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Effects of the COVID-19 pandemic on the mental health of seafarers: A comparison using matched samples

Birgit Pauksztat^{a,*}, Daniela M. Andrei^b, Michelle R. Grech^c

^a Uppsala University, Sweden

^b Future of Work Institute, Curtin University, Australia

^c University of Queensland, Australia

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ABSTRACT

The COVID-19 pandemic and the measures implemented to curb its transmission have altered workplaces and challenged occupational health and safety in unprecedented ways, with high levels of mental distress reported across several industries. In the maritime industry, occupational health and safety risks, including psychosocial risks, were a concern already before the COVID-19 pandemic. However, knowledge about the prevalence of mental health problems and the factors associated with them is still limited. The purpose of this study was to investigate the impact of the COVID-19 pandemic as well as the effects of respondent and work-related characteristics on seafarers' self-reported symptoms of depression and anxiety. Data came from two cross-sectional convenience samples of seafarers on international commercial vessels, surveyed before ($N_{\text{pre-pandemic}} = 793$) and during the pandemic ($N_{\text{pandemic}} = 504$). Matching the two samples on respondent and work-related characteristics using propensity scores, we found that the pandemic contributed to significantly higher levels of depression and anxiety. Further analyses showed that seafarers with longer work periods, those who had been on board longer than expected, and those working on vessels registered with "Flags of Convenience" reported significantly higher levels of both depression and anxiety during the pandemic, but not prior to the pandemic. Taken together, these findings suggest that the impact of the COVID-19 pandemic led to a deterioration of working conditions and increased mental health risks for seafarers. Practical implications for safe-guarding occupational health and safety during this and future crises are discussed.

"I'm already sixth month on a board, with winter trading of the vessel to Iceland through the stormy weather my forces and willingness to be ready to keep the duties are reducing every hour and every day. If the situation with crew rotation will not come effective very soon, only God knows what can be happened due to fatigue of mind, body, soul ..."

(Seafarer, quoted in [Sliskovic, 2020, p.804](#))

1. Introduction

Mental health is a serious issue in organizations all over the world. For example, the [UK Health and Safety Executive \(n.d.\)](#) reports that of the 38.8 million workdays lost in 2019/2020 due to work-related ill health and non-fatal work injuries, almost half (17.9 million) were due to mental health issues such as stress, depression and anxiety. It is not surprising then that the economic costs of mental ill health are estimated

to be high, with the most common mental health problems such as depression and anxiety estimated to cost the global economy US\$ 1 trillion each year ([The Lancet Global Health, 2020](#); see also [Gaillard et al., 2020](#)).

Even before the COVID-19 pandemic, it was widely acknowledged that seafarers were at a higher risk of ill-health and work-related injuries and fatalities than employees in shore-based occupations ([Jepsen et al., 2017](#); [Poulsen et al., 2014](#); [Roberts, 2002](#)). While some studies indicate that seafarers may also be at a high risk of mental ill-health ([Lefkowitz and Slade, 2019](#); [Sampson and Ellis, 2020](#)), we know little about seafarers' mental health and the factors contributing to it. In fact, recent research has pointed towards the inadequacy of the evidence base concerning the prevalence and the risk factors for mental health problems in the maritime industry ([Mellbye and Carter, 2017](#); [Sampson and Ellis, 2020](#)), as well as the lack of systematic comparisons with other

* Corresponding author. Department of Business Studies, Uppsala University, Cramérgatan 3, 62157 Visby, Sweden.

E-mail addresses: birgit.pauksztat@fek.uu.se (B. Pauksztat), daniela.andrei@curtin.edu.au (D.M. Andrei), m.grech@uq.edu.au (M.R. Grech).

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sectors or over time (Sampson and Ellis, 2020).

The impact of the COVID-19 pandemic has exacerbated some of the pre-existing challenges, while also posing new challenges for the maritime industry (Shan, 2021). For instance, measures implemented to reduce the spread of the virus, such as border closures and travel restrictions, have affected crew changes (Doumbia-Henry, 2020; Shan, 2021) and contributed to seafarers' time on board being extended even further, at times beyond the legally permitted maximum length (Coutroubis et al., 2020; Hebbbar and Mukesh, 2020). Shore leave was further restricted or not permitted at all in many ports (Doumbia-Henry, 2020; Hebbbar and Mukesh, 2020; Shan, 2021). This made it difficult to get medical assistance and supplies or carry out repairs and maintenance work (Doumbia-Henry, 2020; Hebbbar and Mukesh, 2020; Shan, 2021). Additional challenges included the fear of infection, uncertainty, job insecurity, and concerns about the well-being of family and friends at home (Coutroubis et al., 2020; Shan, 2021; Sliskovic, 2020).

Evidence from other sectors suggests that the additional challenges brought by the pandemic have negative consequences for employees' ability to cope (Juvet et al., 2021), and contribute to increasing rates of mental health problems such as anxiety, depression, and Post Traumatic Stress Disorder (PTSD) (Salazar de Pablo et al., 2020; Sheraton et al., 2020). While many of these studies relate to employees in the healthcare sector or the general population, there is some emerging evidence that seafarers also experienced high levels of psychological distress, depression and anxiety during the COVID-19 pandemic (Baygi et al., 2021; Qin et al., 2021). However, given the country-specific (Qin et al., 2021) or company-specific (Baygi et al., 2021) samples and the cross-sectional design of these studies, existing evidence does not allow systematic comparison with pre-pandemic levels. Hence it is unclear whether the impact of the COVID-19 pandemic has actually increased mental health problems among seafarers compared to pre-pandemic levels.

In sum, there is little systematic evidence about seafarers' mental health, how it is affected by the COVID-19 pandemic and the role of respondent and work-related risk factors. Therefore, the purpose of this study is, first, to provide empirical evidence on the effects of the COVID-19 pandemic on the mental health of seafarers, taking into account the pre-pandemic levels of mental health in this sector. A second aim is to investigate the effects of respondent and work-related characteristics on seafarers' mental health. The focus will be on depression and anxiety, which are considered the two most widespread mental health problems (Kroenke et al., 2009; Sampson and Ellis, 2020). Data came from two large scale surveys of seafarers on international commercial vessels, one conducted in 2015–2016 and one in 2020.

This study contributes to a more systematic understanding of mental health problems such as anxiety and depression among seafarers by studying them over time using large-scale multinational samples. First, our study provides insights into the effects of the COVID-19 pandemic on seafarers' mental health. Approximating the conditions of a natural experiment, a strength of our study is the use of propensity score matching to compare the responses of seafarers during the pandemic with those of a pre-pandemic control sample. Findings indicate that the COVID-19 pandemic led to a significant increase in participants' self-reported symptoms of depression and anxiety. More generally, these findings also add to our knowledge of the impact of the COVID-19 pandemic beyond the healthcare sector (Salazar de Pablo et al., 2020).

Second, our study provides insights into respondent and work-related risk factors for seafarers' depression and anxiety. Comparing risk factors before and during the COVID-19 pandemic provides a more nuanced perspective of the factors that put seafarers at risk for negative mental health outcomes (Sampson and Ellis, 2020). More specifically, our findings highlight the importance of industry practices related to length of time on board and working conditions and indicate that their effects may be exacerbated during crises such as the COVID-19 pandemic.

