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The Effects of Digital Fatigue on Mental Health in Seafarers: Delphi and Multiple Regression Analysis

Gemi Adamlarında Dijital Yorgunluğunun Mental Sağlık Üzerindeki Etkileri: Delphi ve Çoklu Regresyon Analizi

Türk Denizcilik ve Deniz Bilimleri Dergisi

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ABSTRACT

The process of digitalisation has been found to exert a considerable influence on the mental wellbeing of those engaged in maritime activities, as well as on the prevalence of digital fatigue. The aim of this study is to analyse the effects of digital fatigue on seafarers' mental health. In the study, the data collected through questionnaires were subjected to analysis using regression analysis and the Delphi method. The findings indicate that prolonged screen use, an intensive digital workload, irregular sleep patterns and social isolation are the primary factors contributing to an increased prevalence of mental health issues among seafarers. In particular, digital communication and screen exposure have been identified as having a detrimental impact on mental health. Furthermore, it was determined that the implementation of stress management and psychological support mechanisms can effectively mitigate the adverse effects observed. The participants were predominantly young and had extensive experience with digital technology. Of the 150 seafarers who took part in the study, 70% were male and aged between 26 and 35 years. The findings indicate the necessity for strategic approaches to the management of the psycho-social risks associated with digitalisation. From the findings, only stress management indicates a negative correlation. These include the limitation of digital device usage, the implementation of social support programmes and the introduction of measures for stress management. These results are of significant value to ship-owning companies and maritime authorities, providing guidance on the protection of seafarers' mental health and the reduction of digital fatigue.

Keywords: Digital fatigue, Mental health, Seafarers, Maritime businesses, Regression analysis, Delphi

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ÖZET

Dijitalleşme, gemi adamlarının zihinsel sağlığı ve dijital yorgunluk düzeyleri üzerinde önemli etkiler yaratmaktadır. Bu çalışmanın amacı, dijital yorgunluğun gemi adamlarının zihinsel sağlığı üzerindeki etkilerini analiz etmektir. Araştırmada, anket yoluyla toplanan veriler regresyon analizi ve Delphi yöntemiyle değerlendirilmiştir. Bulgular, uzun süreli ekran kullanımı, yoğun dijital iş yükü, düzensiz uyku ve sosyal izolasyonun, gemi adamlarının zihinsel sağlık sorunlarını artıran başlıca faktörler olduğunu göstermektedir. Özellikle dijital iletişim ve ekran maruziyeti, zihinsel sağlık üzerinde olumsuz etkilere sahiptir. Ayrıca, stres yönetimi ve psikolojik destek mekanizmalarının bu etkileri hafifletmede olumlu katkı sağladığı tespit edilmiştir. Katılımcılar çoğunlukla genç ve dijital teknolojiye yoğun şekilde maruz kalan bir grup olup, araştırmaya katılan 150 gemi adamının %70'i erkek ve 26-35 yaş aralığındadır. Bulgulardan sadece stres yönetimi negatif korolasyona işaret etmektedir. Bulgular, dijitalleşmenin getirdiği psiko-sosyal risklerin yönetimi için dijital cihaz kullanımının sınırlandırılması, sosyal destek programlarının uygulanması ve stres yönetimine yönelik önlemler alınması gibi stratejik yaklaşımları önermektedir. Bu sonuçlar, gemi sahibi şirketler ve denizcilik otoriteleri için gemi adamlarının zihinsel sağlığını koruma ve dijital yorgunluğu azaltma konularında yol gösterici niteliktedir.

Anahtar sözcükler: Dijital yorgunluk, Mental sağlık, Gemi adamları, Denizcilik işletmeleri, Regresyon analizi, Delphi

1. INTRODUCTION

The maritime sector is one of the cornerstones of global trade, with more than 80% of world trade conducted by sea. This sector is undergoing a significant transformation process with constantly developing technologies and digital transformation processes (Arıcan *et al*., 2022). While digitalization aims to ensure that maritime operations are carried out faster, more efficiently and safely, it also affects the workload and mental health of seafarers (Hirata *et al.,* 2022). The term "digital technology" is used to describe a range of tools that enable the compression of large amounts of information into smaller storage devices that can be easily protected and transported (Mustafaoglu and Yasacı, 2018). Mental burden refers to the cognitive and emotional strain caused by excessive demands on an individual's mental resources, such as prolonged concentration or multitasking (Eaton *et al*, 2008). Over-reliance on technology, on the other hand, describes a dependency on digital tools and systems to the extent that it diminishes critical thinking, problem-solving abilities, or overall efficiency in the absence of these technologies. The pervasive use of digital technologies across a multitude of domains and the acceleration of communication processes in the contemporary era have collectively elevated the significance of these devices in people's lives (Pullen, 2009). Technological developments, including tablets, smart watches, smart televisions, computers, mobile phones and the internet, have become integral to the daily lives of individuals. This has had a significant impact on the way people communicate, learn and work. Maritime digitalization covers many technologies from ship management systems to bridge equipment, from electronic navigation systems to remote monitoring and management platforms (Arıcan *et al*., 2023). These technological developments have both transformed the way seafarers do business and increased their mental burden and brought the concept of digital fatigue to the agenda. Digital fatigue is defined in the literature as physical, mental and emotional exhaustion resulting from continuous and intense exposure to digital devices.

Digital fatigue can cause seafarers to lose focus, have difficulty concentrating and make mistakes in their daily operations. Constant use of digital devices disrupts sleep patterns, leading to loss of attention and fatigue, while social isolation and increased stress levels can cause seafarers to feel psychologically exhausted. Seafarers' failure to protect their mental health also risks their long-

term work performance and the safety of maritime operations (Amanuel, 2023). For seafarers, especially long watchkeeping, continuous use of electronic devices and the information load brought by technology come to the fore as factors that increase digital fatigue. Technologies such as E-Navigation systems, advanced radar and automatic identification systems (AIS), Electronic Chart Display and Information System (ECDIS) have made the work of seafarers more complex. Table 1 shows the devices and systems related to maritime digitalization. Increasing digitalization keeps seafarers in front of the screen more and more, which may adversely affect mental health (Ichimura *et al.,* 2022). In recent years, an increase in ship accidents has been observed; 4.81% of these accidents are attributed to human factors such as cognitive overload and perception disorders caused by digital devices (Fan *et al.*, 2020). In recent years, an increase in ship accidents has been observed, with 4.81% attributed to human factors such as cognitive overload and perception disorders caused by digital devices (Fan et al., 2020). These challenges highlight the broader impact of digital fatigue, which not only increases the likelihood of distraction, wrong decisions, and timing errors during navigation but also contributes to mental health challenges such as stress and burnout among seafarers. Thus, digital fatigue emerges as a significant risk factor for both individual well-being and operational safety, underlining the need for targeted interventions.

While digitalization is expected to make maritime operations more efficient, over-reliance on these technologies can increase human errors. The continuous use of technological devices may disrupt the sleep patterns of seafarers and negatively affect their concentration. This situation has negative effects on mental health in the long term and may cause psychological problems such as depression and anxiety (Miseviciene *et al.,* 2020).

