Voyage of Stress: Assessing the Impact of Fatigue and Work Conditions on Indian Merchant Navy Officers.

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Abstract

The maritime industry, a cornerstone of global trade, relies on the dedicated efforts of seafarers who often work in challenging and physically demanding conditions. As a vital component of the shipping sector, Indian seafarers are no exception, facing the rigors of extended periods at sea and the relentless demands of maritime duties. The physical aspects of their work environment, such as noise, vibration, long working hours and prevalence of fatigue, can extremely influence their well-being and stress levels. Within this context, studying the impact of physical factors, specifically fatigue and physical work environment, on the stress levels of Indian seafarers emerges as a matter of critical significance. This study aimed to explore the complex relationship between the physical factors and the stress experienced by Indian seafarers. Employing a descriptive research design, data were collected from 395 Indian merchant navy officers. For data analysis SPSS and SEM were used. The findings of the study revealed a significant relationship between physical factors (fatigue, physical work environment) and stress of Indian Merchant Navy officers.

Keywords: Seafarers, Merchant Navy, Merchant Navy Officers, Stress, Fatigue and Physical Work Environment

1. INTRODUCTION

Merchant navy, often referred to as the merchant marine, plays a crucial role in the global economy by ensuring the transportation of goods, commodities, and resources across the world's seas and oceans. This industry is dependent on a dedicated and highly skilled workforce known as seafarers. Seafarers, whether as officers or ratings, are the backbone of the merchant navy, responsible for the safe and efficient operation of vessels. They perform a wide range of tasks, including navigation, engine operation, cargo handling, and maintenance, often in challenging and physically demanding conditions. These professionals endure long voyages, prolonged separation from their families, and the unpredictable nature of the sea. Their commitment and resilience are essential in ensuring the smooth flow of international trade, making seafarers indispensable contributors to the global supply chain. As they face unique challenges such as stress, isolation, and the physical demands of their work, it is imperative to recognize and address the well-being of seafarers to sustain the industry's safety, efficiency, and sustainability. Studies like those conducted by Anwer et al. (2021) and Adriana et al. (2013) in a broader working population context have illuminated the prominence of physical stressors in contributing to stress among workers. Fatigue, as a primary physical factor of stress, is a pervasive issue in the maritime profession. The irregular work hours, demanding watch schedules, and the inherent unpredictability of weather and maritime emergencies all contribute to the exhaustion experienced by seafarers. This exhaustion can lead to sleep disturbances, reduced cognitive functioning, and a diminished ability to cope with the stressors of the job. Fatigue has been linked to accidents and

errors in the maritime industry, making it not only a personal concern for seafarers but also a substantial safety risk for crew members, vessels, and the environment (Barnett et al., 2019; Moen et al., 2012).

Moreover, the physical work environment aboard ships can add another layer of stress. Factors such as noise, vibration, and the confinement of space can lead to discomfort and exacerbate the challenges of coping with isolation at sea. The work environment also influences crew members' ability to rest and recuperate, which is essential for their physical and mental well-being. The interplay between these physical stress factors is complex and profound, directly impacting the mental health and overall job satisfaction of seafarers (Syrdal et al., 2016; Smith et al., 2015). As stress levels rise, so does the risk of accidents, decreased productivity, and decreased job satisfaction, which can have far-reaching consequences for the maritime industry and global trade.

Understanding and addressing the impact of physical stress factors on seafarers are crucial for several reasons. Firstly, the mental well-being of seafarers directly affects their performance and decision-making capabilities on board, which are essential for the safe and efficient operation of vessels. Secondly, the high stress levels and the fatigue-induced challenges of the maritime profession can lead to adverse mental health outcomes, including depression and anxiety, among crew members, jeopardizing their long-term psychological health (Øvretveit et al., 2020; Eriksen et al., 2019).

In this context, studying stress stemming from physical factors in seafarers is pivotal for identifying strategies to enhance their overall quality of life and to promote safety at sea. It not only addresses the unique challenges faced by seafarers but also acknowledges the importance of safeguarding their mental health and well-being in the interest of the maritime industry and global trade. Moreover, it reinforces the call for industry-wide initiatives and regulations to mitigate the physical stressors faced by seafarers, ultimately creating a safer and more supportive working environment for those who navigate the world's oceans.

2. REVIEW OF LITERATURE

2.1 FATIGUE

Fatigue is generally understood as a condition characterized by acute physical or mental tiredness, resulting in a progressive decline in performance and alertness (Horizon Report, 2011; Thiruvasagam, 2015). The shipping industry, operating around the clock, experiences exceptionally high workloads, contributing to a prevalent issue of fatigue. Seafarers face various factors leading to fatigue, such as poor sleep quality, extended working hours, inadequate rest between shifts, and overwhelming workloads (Allen, 2007; Allen, 2008; Horizon Report, 2011). These factors have been linked to numerous physical and mental health problems among mariners, often culminating in severe outcomes such as suicide (Iversen, 2012).