2. Seafarers' mental health and the impact of the COVID-19 pandemic

In the context of an increased awareness about the importance of mental health and well-being at work, issues related to psychosocial risks experienced by seafarers have recently gained more traction. Unfortunately, empirical evidence on the prevalence of mental health problems experienced in this industry, especially compared to other populations, is scarce, fragmented and inconsistent (Mellbye and Carter, 2017). One reason for this are the difficulties in collecting data systematically from seafarers as they are a heterogeneous, remote, and dispersed population (Sampson and Ellis, 2020).

The available evidence provides some support for the idea that seafaring is an occupation that puts employees at a higher risk of mental health problems compared to other occupational groups (Hemmingsson et al., 1997; Lefkowitz and Slade, 2019; Sampson and Ellis, 2020). Based on a comprehensive study, Lefkowitz and Slade (2019) argued that with 25% of participating seafarers reporting scores indicative of depression and 17% reporting scores indicative of anxiety, the prevalence of both depression and anxiety was higher than in other working populations such as oil and gas workers. Further, in one of the few longitudinal studies available, Sampson et al. (2017) showed that short term mental health problems had increased in the 2011–2016 period for seafarers, with 37% indicating in 2016 that they had experienced a recent onset of mental health deterioration. These figures were worse than most studies on general populations, leading the authors to conclude that the deterioration of the mental health of seafarers was a cause for serious concern.

According to theories of organizational stress, such as the Job Demands-Resources (JD-R) model (Demerouti et al., 2001), demanding aspects of work can deplete employees' resources and energy, thus increasing the risk of physical and mental health problems (Bakker and Demerouti, 2007). Job demands are "physical, social, or organizational aspects of the job that require sustained physical or mental effort and are therefore associated with certain physiological and psychological costs (e.g., exhaustion)" (Demerouti et al., 2001, p. 501). Job resources are characteristics of the job that support employees in achieving goals, stimulate employee development, or reduce the levels of job demands and the costs associated with them (Demerouti et al., 2001). In the maritime context, characteristics of the profession (e.g., isolation, loneliness, separation from family, lack of shore leave), industry characteristics (e.g., job insecurity, long periods of time on board), and work design factors (e.g., physical aspects of work, shift-work, workload) are well-known job demands (Jepsen et al., 2017; Mellbye and Carter, 2017; Österman et al., 2020). As discussed earlier, the COVID-19 pandemic, together with the measures aimed at containing it, can be expected to increase the demanding aspects of the job or even introduce new demands (Shan, 2021), with negative consequences for the mental health of seafarers.

Indeed, empirical support is starting to emerge around the negative effects of the COVID-19 pandemic for mental health outcomes in the general population as well as in specific industries. Meta-analytic and review data indicate that the pandemic has had a strong impact on the levels of psychosocial distress experienced by frontline employees (Salazar de Pablo et al., 2020) as well as the general population, with more than half of the surveyed population experiencing poor mental health (Salas-Nicás et al., 2021; Ruiz-Frutos et al., 2021). However, more systematic comparisons that take into consideration pre-pandemic levels of mental health and well-being paint a more complex picture. Sibley et al. (2020), using propensity matched samples across a range of industries, found mixed effects in relation to mental health and well-being measures. While their results indicate increased levels of mental distress during the pandemic, the effects were not as strong as initially expected and did not extend to other indicators of well-being (e.g., rumination, felt belongingness, perceived social support, life satisfaction, subjective health assessment).

While the evidence around the impact of the COVID-19 pandemic in the general population or occupations such as healthcare is starting to accumulate, this is not the case for the maritime industry. Emerging evidence is sparse and less systematic, but points toward negative impacts of the current crisis on seafarers' mental health and well-being. Baygi et al. (2021), in a cross-sectional study of 439 international seafarers, found a high prevalence of psychiatric disorders, depression and anxiety. Moreover, length of time on board was associated with increased risk of depression. A qualitative study (Sliskovic, 2020) of a large sample of 752 seafarers identified threats to mental, physical and social well-being as the most common themes for seafarers located on board, while seafarers at home focused on threats to their economic well-being. Coutroubis et al. (2021, p. 22) reported that the majority of their cross-sectional sample of commercial seafarers felt "more isolated from the rest of the world" during the pandemic and were concerned about "fellow crew members' mental stress" and their own future employment. However, none of these studies included comparisons with pre-existing levels of these symptoms before the pandemic. This makes it difficult to disentangle the effects of the current pandemic from effects of typical occupational risk factors.

Taken together, existing studies suggest that the wide array of challenges caused by the COVID-19 pandemic may add to the high level of stressors already existing in maritime workplaces prior to the pandemic, thus producing a fertile environment for mental health problems such as anxiety and depression. Therefore we hypothesize:

Hypothesis 1. Mean levels of depression reported by seafarers during the COVID-19 pandemic will be higher compared to mean levels of depression in the pre-pandemic sample.

Hypothesis 2. Mean levels of anxiety reported by seafarers during the COVID-19 pandemic will be higher compared to mean levels of anxiety in the pre-pandemic sample.

3. The role of respondent and work-related characteristics

The second aim of our study was to investigate respondent and work-related predictors of mental health problems experienced by seafarers before and during the COVID-19 pandemic. While the pandemic might be generating increased levels of mental health problems for seafarers compared to pre-pandemic levels, existing data on the effects of the pandemic across occupations, as well as on pre-existent psychosocial risks in the maritime industry suggest that factors at the individual level, at the job level and beyond can play a role in shaping both pre-existing risk for mental health problems as well as additional risks factors related to the pandemic. In fact, a recent review on seafarers' depression and suicide concluded that one of the most consistent findings in this area is the fact that there are variations in the mental health of seafarers depending on respondent and work-related factors (Mellbye and Carter, 2017). What is less clear is if and how these factors affect seafarers' mental health during the pandemic, and whether their pattern of associations with seafarers' mental health is changed by the unfolding crisis. Therefore, in this study we took an exploratory approach to compare how respondent and work-related factors are associated with symptoms of depression and anxiety reported by seafarers before and during the pandemic.

In line with the JD-R model (Bakker and Demerouti, 2007), research in the maritime industry indicates that both respondent and work-related factors are associated with increased psychosocial risks for seafarers. With regard to seafarers' depression and anxiety, previous studies show that seafarers with less experience are more likely to report symptoms of depression (Lefkowitz and Slade, 2019). Further, female seafarers reported higher levels of depression than male seafarers (Lefkowitz and Slade, 2019), perhaps because working in a male-dominated occupation exposes them to additional risks such as discrimination or harassment (Mellbye and Carter, 2017). Last but not least, although issues related to language and culture may be relevant for understanding

seafarers' mental health, there is little systematic research on their actual impact (Carter et al., 2020; Mellbye and Carter, 2017).