Table 1. Systems that can increase the effects of maritime digitalisation processes on seafarers

Technology	Function	Effect on the seafarer
ECDIS	Provides ease of navigation	High attention span and long screen time
AIS	Continuously monitors vessel positions	Information overload, digital tracking obligation
	Monitors the ship's performance and operations	Constant supervisory pressure, performance anxiety
Radar and bridge technologies	Improves navigational safety	Information overload, mental fatigue
Remote ship management	Monitoring and management of ship operations from coast	Feeling of being under control, pressure in decision-making processes
Main machine control panels	Monitoring of critical parameters such as speed, power, operating status and temperature of the engine.	High attention span and long screen time
Integrated Automation System (IAS)	Monitoring and control from a central control panel. It provides control of engines, boilers, cooling systems and other auxiliary devices.	High attention span and long screen time

New demands and increasing operational pressures in the maritime industry due to digitalization have introduced several risk factors that can harm not only the physical but also the mental health of seafarers. Accident analyses conducted over the past decade reveal a significant rise in ship accidents (Karabacak and Köseoğlu, 2021). It was determined that 4.81% of the factors contributing to marine accidents were due to cognitive overload (from computers, electronic navigational instruments, and digital documentation) (Fan *et al.,* 2020). Xue *et al.* (2021) further elaborates that fluctuating environmental factors, combined with human error, significantly contribute to ship accidents, corroborating the role of cognitive overload and absent-mindedness in seafarer-related incidents. Alongside the innovations that digitalization brings to seafarers' work processes, the pressures it places on their mental health are significant.

Wang *et al.* (2021) highlight that both environmental conditions and human errors significantly impact the severity of maritime accidents, aligning with the observed cognitive overload and perception issues in seafarers. These analyses show that absent-mindedness, sleep disorders, and perception issues are prominent in personnel-related accidents (Amanuel, 2023).

The concept of digital fatigue has been studied, particularly in the education system, in relation to the negative effects of online learning on mental health (Romero-Rodríguez *et al.,* 2023). In this context, it is possible to conclude that seafarers' continuous work with digital systems may lead to similar fatigue. The intensive use of digital devices not only negatively affects individuals' mental health but also reduces the performance of those in critical roles, such as healthcare professionals (Hilty *et al.,* 2022). At this point, digital mental health practices are considered an effective solution to combat digital fatigue and burnout (Borghouts *et al.,* 2021).

Digital addiction and digital fatigue have been shown to be manageable during extraordinary situations, such as the COVID-19 pandemic, by developing strategic approaches (Gregersen *et al.,* 2023). During the pandemic, burnout symptoms became widespread due to individuals' excessive use of digital devices, which has shaped much of the research in this field. Similarly, social media fatigue emerged as a common issue, where constant online presence caused stress and anxiety (Suni *et al.,* 2022). This demonstrates that digital fatigue is not only limited to work processes but also negatively impacts social life.

During the COVID-19 pandemic, digital fatigue became a major concern, particularly among academics and other professionals. Ghasemi *et al.* (2021) reported that the mental health of academics deteriorated, and their fatigue levels increased during the pandemic, with continuous use of digital devices being a primary cause.

With the rapid rise of digitalization, social media fatigue has also become a serious issue in the daily lives of individuals. Excessive digital device usage, particularly during the pandemic, led to disruptions in work-life balance and increased mental fatigue (Murtaza and Molnár, 2024). Social media fatigue highlights how the constant need to be online and engage in digital interactions can negatively impact psychological well-being. Bhati *et al.* (2022) found that social media fatigue is particularly prevalent among female students and that it negatively affects academic performance. These findings reveal that digitalization deeply influences not only professional environments but also educational and personal lives. In this context, the digital fatigue of seafarers needs to be objectively measured and assessed (Kunasegaran *et al.,* 2023). Such assessments play a critical role in monitoring and improving the mental health of seafarers. For individuals such as seafarers, who are continuously exposed to digital devices, such fatigue symptoms may lead to a severe decline in mental health and cognitive functions.

Although digitalization enhances operational efficiency in the maritime industry, it also introduces challenges that may negatively impact the mental health of seafarers. While digital technologies such as secure E-Navigation systems and sea surface communication make maritime operations more efficient, they also impose additional stress on workers (Usluer, 2024). Therefore, more research and strategies are needed to better understand and mitigate the effects of digitalization on seafarers. The Delphi and Multiple Regression Analysis methods used in this study are important in terms of deeply examining the effects of digital fatigue and determining the main factors affecting the mental health status of seafarers. While the Delphi method is used to ensure consensus among experts on the criteria affecting digital fatigue, Multiple Regression Analysis allows us to understand the relative effects of these criteria on digital fatigue. These methods enable a clearer analysis of the factors affecting the digital fatigue level of seafarers.

While digital fatigue has been extensively studied in other sectors, its specific impact on maritime professionals remains largely unexplored. Unlike land-based professions, seafarers face unique challenges such as prolonged isolation, irregular work hours, and high-stakes decision-making, all of which can exacerbate the effects of digital fatigue. This research aims to address this gap by investigating

how digital fatigue influences the mental health and operational efficiency of seafarers, offering insights that are critical for improving their well-being and enhancing maritime safety.

The structure of this article is as follows: Section 2 will discuss digital fatigue and its effects on seafarers' mental health. Section 3 presents the impact of digitalization on seafarers' working conditions and a literature review of related studies. Section 4 provides a detailed summary of the methodologies employed, such as the Delphi method and multiple regression analysis. The findings are outlined in Section 5, analysing the effects of digital fatigue on seafarers' mental health. Section 6 discusses the operational and human resource implications of these results for the maritime industry. Finally, Section 7 offers recommendations for mitigating the potential risks of digitalization on seafarers' health and insights for future research.

2. FATIGUE AND ITS EFFECTS ON MENTAL HEALTH

2.1. Digital Fatigue

Digital fatigue is a state of mental, emotional and physical exhaustion caused by continuous and intense exposure to digital devices. This concept is associated with problems such as distraction, information overload and cognitive overload, especially caused by prolonged use of digital screens (Aulia and Asbari, 2023). With the rapid development of the digital age, dependence on technological devices and online interaction times have increased dramatically. Studies show that many people experience digital fatigue from being online all the time, especially as a result of the widespread use of working from home due to the COVID-19 pandemic (Twenge *et al.,* 2018). For example, distraction and difficulty focusing during online meetings can negatively affect employees' work performance and mental health. Bailenson (2021) from Stanford University addresses ‘Zoom fatigue’ caused by online meetings, emphasising that being constantly in front of the screen creates an intense mental burden on individuals. In addition, digital fatigue can also reduce the enjoyment of other activities in daily life. People feel compelled to stay connected to their smartphones even after work, which can put pressure on their personal time and cause physical and mental burnout (Ayyagari *et al.*, 2011). Thus, as the time spent with digital devices increases, individuals' social relationships, sleep patterns and overall happiness levels are also affected (Exelmans *et al.*, 2016). Digital fatigue, a growing issue, refers not only to the physical strain caused by long hours of screen use but also to the mental and emotional exhaustion arising from information overload and the constant need for digital vigilance (Ghasemi *et al.,* 2021). The rise of digital technologies in maritime operations, while improving efficiency, has also resulted in new stressors for seafarers. This phenomenon is particularly relevant in the maritime sector, where seafarers must operate advanced systems like IAS and continuously monitor ECDIS, radar systems, and AIS (Ichimura *et al.,* 2022).