Working in a 24-hour shift pattern on a moving vessel presents challenges in obtaining sufficient sleep, and inadequate sleep emerges as a significant source of stress among seafarers (Rengamani, 2015; Sriya, 2014). Insufficient or poor-quality sleep is recognized as a major contributor to seafarer fatigue (Allen, 2007; Allen, 2008). A recent study highlighted that seafarers on passenger and cargo ships reported higher levels of fatigue compared to those in the offshore resupply industry (Hystad, 2016).

The maritime sector has witnessed costly and damaging casualties attributing to seafarer fatigue, such as the grounding of a Jambo cargo ship in Scotland in June 2003, where the chief officer fell asleep and missed a course change. Similarly, the grounding of the bulk carrier Pasha Bulker in Australia in June 2007 resulted from the master's fatigue. The grounding of the bulk carrier Shen Neng 1 in April 2010

revealed that the officer failed to alter the course due to having only two and a half hours of sleep in the 38.5 hours preceding the incident. Statistics from marine insurance indicate that human error contributes to approximately 60% of shipping accidents (Horizon Report, 2011). Safety at sea is compromised when the crew is fatigued, not fully alert, or takes shortcuts.

Surveys in 2008 and 2010 in Sweden indicated that around 70% of ship officers had nodded off during their watch duty at least once in their career (Horizon Report, 2011). Studies on psychological stress in seafarers revealed issues with sleep quality among marine engineers, with pilots experiencing the shortest duration of sleep ranging from 4 to 6 hours per day. Additionally, a significant number of seafarers reported fragmented sleep, often divided into two periods of 3 hours each (Carotenuto, 2012). Poor sleep disrupts circadian rhythms, negatively impacting the health and safety of seafarers on board. The heightened levels of fatigue in the marine sector contribute to a higher incidence of accidents, violations of the MARPOL conventions leading to marine pollution, and legal consequences for officers, prompting some seafarers to transition to land-based jobs (Caesar, 2015).

2.2 PHYSICAL WORK ENVIRONMENT

The work environment faced by seafarers on board is both demanding and hazardous. Key stressinducing factors in this physical environment include heat, noise, and odours (Sliskovic & Penezic, 2015). Researchers, such as Applebaum et al. (2010), have established a significant correlation between noise levels and perceived stress, leading to intentions to leave the job. Gupta (2014) notes that physical environmental factors profoundly influence the quality of work life aboard, encompassing elements like noise, heat, odours, humidity, dust, light, vibration, temperature extremes, and poorly maintained equipment. These environmental factors impact seafarers, contributing to stress, especially when they perceive an inability to cope with threatening conditions (Zhu, 2014).

Deck officers, stationed on the bridge, contend with bright lights, while engine officers, situated in the engine room, endure high temperatures and engine noise that affects their hearing. Seafarers on chemical and oil tankers face exposure to fumes, impacting both their mental and physical well-being. Heat in the workplace has been identified as a stressor on merchant and passenger vessels (Oldenburg & Baur, 2009). Importantly, seafarers experience stress not only during work but also during leisure, as they are constantly exposed to environmental stressors such as ship movement, noise, vibration, and occasionally odours, directly influencing their sleep and recreational activities. The working conditions of seafarers are directly linked to their physical and mental health, with environmental stressors encompassing exposure to high temperatures and hazardous substances (Sunanda, 2018). Additionally, poor mental health is closely linked to unfavourable working conditions, the pace of job execution, and inconvenient shifts. A repetitive and dehumanizing environment adversely affects physical health, aligning with the findings of Oldenburg et al. (2009), who highlight that a hazardous work environment on board negatively impacts both the physical and mental well-being of seafarers.

2.3 STRESS

The issue of stress in seafaring has become a global concern, particularly as it is closely tied to physical stress factors. The relationship between stressors on board and job performance is inversely proportional, contributing to a higher likelihood of seafarers leaving the organization (Gupta, 2014). Stress rarely emanates from a single source; rather, it is associated with various factors. Seafarers, being away from home for extended periods, lead lives with limited social interactions, monotonous work routines, fewer recreational activities, and face challenging physical environments, all of which contribute to the onset of stress among mariners (Raunak, 2016).