In terms of work-related factors, hierarchical level on board was shown to be associated with indicators of mental health problems such as anxiety and depression (Carotenuto et al., 2013; Jegaden et al., 2019; Lefkowitz and Slade, 2019). Department and ship type also show significant associations with mental health problems (Carotenuto et al., 2013; Lefkowitz and Slade, 2019). In addition, industry reports (Australian Maritime Safety Authority, 2020; Paris MoU on Port State Control, 2020) suggest that there might be differences between flag states. Flag states have primary jurisdiction over ships registered under their flag and are responsible to certify that these ships meet international obligations on safety, crewing and pollution prevention. However, to our knowledge, potential associations between flag state and mental health have not been reported in studies to date.

Emerging studies focusing on the effects of the COVID-19 pandemic in seafaring as well as other occupations also point towards the idea that respondent and work-related characteristics can play a role in how people experience the pandemic and respond to the challenges posed by this global crisis. For example, Baygi et al. (2021) identify respondent characteristics such as age, marital status and work-related factors such as the length of stay on board and hierarchical level as having significant associations with the severity of depression, anxiety and stress symptoms reported by seafarers during the COVID-19 pandemic.

However, a closer analysis of existing evidence indicates that the reported patterns of associations between respondent and work-related factors and indicators of seafarers' mental health problems are often inconsistent across studies and time. For example, Lefkowitz and Slade (2019) found that anxiety was higher among deck personnel than among engine personnel, whereas Carotenuto et al. (2013) found that anxiety was higher among engine personnel than among deck personnel. Similarly, while Carotenuto et al. (2013) found ratings and non-officers to be at increased risk for stress related problems, Oldenburg and Jensen (2019) identified officers as the category at the highest risk. This could be due to changes in the nature of work, contracts, and available technology (Mellbye and Carter, 2017) but a crisis of the magnitude of the COVID-19 pandemic might further shape or change these patterns of association. As systematic evidence around these associations and the way they might have been impacted by the pandemic is virtually non-existent, in the present study we set out to investigate the role of respondent and work-related risk factors.

Research Question 1. What is the effect of respondent and work-related factors on seafarers' depression?

Research Question 2. What is the effect of respondent and work-related factors on seafarers' anxiety?

4. Methods

4.1. Procedure

The data for this study come from two cross-sectional surveys of seafarers on international commercial vessels. Survey A was conducted in 2015–16 before the COVID-19 pandemic. Survey B was conducted during the COVID-19 pandemic between 3 July and 25 September 2020. Although the surveys were designed to address different research questions (Survey A: Andrei et al., 2020a,b; Cham et al., 2021), there was sufficient similarity in key measures to allow a joint analysis and comparison in this study.

Both surveys were in English, the working language in the maritime industry. They were available in a web-based version and a paper version (Survey A) and as a web-based survey (Survey B), respectively. Both surveys used a convenience sampling approach to reach seafarers onboard international commercial vessels, distributing the survey as widely as possible through shipping companies, national and international industry organizations, maritime education institutions and

welfare organizations. Survey A was distributed in person by researchers during Port State inspections on vessels calling at ports in Western Australia and Queensland, as well as through partnerships with seafarers' welfare centres, pilots, safety training providers and shipping companies. Survey B was largely promoted online. In some ports, where local conditions permitted, seafarer centres, port chaplains and ITF inspectors helped to promote the survey.

The studies received human research ethics approval from the University of Western Australia Human Research Ethics Committee (RA/4/1/9059) (Survey A) and from the Research Ethics Committee at the World Maritime University (REC-20-27R) (Survey B), respectively. In line with APA ethical guidelines, participation in both surveys was voluntary and responses were anonymous. In Survey A, participants read the information about the study, and indicated their informed consent by their decision to complete and return the survey. In Survey B, respondents provided informed consent at the start of the survey by confirming that they were 18 or older, had read the information about the study and agreed to participate.

4.2. Participants

This study is based on responses from seafarers who worked on international commercial vessels and who, at the time of the survey, had been on board for at least one week. Excluding respondents with missing values on the variables used in the matching and regression analyses left 1297 respondents (Survey A: 793; Survey B: 504) for the analyses in this study.

Table 1 shows respondent and work-related characteristics for respondents overall and for each sample separately. Considering both samples jointly, most of the 1297 respondents were men (96.1%; 17 cases with missing information). 68.1% were from countries in Asia or the Middle East (43.6% were from the Philippines), and 28.1% were European nationals. Respondents were between 18 and 65 years old ($M = 36.8$, $SD = 10.8$; 64 cases with missing information) and had worked at sea between 0 and 47 years ($M = 13.4$, $SD = 10.6$). About half of the respondents (56.6%) were officers, and 55.8% worked in the deck department. According to their contract, 16.0% of the respondents expected to be on board for less than three months, 23.7% for about three to five months, and 60.4% for six months or more. At the time of the survey, respondents had been on board between less than a month and eighteen months ($M = 3.9$, $SD = 3.0$). Respondents worked on container ships (32.2%), bulk carriers (23.4%), general cargo ships (20.2%), tankers (17.1%), as well as on specialized ships (4.1%) and passenger ships (3.0%). 42.6% worked on ships with flags categorized as "Flag of Convenience" (FOC) registers, as defined by the ITF's fair practices committee (ITF, 2020). On average, ships had made between two and three port calls during the last seven days ($M = 2.5$, $SD = 1.5$). However, as shown in Table 1, independent samples *t*-tests showed significant differences between the two samples for all of these variables, except for the percentage of respondents working in the engine department and the actual number of months on board.

4.3. Measures

In this section we describe the measures used in this study. Where measures differed between surveys, we describe the measures used in each survey and how they were recoded and combined for the present study.

4.3.1. Anxiety and depression

As shown in Table 2, each survey included four items that measured symptoms of anxiety and depression. All items were based on established scales, but the wording was simplified and adapted to the seafaring context where pilot tests and discussion with industry experts in the research teams indicated that this would make the wording clearer to respondents.

Anxiety was measured based on the 2-item General Anxiety Disorder scale (GAD-2; Kroenke et al., 2007, 2010). Survey A used only one of the items. Survey B used both items, with Cronbach's $\alpha = 0.85$. For the present study, anxiety was measured using one item (Table 2: Item 1) for Survey A respondents, and by taking the average of the two items (Items 1 and 2) for Survey B respondents.

Our measure of **depression** is based on the 2-item version of the Patient Health Questionnaire (PHQ-2; Kroenke et al., 2003, 2010; Löwe et al., 2005), which is designed to measure the core symptoms of depression, i.e. depressed mood (Table 2: Items 3 and 4) and anhedonia (Item 5). Depressed mood was measured with two items in Survey A (Items 3 and 4) and one item (Item 3) in Survey B. In both surveys, the item measuring anhedonia (Item 5) was phrased positively in the survey, and reverse-coded for the analyses¹. In Survey A, this item was based on the Mental Health Continuum, Short Form (Lamers et al., 2011). In Survey B, it was based on the World Health Organization Wellbeing Index (WHO-5; Topp et al., 2015), which is similar to the PHQ-2 item measuring anhedonia, but phrased positively. Cronbach's α was 0.75 for Survey A respondents, and 0.65 for Survey B respondents. For the present study, depression is the average of the items measuring anhedonia (Item 5) and depressed mood (which in turn is the average of Items 3 and 4 for Survey A respondents, and Item 3 for Survey B respondents).

