KESANS: International Journal of Health and Science
2808-7178 / 2808-7380
http://kesans.rifainstitute.com/index.php/kesans/index

Physical Fatigue as a Determinant of Occupational Accident Risk among Maritime Transport Workers

Indah Ayu Lestari, Kresna Febriyanto
Faculty of Public Health, Universitas Muhammadiyah Kalimantan Timur, Indonesia
2211102413240@umkt.ac.id

Article Information
Submitted: **20 October 2025**
Accepted: **09 November 2025**
Publish: **15 November 2025**

Keyword: Accidents; Physical Fatigue; Maritime Workers; Sea Transportation

Abstract
Introduction: *Work accidents in Indonesia's maritime transport sector remain a major issue, often associated with physical fatigue due to prolonged working hours, insufficient rest, and exposure to extreme conditions.* ***Objective:*** *This study aimed to analyze the relationship between physical fatigue levels and occupational accident incidence among maritime transport workers in Samarinda and Balikpapan.* ***Method:*** *A cross-sectional study involving 136 crew members was conducted using accidental sampling. Physical fatigue was assessed with the Cumulative Fatigue Symptom Index (CFSI), and accident data were collected through a structured questionnaire. The Chi-square test was used for statistical analysis.* ***Result and Discussion****: High fatigue was reported by 51.5% of participants, and 67.6% had experienced work accidents. A significant association was found between fatigue and accident occurrence ($p < 0.001$), where workers with mild fatigue had a threefold lower risk of accidents (OR = 0.333; 95% CI: 0.237–0.469).* ***Conclusions:*** *Physical fatigue significantly increases the risk of occupational accidents among maritime transport workers, underscoring the importance of fatigue management and safety interventions in maritime operations.*

How to Cite **Indah Ayu Lestari, Kresna Febriyanto/Physical Fatigue as a Determinant of Occupational Accident Risk among Maritime Transport Workers, Vol. 5, No. 2, 2025**
DOI https://doi.org/10.54543/kesans.v5i2.472
e-ISSN/p-ISSN **2808-7178 / 2808-7380**
Published by **CV Rifainstitut/KESANS: International Journal of Health and Science**

Introduction

The maritime sector plays a vital role in global trade and Indonesia's national economy, especially as an archipelagic nation that depends heavily on sea transportation to connect its islands. The ocean functions not only as a logistics corridor but also as a primary source of livelihood for millions of people involved in shipping, fishing, and logistics. However, the maritime industry remains one of the most hazardous sectors worldwide, characterized by a persistently high rate of occupational accidents (Bowo et al., 2021). Epidemiological data show that maritime workers are up to 21 times more likely to experience fatal accidents than land-based workers (Roberts et al., 2014).

According to the European Maritime Safety Agency (EMSA), between 2014 and 2023, there were 444 maritime accidents resulting in 650 fatalities across Europe (EMSA, 2024). Similarly, Indonesia home to the world's second-longest coastline recorded 178 ship accidents from 2015 to 2023. The Indonesian National Transportation Safety Committee reported 102 serious accidents and 76 minor incidents during this period, leading to 925 casualties (KNKT, 2024). These statistics illustrate the persistent vulnerability of Indonesian maritime workers to high-risk working conditions that threaten both their safety and health. The causes of maritime accidents are multifactorial, involving both technical and human factors. Technical failures such as equipment malfunction, navigational error, or extreme weather often contribute to accidents. However, numerous studies have emphasized that human factors particularly physical fatigue play a dominant role in occupational safety failures (Gustian et al., 2025).

Occupational fatigue is a common problem across many sectors, caused by prolonged workloads, irregular schedules, and psychosocial stressors. In Central Java, 63.9% of informal workers were reported to experience severe fatigue, which significantly reduced productivity and increased accident risk (Haliza & Nugroho, 2024). In maritime settings, fatigue risks are further exacerbated by extended working hours, shift rotations, and harsh environmental exposures such as heat, noise, vibration, and high psychological demands (Russo et al., 2022; Layuk et al., 2022).

Fatigue negatively affects alertness, reaction time, and cognitive performance all of which are essential for quick decision-making at sea. Studies estimate that fatigue contributes to approximately 16% of maritime accidents and 33% of worker injury cases (Maternová et al., 2024). The International Labour Organization (ILO) highlights that Indonesian seafarers are particularly vulnerable due to long working hours, limited rest opportunities, and weak enforcement of rest-time regulations (ILO, 2025). These cumulative factors make physical fatigue a critical threat to worker safety and the operational sustainability of maritime industries.

