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Title Page

Prevalence and Risk Factors of Depression Symptoms among Chinese Seafarers During the COVID-19 Pandemic: a cross-sectional study

Wenzhe Qin[a]; Lei Li[b,c]; Dongshan Zhu[a], Chengfei Ju[c]; Pengfei Bi[c]; Shixue Li[a]

a. Centre for Health Management and Policy Research, School of Public Health, Cheeloo College of Medicine, Shandong University, Jinan, China; NHC Key Lab of Health Economics and Policy Research (Shandong University), Jinan, 250012, China.

b. Jinan Airport Customs, Jinan, 250013, China

c. Rongcheng Customs, Rongcheng, 264300, China

Corresponding author: Shixue Li, Professor

Centre for Health Management and Policy Research, School of Public Health, Cheeloo College of Medicine, Shandong University, Wenhuaxi Road44#, Jinan, Shandong, 250012, China.

Tel and fax: +86-0531-88382127. Email: shixueli@sdu.edu.cn

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Abstract

Background: To curb the spread of COVID-19, most countries have adopted measures of ports banning shore leave and placed restrictions on crew change. Seafarers may bear excess pressure during the COVID-19 pandemic. This study aimed to investigate the prevalence and risk factors associated with depression symptoms among Chinese seafarers during the COVID-19 pandemic.

Design: Cross-sectional study.

Methods: This field survey-based study was conducted in Rongcheng port, Shandong Province, China, from June 10, 2020 to July 25, 2020. Socio-demographic, occupational characteristics and health related behaviors were collected through a face-to-face questionnaire. Self-rating Depression Scale (SDS) was used to evaluate depression status during the preceding week. Logistic regression models were used to explore related factors of depression.

Results: 441 male Chinese seafarers were enrolled. Overall, the proportions of seafarers with low, moderate and severe depressive symptoms were 103 (23.35%), 41 (9.30%) and 40 (9.07%), respectively. Compared to those with a good self-rated health (SRH), seafarers with poor SRH had higher odds of depression (Odds ratio [OR],2.24; 95%CI,1.22-4.11). Less leisure time or physical exercise was associated with more severe self-reported depression symptoms (1~3/week vs ≥4/week: OR,1.72; 95%CI, 0.71-4.14; none vs ≥4/week OR,3.93; 95%CI, 1.67-9.26). Poor sleep quality was associated with a higher likelihood of reporting severe depression (fair vs good: OR,2.78; 95%CI, 1.54-5.01; poor vs good: OR,4.30; 95%CI, 1.65-11.24). The more times of working overtime a week, the higher likely to report severe depression symptoms (1~2/week vs none: OR,1.82; 95%CI, 1.04-3.18; ≥3/week vs none: OR,2.49; 95%CI, 1.05-5.92). Also, high perceived work stress was linked to higher odds of being depression (intermediate vs low: OR,2.06; 95%CI, 0.78-5.46; high vs low: OR,3.83; 95%CI, 1.35-10.90).

Conclusions: There is a high depression burden associated with the COVID-19

among seafarers. Special interventions that protecting the mental health of seafarers is even more critical in the context of a pandemic.

Key words: Depression; COVID-19; International voyage; Seafarers; Related factors

Strengths and limitations of this study:

- This is the first study that evaluated the depression status and related factors of seafarers during the COVID-19 pandemic.
- This study may provide important evidence to direct the promotion of mental wellbeing among seafarers.
- The mental health status of seafarers before COVID-19 pandemic was not measured.
- The participants are from Chinese seafarers, thus the extrapolate of the findings might be limited.

Introduction

On March 11, 2020, the World Health Organization declared the outbreak of the coronavirus disease 2019 (COVID-19) a global pandemic.[1] As of November 8, 2020, there are more than 49 million cases and 441696 deaths worldwide.[2] The pandemic also severely impacts the global economy and the global supply chain, including international shipping.