Respondents were asked to report how frequently they had felt or experienced symptoms of anxiety and depression. Both surveys used 5-point scales from 1 = "never" to 5 = "always" (Survey A) / "every day" (Survey B). In this way, the answer categories were similar, although the reference period was longer in Survey A ("over the past month" than in Survey B ("during the last seven days"). In Survey B, a seven-day period was chosen for increased sensitivity to the potential effects of rapid local, national and international developments during the pandemic. In addition, this increased the number of potential respondents by including seafarers who had only been on board for a short time. Research suggests that recent experiences may be more readily available for recall, and hence more strongly reflected in survey responses than more distant experiences (Tversky and Kahneman, 1974). In line with this, and given that the answer scales in the two surveys had similar end point labels, we treated them as equivalent.

4.3.2. Respondent and work-related characteristics

Respondents' **gender** was measured in both surveys, with options "male" and "female" (Survey A) and "man", "woman", and "other/don't want to say" (treated as missing answer) (Survey B), respectively. For this study, non-missing answers were coded 0 = "man" and 1 = "woman".

Respondents' **nationality** was measured with an open question in both surveys. From this information, we created a binary variable to indicate citizens of countries in Asia (incl. Middle East). In addition, for each country, we created a variable indicating the **life expectancy** (in years) at birth for both sexes combined, for the years 2015–2020, rounded to full years, based on UN mortality statistics (United Nations, Department of Economic and Social Affairs, Population Division, 2019).

Respondents' **age and experience at sea** were measured using an open question in Survey A. For this study, answers were rounded to full years. In Survey B, respondents were asked to select their year of birth and the year when they started to work as a seafarer from a drop-down list. Based on this, we calculated respondents' age (in years) and experience at sea (in years) at the time of the survey.

Respondents' department and hierarchical level was coded based on respondents' answers to a question about their position on board. In

¹ Although reverse-coded items contribute to lower Cronbach's α and a lower fit in confirmatory factor analysis, the surveys intentionally balanced positively and negatively phrased items to reduce the risk of triggering negative emotional responses among respondents.

Table 1
Respondent and work-related characteristics.

	All			Survey A			Survey B			Independent samples <i>t</i> -test
	<i>n</i>	<i>M</i>	<i>SD</i>	<i>n</i>	<i>M</i>	<i>SD</i>	<i>n</i>	<i>M</i>	<i>SD</i>	
Gender (1 = woman)	1280	0.03	0.16	779	0.02	0.12	501	0.04	0.20	<i>t</i> (1278) = -2.65, <i>p</i> = .008
Age	1233	36.79	10.79	778	34.42	10.32	455	40.84	10.39	<i>t</i> (1231) = -10.51, <i>p</i> < .001
Experience at sea	1297	13.40	10.58	793	10.02	8.88	504	18.71	10.87	<i>t</i> (1295) = -15.06, <i>p</i> < .001
Life expectancy	1297	73.63	4.78	793	72.15	3.81	504	75.97	5.21	<i>t</i> (1295) = -14.25, <i>p</i> < .001
Nationality: Asia	1297	0.68	0.47	793	0.85	0.35	504	0.41	0.49	<i>t</i> (1295) = 17.62, <i>p</i> < .001
Hierarchical level	1297	2.48	1.53	793	1.91	1.33	504	3.37	1.38	<i>t</i> (1295) = -18.96, <i>p</i> < .001
Department: deck	1297	0.56	0.50	793	0.50	0.50	504	0.64	0.48	<i>t</i> (1295) = -5.10, <i>p</i> < .001
Department: engine	1297	0.30	0.46	793	0.30	0.46	504	0.29	0.46	<i>t</i> (1295) = 0.20, <i>p</i> = .841
Expected length of work period	1297	5.59	1.32	793	6.19	0.82	504	4.64	1.38	<i>t</i> (1295) = 22.93, <i>p</i> < .001
Months on board	1297	3.89	3.05	793	3.88	2.49	504	3.90	3.76	<i>t</i> (1295) = -0.14, <i>p</i> = .889
Over contract	1297	0.44	0.71	793	0.22	0.47	504	0.78	0.87	<i>t</i> (1295) = -13.14, <i>p</i> < .001
Passenger ship	1297	0.03	0.17	793	0.02	0.14	504	0.05	0.21	<i>t</i> (1295) = -2.69, <i>p</i> < .001
Flag of Convenience	1297	0.43	0.50	793	0.49	0.50	504	0.32	0.47	<i>t</i> (1295) = 6.15, <i>p</i> < .001
Port calls during last seven days	1297	2.53	1.46	793	2.28	1.14	504	2.93	1.78	<i>t</i> (1295) = -7.38, <i>p</i> < .001

Notes: Means and standard deviations based on all available cases. * *p* < .05, ** *p* < .01, *** *p* < .001.

Table 2
Items measuring anxiety and depression.

Item	Survey A	Survey B	Concept
1	Always worrying about something (<i>GAD-2</i>)	Always worrying about something (<i>GAD-2</i>)	Anxiety
2	(-)	Feeling afraid, anxious or nervous (<i>GAD-2</i>)	Anxiety
3	Depressed or hopeless (<i>PHQ-2</i>)	Feeling sad, depressed or hopeless (<i>PHQ-2</i>)	Depression
4	Upset or sad	(-)	Depression
5	Interested in life (<i>MHC-SF</i>)	My days have been filled with things that interest me (<i>WHO-5</i>)	Depression

Note. Wording of items in each survey, with item source in parentheses. *GAD-2* = General Anxiety Disorder scale (*GAD-2*; Kroenke et al., 2007). *MHC-SF* = Mental Health Continuum, Short Form (Lamers et al., 2011). *PHQ-2* = Patient Health Questionnaire (*PHQ-2*; Kroenke et al., 2003). *WHO-5* = World Health Organization Wellbeing Index (*WHO-5*; Topp et al., 2015).

Survey A, this was an open question. In Survey B, respondents selected the appropriate position from a list; the list also included the option “other, what?” where respondents could provide their own description. Based on this, respondents’ hierarchical level was coded “5” for captains, “4” for senior officers, “3” for other officers, “2” for bosuns and foremen, “1” for ratings and “0” for cadets. Further, we coded respondents’ department, distinguishing between deck, engine, galley and other. For the analyses, we used a binary variable (“department: deck”) to distinguish deck officers and deck crew from others (1 = “deck” and 0 = “other”).

The expected length of their current work period according to their contract was measured with an open question in Survey A. In Survey B, respondents indicated the expected length of their current work period on a 7-point scale, with answer categories 1 = “about 2 weeks or less”, 2 = “about 3–4 weeks”, 3 = “about 5–7 weeks”, 4 = “about 8–11 weeks”, 5 = “about 3–5 months”, 6 = “about 6–8 months”, 7 = “9 months or more”, and an additional option “other, what?” followed by an open field. For this study, Survey A responses were coded into the categories used in Survey B.