Previous studies in Indonesia have found significant associations between physical fatigue and occupational accidents among maritime workers (Mansyur et al., 2021) and divers (Hidayat & Febriyanto, 2021). Crews often work more than 72 hours per week with irregular sleep and rest patterns, increasing the likelihood of chronic fatigue. International research further confirms that crew shortages, job insecurity, and weak regulatory oversight intensify fatigue risks (Rajapakse & Emad, 2023). Many seafarers report persistent exhaustion, poor sleep quality, and reduced vigilance, which can delay responses during emergencies and increase operational errors (Galić et al., 2023).

Despite growing awareness, most studies on maritime fatigue have been conducted in developed countries or within other transportation sectors such as land and air (Crestelo Moreno et al., 2023; Ananda et al., 2025). Research focusing on Indonesian maritime workers remains limited and fragmented, leaving a knowledge gap regarding how

physical fatigue contributes to work accidents under local working conditions (Bernardes et al., 2020). Differences in shift systems, safety culture, and regulatory enforcement between Indonesia and developed nations may result in distinct fatigue–accident dynamics (Abrahamsen et al., 2023; Zhao et al., 2023). Furthermore, climate change, high waves, and increasing maritime traffic intensify workload pressures, making localized research increasingly urgent.

To address these gaps, this study aims to analyze the relationship between physical fatigue levels and the occurrence of occupational accidents among maritime transport workers in Samarinda and Balikpapan, Indonesia. The findings are expected to provide empirical evidence for developing effective fatigue management strategies, designing safer work schedules, and informing policy interventions that enhance maritime occupational safety and worker well-being.

Method

This quantitative study employed a cross-sectional design to analyze the relationship between physical fatigue and occupational accidents among maritime transport workers. The cross-sectional approach enabled data collection at a single time point without repeated observation, providing a snapshot of the actual working conditions. The study was conducted in Samarinda and Balikpapan, East Kalimantan, Indonesia, from February to April 2025. These locations were chosen because they represent key maritime transport areas with active crew operations and relevant safety challenges. Using the Slovin formula with a 10% margin of error, a total of 136 respondents were selected as the study sample. The accidental sampling technique was used because of the dynamic and hard-to-reach nature of maritime work (Pajri et al., 2023). Respondents were selected if they had been employed for at least six months and voluntarily agreed to complete the questionnaire. Participants who did not provide informed consent or were unavailable during the data collection period were excluded from the study.

Two main instruments were used in this study. Physical fatigue was measured using the Cumulative Fatigue Symptom Index (CFSI) developed by Yoshitake (1987), which assesses subjective fatigue symptoms across eight dimensions: sleepiness and tiredness, decreased motivation, reduced activity, impaired attention and concentration, memory problems, emotional instability, sleep disturbances, and general physical complaints (Yamaguchi et al., 2022). The CFSI was translated and culturally adapted through a forward–backward translation process to ensure conceptual consistency. Instrument validation conducted among seafarers in Tarakan yielded correlation coefficients ranging from 0.381 to 0.734 (r-table = 0.361), and a Cronbach's Alpha of 0.861, confirming strong internal reliability. Data normality was confirmed using the Kolmogorov Smirnov test, and fatigue levels were categorized as high (>8) or low (<8) based on the mean CFSI score.

Work accidents were assessed using a self-developed incident questionnaire, designed based on previous literature and observational methods. The tool captured information on accident occurrence within the past year, types of accidents (falls, being struck, being trapped, electric shock, or chemical exposure), and injury characteristics (cuts, bruises, fractures, etc.). The questionnaire was also validated among seafarers in Tarakan, yielding correlation coefficients between 0.881 and 0.999 ($p < 0.05$) and a Cronbach's Alpha of 0.997, indicating excellent reliability.

Data processing followed a structured protocol using Microsoft Excel for data entry and SPSS version 25 for statistical analysis. Descriptive (univariate) statistics were used to summarize respondents' characteristics, while Chi-square tests were applied to assess the relationship between physical fatigue and occupational accidents. The odds ratio (OR) with a 95% confidence interval (CI) was computed to determine the strength of association between the two variables.

Data were collected using a structured questionnaire, distributed to respondents during rest periods or while waiting for ship departures to ensure undisturbed participation. Before data collection, respondents were informed about the study purpose and procedure and signed an informed consent form. Ethical approval was obtained from the Ethics Committee of the Faculty of Medicine, Mulawarman University (No. 140/KEPK-FK/VII/2024). Participation was voluntary, and confidentiality was strictly maintained.