In addition to the operational pressures, digital communication platforms—such as those used for remote ship management—add to the burden by requiring seafarers to stay connected and responsive at all times. This perpetuates feelings of being under constant supervision, which can heighten stress levels and lead to burnout (Usluer, 2024). Unlike traditional maritime operations where human judgment was paramount, modern systems demand continuous interaction with digital devices, leaving little room for mental respite. Moreover, the frequent alerts and alarms from these systems increase cognitive load and can detract from the seafarer’s focus on critical tasks, exacerbating mental fatigue (Fan *et al.,* 2020).

Research by Xu (2023) indicates that prolonged digital exposure directly correlates with mental health decline, noting heightened levels of anxiety, irritability, and sleep disorders among seafarers. These factors are further amplified during long voyages, where seafarers often lack social interaction, leading to isolation and an over-reliance on digital systems for both work and personal communication. Such isolation can intensify the effects of digital fatigue, making it a critical issue for the maritime industry to address.

Digital fatigue can lead to mental health problems in seafarers, such as increased stress, anxiety, and difficulty concentrating. Seafarers

work under high cognitive load due to prolonged screen use and tasks that require constant monitoring. Research shows that digital fatigue reduces attention span and reduces work efficiency (Hilty *et al.,* 2022). For example, excessive use of digital devices can disrupt sleep patterns, which can lead to a decrease in work performance of up to 20% (Xu, 2023). In addition, the pressure to be constantly online increases stress levels in seafarers, deepening the feeling of mental burnout (Romero-Rodríguez *et al.,* 2023).

In this context, it is essential to develop robust strategies aimed at mitigating digital fatigue, including rotating watchkeeping patterns, limiting unnecessary digital exposure, and offering mental health support tailored to seafarers' unique working conditions (Hilty *et al.,* 2022). Table 2 below provides a summary of the key effects of digital fatigue on seafarers' mental well-being.

Table 2. The effects of digital fatigue on employees' mental health (Daniel *et al.,* 2022)

Effect	Description
Stress level	Long screen times increase
Sleep pattern	Screen use impairs sleep
Work efficiency	Fatigue negatively affects

2.2. Mental Health

Mental health is a state of emotional, psychological, and social well-being (Alonso *et al.,* 2016). This balance directly influences how a person thinks, feels, makes decisions, and interacts with the world around them. It also plays a critical role in abilities such as managing stress, overcoming challenges, and leading a productive life (Aulia and Asbari, 2023). For seafarers, mental health is particularly crucial due to stressors such as long voyages, limited social interaction, physical isolation, and changing weather conditions (Fu *et al.,* 2020). Individuals in this profession often work in confined, demanding environments, far from their families and social circles (Khodabakhsh *et al.,* 2021). Additionally, factors like watchkeeping work, disrupted sleep patterns, and tasks requiring constant attention can all negatively impact seafarers' mental health (Baygi *et al.,* 2022). Factors affecting the mental state of seafarers can be explained as age, marital status, loneliness, social isolation, being away from spouse and family, communication problems, boredom, burnout, stress, irregular and insufficient sleep, long and watchkeeping work, fatigue, spending time with ship personnel, intense workload, port inspections, insufficient shore leave, authoritarian hierarchy and mobbing on board, type of ship, piracy, traumatic events and work accidents (Baş and Doymuş, 2023).

Within the maritime context, mental health is particularly significant due to the unique stressors seafarers face, including isolation, long working hours, exposure to digital technology, and the high-pressure environment of their work. These factors can lead to issues such as anxiety, depression, and burnout, which not only affect their personal well-being but also have operational implications for safety and efficiency at sea. Seafarers are particularly vulnerable to digital fatigue due to the constant reliance on digital systems for navigation, communication, and operational tasks, often coupled with the challenges of being in confined spaces and working irregular hours. This makes digital fatigue a critical issue that requires targeted strategies to mitigate its effects on mental health and safety at sea. Seafarers work under psychological pressure due to constantly changing environmental conditions, long watchkeeping and limited social interaction opportunities on board. This can lead to mental health problems such as loneliness, social isolation and depression. For example, fatigue resulting from long watchkeeping can lead to distraction and incorrect critical decision-making. These mental health problems can manifest themselves in daily work life as inattention, loss of focus and a tendency to make mistakes, increasing operational risks. The cumulative effect of these challenges makes it

especially difficult for seafarers to maintain mental and psychological stability. Therefore, safeguarding the mental health of seafarers is vital not only for their well-being but also for ensuring the safety and efficiency of maritime operations. Stress management and psychological support strategies have been observed to play a critical role in alleviating digital fatigue and its effects on mental health in seafarers. Studies show that such strategies reduce individuals' stress levels and increase mental resilience (Borghouts *et al.,* 2021).

3. LITERATURE REVIEW

The first study examining the effects of digital fatigue on mental health was conducted by Fu *et al.* (2020). This research indicated that social media overload contributes to mental fatigue and burnout among individuals who excessively use information and system features. Stressor–strain–outcome method was used in their studies. Using this survey method, the study found that users overwhelmed by excessive information eventually reach a point where they abandon social media platforms. This finding underscores the importance of addressing mental health issues arising from intensive digital platform use. Miseviciene *et al.* (2020) also explored the negative impacts of excessive digital technology use on health. Their research emphasized that "information fatigue" has severe consequences for mental well-being. The continuous influx of digital information was shown to exacerbate anxiety and burnout syndromes, increasing mental health problems. Like Fu *et al.,* this study used a survey to gather data, revealing that prolonged use of digital platforms is a significant contributor to digital fatigue, which seriously threatens mental health.

Tuncer and Levendeli (2022) focused on the mental and physical fatigue caused by excessive social network use in the digital communication age. Survey method and descriptive analysis were used in their studies. Their survey-based analysis revealed that the constant flow of interactions and notifications on social media platforms leads to mental overload, prompting individuals to reduce their usage. This finding highlights the role of social media platforms in creating mental fatigue through continuous interaction.

The relationship between digital addiction and sleep disorders was examined by Dresp-Langley and Hutt (2022). Clinical research and descriptive analysis were used in their studies. Their clinical research found that digital addiction disrupts sleep patterns, negatively impacting mental health. The study demonstrated that prolonged exposure to digital screens reduces sleep quality and triggers broader mental health issues.

Febreza and Junaidi (2022) investigated digital fatigue among university students, particularly in the context of online education. In their studies, 'selection and observation' and descriptive analysis were used as methods. Using selection and observation techniques, their study showed that prolonged screen exposure during online learning increased mental fatigue, reduced students' attention levels, and disrupted learning processes. This research highlighted the mental health challenges that arise from the watchkeeping to online education, particularly during the COVID-19 pandemic.

Aulia and Asbari (2023) conducted a qualitative descriptive study on the effects of digital fatigue on mental health. Qualitative descriptive study and descriptive analysis were used as methods in their studies. They found that digital fatigue leads to distraction, mental burnout, and anxiety, exacerbated by the growing use of digital media. The study stresses the importance of addressing digital fatigue's impact on mental health, particularly as media use increases.