In addition to regular ship duties, seafarers must ensure compliance with numerous rules and regulations, such as port state control, flag state requirements, international and local port rules, vetting inspections, internal and external audits, and various surveys. These responsibilities have been linked to the challenges of fatigue and disrupted sleep among seafarers (Freudenberger, 2006 & Iversen, 2012). Stress has a strong correlation with inadequate sleep/rest and heightened work pressure (Havold, 2015). Stressors on board and job satisfaction exhibit a negative relationship, leading to a greater inclination among seafarers to leave their organizations (Gupta, 2014; Rengamani, 2015).Panganiban & Gracia's study (2017) highlights the significant role of physical stress factors in the onset of stress among seafarers' stress, often leading to depression and suicides among mariners. Elevated stress levels can result in sleep disturbances, reduced cognitive functioning, and impaired decision-making abilities, posing safety risks for both crew members and the effective operation of vessels (Barnett et al., 2019; Moen et al., 2012).

Seafarers experiencing stress may also struggle with mental health issues, such as depression and anxiety, further disrupting their personal and professional lives (Øvretveit et al., 2020). Recognizing the far-reaching impact of stress on seafarers and the maritime sector as a whole, addressing stress and its underlying causes is crucial. Therefore, the present study comprehensively investigates the impact of physical work environment and fatigue on the stress levels experienced by Indian Merchant Navy officers during their maritime duties.

On the basis of review of literature stated above a model was developed for the present study.

FIGURE 1: Conceptual Model of Research



Source: Researcher's Survey

3. RESEARCH METHODOLOGY

3.1 Research Design

The study employed descriptive research design, also the study was quantitative and cross sectional in nature.

3.2 Research Objective & Hypotheses

• To examine the role of Physical factors in determining stress of Indian Merchant Navy Officers.

To attain the above objective following two hypotheses were formulated on the basis of available literature.

• H₁. There exists a significant relationship between Fatigue and Stress of respondents.

• H₂. There exists a significant relationship between Physical Work Environment and Stress of respondents.

3.3 Sample & Data Collection

Population for the present study comprised of Merchant navy officers of Indian origin sailing on Indian and foreign flag vessels which are approximately 66000 in number. The sample size of the study was obtained through a formula given by Yamane (1967). Data for the research was gathered from Indian merchant navy officers undergoing short term post sea training courses from 15 randomly selected Directorate general of shipping approved maritime training institutes located across India. The responses of 395 officers complete in all respect were taken for final analysis of which n=5 were females n= 390 were males. Of the total respondents 236 were Deck officers and 159 were Engine officers.

3.4 Tools/Instruments

Physical work environment was measured using Occupational stress inventory- revised (OSI-R) developed by Osipow (1998). 7 point Likert scale ranging from Strongly Agree =7 to Strongly Disagree =1 was opted to quantitatively measure the items of the scale. High score meant poor physical work environment and low score meant good physical work environment onboard. Sample items from the scale include: "on my job I am exposed to high level of noise", "my job is physically dangerous" etc. The reliability and validity of scale was assessed using Confirmatory factor analysis. The scale showed good psychometric properties (CR= .86, AVE= .50, α = .86).

Fatigue was measured using 4 item SF-36 Vitality sub scale developed by John ware and Cathy Sherbourne. 7 point Likert scale ranging from Strongly Agree =7 to Strongly Disagree =1 was used to measure the items of the scale. High score meant high level of fatigue and low score meant low fatigue onboard. Sample items from the scale include: "During last sail I felt full of life". The reliability and validity of scale was assessed using Confirmatory factor analysis using AMOS software. The scale showed good psychometric properties for the present study (CR= .69, AVE= .53, α =.68).

Stress was assessed using Perceived stress scale (PSS-10) developed by Cohen et al. (1983) and was adapted in the context of merchant navy. 7 point Likert scale ranging from Strongly Agree =7 to Strongly Disagree =1 was used to measure the items of the scale. The positively phrased items of the scale were scored reversed to arrive at final score. The sample item of the scale includes: "During my last sail I felt upset because something happened unexpectedly" etc. the reliability and validity of scale was checked using confirmatory factor analysis (CFA). The scale showed good psychometric properties with CR = 0.89, AVE =0.65, α =.79.

4. RESULTS

The results of the measurement model- Confirmatory factor analysis has been presented in the following table.

| Variables | Μ | SD | CR | AVE | α | | 1 | 2 | 3 |
|------------------------------|------|------|-----|-----|-----|------------|--------|--------|-----|
| 1. Fatigue | 3.50 | 1.5 | .70 | .53 | .70 | .73 to .74 | .72 | | |
| 2. Physical work environment | 5.02 | .83 | .86 | .50 | .86 | .68 to .77 | .17*** | .70 | |
| 3. Stress | 4.20 | 1.58 | .89 | .65 | .79 | .68 to .85 | .51*** | .54*** | .81 |

Table 1: Mean, Standard Deviation, Reliability & Validity outputs.