Shipping is the lifeblood of global supply chain and accounts for 90% of world trade.[3] Thus, ships continue sailing even in the COVID-19 pandemic. Seafarers play an essential role in maintaining the flow of vital goods, such as food, goods and medical supplies.[4] Globally, there are 2 million seafarers ensuring global needs of goods for daily life.[5]

To control the spread of COVID-19, most countries have adopted measures of ports banning shore leave and placed restrictions on crew change. As of December 2020, it is estimated that 400,000 seafarers are currently stranded on ships beyond the end of their original contracts and unable to be repatriated, due to COVID-related travel restrictions. A similar number of seafarers are stuck at home, unable to join ships and provide for their families.[6]

Long-term work at sea, in a relatively small and enclosed environment, boring amateur life and family separation, a total absence of shore leave, virus fears, a perceived lack of COVID-19 precautions on board vessels, and isolation on board may all naturally cause mental health crisis, such as emotional instability, anxiety, and depression.[7] Some organizations call for attention to the mental health of these seafarers 'trapped on board', unfortunately there still have been a number of reported suicides on board ships.[8,9]

Previous studies have suggested that seafarers' mental health is poor. A meta-analysis of Chinese seafarers found that the mental health status of seafarers was worse than the Chinese general population, especially the prevalence of depression.[10] One fourth

seafarers were suffering from depression.[11] Evidence has shown COVID-19 has negative impact on the mental health.[12-15] Considering the specific working conditions of seafarers, we suppose that seafarers' mental health may deteriorate during the COVID-19 pandemic, and they may suffer high prevalence of depression.

We aim to evaluate prevalence of depression among international seafarers during COVID-19 pandemic, and to explore potential risk factors associated with depression symptoms. This year, the Day of the Seafarer campaign calls on member states to recognize seafarers as key workers. This study may provide important evidence to direct the promotion of mental wellbeing among seafarers.

Methods

Study design and participants

A cross-sectional study was conducted in Rongcheng port, Shandong Province, China, from June 10, 2020 to July 25, 2020. To ensure the authenticity and reliability of data, the survey was anonymous, and all data was collected face-to-face by trained front-line quarantine officers of customs using a self-administered questionnaire (SAQ). A structured questionnaire packet that included five parts: socio-demographic information, occupational characteristics, health related behaviors, health condition and self-rating depression scale (SDS).

Eligible participants were Chinese seafarers. Two-stage sampling strategy was applied: in the first stage, a cluster random sampling method was employed to select the entry international ocean ships. The ship and crew information must be declared to the customs 24 hours before the entry of the ship, thus we coded the ship entering the next day in advance and select one ship by random number method. A total of 30 ships were selected. Second, all Chinese seafarers on the selected ship were interviewed. The target sample size of participants was determined using the formula $N=Z_{\alpha}^2P(1-P)/d^2$, in which $\alpha=0.05$ and $Z_{\alpha}=1.96$, and the estimated acceptable margin of error for proportion d was 0.05. The proportion of seafarers with depression

symptoms was estimated at 50.76%, based on a previous study before the COVID-19 outbreak.[16] To improve the effective response rate, we amplified the sample size by 15% with a goal of at least 442 participants. A total of 450 seafarers were included during the actual investigation and 9 participants refused to participate in this survey. Finally, 441 individuals completed the survey.

Key Definitions

Self-rating Depression Scale (SDS)

The 20-item Zung Self-Rating Depression Scale (SDS) was used to evaluate the depression symptoms of seafarers.[17] Ten items are scored positively (e.g., "I feel downhearted and blue") and other ten scored negatively (e.g., "I still enjoy the things I used to do"). The seafarers were asked to rate how frequently they experienced each symptom during the past week. Responses were distributed on a 4-point Likert scale (1= a little of time, 2= some of the time, 3= good part of the time, 4= most of the time). The sum of the scores obtained on the 20 items were raw scores, and the raw scores are converted to a standard score (100-point scale) by multiplying by 1.25. A higher score indicates more severe depression symptoms. The severity of depression can be converted as follows: normal (≤49), mild (50-59), moderate (60-69), and severe (≥70). Previous study shows that the presence of major depressive disorder during the COVID-19 pandemic maybe need more concern.[18] We classified depression symptoms into two categories: 1=none/mild, 2=moderate/severe. Binary classification of depression symptoms was defined by a score of 60 or greater. The SDS is widely used in previous studies and has a good reliability and validity. The Cronbach's α was 0.76 in this study.