The actual number of months on board at the time of the survey was measured with an open question in Survey A. In Survey B, respondents were asked to indicate the date when they came on board, and the number of months they had been on board was calculated from this and the survey completion date.

Over contract, a variable measuring respondents being on board longer than expected, was created by comparing the actual number of months on board with the expected length of the work period. The variable was coded “0” for respondents who had not yet reached the expected end of their work period, “1” for respondents who were around the expected end of their work period, and “2” for those who had been on board for longer than expected.

We used the number of port calls as a proxy for workload

(Pauksztat, 2017). The number of port calls was measured in Survey A with an open question, asking respondents for the number of port calls their ship usually makes in one month. In Survey B, respondents were asked to indicate the number of port calls during the last seven days on a 12-point scale, from 1 = “none” to 12 = “more than 21”. For this study, the number of port calls per month reported by Survey A respondents was divided by 4 to obtain the average number of port calls per week, and then recoded into the categories used in Survey B.

Information on ship type and the vessel’s flag state was obtained from two ship tracking websites (Marine Traffic and Vessel Tracker) in Survey A, based on the ship’s name or IMO number that respondents provided in the survey. In Survey B, respondents were asked to select their ship type from a list, which also included an “other, what?” option with an open field. In addition, respondents were asked about their ship’s flag state with an open question. Based on these responses, for this study, ship type was coded “bulk carrier”, “container ship”, “general cargo”, “tanker”, “passenger ship”, and “specialized ship”. Based on the information about the ship’s flag state, we created a variable measuring whether respondents worked on vessels with flags categorized as Flag of Convenience (FOC) registers, as defined by the ITF’s fair practices committee (ITF, 2020). The variable was coded 1 = “yes”, 0 = “no”.

4.3.3. Impact of the COVID-19 pandemic

For the comparison between matched samples, a binary variable (treatment) was used to distinguish between respondents belonging to the control group (i.e., Survey A respondents) and the treatment group (i.e., Survey B respondents).

To assess the severity of the impact of the COVID-19 pandemic, Survey B respondents were asked to indicate how seriously the pandemic had affected their work and life on board and their personal situation. The items are “work routines on this ship”, “interactions between ship and shore”, “the crew’s non-work life on board”, “crew

changes (e.g., change dates, travel to/from home) for crew of this ship”, “getting supplies for the crew (e.g., food) or the ship (e.g., spare parts)” (item added at the end of July 2020), “the health or financial situation of your family” and “your employment (e.g., income, future work opportunities, etc.)”. Answer categories ranged from 1 = “not at all” to 7 = “to a very high extent”. Cronbach’s alpha (for Survey B respondents) was 0.79.

4.4. Analytical approach

4.4.1. Descriptive statistics for depression and anxiety

To describe and compare the level of depression and anxiety in Survey A and Survey B, we used descriptive statistics and independent samples *t*-tests. Further, within each sample, we compared levels of anxiety and depression using paired samples *t*-tests. Table 3 shows correlations among the variables for Survey A respondents and Survey B respondents, respectively.

4.4.2. Matched samples comparison

To address Hypotheses 1 and 2 concerning the impact of the COVID-19 pandemic on seafarers’ depression and anxiety, the 2020 sample (Survey B) was matched to the 2015–16 sample (Survey A) in order to reduce bias due to differences in respondent and work-related characteristics between the two samples.

Variables used to match the samples were selected according to the disjunctive cause criterion (VanderWeele, 2019). That is, matching was based on variables that preceded the treatment (i.e., the COVID-19 pandemic), and that affected either the treatment (i.e., the impact of the COVID-19 pandemic) and/or the outcome (i.e., anxiety, depression). Variables that might themselves be affected by the treatment were not used for the matching (Stuart, 2010; VanderWeele, 2019). Following Stuart (2010), variables were selected on theoretical grounds and based

on empirical findings in previous studies. Thus matching was based on seven variables that measured respondents’ experience at sea, life expectancy in country of citizenship, citizenship in countries in Asia, hierarchical level, department (deck), as well as whether respondents worked on a passenger ship and on vessels with a “Flag of Convenience”.

Experience at sea and hierarchical level (both associated with the type of contract, and hence with level of income and job security), deck department (associated with a higher likelihood of contact with shore personnel), passenger ship (associated with a higher risk of infection from passengers), “Flag of Convenience” register (often associated with lower standards in working conditions, income and job security) and life expectancy in country of citizenship (reflecting living standards and quality of health care system) were expected to affect the severity of the impact of the pandemic. With regard to variables affecting seafarers’ depression and anxiety, previous studies suggest that seafarers with less experience are more likely to report symptoms of depression (Lefkowitz and Slade, 2019). Previous studies also found associations between depression, anxiety and hierarchical level, department and ship type (Carotenuto et al., 2013; Jegaden et al., 2019; Lefkowitz and Slade, 2019), although, as discussed earlier, the results were not always consistent. National or cultural differences could play a role as well (Mellbye and Carter, 2017).

To estimate the average marginal effect of the pandemic on seafarers’ anxiety and depression, we used propensity score matching, using the full matching procedure from the R package MatchIt (Ho et al., 2007, 2011). The propensity score was estimated with logistic regression (option “glm” in MatchIt). This provided adequate balance (Table 4), as indicated by an overall standardized mean difference of 0.0012 and standardized mean differences for all covariates below 0.135. Considering the standardized mean differences for squared covariates and interactions between covariates, six (of 24) estimates were between 0.150 and 0.285, and the remaining estimates were below

Table 3
Correlations.