*****p* <0.001

Source: Researcher's Survey

The above table signifies the existence of reliability and validity of all the constructs under study. The values of AVE, Construct reliability & α are well above the threshold limit of 0.50 and 0.70. All the items of the scales were found statistically significant and related to their underlying factors at a level above 0.68.

The model of the study (Figure 1) was tested for its goodness of fit and the results indicated that model fits the data well. ($\chi^2/df = 2.5$, CFI = 0.93, RMSEA= 0.05, NFI= 0.91 TLI= 0.91).

4.1 Hypotheses Testing- with Path Modeling (SEM)

Using structure equation path modeling the hypothesized relationship between constructs was examined.

The results of the analysis revealed that the Fatigue (M= 4.40, SD= 1.5) had a positive and significant impact on the stress (M= 4.71, SD= 0.88) of Indian merchant navy officers (β = .21, p \leq 0.001). Hence, the hypothesis H₁: There exists a significant relationship between fatigue and stress of respondents is fully supported.

The relationship between Physical work environment (M= 5.01, SD= 0.85) and stress (M= 4.71, SD= 0.88) was also examined and it was found that there exist a positive and significant association between physical work environment onboard and stress of Indian merchant navy officers (β = .29, p \leq 0.05) resulting in acceptance of Hypothesis H₂, which means the physical work conditions prevailing onboard significantly impacts the stress levels of merchant navy officers.

The results of path model indicated that both predictor variables namely fatigue and physical work environment explained 57% of variance in stress of Indian marine officers.

5. DISCUSSION

The main objective of this study was to examine the role of physical factors in determining the stress of Indian Merchant Navy officers. For which the impact of fatigue and physical work environment on stress of Indian merchant navy officers was examined and the findings of the study supported both the hypotheses confirming the existence of poor physical work conditions and fatigue among mariners. Indicating that as the fatigue increases it directly influences the stress of Indian marine officers. The results of the study were consistent with the studies conducted by Hystad et al (2013), Ugurlu et al (2015), Thiruvasagam and Rengamani (2015) and Chambers & Main (2015) which reported that there exist a positive and significant relationship between Fatigue and Stress. As such with the increase in level of fatigue the stress of seafarers tend to increase. Similarly, the physical work environment

reported by marine officers was found poor which further indicated that as the physical work conditions onboard degrades the level of stress among Indian merchant navy officer's increases. The result obtained through analysis was found in consensus with findings of Nicolas et. al (2016); Oldenburg & Jensen (2019), Sliskovic et al (2015) and Panganiban & Gracia (2017).

6. CONCLUSION

In conclusion, the findings of this research underscore the critical importance of addressing fatigue and improving the physical work environment onboard for Indian marine officers. The study reveals a substantial and significant impact of these factors on the stress levels experienced by these professionals. Fatigue arising from demanding work schedules and the challenging maritime environment is revealed as a pervasive issue, influencing not only the officers' physical well-being but also their mental health. Additionally, the adverse effects of a poor physical work environment, encompassing factors such as noise, limited personal space, and the challenges of life at sea, are pronounced contributors to heightened stress levels among Indian marine officers. Recognizing these stressors is pivotal for the development of targeted interventions and improvements in working conditions to enhance the overall quality of life and job satisfaction of Indian marine officers, ultimately contributing to the safety and efficiency of maritime operations.

7. SCOPE FOR FUTURE RESEARCH

The findings of this research on the significant impact of fatigue and poor physical work environments on the stress levels of Indian marine officer's open avenues for extensive future research. Exploring potential interventions and coping mechanisms tailored to the unique challenges faced by marine officers could be a promising area. Further investigations could delve into the effectiveness of fatigue management strategies, considering variables such as rest periods, workload distribution, and sleep hygiene. Additionally, examining the role of technological advancements in mitigating the impact of poor physical work environments, such as the implementation of noise reduction measures or ergonomic improvements, could be crucial. Longitudinal studies tracking the evolving stress levels and well-being of marine officers over extended periods would provide a nuanced understanding of the persistence and fluctuations in stress patterns. Furthermore, comparative studies with marine officers from different cultural backgrounds or those serving on varying types of vessels could offer insights into the universality or specificity of stressors. The interdisciplinary nature of such research, incorporating elements of psychology, occupational health, and maritime engineering, could contribute holistic solutions to enhance the working conditions and mental health of Indian marine officers.

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