby minimising psychological pressure.

CONCLUSION AND RECOMMENDATIONS

This study analysed the relationship between age, nutritional status, length of service, workload, and stress with work fatigue among employees at the Jambi City Health Department in 2025. The results showed that 38 workers (48.7%) experienced moderate work fatigue. Factors significantly associated with work fatigue were age, length of service, and workload among employees at the Jambi City Fire and Rescue Department in 2025. This study emphasises the importance of paying more attention to physical and mental health by adopting a healthy lifestyle, such as ensuring adequate rest time, consuming a balanced diet, and regularly exercising. It also recommends getting into the habit of stretching before and after work to reduce muscle tension and prevent excessive fatigue.

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