Yasin *et al.* (2023) focused on the effects of smartphone overuse on mental fatigue and cognitive flexibility. Survey method and descriptive analysis were used in their studies. Their survey revealed that smartphone addiction contributes to mental fatigue and diminishes cognitive flexibility, underscoring the detrimental effects of digital fatigue on mental processes.

Finally, Singh and Pathak (2024) explored the increased screen time experienced by young people during the COVID-19 pandemic. Through qualitative and quantitative methods, their study found that this increased screen time led to mental health issues such as fatigue,

depression, and anxiety. The findings illustrate the long-term negative impacts of digital fatigue on the mental health of young individuals.

These studies collectively highlight the significant risks of digital fatigue on mental health, emphasizing the need to manage the overuse of digital technologies. Table 3 provides a summary of the key publications that form the basis of this study, outlining the gaps in the literature and underscoring the importance of further research in this area.

Table 3. Summaries of similar publications in the literature

Author(s)	Publication year	Journal name	Title	Subject	Method	Main findings
Mustafaoğlu, *et al.*	2018	Nobel	The negative effects of digital technology usage on children's development and health	Negative effects of digital technology on health	Literature review	It was emphasised that excessive use of digital technologies can lead to physical and mental health problems in individuals.
Fu *et al.*	2020	Information Processing & Management	Social media overload, exhaustion, and use discontinuance: examining the effects of information overload, system feature overload, and social overload	System feature overload, information overload and social overload lead to individuals' social media fatigue.	Stressor–strain–outcome	System feature overload, information overload and social overload have been found to lead to user fatigue.
Miseviciene, *et al.*	2020	Education scientific conference	Impact of digital technologies on people health and means to avoid information fatigue	The effects of digital technologies on human health and ways to avoid information fatigue the relationship between digital fatigue and mental health	Survey	Excessive use of digital technologies leads to information fatigue, and it is recommended to apply information management techniques to avoid this situation.
Tuncer and Levendeli	2022	Selçuk iletişim	From connected individual to tired individual: social network fatigue in the age of digital communication	Social media fatigue in the age of digital communication	Survey	Excessive use of social networks creates mental and physical fatigue in individuals, which leads users to interact less.
Daniel and Aleksander	2022	Fusion of multidiscipline research; an international journal	Future facts: unveiling mental health issues in the digital age	Mental health issues in the digital age	Literature review	It has been emphasised that digital stress and the increase in screen time that individuals are exposed to in the digital age negatively affect the mental health of individuals.
Dresp-Langley and Hutt	2022	IJERPH	Digital addiction and sleep	Digital addiction and sleep disorders	Clinical research	It has been observed that digital addiction leads to disturbances in sleep patterns, and this has negative effects on general health.

Table 3. Summaries of similar publications in the literature (continued)

Romero-Rodríguez *et al.*	2023	Education XXI Conference	Digital fatigue in university students because of online learning during the Covid-19 pandemic	Digital fatigue caused by online learning during the pandemic	Self-administered survey	It has been found that digital fatigue is a common problem among university students studying online during the pandemic. This fatigue negatively affected academic performance.
Xu	2023	WMU	Research on prevention and management of seafarer fatigue	Significance of fatigue management.	Document analyses	Investigate the use of fatigue detection devices and sleep monitoring devices on board ships, assessing their accuracy and applicability in the maritime sector.
Tutar and Mutlu	2024	Journal of Communication Theory and Research	Digital fatigue scale: Validity and reliability study	Validity and reliability study of digital fatigue scale	Factor analysis	It was found that the Digital Fatigue Scale (DFS) is a valid and reliable scale and has a high capacity to measure fatigue experienced in digital environments.

Based on the findings from the aforementioned studies, it can be indirectly concluded that digital fatigue significantly impacts the mental health of employees and students across various sectors. However, there remains a notable gap in the literature regarding the specific relationship between digital fatigue levels and mental health among seafarers. This study aims to address this gap by providing a comprehensive examination of how digital fatigue affects the mental well-being of seafarers. By exploring this relationship in depth, the research seeks to contribute valuable insights that can inform strategies for mitigating the negative effects of digital fatigue within the maritime sector.

4. MATERIAL AND METHOD

In this study, two primary methods will be used to analyse the relationship between the digital fatigue levels of seafarers and their mental health: the Delphi Method and Multiple Regression Analysis.

4.1. Delphi Method

The Delphi method will be employed to determine the criteria for analysing the relationship between digital fatigue levels and mental health. This method is a well-established technique used in survey studies. By utilizing sequential questionnaires, it evaluates opinions in a non-adversarial manner and provides repeated feedback on the current state of the group's consensus. This process informs group members about the status of their consensus, helps identify issues that participants may have overlooked or considered unimportant, and allows them to revise their opinions (Keeney *et al.,* 2011). Unlike brainstorming techniques used in nominal group approaches, the Delphi method enables the collection of opinions without the need for participants to be physically present. This is particularly beneficial for improving communication among larger, diverse, and geographically dispersed groups, which is a limitation of other existing methods. Consequently, it allows for a broad range of perspectives to be expressed, forming a solid basis for the analysis. Additionally, it minimizes psychological influences such as conformity to

dominant views or social pressures, fostering independent thinking and the gradual development of reliable judgments (Linstone, 1979).

In Delphi applications, different consensus levels and scoring methods are employed based on sample size, research purpose, and available resources (Ndour *et al.,* 1992; Dalkey and Helmer, 1963; Hasson *et al.,* 2000). Similar to the study conducted by Hasson *et al.,* this research will use a 75% agreement rate and a scoring system ranging from 1 to 5. A total of 8 experts from maritime companies and organizations conducting psychological assessments of ship personnel will be selected for the questionnaire study. These experts were chosen because they have directly worked with ship personnel or have conducted assessments on their mental health and performance, which is considered crucial for the questionnaire's applicability. Their experience contributes to the realistic and relevant results of the survey questions. Experts were also used to identify the main factors used as independent variables. All selected experts work in marine psychology and ship management departments, possess at least ten years of industry experience, and are recognized as specialists in their fields. They included senior managers from maritime companies, psychologists specializing in occupational mental health, and maritime safety experts with a deep understanding of the challenges faced by seafarers. Their diverse backgrounds and roles in the industry ensured that the Delphi process was informed by a well-rounded perspective, allowing for more accurate and comprehensive insights into the mental health and digital fatigue issues affecting maritime professionals. The characteristics of these experts are detailed in Table 4. The 8 experts selected for the Delphi method were chosen based on their extensive experience in maritime operations, psychology, and mental health

Table 4. Profile of experts

Expert	Area of expertise	Specialised area	Working time (Year)
Expert 1	Psychologist	SMCPC *	11
Expert 2	Ship management	SFM**	12
Expert 3	Psychologist	SMCPC	11
Expert 4	Ship management	SFM	15
Expert 5	Ship management	SFM	11
Expert 6	Psychologist	SMCPC	14
Expert 7	Ship management	SFM	15
Expert 8	Psychologist	SMCPC	12

SMCPC*: Seafarers and maritime companies psychological counselling, SFM**: Ship and fleet management

The Delphi Method is a research technique that allows participants to anonymously share their views and work towards consensus through multiple rounds of feedback. This method is particularly effective for gathering expert opinions and supports decision-making processes on complex issues. In this study, the Delphi Method will be implemented according to the steps illustrated in Figure 1:

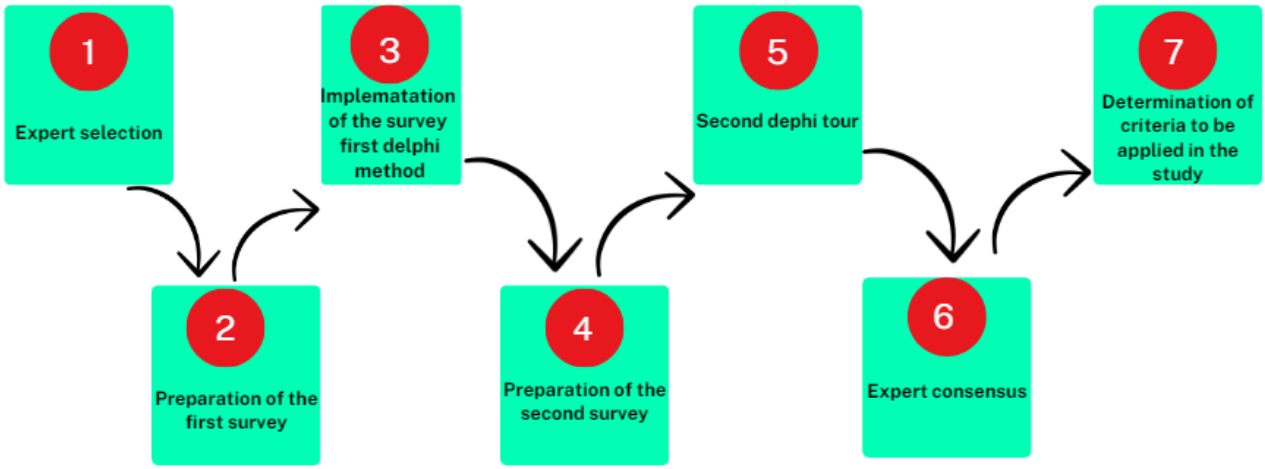

Figure 1. The flow of the Delphi method used in the study

4.2. Multiple Regression Analysis

Multiple regression analysis is a statistical method used to examine the relationship between a dependent variable and more than one independent variable (Montgomery *et al.,* 2021). Multiple regression analysis is a statistical method used to explore the relationship between a dependent variable (mental health) and multiple independent variables (such as digital fatigue, sleep patterns, screen time, and work hours). In this study, multiple regression analysis was employed to assess how various factors related to digital fatigue contribute to changes in mental health outcomes among seafarers. This method provides insight into the specific impact of digital technology usage on mental well-being, which is crucial for understanding and addressing mental health challenges in the maritime context. In this study, the dependent variable will be the mental health of seafarers, while the independent variables will be the factors affecting digital fatigue.

The mathematical expression of the Multiple Linear Regression model is expressed in equation (1).

$$Y = \beta_0 + \beta_1.X_1 + \beta_2.X_2 + \ldots\ldots\ldots + \beta_k.X_k + \varepsilon \quad (1)$$

In this formula, β_0 and β_1 are unknown parameters of the model. ε is the error term and Y is the observable dependent variable, and X is the observable independent variable values (Seber and Lee, 2012). Karabulut and Şeker used the Multiple Linear Regression Analysis model as in equation (1) in their study in 2018 (Karabulut and Şeker, 2018). In this study, the Multiple Linear Regression Analysis model was used in a similar way. The reason for using this model is that it is accepted in the literature and is used as a powerful tool for understanding complex relationships in health and accident analyses, identifying risk factors and developing preventive strategies. In this study, the data collected through the questionnaire will be analysed with the stages in Figure 2:

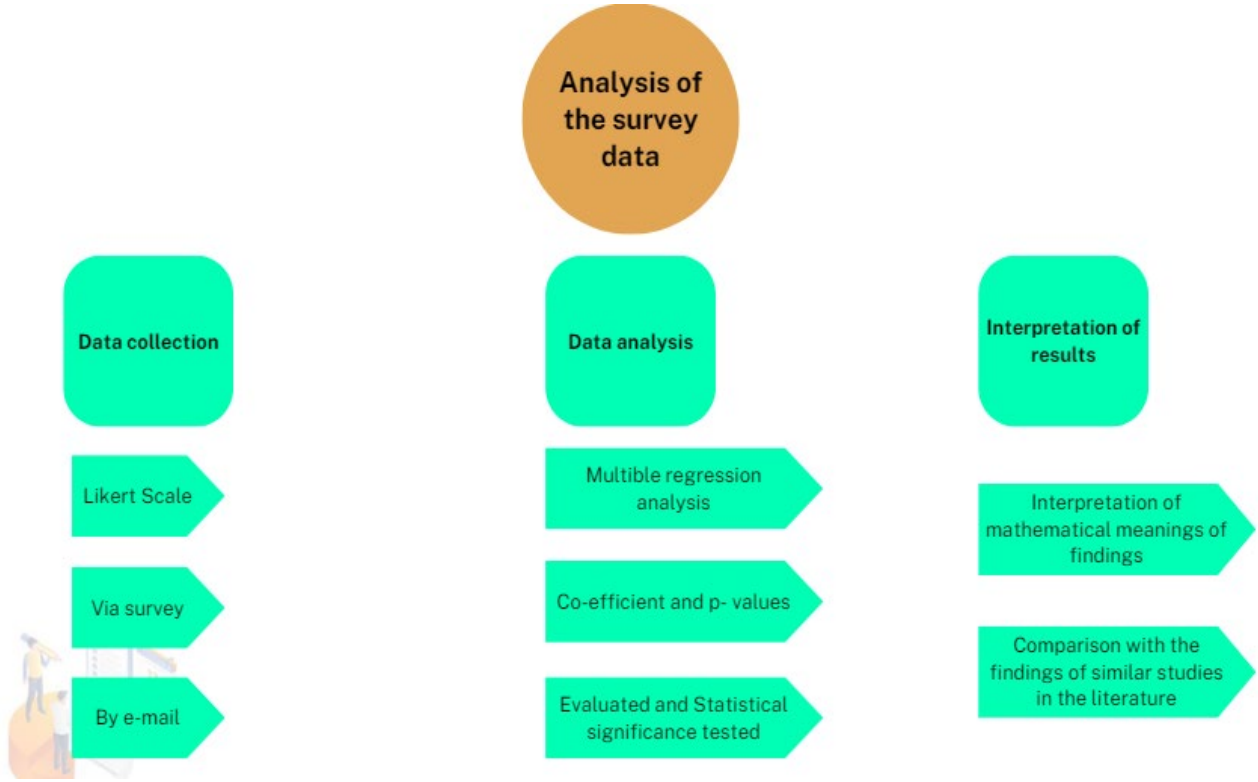

Figure 2. Diagram of the analysis of survey data

4.3. Questionnaire Form

The questionnaire utilized in this study was designed to assess the effects of digital fatigue and mental health among seafarers. It was based on the "Digital Burnout Scale," developed by Erten and Özdemir (2020) in their "Digital Burnout Scale Development Study." Cronbach's alpha (reliability analysis) coefficient was reported to have high internal consistency (0.957). Before administering the questionnaire to seafarers, it was tested for logical compatibility within the maritime context to ensure its relevance. For parametric tests to be applicable, conditions such as the normal distribution of data, random sampling, and similar subgroup variances must be met. However, beyond meeting statistical requirements, it is crucial that the data accurately reflects reality, as the primary purpose of scientific research is to generalize findings about a population by studying a sample representative of that population (Altunışık, 2008).

