Journal of Positive School Psychology
2022, Vol. 6, No. 5, 3699-3708 http://journalppw.com

Fatigue Affecting Work Performance In The Shipping Industry

M.I.R. Suhrab[a] , Mohammad Abdullah Abu Sayed[b]

[a] Faculty of Maritime Studies, University Malaysia Terengganu, Malaysia, m.ismail@umt.edu.my
[b] Research Scholar, FCT Nova, Industrial Engineering, Caparica, Almada,Setubal, Portugal.
(Master Mariner) m.sayed@campus.fct.unl.pt

ABSTRACT

The maritime industry is widely regarded as "physically demanding jobs in one of the most dangerous work environments." Occupational fatigue has been associated with poor work performance, accidents, injuries, ill-health, sick leave, and disability in the general working population. The objectives of the research study were to measure the fatigue level and the work performance of seafarers, identify the risk factor of fatigue and work performance that happened to the seafarer, and observe the relationship between fatigue and work performance among seafarers. This research took a methodological approach that combined several methodologies to investigate fatigue risk factors, collect data, and examine seafarer exhaustion. The relevant materials were studied in advance, including papers from current journals, books, and others. The descriptive survey method was used in this investigation. The hypothesis about the relationship between fatigue level and seafarers' work performance was measured. The high-risk factors for both the level of fatigue and work performance were identified by data collection. Some methods observed and assured the relationship between the level of fatigue and work performance. Finally, an efficient method to define the role of fatigue in marine casualties was used to analyze all the major components of the fatigue issue and its impact on seafarer performance at work. As a result, a comprehensive understanding of fatigue is achieved, concluding that fatigue is a complex issue that poses a potential hazard in the shipping industry.

Keywords: Seafarer, Fatigue, Work Performance, Risk Factor, Maritime Industry.

1. INTRODUCTION

1.1. Background

There is considerable concern about seafarer weariness throughout the shipping industry. On some ship types, a combination of restricted manpower, rapid turnarounds, short sea voyages, and bad weather and traffic conditions can result in seafarers working long hours with little recuperative rest. Maritime regulators, ship owners, labour unions, and P&I clubs are all aware of this.

The situation in commercial shipping can be linked to their working hours, conditions, and performance impact in process industries, road transport, and civil aviation, where safety is a primary concern. In these circumstances, exhaustion and poor performance can result in environmental harm, illness, and a shorter life span among highly skilled seafarers in short supply. The effects of stress and health factors associated with long periods away from home, poor connectivity, and consistently high workload on seafarers require a holistic approach.

During their tour of duty, seafarers face various challenges at various sections of the voyage, all of which cause them to become exhausted. Fatigue hampers performance while performing responsibilities, particularly in congested waterways with high traffic loads, such as ports and coastal areas. According to statistics, navigation officers make more mistakes in these places than in other portions of the route. Due to increasing staffing levels, long working hours, time limits, poor quality sleep during the tour of duty, and stressful and exhausting activities, the danger of human error is enhanced in the coastal areas of the destination port. Consequently, maritime accidents cause irreversible damage to the maritime environment, numerous deaths, and financial losses (Yancheshmeh et al., 2020).

1.2. Brief of Content Introduction

The impact of fatigue on health and safety is directly linked to the issue of adequate crewing. This study examined our current understanding of these issues and assessed how various methods could avoid and control exhaustion. It aimed to provide a foundation for reviewing the criteria for determining healthy manning levels while also providing an overview of fatigue in the maritime sector.

Over the last few decades, the change in crewing levels has been one compelling cause to investigate seafarers' fatigue. Many big commercial vessels with crews of 40 people went to sea thirty years ago. Far larger ships now have crews of half that size, and smaller ships also have crews of less than ten. This manning reduction results from over a century of continuous technological and organizational change. Crew reductions, if not handled properly, will compromise protection and have a negative impact on seafarers' health. Increased fatigue is one cause for this, but other direct effects of unhealthy manning levels, such as a lack of vital maintenance, may also exist. It is believed that study into seafarer fatigue and safe manning levels should be carried out as part of a marine health and safety strategy.