Result and Discussion

1. Result

Table 1 presents the distribution of respondents' characteristics (n = 136). Most respondents were in the middle adult age group (36–45 years) with 29.4%. These data indicate that the majority of respondents were within the productive age range. In terms of length of service, 80.1% of respondents had worked for more than five years, while 19.9% had less than five years of service. This suggests that most respondents were experienced workers who had been exposed to maritime occupational risks for a long time.

Regarding physical fatigue, 51.5% of respondents reported high fatigue levels, while 48.5% experienced mild fatigue. This indicates that more than half of the respondents frequently experienced symptoms of physical exhaustion such as tiredness, lack of motivation, and muscle strain after prolonged work shifts. The history of occupational accidents showed that 67.6% of respondents had experienced at least one work accident, while 32.4% had never experienced one. This high proportion reflects that most maritime workers are exposed to accident risks during their operational activities. As shown in the table, the most common type of accident reported was falling (39.0%). For the type of injury, the most frequently reported were superficial wounds such as cuts, punctures, or scratches (55.9%). These data suggest that although most injuries were mild or moderate, their frequent recurrence may impair work performance and increase long-term fatigue accumulation among maritime workers.

The analytical results presented in Table 2 show a significant relationship between physical fatigue and occupational accidents ($p < 0.001$). Among the 66 respondents categorized as having mild fatigue, 44 individuals (66.7%) reported never experiencing a work accident, while 22 individuals (33.3%) had experienced one. Conversely, all 70 respondents (100%) classified as having high fatigue reported experiencing work accidents. The statistical analysis produced an odds ratio (OR) of 0.333 (95% CI: 0.237–0.469), indicating that workers with mild fatigue were approximately three times less likely to experience a work accident compared to those with high fatigue levels. These findings confirm that physical fatigue plays a crucial role in increasing the risk of occupational accidents among maritime workers. Therefore, preventive efforts through workload regulation, adequate rest periods, and fatigue awareness programs are essential strategies to minimize accident rates and promote safer maritime working environments.

Table 1
Distribution of Respondents' Characteristics

NO	VARIABLE		N	%
1	Age (years)	17 – 25 (Late adolescence)	8	5.9
		26 – 35 (Early adulthood)	36	26.5
		36 – 45 (Middle adulthood)	40	29.4
		46 – 55 (Late adulthood)	23	16.9
		56 – 65 (Elderly)	20	14.7
		> 66 (Advanced elderly)	9	6.6
2	Length of service (years)	< 5	27	19.9
		> 5	109	80.1
3	Physical fatigue level	Mild	66	48.5
		High	70	51.5
4	Work accident experience	Ever	92	67.6
		Never	44	32.4
5	Type of accident			
	Falling		53	39
	Struck by object		41	30.1
	Trapped between objects		45	33.1
	Electric shock		29	21.3
	Exposure to materials/radiation		3	2.2
6	Type of injury			
	Cut/puncture/scratch		76	55.9
	Fracture		25	18.4
	Sprain		40	29.4
	Muscle/ligament strain		44	32.4
	Bruise		44	32.4
	Amputation		1	0.7
	Acute poisoning		23	16.9
	Burn		24	17.6
	Superficial wound		76	55.9

Source: Primary research data, 2025

Table 2
Relationship between Physical Fatigue and Work Accidents

Variable	Level	Work accident		p-value	OR (95% CI)
		Never	Ever		
		n	n		
Physical fatigue	Mild	44	22	<0.001*	0.333 (0.237 – 0.469)
	High	0	70		

Source: Primary research data, 2025

2. Discussion

The findings of this study reveal that maritime workers face a significant risk of physical fatigue, which shows a direct relationship with the incidence of occupational accidents. Rather than functioning merely as a temporary physiological response, fatigue emerges as a systemic issue rooted in long working hours, limited rest opportunities, and heavy physical demands. These factors collectively diminish workers' alertness and increase their susceptibility to errors. The persistence of fatigue among respondents with extensive work experience indicates that tenure alone is not a protective factor against safety risks. This outcome highlights the importance of organizational and environmental conditions in shaping fatigue levels, a finding that aligns with recent studies showing that experience does not buffer fatigue when operational demands remain excessive (Ma & Liao, 2025; Zhao et al., 2023).