		1	2	3	4	5	6	7	8
1	Depression		0.643***	-0.029	-0.121**	-0.075*	0.097**	-0.021	-0.052
2	Anxiety	0.667***		-0.003	-0.070	-0.046	0.081*	-0.050	0.000
3	Gender (1 = woman)	0.053	0.054		0.036	-0.038	0.059	-0.156***	-0.032
4	Age	-0.138**	-0.097*	-0.144**		0.830***	-0.013	-0.133***	0.302***
5	Experience at sea	-0.129**	-0.075	-0.149**	0.906***		-0.003	-0.225***	0.416***
6	Life expectancy	-0.078	-0.095*	0.164***	0.109*	0.173***		-0.380***	0.081*
7	Nationality: Asia	-0.004	0.036	-0.113*	-0.080	-0.159***	-0.796***		-0.187***
8	Hierarchical level	-0.089*	0.011	-0.049	0.493***	0.570***	0.277***	-0.321***	
9	Department: deck	-0.069	0.019	0.051	0.028	0.136**	0.045	0.001	0.338***
10	Number of port calls	-0.076	-0.040	-0.093*	0.058	0.030	0.057	-0.044	-0.006
11	Flag of Convenience	0.190***	0.194***	-0.059	-0.063	-0.053	-0.367***	0.245***	-0.050
12	Passenger ship	-0.046	-0.020	0.186***	0.008	-0.019	0.089*	-0.129**	-0.054
13	Expected length of work period	0.141**	0.148**	-0.068	-0.151**	-0.175***	-0.603***	0.583***	-0.280***
14	Months on board	0.246***	0.212***	-0.062	-0.140**	-0.164***	-0.479***	0.509***	-0.239***
15	Over contract	0.287***	0.261***	-0.004	-0.124**	-0.128**	-0.323***	0.336***	-0.117**
		9	10	11	12	13	14	15	
1	Depression	0.052	0.029	0.009	-0.021	0.015	0.008	-0.041	
2	Anxiety	0.023	0.015	-0.015	0.019	-0.024	-0.015	0.000	
3	Gender (1 = woman)	-0.064	0.143***	0.128***	0.362***	-0.003	-0.011	0.006	
4	Age	-0.035	-0.006	-0.026	0.015	-0.148***	-0.066	0.046	
5	Experience at sea	0.090*	0.059	-0.050	-0.003	-0.240***	-0.106**	0.039	
6	Life expectancy	0.017	0.118**	-0.043	0.126***	-0.235***	-0.036	0.075*	
7	Nationality: Asia	-0.019	-0.204***	-0.042	-0.178***	0.441***	0.124***	-0.108**	
8	Hierarchical level	0.241***	0.010	-0.084*	-0.039	-0.438***	-0.227***	0.090*	
9	Department: deck		0.118**	0.009	-0.084*	-0.037	-0.031	-0.019	
10	Number of port calls	0.008		0.282***	0.276***	0.030	0.015	-0.011	
11	Flag of Convenience	-0.010	-0.096*		0.123**	0.338***	0.083*	-0.116**	
12	Passenger ship	-0.068	-0.065	0.104*		-0.061	-0.025	-0.006	
13	Expected length of work period	0.028	-0.198***	0.293***	-0.083		0.320***	-0.293***	
14	Months on board	-0.012	-0.106*	0.314***	-0.104*	0.545***		0.442***	
15	Over contract	0.004	-0.054	0.257***	-0.082	0.234***	0.826***		

Note. Pearson correlations (using pairwise deletion) for Survey A respondents above the diagonal, and for Survey B respondents below the diagonal. * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 4
Sample means and balance information.

	Survey A: original sample		Survey A: matched sample		Survey B sample		Balance for matched data				
	Mean	Std. deviation	Mean	Std. deviation	Mean	Std. deviation	Std. mean diff.	Variance ratio	eCDF: mean distance	eCDF: maximum distance	Std. pair distance
Distance	0.2557	0.5973	0.5976	1.2479	0.0012	0.9942	0.0027	0.0317	0.0074		
Experience at sea	10.0189	19.6980	18.7143	8.0003	-0.0905	0.8392	0.0371	0.1040	0.7191		
Life expectancy	72.1450	75.6535	75.9722	0.7351	0.0612	0.9099	0.0404	0.1100	0.5777		
Nationality: Asia	0.8537	0.4070	0.4087	-0.9052	0.0036		0.0018	0.0018	0.2518		
Hierarchical level	1.9067	3.3237	3.3750	1.0672	0.0373	0.9580	0.0205	0.0464	0.4759		
Department: deck	0.5032	0.6204	0.6448	0.2961	0.0511		0.0245	0.0245	0.8811		
Flag of Convenience	0.4918	0.3859	0.3234	-0.3600	-0.1335		0.0625	0.0625	0.8167		
Passenger ship	0.0189	0.0762	0.0476	0.1348	-0.1342		0.0286	0.0286	0.2679		

Note. Std. = standardized; diff. = difference; eCDF = empirical cumulative density function.

0.150. Additional analyses showed that balance was better with this approach than with alternatives, such as nearest neighbour propensity score matching without replacement.

To estimate the treatment effect and its standard error, we used linear regression with anxiety and depression as the outcome. For the estimation we used the “lm” function (R package lme4; Zeileis and Hothorn, 2002) with a cluster-robust standard error (as implemented in the “vcovCL” function in the R package sandwich; Zeileis, 2004; Zeileis et al., 2020), with pair membership as the clustering variable. The model included the treatment effect and the covariates used for the matching, together with the matching weights. Table 5 shows the results.

Following up on this, we carried out additional analyses to examine whether respondent and work-related characteristics were associated with the severity of the impact of the pandemic among Survey B respondents. To this end, we used OLS regression in SPSS version 27 with severity of the impact of the pandemic as the dependent variable, adding all predictors simultaneously. Initial analyses showed one outlier (standardized residuals greater than 3). Because the outlier’s inclusion or exclusion had virtually no effect on the size, direction or significance of the effects, and thus did not change the results, Table 6 shows the results including all cases.

4.4.3. OLS regression

To address Research Questions 1 and 2 concerning the effect of respondent and work-related characteristics on depression and anxiety, we used OLS regression in SPSS version 27. The data for Survey A and Survey B respondents were analysed separately, with all predictor variables added simultaneously. Because initial analyses indicated the presence of outliers (standardized residuals greater than 3) for Survey A for depression as dependent variable, we used bootstrapping to estimate the coefficients, standard errors and significance tests (bootstrap sample size = 20,000) presented in Model 1. Table 7 shows the results.

5. Results

We start by examining the self-reported frequency of symptoms of depression and anxiety in the two samples. For depression, we found that the mean was significantly higher among Survey B respondents (M = 2.50, SD = 1.03) than among Survey A respondents (M = 1.88, SD = 0.75; $t(1295) = -11.68, p < .001$). 18.7% of Survey A respondents reported never having experienced any symptoms of depression, whereas 0.4% reported having “always” experienced all symptoms during the past month. In Survey B, 10.9% of the respondents reported no symptoms of depression, while 2.4% reported having experienced all of the symptoms “every day” during the past week.

Turning to anxiety, there was a high percentage of respondents reporting no symptoms of anxiety (Survey A: 38.1%; Survey B: 16.3%). At the other end of the scale, 3.5% of Survey A respondents and 5.2% of Survey B respondents had experienced symptoms of anxiety “always” / “every day”. Average levels of anxiety were significantly higher among Survey B respondents (M = 2.63, SD = 1.17) than among Survey A

Table 5
Estimating the effect of the pandemic.

	Depression <i>b</i> (SE)	Anxiety <i>b</i> (SE)
Intercept	1.287 (0.531)	1.752 (1.595)
Treatment	0.641*** (0.067)	0.480*** (0.132)
Experience at sea	-0.010* (0.004)	-0.026*** (0.007)
Life expectancy	0.012 (0.007)	0.009 (0.021)
Nationality: Asia	-0.098 (0.073)	-0.077 (0.181)
Hierarchical level	-0.037 (0.033)	0.113 (0.061)
Department: deck	-0.075 (0.078)	-0.230 (0.170)
Flag of Convenience	0.133 (0.077)	0.138 (0.142)
Passenger ship	-0.384* (0.177)	-0.692*** (0.187)

Table 6
OLS regression with severity of the impact of the pandemic as dependent variable.