2. LITERATURE REVIEW

2.1. Seafarer

As technology developments hastened the operational processes in maritime transportation, the human aspect has become a key issue. Seafarers and other transportation employees and/or shift employees suffer from irregular and long working hours, fast changes in work settings, and other organizational and/or individual issues that negatively impact their performances. In terms of physical and mental tiredness (Hystad & Eid, 2016), being a seafarer is considered a very stressful and high-risk vocation (Oldenbur et al., 2010). Seafarers who work under the effect of these stressors are naturally affected on psychophysiological and cognitive levels, lowering their total performance (Ozsever & Tavacioglu, 2018).

2.2. Fatigue

In several disciplines, the term "fatigue" denotes various diseases and sufferings. Fatigue, on the other hand, has no commonly accepted technical description. It's a tired, drowsy, or sleepy feeling that might last for hours or days of physical or mental labor, long durations of anxiety, exposure to severe surroundings, or sleep deprivation (IMO, 2001). Regarding fatigue at sea, the following definition is found in IMO's MSC/Circ.813/MEPC/Circ.330, List of Human Element Common terms:

"A decrease in physical and/or mental competence as a result of physical, mental, or emotional exertion can impair practically all physical capacities such as strength, speed, reaction time, coordination, decision making, or balance (IMO, 1999)".

Fatigue is a common symptom of many diseases and can even be seen in healthy people (Pawlikowska et al., 1994; Watanabe, 2008). Fatigue has been linked to accidents and injuries in the general working population (Bonnet and Arand, 1995; Hamelin, 1987). Fatigue is also has been linked to poor health (Andrea et al., 2003; Folkard et al., 2005; Huibers et al., 2004; Leone et al., 2006), as well as poor work performance (Charlton and Baas, 2001), sick leave, and disability (Andrea at al., 2003; Folkard at al., 2005; Huibers at al., 2004; Leone et al., 2006; Janssen at al., 2003; van Amelsvoort et al., 2002).

2.3. Fatigue among the Seafarers

Fatigue is a problem that affects all forms of transportation and companies that operate 24 hours a day. Because of the specialized nature of seafaring, which requires constant awareness and excellent concentration from its personnel, weariness at sea is extremely severe (Wang, 2012). Furthermore, additional distinguishing characteristics of sailing include long durations away from home, restricted communication among colleagues, and persistently high workloads. Working in these conditions might impact seafarers' health and potentially shorten their life span due to weariness and poor performance (Smith, 2007). Some of the possible impacts of fatigue were outlined in the IMO paper "Guidelines on Fatigue" in terms of their performance impairments and associated symptoms (IMO, 2006). The shipping industry is not out of this impact.

Fatigue has been shown to have a negative impact on alertness, which indicates that when making conscious decisions, the brain's functional state deteriorates (IMO, 2001). When a seafarer's attentiveness is reduced, responding to signals, challenging situations, and other tasks on board a ship takes longer. Furthermore, "a decrease in alertness will cause attention to be redirected to major aspects rather than minor ones" (Cardiff University, 1996). The seafarer's concentration and sustained attention will be considerably harmed due to this consideration. As a result, decreased attentiveness can significantly reduce work performance in terms of physical, psychological, and mental components (IMO, 2001).

Seafaring fatigue is a significant concern for maritime health and safety as it eventually leads to human error. For years, it has been commonly believed that most accidents and vessel losses were associated with human error. Still, recently it has been proposed that fatigue is a significant component in the chain of events contributing to an accident (Baulk & Reyner, 2002).

The MAIB Bridge Watchkeeping Safety Study (2004) examined the association between fatigue-inducing working conditions and accidents. This study confirmed that minimal manning, consisting of a master and a chief officer as the only two watchkeeping officers on vessels operating around the UK coastline, leads to watchkeeper fatigue and the inability of the master to fulfill his duties, in turn, frequently leads to accidents. It also found that standards of the lookout, in general, are poor, and late detection or failure to detect small vessels is a factor in many collisions. The study concluded that the current provisions of STCW 95 regarding safe manning, hours of work, and lookout are not adequate. Houtman et al. (2005) reported results also confirmed that fatigue might be a risk factor in collisions and groundings. Such incidents can have serious economic consequences for companies. In addition, accidents at sea can be devastating for the marine environment and fatal for the seafarers involved.