After the questionnaire was prepared, it underwent a pre-test on a sample of 30 individuals to evaluate its reliability and the consistency of the questions. Cronbach's alpha reliability coefficient was employed to measure this reliability. Cronbach's alpha reliability coefficient was 0.915 in the pre-test. Following this, the finalized questionnaire was distributed to seafarers for data collection.

The questionnaire consists of two main parts, totalling 29 questions. The first section consists of 5 questions aimed at collecting demographic information including age, gender, job position, income status and sea experience. The second part includes 24 questions using a 5-point Likert scale, focusing on factors affecting the digital fatigue and mental health levels of seafarers. Participants are asked to share their views on issues such as digital ageing, digital deprivation and emotional exhaustion. Confidentiality of participants will be maintained throughout the process, and the data collected will be analysed in the findings section of the study.

5. FINDINGS

5.1. Delphi Results

In the group discussions utilizing the Delphi method, participants were asked to evaluate 28 factors affecting digital fatigue and mental health. The experts provided their opinions on these criteria, and all criteria along with their average scores are presented in Table 5. Five criteria with an average score of 4 and above were identified as significant. Among these criteria, factors such as digital screen usage time, digital workload, the impact of sleep patterns, stress management, and the effects of social isolation were found to be crucial for protecting mental health. This process helped establish the main variables of the study.

As indicated in Table 5, digital screen usage time (4.50) and digital workload (4.33) emerged as key contributors to digital fatigue. In contrast, the effects of stress management (4.37) and sleep patterns (4.75) were highlighted as crucial for maintaining mental well-being. Additionally, the impact of social isolation (4.58) was noted as a significant concern, further emphasizing the relevance of digital-related work environments to seafarers' mental health. These five factors were identified as the most critical regarding digital fatigue and mental health, forming the core areas for further analysis in this research. Table 5 provides a detailed breakdown of these findings, including the means, standard deviations, and quartile distributions of the key variables. This statistical analysis offers a clearer understanding of the factors contributing to digital fatigue and their relationship to seafarers' mental health.

Table 5. Scoring of criteria as a result of delphi survey

Criteria	Means	Standard deviation	Q_3%75	Median	Q_1%25	Quarter width
Sleep patterns	4.75	0.62	5	5	5	0
Digital display Duration of use	4.50	0.67	5	5	4	1
Type of digital devices	3.08	0.67	3.75	3	3	0.75
Digital workload	3.25	1.29	4.75	3	2.25	2.5
Use of artificial intelligence and automation	3.59	0.77	4	4	3	1
Personal information security concerns	3.17	0.72	4	3	3	1
Working hours and overtime	3.92	0.90	4.75	4	3.25	1.5
Accessibility of digital communication tools	3.17	0.72	4	3	3	1
Internet connection quality	3.42	1.00	4	3	3	1
Business processes and procedures	2.75	0.87	3	3	2	1
Outdoor activities	3.07	0.66	3.76	3	3	0.75
Outdoor or indoor work	3.58	0.79	4	4	3	1
Personal support systems	3.25	1.29	4.75	3	2.25	2.5
Stress management effect	4.37	0.64	5	4	4	1
Access to psychological support training and development	3.21	0.71	4	3	3	1
Opportunities	3.92	0.90	4.75	4	3.25	1.5
job satisfaction	3.41	0.75	4	3	3	1
Job security concerns	3.28	0.72	4	3	3	1

Table 5. Scoring of criteria as a result of delphi survey (continued)

Mental health status	2.83	0.72	3	3	2	1
Working groups and team dynamics	3.42	1.00	4	3	3	1
Management and leadership style	3.92	0.90	4.75	4	3.25	1.5
Device usage time	3.17	0.72	4	3	3	1
Digital communication intensity	3.21	0.73	4	3	3	1
Digital technology proficiency level	3.41	0.75	4	3	3	1
Digital workload	4.33	0.89	5	5	3.25	1.75
social isolation	4.58	0.67	5	5	4	1

5.2. Demographic Structure

The questionnaire used in this study was administered to 150 participants to assess the effects of digital fatigue and mental health among seafarers. According to Dolsen and Maclis (1991), a response rate exceeding 65% from questionnaires sent to participants is considered sufficient for meaningful contributions to survey studies. In this research, a target of at least 200 seafarers was set, and a response rate of 75% was achieved, resulting in 150 completed responses. This sample size is deemed adequate for interpreting the findings. Additionally, Tavşancıl and Keser (2002) state that the sample size for applying factor analysis should be at least five times the number of items on the scale. With 20 questions in the questionnaire, the sample size comfortably surpassed the minimum requirement of 100 participants.

Demographic information about the participants and findings related to digital device usage are presented in Table 6. The table 6 reveals that the majority of respondents (40%) fall within the 26–35 age group, with a significant male representation (70%). Participants' roles varied, with most being deck or engine officers (40%), followed by chief engineers (35%). Notably, 45% of participants had less than five years of experience, indicating a relatively young workforce among the sample.

Table 6. Demographic information

Demographic criteria	Options	Percentage (%)
Age group	18-25	30
	26-35	40
	36-45	30
Gender	Female	30
	Male	70
Working position	Master	25
	Chief engineer	35
	Deck/Engine officers	40
Experience duration	0-5 year	45
	6-10 year	30
	11 year and over	25
Income status	High	30.5
	Middle	69.5

The analysis of the factors related to screen usage time, stress management, social communication, digital workload and sleep patterns, which are the titles of the main sections of the survey, according to the findings of the survey, is given in Table 7 with explanations.

Table 7. Explanation of the factors according to the survey results of the analysis.

Factor	Description
Digital screen usage time	35% of the participants use digital devices for an average of 4-6 hours a day, 30% for 1-3 hours, 20% for 7-9 hours, and 15% for more than 10 hours. The most frequently used digital devices are computers (80%), smartphones (65%), and tablets (40%).
Stress management	60% of the participants stated that they have been frequently feeling stressed recently, while 25% mentioned that they experience this occasionally. Regarding the effect of digital device use on mental health, 55% of the participants indicated that this effect is at a moderate level, while 25% reported it as being very high. Attention deficit" was found by 65%. The rate of those who said they were stressed was 52.3%.
Social isolation	35% of the participants stated that social isolation in digital technologies is at a moderate level. The other 65% of the participants stated that it is at a low level. Feel lonely when they do not have their digital devices is %31. The rate of those who feel restricted is 35%.
Digital workload	40% of the participants evaluated the workload as intense. 35% of the participants who evaluated the effect of task variety found this very impressive.
Sleep patterns	65% of the participants stated that sleep disorders are high. It was stated that 25% of them were normal and 10% of them had the highest level of sleep disturbance.