Dominant symptoms such as general tiredness and dizziness suggest the presence of brain fatigue, which can decrease concentration and delay responses to hazards. In maritime operations that require continuous vigilance, these cognitive impairments increase the probability of human error and accident occurrence. Such findings align with evidence that fatigue diminishes cognitive performance and hazard perception (Xu, 2023). In this study, respondents reported frequent occurrences of slips, trips, and falls, reflecting reduced alertness under fatigue. Similar observations have been reported by the European Maritime Safety Agency, which noted that most onboard accidents are caused by fatigue-induced inattention (EMSA, 2024). Therefore, fatigue can be understood not only as a health issue but also as a performance and safety threat.

The distribution of injury types further illustrates the physical hazards of maritime work. Surface injuries such as scratches, cuts, and puncture wounds were the most commonly reported, affecting more than half of the respondents. While these injuries are typically mild, their recurrence indicates persistent unsafe conditions onboard, including slippery decks, inadequate protective equipment, and the use of sharp or heavy tools. These results are in line with previous studies that also identified high rates of minor injuries related to deck operations (Sagaro & Amenta, 2025), and open wounds as the most common injury among crew members (Bilir et al., 2023). Chronic fatigue may amplify workers' vulnerability to these conditions, creating a cycle in which fatigue and minor accidents reinforce each other over time.

Further statistical analysis demonstrated a significant association between the level of physical fatigue and the occurrence of work accidents. Workers who reported mild fatigue were three times less likely to experience accidents than those with high fatigue levels. This supports the theoretical framework suggesting that fatigue mediates the relationship between workload and accident probability. Fatigue thus functions as both a health and safety determinant in maritime work environments. Previous studies also highlight fatigue as one of the leading causes of occupational accidents in the maritime and offshore sectors, as it impairs vigilance and decision-making capacity (Khan et al., 2022; Galić et al., 2023). Accumulated fatigue from long working hours and irregular rest patterns further deteriorates safety performance, particularly when rest periods are inadequately managed (Zhao et al., 2023; Aria et al., 2024). The fact that all respondents in the high-fatigue group reported accident experiences reinforces the critical importance of fatigue management in maritime safety systems (Rüpke & Athanassiou, 2024).

From a contextual standpoint, these findings reflect the operational realities of Indonesia's maritime sector, where smaller fleets often operate under limited supervision and resource constraints. Inadequate crew numbers, long voyage durations, and weak enforcement of working-hour regulations contribute to chronic fatigue among seafarers. These challenges mirror those reported in other Southeast Asian maritime studies, where insufficient rest periods and high workloads have been empirically linked to accident risk (Aria et al., 2024). Consequently, fatigue management should not only be viewed as an individual responsibility but also as a structural and regulatory issue.

The implications of this study extend across multiple levels. At the individual level, seafarers should receive training on recognizing early signs of fatigue and adopting effective recovery strategies. At the organizational level, shipping companies must enforce humane shift schedules, adequate rest periods, and job rotation systems to prevent cumulative fatigue. At the regulatory level, maritime authorities should strengthen compliance monitoring with international standards such as the Standards of Training, Certification, and Watchkeeping (STCW) and the Maritime Labour Convention (MLC), particularly in enforcing rest-hour regulations. Regular fatigue assessment and monitoring could be integrated into occupational health programs to enhance early detection and prevention efforts.

From a theoretical perspective, this study contributes to the fatigue–safety performance framework by demonstrating the mediating role of fatigue between workload and accident likelihood. It expands empirical understanding by situating these relationships within the Indonesian maritime context, which remains underrepresented in global literature. Future research should employ longitudinal or mixed-method designs to capture the temporal dynamics of fatigue accumulation and its interaction with psychosocial and environmental factors.

Several limitations must be acknowledged. The cross-sectional nature of this study restricts causal inference, and reliance on self-reported questionnaires introduces potential reporting bias, as participants may under- or overestimate their fatigue levels. Objective physiological measures such as actigraphy or heart rate variability could provide a more accurate assessment in future research. Moreover, since the study was conducted within a specific regional maritime community, generalization to all Indonesian seafarers should be made cautiously.

Overall, the results reinforce the conclusion that fatigue represents a critical determinant of maritime safety outcomes. Beyond its physiological effects, fatigue reflects deeper organizational and regulatory challenges within the maritime industry. Strengthening fatigue management strategies, improving awareness programs, and ensuring adequate rest opportunities will not only reduce accident rates but also promote safer and more sustainable maritime operations. This conclusion aligns with global evidence from 2020–2025 emphasizing that without comprehensive intervention, fatigue will remain a persistent contributing factor to maritime accidents worldwide.