	<i>b</i> (<i>SE</i>)
Intercept	1.572 (1.413)
Experience at sea	0.000 (0.005)
Life expectancy	0.014 (0.017)
Nationality: Asia	0.302 (0.174)
Hierarchical level	0.155** (0.048)
Department: deck	-0.003 (0.110)
Number of port calls	-0.069* (0.028)
Flag of Convenience	0.234* (0.116)
Passenger ship	0.690** (0.234)
Expected length of work period	0.230*** (0.055)
Months on board	-0.016 (0.030)
Over contract	0.234* (0.112)
R ²	0.181
Adjusted R ²	0.163
F	9.876

Note. Unstandardized coefficients and standard errors. Survey B respondents only (*n* = 504). * *p* < .05, ** *p* < .01, *** *p* < .001.

respondents (*M* = 2.11, *SD* = 1.12; *t*(1295) = -7.83, *p* < .001).

Depression and anxiety were highly correlated among Survey A respondents (Table 3: *r* = 0.643, *p* < .001) and among Survey B respondents (*r* = 0.667, *p* < .001). Further, average levels of anxiety were significantly higher than levels of depression both among Survey A respondents (*t*(792) = 7.69, *p* < .001) and among Survey B respondents (*t* (503) = 3.10, *p* = .002).

Hypotheses 1 and 2 concerned the impact of the COVID-19 pandemic on seafarers' depression and anxiety, respectively. As shown in Table 5, we found a significant treatment effect both for depression (*b* = 0.641, *SE* = 0.067, *p* < .001) and anxiety (*b* = 0.480, *SE* = 0.132, *p* < .001), indicating significantly higher average levels of symptoms of depression and anxiety during the pandemic than before. This provided support for Hypotheses 1 and 2.

We conducted additional analyses to examine whether the severity of the impact of the pandemic experienced by Survey B respondents was associated with respondent and work-related characteristics. As shown in Table 6, the impact of the pandemic was rated significantly lower by respondents whose vessels had called at a larger number of ports during the last week (*b* = -0.069, *SE* = 0.028, *p* = .015). Those at higher hierarchical levels (*b* = 0.155, *SE* = 0.048, *p* = .001), respondents working

on passenger vessels (*b* = 0.690, *SE* = 0.234, *p* = .003) and on vessels with Flags of Convenience (*b* = 0.234, *SE* = 0.116, *p* = .044) reported a higher impact of the pandemic.

In addition, respondents with longer expected work periods (*b* = 0.230, *SE* = 0.055, *p* < .001) and those who had been on board longer than expected (*b* = 0.234, *SE* = 0.112, *p* = .038) reported a significantly more severe impact of the pandemic. Additional analyses showed that the actual number of months on board had a significant effect (*b* = 0.037, *SE* = 0.016, *p* = .024; model not shown) when being "over contract" was not included in the model, but (as shown in Table 6) its effect was non-significant when being "over contract" was included.

We now turn to Research Questions 1 and 2, which concerned the effects of respondent and work-related characteristics on depression and anxiety, respectively. Considering depression, for Survey A respondents (Table 7, Model 1), we found a significant positive effect of life expectancy in respondents' country of citizenship (*b* = 0.020, *SE* = 0.008, *p* = .011). Other respondent and work-related characteristics had non-significant effects. For Survey B respondents (Model 2), we found a significant negative effect of being a citizen of a country in Asia (*b* = -0.578, *SE* = 0.154, *p* < .001), and significant positive effects of working on vessels with Flags of Convenience (*b* = 0.279, *SE* = 0.103, *p* = .007), long expected work periods (*b* = 0.124, *SE* = 0.048, *p* = .011) and being "over contract" (*b* = 0.392, *SE* = 0.100, *p* < .001).

Turning to predictors of anxiety, for Survey A respondents (Table 7, Model 3), all of the predictors had non-significant effects in the regression analysis. By contrast, for Survey B respondents (Model 4), the significant predictors of anxiety were the same as for depression. We found a significant negative effect of being a citizen of a country in Asia (*b* = -0.370, *SE* = 0.178, *p* = .038), and significant positive effects of working on vessels with Flags of Convenience (*b* = 0.317, *SE* = 0.118, *p* = .008), long expected work periods (*b* = 0.169, *SE* = 0.056, *p* = .003) and being "over contract" (*b* = 0.467, *SE* = 0.115, *p* < .001).

6. Discussion

Drawing on data from two large-scale survey studies of seafarers on international commercial vessels in 2015–16 and 2020, this study investigated the impact of the COVID-19 pandemic on seafarers' self-reported symptoms of depression and anxiety, and examined associations with respondent and work-related risk factors. Matching the two samples on respondent and work-related characteristics using propensity scores, we found that the COVID-19 pandemic contributed to

Table 7
OLS regression with depression and anxiety as dependent variables.

	Depression		Anxiety	
	Survey A Model 1 <i>b</i> (<i>SE</i>)	Survey B Model 2 <i>b</i> (<i>SE</i>)	Survey A Model 3 <i>b</i> (<i>SE</i>)	Survey B Model 4 <i>b</i> (<i>SE</i>)
Intercept	0.631 (0.669)	2.895 (1.255)	0.847 (0.989)	1.924 (1.444)
Experience at sea	-0.005 (0.004)	-0.007 (0.005)	-0.008 (0.005)	-0.009 (0.006)
Life expectancy	0.020* (0.008)	-0.009 (0.015)	0.019 (0.011)	-0.004 (0.017)
Nationality: Asia	-0.015 (0.095)	-0.578*** (0.154)	-0.121 (0.140)	-0.370* (0.178)
Hierarchical level	-0.027 (0.026)	-0.025 (0.043)	0.005 (0.037)	0.068 (0.050)
Department: deck	0.090 (0.055)	-0.119 (0.097)	0.057 (0.083)	-0.013 (0.112)
Number of port calls	0.015 (0.025)	-0.019 (0.025)	0.003 (0.039)	0.007 (0.029)
Flag of Convenience	0.003 (0.060)	0.279** (0.103)	-0.046 (0.090)	0.317** (0.118)
Passenger ship	-0.218 (0.238)	-0.318 (0.208)	0.064 (0.311)	-0.107 (0.240)
Expected length of work period	-0.022 (0.051)	0.124* (0.048)	0.011 (0.073)	0.169** (0.056)
Months on board	0.009 (0.014)	-0.018 (0.027)	-0.005 (0.021)	-0.046 (0.031)
Over contract	-0.099 (0.083)	0.392*** (0.100)	-0.005 (0.110)	0.467*** (0.115)
R ²	0.024	0.151	0.011	0.116
Adjusted R ²	0.010	0.132	-0.003	0.097
F	1.758	7.964	0.797	5.884
<i>n</i>	793	504	793	504

Note. Unstandardized coefficients and standard errors. Model 1 estimates are based on bootstrapping (bootstrap sample size = 20,000). * *p* < .05, ** *p* < .01, *** *p* < .001.

significantly higher levels of both depression and anxiety. Additional analyses indicated that seafarers with longer expected work periods, those who had been on board longer than expected, and those who worked on vessels with “Flags of Convenience” reported significantly higher levels of both depression and anxiety during the pandemic, but not prior to the pandemic.