2.4. Effects of Fatigue on Work Performance

Fatigue has been designated as a dangerous element because it inhibits work performance and is difficult to comprehend by people who frequently cannot discern their state of weariness (IMO guidance, 2006). Many studies have revealed the critical consequences of fatigue on work performance, resulting in a clear picture of the situation. The first effect is the loss of knowledge, facts, and steps in a sequence due to the individual's faults of consciousness and memory (MSC/Circ.1014, 2001). The second effect is the seafarer's significant danger while performing demanding tasks during navigation (Smith, 1999). In this case, a tired seafarer has constantly tried to find a quick solution to a problem and will put in less effort than is required to complete the work, resulting in poor decisions (Xhelilaj & Lapa, 2010).

The impact of fatigue on an individual's ability to react, identify and interpret stimuli (driving force) in the workplace is another effect (Lapa, 2010). Furthermore, weariness promotes indifference and lowers motivation at work, resulting in poor performance of seafarers (Xhelilaj, 2010). The last result is fatigue's negative impact on problem-solving and decision-making, both critical components of the maritime task (IMO, 2001). Overall, fatigue impacts work performance are critical to recognize and comprehend since it can jeopardize a seafarer's life and ship safety (Xhelilaj & Lapa, 2010).

Finally, fatigue can impair seafarers' health by increasing their risk of chronic disease, as well as endangering their lives and the safety of their ships by significantly lowering their alertness levels and degrading their job performance (Wang, 2012).

2.5. Risk Factors

Voyage duration, sleep quality, ambient conditions, job demands, hours of duty, shift nature, and port frequency/turnaround time are all factors that contribute to weariness, according to the Cardiff Seafarers' Fatigue Program (Smith et al., 2006). As risk factors are increased, the likelihood of experiencing poor health due to weariness increases (e.g., 1-2 factors double the risk of being extremely fatigued, but 7 or 8 factors increase the risk 30 times). The conclusions of the poll are supported by diary data. Studies of seafarer fatigue risk factors may concentrate on one or more of the identified maritime and occupational risk factors for fatigue that have been proven in jobs other than seafarers.

Symptoms of fatigue are linked to various occupational and environmental risk factors at sea (sleep quality, work hours and shifts, tour length, job demands, work stress, sleep correlated with the number of risk factors, and poorer cognitive and health outcomes). Other recent research has shown that these elements must be examined in conjunction to explain weariness at sea and have underlined that working more than 2 × 6 hours per 24 hours should be avoided because it leads to excessive sleepiness. One of the most inescapable aspects of working aboard a ship is continuous shift work, which is also one of the leading causes of weariness. Shift employees report more significant sleep problems than day workers, which is the most prevalent health effect of shift work (Akerstedt, 1990; Akerstedt, 2003).

3. METHODOLOGY

3.1. Introduction

This research took a methodological approach that combined several methodologies to investigate fatigue risk factors, collect data, and examine seafarers' exhaustion. The relevant materials, including papers from current journals, books, international conventions, pertinent IMO documents and circulars, and validated materials from websites, were thoroughly studied in advance. Accident statistics were collected and evaluated to address the weariness at sea.

3.2. Research Design

In this study, the quantitative research method was used to fulfilling the objectives. For the data collection, a questionnaire-based survey method was used in this investigation. In the data collection procedure, the questionnaire was the essential tool. This survey included seafarers in Malaysia by using the simple random sampling process. During the survey, social media provided a google form link to the respective seafarer communities.

3.3. Study Area and Population

The research area was on social media and websites, including Facebook, Instagram, Telegram, and others related to the study. The respondent consisted of seafarers in Malaysia, including various types of fatigue and rank of officers.