Conclusion

This study confirms that physical fatigue is a significant determinant of occupational accident risk among maritime workers. The findings show that higher fatigue levels are strongly associated with increased accident rates, emphasizing that fatigue is not merely a physiological condition but a critical occupational safety issue.

Effective fatigue management through regulated working hours, sufficient rest periods, and the application of ergonomic principles in work design is essential to reduce accident incidence and enhance crew well-being. At the policy level, the harmonization of national maritime regulations with International Maritime Organization (IMO) standards should be strengthened to ensure better occupational safety and health protection for seafarers.

Reference

Abrahamsen, A. S., Johannesen, Á., Debes, F., van Leeuwen, W. M. A., & Weihe, P. (2023). Working environment and fatigue among fishers in the north Atlantic: a field study. *International Maritime Health*, *74*(1), 1–14. https://doi.org/10.5603/IMH.2023.0001

Ananda, V. R., Anita, K., & Prasetya, T. B. (2025). Dampak Kelelahan Kerja Terhadap Risiko Incident Pada Crew Kapal PT Dian Ciptamas Agung Cabang Berau Kalimantan Timur. *Indonesian Journal of Port and Shipping Management*, *2*(2), 66–75. https://doi.org/10.46484/ijpsm.v2i2.1124

Aria, M., Khazim, I., Ilyas, M., Kekalih, A., & Fuady, A. (2024). Work-Related Fatigue Among Indonesian Offshore Oil and Gas Workers. *Occupational Medicine*, *74*(5), 364–369. https://doi.org/10.1093/occmed/kqae040

Bernardes, S. M. F., Assuncão, A., Fujão, C., & Carnide, F. (2020). Normative Reference Values Of The Handgrip Strength For The Portuguese Workers. *PLoS ONE*, *15*(8 August). https://doi.org/10.1371/journal.pone.0236555

Bilir, N. A., Scheit, L., Dirksen-Fischer, M., Terschüren, C., Herold, R., Harth, V., & Oldenburg, M. (2023). Accidents, diseases and health complaints among seafarers on German-flagged container ships. *BMC Public Health*, *23*(1). https://doi.org/10.1186/s12889-023-15943-x

Bowo, L. P., Prilana, R. E., & Furusho, M. (2021). Human Error Assessment of Situation Awareness in Bridge Operations: A Case Study of Indonesian Maritime Accidents. *IOP Conference Series: Materials Science and Engineering*, *1052*(1), 1–14. https://doi.org/10.1088/1757-899x/1052/1/012012

Crestelo Moreno, F., Soto-López, V., Menéndez-Teleña, D., Roca-González, J., Suardíaz Muro, J., Roces, C., Paíno, M., Fernández, I., & Díaz-Secades, L. A. (2023). Fatigue As A Key Human Factor In Complex Sociotechnical Systems: Vessel Traffic Services. *Frontiers in Public Health*, *11*. https://doi.org/10.3389/fpubh.2023.1160971

EMSA. (2024). *Annual Overview Of Marine Casualties And Incidents 2024*.

Galić, M., Sić, L., & Slišković, A. (2023). "I Constantly Feel Worn Out": Mixed-methodology Approach to Seafarers' Sleep on Board. *Inquiry: The Journal of Health Care*, *60*. https://doi.org/10.1177/00469580231159746

Gustian, H. D., Junadi, & Qamaruddin. (2025). Manajemen Kelelahan sebagai Strategi Peningkatan Kinerja dan Keselamatan Pelaut di Industri Maritim Indonesia. *Jurnal Ilmiah Wahana Pendidikan*, *2025*(8.D), 317–327. https://doi.org/https://jurnal.peneliti.net/index.php/JIWP/article/view/12809

Haliza, J. S. N., & Nugroho, B. Y. S. (2024). Analysis Of Work Fatigue Among Workers In The Formal And Informal Sectors In Central Java. *HEARTY: Jurnal Kesehatan Masyarakat*, *12*(2), 181–185. https://doi.org/https://doi.org/10.32832/hearty.v12i2.14794

Hidayat, R., & Febriyanto, K. (2021). Hubungan Kelelahan Kerja Dengan Kejadian Kecelakaan Kerja Pada Penyelam Tradisional Di Pulau Derawan Provensi Kalimantan Timur. *Borneo Student Research*, *2*(2), 1045–1051.