Previous cross-sectional studies on seafarers’ mental health during the COVID-19 pandemic (Baygi et al., 2021; Qin et al., 2021) suggested that the pandemic might have led to an increase in mental health problems. However, due to the cross-sectional design, these studies could not account for the pre-pandemic levels of seafarers’ depression and anxiety. Approximating the conditions of a natural experiment by comparing matched samples, our findings provide stronger empirical support for this idea, showing that the COVID-19 pandemic led to a significant increase in the frequency of seafarers’ self-reported symptoms of depression and anxiety. Given that much previous research on the effects of the COVID-19 pandemic on occupational health and safety has focused on the healthcare sector, these findings add to our knowledge of the impact of the pandemic in other sectors.

Our study also provides insights into respondent and work-related risk factors associated with seafarers’ depression and anxiety before and during the pandemic. The findings revealed a distinctive pattern. First, *prior* to the pandemic, none of the variables had significant effects on anxiety, and only one variable (i.e., life expectancy in participants’ country of citizenship) had a significant effect on depression. These non-significant effects appear to be in line with previous cross-sectional studies that showed diffuse patterns of association, with non-significant and/or inconsistent findings. A possible explanation may be that differences in mental health are related to individual factors such as life experiences (American Psychiatric Association, 2013), which are not captured by respondent and work-related variables. Another possible explanation could be group-level variables, such as company culture (Yuen et al., 2020), which might explain inconsistent findings between studies that used clustered (e.g., company-specific) samples (e.g., concerning hierarchical level: Carotenuto et al., 2013; Oldenburg and Jensen, 2019).

By contrast, several work-related factors had strong effects on seafarers’ mental health *during* the COVID-19 pandemic. This could be related to shared experiences during the pandemic, which are reflected in systematic differences between respondents, leading to significant effects. In line with this, we found that the severity of impact of the pandemic was associated with seafarers’ time on board (expected length of work period; being over contract), position (hierarchical level) and vessel characteristics (“Flag of Convenience” registers; ship type; number of port calls), rather than seafarers’ personal characteristics such as experience at sea or nationality. Similarly, Baygi et al. (2021), based on data collected around the same time as Survey B, found significant associations between mental health and hierarchical level and length of time on board, but not with personal characteristics such as age, marital status, or experience at sea.

The significant effects of length of time on board and “Flag of Convenience” registers suggest that in order to understand the prevalence of mental health problems in the maritime industry, we need to go beyond individual level risk factors and take into account systemic risk factors associated with industry practices (Sampson and Ellis, 2020). Studies suggest that the maritime industry was already operating at the limit prior to the COVID-19 pandemic. For example, regulations related to crewing numbers, length of time on board and work hours were often applied to the limit; when it was not possible to meet the limits concerning work and rest hours, in some cases records were adjusted (Baumler et al., 2021). Hence the industry is known for long working hours, as well as high levels of stress, burnout, and fatigue (Chung et al., 2017; Håvold, 2015; Jepsen et al., 2017; Oldenburg et al., 2013). Already operating at the limit, the industry was left without a “buffer” to absorb the impact of the COVID-19 pandemic. For example, whereas regulations specified that length of time on board could not exceed 11 months (International Labour Organization, 2015), most shipping

companies were using 11 months as the norm. This meant that when the COVID-19 pandemic disrupted crew changes, many seafarers found themselves on board for 11 months or more (De Beukelaer, 2021). In this way, the COVID-19 pandemic has exposed and exacerbated some of the pre-existing systemic problems in the maritime industry (Shan, 2021).

6.1. Practical implications

The findings demonstrate that certain characteristics of the maritime work environment have a negative impact on seafarers’ mental health. Hence, ensuring seafarers’ well-being throughout, both during ‘normal’ operations and in times of crisis, is important for employee welfare as well as for the industry’s sustainability. There are three points to consider in relation to practical implications.

The first point concerns ensuring that job demands do not require employees to continuously extend themselves to the limit, for instance with regard to workload, work hours, or the length of time on board. Reducing the pressure entailed by high job demands will not only benefit employees’ mental health but should also help to reduce the risk of accidents and injuries (Smith et al., 2006), and create a “buffer” that would allow organizations to better absorb additional demands in times of crisis.

The second point concerns the provision of adequate resources for handling high job demands. This will not only impact positively on seafarers’ work but would also provide crews with enough time to build resources, for instance by increasing crew members’ skills and competence through on-the-job learning from more experienced colleagues, or by supporting the development of onboard social support through social and recreational activities. In this way, organizations can enhance resilience to respond quickly and effectively to sudden rises in job demands or crises.

Third, organizations should proactively take steps to improve seafarers’ mental health. This could involve the measures suggested by Sampson and Ellis (2020). More generally, organizations should commit to improving their employees’ psychological health and safety (Dollard and Bailey, 2021); among other things, this involves prioritizing employees’ mental health, employee consultation and participation in improving mental health, and establishing systems for communicating and resolving mental health concerns. In this way, organizations can maintain a safe and healthy workplace during times of stability, and create a buffer that will help to cope with disruptive external events such as the COVID-19 pandemic.

6.2. Limitations and directions for future research

In research on seafarers, where practical constraints make it difficult to obtain panel data in survey studies with large samples (for a notable exception, see Wadsworth et al., 2006), analyses of developments over time are typically based on comparisons of multiple cross-sectional samples (e.g., Sampson et al., 2017). Like previous studies, our study was based on data from two cross-sectional surveys of seafarers on international commercial vessels, obtained through convenience sampling before and during the pandemic. Potential biases stemming from differences in sample characteristics were reduced through propensity score matching prior to estimating the effect of the COVID-19 pandemic on depression and anxiety. Although the data came from two different studies, the measures used in the two studies were similar. Nevertheless, some differences concerning item wording and the length of the reference time period for the dependent variables should be noted, even though the nature and extent of the potential impact of these differences is not clear.

Whereas previous research has demonstrated the impact of work hours and watch schedules (Jepsen et al., 2017), our study suggests that other aspects of working conditions, such as the length of time on board, deserve further attention. In addition, our study indicated a significant impact of working on vessels with flags categorized as “Flags of

Convenience” (ITF, 2020). More research to pinpoint the factors causing these differences is needed. Further, future studies should expand the range of variables considered, including for instance job resources such as job control or social support (Bakker and Demerouti, 2007). To distinguish between company, vessel and individual level factors, ideally future studies should adopt a multilevel design.

6.3. Conclusion

Our study contributes to a more systematic body of knowledge about the effects of the COVID-19 pandemic on seafarers’ mental health. Employing a rigorous research design that allows for comparisons across time periods, our results provide strong evidence for increased levels of depression and anxiety in the maritime industry due to the pandemic. This is problematic as employees in this sector were already identified to be at higher risk for mental health problems. Moreover, examining potential predictors of mental health problems before and during the pandemic, we found that factors at the job, vessel and industry level were significantly associated with the severity of depression and anxiety symptoms experienced during the pandemic. These patterns of association point towards the need to address systemic issues in this industry that contribute to its increased vulnerability during the pandemic.

We hope that our research will instigate further systematic investigations on seafarers’ mental health in general and the experience of the ongoing pandemic in particular. A systematic understanding of the changes associated with the pandemic as well as the contributing factors will allow for better and more targeted opportunities to intervene and alleviate mental health problems.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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