3.4. Statistical Treatment of Data

The research study was to express and present the data in both qualitative and quantitative ways. The data collected from the respondents through the questionnaire were analyzed, observed, and interpreted. Frequency count, percentage, and weighted mean were the statistical measurements used (Arceno, 2018).

- Frequency Count. This study counted the number of respondents who filled in their profile, rank, vessel type, working experience, and other details.
- Percentage. This measurement was used to determine how many respondents signified various items of the questionnaire on the risk factors of fatigue level and work performance.
- Weighted Mean. This method determined respondents' perception of fatigue and work performance with a five-point scale.

3.5. One-Way ANOVA SPSS

The one-way analysis of variance (ANOVA) was performed to see any statistically significant differences in the means of two or more unrelated groups (although only to see when there was a minimum of three rather than two groups). One-way ANOVA was conducted to see if work performance variables were based on fatigue levels (e.g., low, medium, and high-fatigue seafarers). It could divide seafarers into three independent groups. It's also important to remember that the one-way ANOVA is an omnibus test statistic that couldn't tell us which specific groups were significantly different from each other; it can only say that at least two of them were because my study design may have three, four, five, or more groups, its critical to figure out how they differ from one another.

3.6. T-Test Method

A t-test is a hypothesis-testing technique that can assess an assumption that applies to a population. A t-test is an inferential statistic used to see if there is a significant difference in the means of two groups that are related somehow. It's employed chiefly when data sets, such as those obtained by flipping a coin 100 times, are expected to follow a normal distribution and have unknown variances. This study observed the difference between fatigue and work performance among the deck and the engine departments.

4. RESULTS AND DISCUSSION

Figure 1: Graph by gender

Figure 2: Graph by age group

Table 1: Descriptive statistics of piper fatigue scale (PFS) for the Malaysian seafarers (Obs= 196)

Items	μ(SD)	Factor 1 loadings	Factor 2 loadings	Eigen values	Proportion of variation	Cronbach α
F12	2.57(1.168)	0.8463		15.4913	73.77%	0.9732
F15	2.79(1.125)	0.8129				
F14	2.80(1.201)	0.8116				
F19	2.56(1.208)	0.7934				
F13	2.56(1.119)	0.7779				
F17	2.68(1.124)	0.7593				
F16	2.67(1.218)	0.7583				
F21	2.46(1.134)	0.7448				
F18	2.70(1.097)	0.7231				
F20	2.51(1.222)	0.7197				
F11	2.59(1.094)	0.7171				
F2	2.76(1.232)		0.8410	1.2264	5.84%	0.9707
F5	2.67(1.148)		0.8133			
F9	2.73(1.179)		0.7987			
F1	2.77(1.201)		0.7984			
F4	2.86(1.205)		0.7763			
F6	2.77(1.233)		0.7540			
F3	2.64(1.213)		0.7496			
F10	2.54(1.152)		0.7470			
F8	2.68(1.143)		0.7276			
F7	2.67(1.170)		0.7269			
Total						0.9819

Notes: *The measure of Sample Adequacy: Kaiser Meyer Olkin KMO= 0.967, with Bartlett test of sphericity= 5441.988, df=210, p<0.0001

Table 2: Descriptive statistics of work performance scale for the Malaysian seafarers (Obs= 196)

Items	μ(SD)	Factor 1 loadings	Factor 2 loadings	Factor 3 loadings	Eigenvalues	Proportion of variation	Cronbach α
Wp16	2.27(1.368)	0.8802			7.3747	40.97%	0.9054
Wp15	2.36(1.376)	0.8384					
Wp14	2.20(1.307)	0.8353					
Wp17	3.148(1.187)	0.8093					
Wp18	3.05(1.202)	0.7770					
Wp13	2.44(1.393)	0.6927					
Wp12	3.25(1.233)	0.5877					
Wp3	4.21(0.835)		0.8843		3.1021	17.23%	0.9002
Wp4	4.29(0.823)		0.8666				
Wp5	4.25(0.793)		0.8294				
Wp1	3.84(0.883)		0.7910				
Wp6	4.14(0.923)		0.7315				
Wp2	3.70(0.936)		0.7229				
Wp7	2.79(1.499)			0.7208	1.1382	6.32%	0.7818
Wp9	2.81(1.350)			0.6534			
Wp8	3.22(1.374)			0.6128			
Wp11	2.87(1.265)			0.5798			
Wp10	3.35(1.143)			0.5759			
Total							0.9110