ILO. (2025). *Understanding Working Conditions Of Fishers In Indonesia*. https://doi.org/10.54394/HTBY3881

Khan, A. H., Aziz, H. A., Khan, N. A., Hasan, M. A., Ahmed, S., Farooqi, I. H., Dhingra, A., Vambol, V., Changani, F., Yousefi, M., Islam, S., Mozaffari, N., & Mahtab, M. S. (2022). Impact, disease outbreak and the eco-hazards associated with pharmaceutical residues: a Critical review. *International Journal of Environmental Science and Technology*, *19*(1), 677–688. https://doi.org/https://doi.org/10.1007/s13762-021-03158-9

KNKT. (2024). *Laporan Statistik Investigasi Kecelakaan Transportasi Tahun 2024 Semester 1*.

Layuk, S., Martiana, T., Alow, G. B. H., Katiandagho, D., Pomalango, C., Afiyah, R. K., & Hasina, S. N. (2022). Physical Environment And Work Fatigue Among Ship Engine Room Crew. *International Journal of Health Sciences*, *6*(3), 1556–1564. https://doi.org/10.53730/ijhs.v6n3.13248

Ma, M., & Liao, R. (2025). Factors Affecting Seafarers' Fatigue: A Scoping Review. *Frontiers in Public Health*, *13*, 1–13. https://doi.org/10.3389/fpubh.2025.1647685

Mansyur, M., Sagitasari, R., Wangge, G., Sulistomo, A. B., & Kekalih, A. (2021). Long Working Hours, Poor Sleep Quality, And Work-Family Conflict: Determinant Factors Of Fatigue Among Indonesian Tugboat Crewmembers. *BMC Public Health*, *21*(1), 1–7. https://doi.org/10.1186/s12889-021-11883-6

Maternová, A., Materna, M., & Nichtová, R. (2024). Fatigue In The Air And At Sea: Comparing Impact And Regulations In Aviation And Maritime Transport. *AERO Journal*, *22*(2), 12–15. https://doi.org/10.26552/aer.C.2024.2.3

Pajri, I., Sribudiani, E., & Pebriandi. (2023). Karakteristik Pengunjung Ekowisata Hutan Pinus Bukit Candika Bangkinang, Kabupaten Kampar, Provinsi Riau. *INNOVATIVE: Journal Of Social Science Research*, *3*(6), 8041–8051. https://doi.org/https://j-innovative.org/index.php/Innovative

Rajapakse, A., & Emad, G. R. (2023). Fatigue, an unsolved puzzle that continues contributing to accidents at sea. *Marine Policy*, *155*. https://doi.org/10.1016/j.marpol.2023.105745

Roberts, S. E., Nielsen, D., Kotłowski, A., & Jaremin, B. (2014). Fatal accidents and injuries among merchant seafarers worldwide. *Occupational Medicine*, *64*(4), 259–266. https://doi.org/10.1093/occmed/kqu017

Rüpke, I., & Athanassiou, G. (2024). Contributing Factors Of Fatigue On Seagoing Vessels. *Zeitschrift Für Arbeitswissenschaft*, *78*(4), 469–491. https://doi.org/10.1007/s41449-024-00451-4

Russo, A., Vojković, L., Bojic, F., & Mulić, R. (2022). The Conditional Probability for Human Error Caused by Fatigue, Stress and Anxiety in Seafaring. *Journal of Marine Science and Engineering*, *10*(1576), 1–18. https://doi.org/10.3390/jmse10111576

Sagaro, G. G., & Amenta, F. (2025). Telemedicine-Assisted Work-Related Injuries Among Seafarers on Italian-Flagged Ships: A 13-Year Retrospective Study. *Healthcare*, *13*(18), 2375. https://doi.org/10.3390/healthcare13182375

Xu, Y. (2023). *Research on Prevention and Management of Seafarer Fatigue* [World Maritime University]. https://commons.wmu.se/all_dissertations

Yamaguchi, S., Watanabe, K., Sugimura, N., Shishido, I., Konya, I., Fujita, T., Yoshimitsu, Y., Kato, S., Ito, Y. M., & Yano, R. (2022). Salivary Biomarker Profiles and Chronic Fatigue among Nurses Working Rotation Shifts: An Exploratory Pilot Study. *Healthcare*, *10*(8), 1–12. https://doi.org/10.3390/healthcare10081416

Zhao, Z., Tang, L., & Wu, Y. (2023). Fatigue During The COVID-19 Pandemic: The Experiences Of Chinese Seafarers. *Marine Policy*, *153*. https://doi.org/10.1016/j.marpol.2023.105643