The key factors examined in the questionnaire—digital screen usage time, stress management, social isolation, digital workload, and sleep patterns—are critical in understanding digital fatigue and its impact on mental health. These factors are explored in Table 7, which provides detailed explanations based on the survey results. About 35% of the participants reported using digital devices for an average of 4–6 hours per day, while 15% indicated usage of over 10 hours per day. The findings revealed that 60% of participants frequently felt stressed, with 55% attributing this to digital device usage. Social isolation was reported as a moderate issue by 35% of participants, though the majority (65%) rated it as a low-level concern. This discrepancy suggests that while digital technology can contribute to isolation, it may not be the most pressing issue for most respondents. As an important finding in table 7, 65% of the respondents agreed or strongly agreed with the question "I have attention deficit". Similarly, the rate of those who said that they felt stressed was 52.3%. The number of people who felt restricted was 35%. The number of respondents who said that they feel lonely when they do not have their digital devices (phone, tablet, computer, etc.) with them is 31%. Around 40% of participants rated their digital workload as heavy, with 35% indicating that the diversity of tasks was a significant factor in contributing to mental strain. This shows that while workload is a key stressor, task variety also plays a crucial role in overall digital fatigue. The survey found that 65% of participants experienced significant sleep patterns, underscoring the strong connection between digital device use and sleep disruption.

5.3. Regression Analysis Results

Regression analysis was conducted to examine the relationship between digital device use and mental health status. In order to utilize Formula (1), the values included as independent variables have the following meanings. Independent variables β_0: constant term (average mental health score), β_1: Effect of Digital Screen usage time, β_2: Effect of digital workload, β_3: Effect of sleep pattern, β_4: Effect of stress management, β_5: Effect of social isolation, $\in$: Error term. The effects of the values determined in the questionnaire and the independent variables calculated with the help of formula (1) on mental

health are presented in Table 8 in single, double, triple, quadruple and quintuple combinations.
The analysis results show that there is a negative relationship between digital screen usage time and mental health status, but stress management has a positive effect. For example, each hour increase in screen time decreases the mental health score by an average of 0.15, while a unit increase in stress management increases the mental health score by an average of 0.30. The findings also highlight that digital workload, and social isolation had less of an impact individually, but when combined with screen usage time and other variables, they contributed to a more significant overall effect on mental health. For example, the combination of digital screen usage time, workload, and sleep patterns resulted in a larger decrease in mental health scores (-0.35), whereas the inclusion of stress management in the analysis mitigated this effect (-0.05).

Table 8. The effects of independent variables on mental health

$\boldsymbol{\beta_n}$	(betaβ)	$\boldsymbol{\beta_n}$	(betaβ)	$\boldsymbol{\beta_n}$	(betaβ)	$\boldsymbol{\beta_n}$	(betaβ)	$\boldsymbol{\beta_n}$	(betaβ)
Digital screen usage time	-0.15	Digital screen usage time and digital workload	-0.25	Digital screen usage time, digital workload and sleep patterns	-0.35	Digital screen usage time, digital workload, sleep patterns and stress management	-0.05	Digital screen usage time, digital workload, sleep patterns, stress management and social isolation	-0.10
Digital workload	-0.05	Sleep patterns and stress management	0.20	Stress management, social isolation and digital screen usage time	0.10				
Sleep patterns	-0.10	Social isolation and digital screen usage time	-0.20						
Stress management	0.30								
Social isolation	-0.05								

6. DISCUSSION

In this study, the results of the survey study, Delphi and regression analysis conducted to determine the effects of various factors on the digital fatigue and mental health of seafarers support the information in the literature. The survey results show that digital fatigue and mental health problems increase with the increase in the use of digital devices by seafarers. These findings confirm the relationship between digital fatigue and psychological health, which was previously revealed in the studies conducted by Febreza and Junaidi (2022). The findings obtained as a result of the Delphi analysis list the important criteria on the mental and physical health of seafarers. In the first place, sleep patterns play a critical role in seafarers' healthy lives, as long working hours and irregular watchkeeping can negatively affect sleep quality (acc. table 5). Social isolation comes second, emphasizing that isolated working conditions on the ship for long periods create psychological pressure and threaten individual well-being. The third criterion, the level of digital technology workload, shows the importance of employees being able to use these technologies effectively with the spread of digitalization in modern

maritime activities. The stress management effect reveals how vital seafarers' ability to cope with stress is in managing the challenges and workload encountered on board (acc. table 5). While digital screen usage time stands out as a factor affecting employees' mental and physical energy, digital device screen usage reveals the effects of continuous screen work on digital fatigue and health (acc. table 5). These findings show that the maritime sector offers a wide range of improvement opportunities from digital skills to social support systems to increase the performance and well-being of employees. According to Table 7, the most used devices included computers (80%), smartphones (65%), and tablets (40%), suggesting that the high digital screen usage contributes significantly to the participants' daily activities and, potentially, to their fatigue levels. This highlights the moderate to high impact that digital environments have on mental health, particularly concerning stress levels. According to table 7, sleep patterns emerged as one of the most critical factors affecting both digital fatigue and overall mental health. In the row under the stress management heading in Table 7, 65 percent of respondents admitted to suffering from attention deficit disorder, highlighting the potential negative effects of digitalization on individuals. This finding suggests that digital fatigue or distraction from constant digital interaction is common. Similarly, stress management was mentioned under stress management and 52.3 percent of respondents reported feeling stressed, indicating that digital technologies can be a stressor in everyday life. The constant connectivity of the digital environment can cause pressure and stress on individuals. Another important finding under the row titled social isolation in Table 7 is that 35 percent reported feeling restricted by digital devices. This shows that digital devices can create a sense of obligation instead of freedom. Thirty-one percent of the participants stated that they felt lonely when their digital devices were not with them. This finding sends an important signal about developing digital addiction and excessive emotional attachment to devices. Feeling lonely without devices indicates the degree of emotional attachment to the digital world. These findings provide important data that draw attention to the possible effects of digitalization on individuals' mental health. Delphi analysis provided a critical method to identify the factors that digital fatigue most affects seafarers' mental health. In particular, criteria such as sleep patterns, social isolation and digital workload were found to be important in protecting seafarers' mental health. For example, the negative relationship between long screen time and sleep disturbances may increase the risk of distraction and work accidents. In maritime operations, practical applications such as regulating watchkeeping hours and limiting screen time can reduce these risks. These findings show that certain criteria directly contribute to operational safety and employee health in the maritime sector.

In the regression analysis, it was seen that digital screen usage time had the highest impact. In addition, it was determined that stress management has a positive and positive effect on mental health if it is done well (acc. table 8). Stress management factor has the highest positive effect with 0.30. This indicates that stress management plays a more significant ameliorative role on seafarers' mental health compared to other factors. As seen in Table 8, stress management has the potential to offset the negative effects of other factors such as digital screen time, digital workload and social isolation. If this factor is not managed effectively, the negative effects on seafarers' mental health can be exacerbated, leading to decreases in work productivity, burnout syndromes and long-term health problems. Therefore, prioritizing stress management and supporting seafarers in this regard plays a critical role in reducing digital fatigue and other psychosocial risks. Another prominent result in this study is that maritime companies should support seafarers, especially on stress. In addition, it was seen that the interactions between screen time and digital workload have a significant effect on mental health. Each additional unit of screen time and digital workload combined significantly declines mental health (acc. Table 8). This situation shows that the digital fatigue experienced by seafarers because of prolonged screen use negatively affects their psychological health. Previously,

Ahsan *et al.* (2019) also showed a strong relationship between constant digital device use and stress and anxiety levels in their study on university students.