Notes: *The measure of Sample Adequacy: Kaiser Meyer Olkin KMO= 0.885, with Bartlett test of sphericity= 2357.887, df=153, $p<0.0001$

Table 3: Percentage distribution and descriptive statistics of study population (Obs=196)

Variables	N (%)	μ(SD)
Gender		
Male	187 (95.41%)	
Female	9 (4.59%)	
Age group (years old)		
20-29	82 (41.84%)	
30-39	81 (41.33%)	
40 and above	33 (16.84%)	
Rank		
Captain/master	27 (13.78%)	
Chief Officer/ Engineer	40 (20.41%)	
Second Officer/ Engineer	46 (23.47%)	
Third Officer/Engineer	25 (12.76%)	
Fourth Engineer	10 (5.10%)	
Deck Cadet/Engineer	18 (9.18%)	
Other	27 (13.78%)	
Department		
Engine	100 (51.02%)	
Deck	90 (45.92%)	
Others (including catering)	6 (3.06%)	
Experience		
<1 year	15 (7.65%)	
1-5 years	62 (31.63%)	
6-10 years	28 (14.29%)	
10< years	91 (46.43%)	

Fatigue		55.98(21.087)
Fatigue duration		
Minutes	12 (6.12%)	
Hours	32 (16.33%)	
Days	31 (15.82%)	
Weeks	19 (9.69%)	
Months	36 (18.37%)	
Others	13 (6.63%)	
Not feeling fatigue	53 (27.04%)	
Work performance		58.20(13.485)

Table 4: Correlational co-efficient between fatigue and work performance grouped by age and gender

Grouped by	Fatigue × Work Performance
Age	
Age group 20-29	-0.3845***
Age group 30-39	-0.1661
Age group 40 and above	-0.1286
Gender	
Male	-0.2531***
Female	0.0678
Overall	-0.2359***

Notes: *indicates <1% level of significance

The study pertained to the management of seafarers' fatigue, and 41.84% of the respondents fell under the age category of 20-29 years. 41.33% of the respondents were under age 30-39 years old, and 16.84% were between 40 and above. The questionnaire was answered by 187 (95.41%) male respondents and 9 (4.59%) female respondents.

The questionnaire study results on seafarers' work-related weariness demonstrated that all the fatigue components had high values of 55.98 (21.087) while work performance had 58.20 (13.485), as shown in Table 3. This implied that deck-side or engine-side seafarers experienced mental strain while performing their duties and were subjected to significant degrees of physical oppression. Furthermore, issues such as lack of sleep, insufficient rest, lack of self-confidence to work, sense of threat, uncomfortable working conditions, and lack of support from their peers or superiors had significant impacts on seafarers. The fatigue level on ships traveling across the world was thought to be higher due to stress and exhaustion. Overwork, poor workforce levels, insufficient rest hours, pressure from the workplace or environment, and long contracts leading to high Covid-19 cases were likely causes.

Table 4 shows the correlation between age and gender of seafarers played a role in higher fatigue and work performance levels. The age of seafarers was divided into 3 categories, aged 20-29 years old (-0.3845), aged 30-39 years old (-0.1661), and aged 40 years old & above (-0.1286). The younger groups had more work performance than the older groups. This means that age advances may refuse the impact of fatigue on work performance. On the other hand, male seafarers (-0.2531) were significantly more fatigue than female seafarers (0.0678).

Fatigue has been designated a dangerous element because it hinders work performance and is difficult to comprehend for people who frequently cannot discern their level of weariness (Fatigue: IMO guidance, 2006). Many studies and research have revealed the most significant consequences of fatigue on workplace performance, providing a clear picture of the situation.