The findings of this study support and expand on previous research that has examined the link between digital fatigue and seafarers' mental health in depth. For example, Fan *et al.* (2020) reported that digital device use negatively affects mental health by increasing distraction and stress levels. This study makes a significant contribution to the existing knowledge by offering a perspective that also highlights the impact of digital fatigue on operational performance, especially in the maritime sector. These findings reveal that digitalization in maritime should be carefully considered not only in terms of productivity but also employee health.

Similarly, the effects of digital screen usage time, digital workload and sleep patterns on mental health are also clear. This four-variable effect increases the mental health score negatively by 0.35 (acc. Table 8). This result indicates that sleep disorders, screen time and digital work concepts worsen the psychological state of seafarers. In the literature, it has been stated in Alonso *et al.* (2016) that sleep quality has significant effects on work performance and general quality of life.

In this study, the relationship between social isolation and digital device use was also found to be significant. Reducing social isolation is effective in reducing the digital fatigue levels of seafarers. This study reveals that determined that social isolation has negative effects on the mental health of seafarers, which has not been revealed in studies outside of maritime. This criterion emerged as a different feature of the study from other studies. Unlike previous studies, this research identifies social isolation as a significant contributor to digital fatigue in maritime settings. Maritime companies can improve digital fatigue and mental health by effectively implementing stress management and psychological support systems. Companies can provide regular psychological counselling, especially for seafarers working on long-term assignments. They can also monitor the frequency of use of digital devices and offer digital detox days at certain intervals. For example, planning activities that increase social interaction of personnel on board can contribute to reducing social isolation. Such practices not only increase the mental resilience of seafarers, but also improve work performance. In this context, monitoring the long-term impact of stress management programs and support systems allows maritime companies to create a healthier work environment.

7. CONCLUSION

This study aimed to determine the effects on digital fatigue and mental health of seafarers. The findings obtained through the survey study and regression analysis show that the mental health of seafarers is negatively affected by the increase in digital device use.

Digital fatigue directly impacts seafarers' mental health, leading to reduced job performance. The regression analysis reveals that these relationships are statistically significant and that the 5 factors identified as a result of the Delphi method have significant effects on mental health. In particular, the relationship between digital device use time and mental health stands out as an important finding that should be noted.

In addition, this study concluded that factors such as social isolation, sleep patterns and stress management also affect the mental health of seafarers. This study determined that social communication plays an important role in reducing digital fatigue and improving mental health. In this context, it is emphasized that strategies should be developed to support the psychological health of individuals working in the ship industry. In maritime applications, flexible working hours that support sleep patterns can be created in watchkeeping planning to reduce digital fatigue. In order to reduce social isolation, it is important to develop technological infrastructures that will allow crew members to communicate regularly with their friends and families. In addition, psychological support programs can be organized at regular intervals to support the stress management skills of ship crew.

This study determined that factors such as digital screen time and digital communication intensity

negatively affect mental health in seafarers. The data obtained show that prolonged screen use in particular causes distraction and concentration difficulties. For example, a crew member who is distracted by intense screen use may miss a critical detail while monitoring navigation systems. Similarly, prolonged digital exposure can increase the response time to alarm systems, which can lead to incorrect or delayed decisions in emergency situations. Social isolation and disruptions in sleep patterns also have a negative impact on mental health; this reduces both the daily work performance and the general quality of life of the crew.

The intensive use of digital devices, the necessity to be constantly online, the pressure of communication and the uninterrupted flow of information trigger digital fatigue, which causes psychological problems such as distraction, stress and burnout in seafarers. Especially in isolated working environments such as ships, the deepening of these problems can weaken decision-making processes and increase the risk of accidents. Inattention, incorrect interventions and wrong decisions due to mental fatigue and stress can lead to ship accidents. Therefore, it should not be ignored that digitalization is a factor that indirectly affects accidents in the maritime sector. This study makes significant contributions to the literature on digital fatigue and mental health of seafarers and reveals the need for further research in this area.

Based on the findings of this study, solution suggestions are given below.

-Limiting and regulating the digital device usage time of the personnel working on ships can reduce digital fatigue. Eye strain and mental fatigue can be prevented by taking breaks instead of prolonged exposure to digital devices during work.

-Social communication support programs can be developed to prevent social isolation of ship personnel. More frequent communication with friends and family can strengthen psychological well-being.

-Digital tools can be made more user-friendly for ship personnel to feel less digital fatigue. Software and devices with simple, fast and easy interfaces can reduce digital stress.

There are some limitations in this research. Among these limitations are the limited sample and the use of a single survey method. The time factor was ignored as the study collected data over a specific period. Long-term studies are needed to understand how changes in seafarers' digital fatigue and mental health evolve over time. External factors that have an impact on digital fatigue and mental health have been addressed in a limited way in this study. For example, seafarers' social life, sources of stress other than work intensity and factors in their personal lives could be examined more comprehensively. In addition, only Turkish seafarers were included in the sample.

Future studies can deepen these findings and provide more comprehensive data to determine strategies for protecting and improving the health of seafarers. It is important to monitor the effects of seafarers' use of digital devices on their mental health in the long term. In this context, longitudinal studies can be conducted to observe how the effects of digitalization change over time. More effective stress management and psychological support programs should be developed for seafarers who experience digital fatigue and mental health problems. Studies on this subject may provide recommendations for maritime companies. Future studies could examine the effects of digital devices and business processes on maritime operational efficiency in relation to mental health. While digitalization is hypothesized to improve business performance, how these processes also affect seafarers' psychological well-being could be explored. Besides this, future research could examine the long-term effects of digital fatigue on seafarers' work efficiency. In addition, the effects of demographic differences could be revealed in more detail by investigating the levels of digital fatigue experienced by seafarers of different age groups and experience levels.

The findings of this study underscore the critical need for industry-wide policies aimed at monitoring and managing digital fatigue among seafarers. Given the strong correlation between digital fatigue and mental health issues, it is imperative that maritime companies and regulatory bodies implement measures to protect seafarers' well-being. This includes establishing guidelines to limit screen time, promoting better

sleep patterns, and providing psychological support services on board. Such policies could not only improve the mental health of seafarers but also enhance operational safety, reducing the risk of accidents linked to cognitive overload and distraction. Ultimately, these changes could lead to a healthier, more productive workforce, ensuring safer and more efficient maritime operations.

As a result, protecting the health of seafarers in the digital age is of critical importance for increasing efficiency in the sector and ensuring workforce sustainability.

AUTHORSHIP CONTRIBUTION STATEMENT

Ozan Hikmet ARICAN: Conceptualization, Methodology, Validation, Formal Analysis, Resources, Writing - Original Draft, Writing-Review and Editing, Data Curation, Software, Visualization, Supervision, Project administration

CONFLICT OF INTERESTS

I declare that this article has no real, potential or perceived conflict of interest.

ETHICS COMMITTEE PERMISSION

I declare that this study was conducted in accordance with the procedures of the ethics committee for human or animal experiments. Ethics committee approval was obtained with the decision number 21 (E-94094268-200-655429) taken at the meeting of Kocaeli University Social and Human Sciences Ethics Committee dated 20/09/2024 and numbered 2024/09.

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