The specific elements of the operational regime onboard that the shipping sector represents today, which focuses mainly on extended working hours, is a significant contributor to the weariness and stress among seafarers. In this regard, maritime businesses must thoroughly examine working schedules and rest break durations to develop new working strategies to lessen the impact of fatigue factors on seafarers (Parker et al., 1997). Several researches also have been conducted by maritime institutions implying proper monitoring of working hours will assist seafarers in distinguishing between work and rest, resulting in fatigue relief at sea (IMO, 2001). Furthermore, external authority verifying working hour regulations will undoubtedly assist seafarers in adhering to rest hours, reducing fatigue onboard (Parker et al., 1997). Overall, the increasing fatigue level can degrade work performance.

5. CONCLUSION

Fatigue is described as a temporary loss of strength and energy caused by strenuous physical or mental exertion. Fatigue can decrease seafarers' work performance, reduce attentiveness, and impact their problem-solving and decision-making ability, resulting in blunders and maritime tragedies. In a nutshell, the role of fatigue in maritime casualties was assessed by analyzing all the significant components of the fatigue issue and its impact on human performance at work. According to the research study, the long working days, heat and vibration in the workplace, isolation from families, time pressure/hectic activities, lack of rest, lack of sleep, high workload, and repetitive labor are the major fatigue linked occupational signs on board. Considering these findings, a comprehensive understanding of fatigue is achieved by identifying fatigue background, potential obstacles, definition, and unique aspects of the shipping industry, leading to the conclusion that fatigue is a complex issue that poses a potential hazard in the shipping industry.

REFERENCES

1. An J, Liu Y, Sun Y, Liu C. (2020). Impact of Work-Family Conflict, Job Stress and Job Satisfaction on Seafarer Performance. International Journal of Environmental Research and Public Health, 17(7):2191.
2. Akhtar, M. J., & Bouwer Utne, I. (2015). Common patterns in aggregated accident analysis charts from human fatigue-related groundings and collisions at sea. Maritime Policy & Management, 42(2), 186-206.
3. Azimi F.Y., Mousavizadegan SH, Amini A, Smith AP, Kazemi R. (2020). Poor sleep quality, long working hours, and fatigue in coastal areas: a dangerous combination of silent risk factors for deck officers on oil tankers. International Maritime Health. 71(4), 237-248.
4. Beurskens AJHM, Bultmann U, Kant IJ, Vercoulen JHMM, Bleijenberg G, Swaen GMH. (2000). Fatigue among working people: validity of a questionnaire measure. Occupational and Environmental Med, 57, 353-357.
5. Hystad, S.W., Eid, J. (2016). Sleep and fatigue among seafarers: The role of environmental stressors, duration at sea and psychological capital. Safety and Health Work, 7(4), 363-371.
6. Hystad S.W, Saus E.R, Saetrevik B, Eid J. (2013). Fatigue in seafarers working in the offshore oil and gas re-supply industry: effects of safety climate, psychosocial work environment, and shift arrangement. International Maritime Health, 64(2), 72-9.
7. Jepsen JR, Zhao Z, van Leeuwen WM. (2015). Seafarer fatigue: a review of risk factors, consequences for seafarers' health and safety, and options for mitigation. International Maritime Health. 66(2),106-17.
8. Ozsever B, Tavacioglu L. (2018). Analyzing the effects of the working period on psychophysiological states of seafarers. International Maritime Health. 69(2), 84-93.
9. Phillips, R. (2000). Sleep, watchkeeping, and accidents: a content analysis of incident at sea reports. Transportation research part F: traffic psychology and behaviour, 3(4), 229-240.
10. Simkuva, H. & Purins, A. & Mihailova, Sandra & Mihailovs, Ivans. (2016). Optimization of work and rest hours for navigation officers on the ship. SHS Web of Conferences. 30. 00004.

11. Xhelilaj, E., & Lapa, K. (2010). THE ROLE OF HUMAN FATIGUE FACTOR TOWARDS MARITIME CASUALTIES. Constanta Maritime University Annals, 11(13).
12. Wang, H. (2012). Study on the assessment of seafarers' fatigue. World Maritime University Dissertations. 21.