Socio-demographic factors

Data on age, sailing age, gender, marital status, educational level and individual income. Age and sailing age were measured in chronological years; Gender was dichotomized; Marital status was categorized into married and others; education level was divided into three levels: high school or below, junior college, Bachelor's degree

or above; Average monthly income prior to the study was collected.

Occupational characteristics

Occupation-related factors included sailing duration, type of working ship, position, night shift frequency per week, overtime work frequency per week, self-perceived work stress. Overtime work was defined as "work continuously for more than 10 hours one day". Respondents were asked to rate their work-related stress with a question as "In general, how would you rate your recent work stress". 3-point Likert scale were used: 3=high, 2=intermediate, 1=low.

Health related data and health related behaviors

Health conditions was measured with self-rated health (SRH) and chronic disease. Previous studies have shown that SRH is an effective and reliable measure of health.[19] Five possible categories were provided: 5=excellent, 4=very good, 3=good, 2=fair, 1=poor. Because of the missing option, we recode SRH into a binary variable. "excellent", "very good", or "good" were regarded as health good, while "fair" or "poor" were regarded as health poor. Chronic disease was dichotomized according to their responses.

Health related behaviors included smoke, drink, sleep duration, self-rated sleep quality, leisure time or physical exercise (LPE). Sleep duration was measured with the number of hours sleep at night. Sleep quality was divided into three categories: 3=excellent, 2=fair, 1=poor. LPE was calculated as the frequency of engaging in leisure activities or physical exercise (such as walking, playing table tennis, or working out at a gym) per week on board. Chronic disease and self-rated health (SRH) were applied to represent health conditions.

COVID-19 stress

Seafarers were asked "In the current global outbreak of COVID-19, how would you rate the COVID-19-related stress on you and your relatives (such as be infected, lose job, have financial problems and so no)?" 3-point Likert scale were used: 3=high,

2=fair, 1=low.

Ethics statement

Written informed consent was received before the respondents began the questionnaire. This study was approved by the ethics committee of Shandong University, and which was performed in accordance with the Helsinki Declaration.

Statistical Analysis

Characteristics of seafarers by depression groups were described. Data are presented as mean (standard deviation, SD) for continuous variables and as the *n* (%) for categorical variables. Statistical differences of depression among subgroups were tested using independent sample t-tests (continuous variables) or $\chi 2$ tests (categorical variables). Multivariable logistic regression models were employed to estimate odds ratio (OR) and 95% CIs for the associations between risk factors and depression symptoms. All statistical tests were two-tailed, and the level of significance was set at 0.05. All analysis was performed using SPSS statistical software version 25.0 (IBM Corp).

Results

Demographic Characteristics

The mean age was 37.54±9.74 years; the median sailing age was 8.0(3.0-13.0) years; 53.5% were high school or below and 7.5% were Bachelor's degree or above; 74.6% were married; 52.2% were ordinary crew. The ship types that seafarers work on are mainly cargo ships and bulk carriers. By the end of this survey, the median sailing duration was 7.0(5.0-9.0) months without disembark and traveling home (Table 1).

Prevalence of depression symptoms in seafarers

In 441 seafarers, the highest standard score of depression was 73, and the total mean standard score was 38.33±10.8. According to the standard score, a considerable proportion of seafarers reported symptoms of depression (184 [41.7%]), of which 103

(23.35%), 41 (9.30%) and 40 (9.07%) categorized as having low, moderate and severe depressive symptoms, respectively. The demographic characteristics of seafarers was presented in **Table 1.**

Table 1 Characteristics of All Participants by Level of Depression Symptoms

Characteristic	Total, No. (%) (N=441)	Severity of depression, No. (%)		*P* value
		Normal/mild (n=360)	Moderate/Severe (n=81)	
Sailing age [a]*, year*	8.0(3.0-13.0)	8.0(3.0-13.0)	8.0(2.0-12.0)	0.402[b]
Sailing duration [a]*, month*	7.0(5.0-9.0)	7.0(5.0-9.0)	7.0(6.0-9.0)	0.432[b]
Age (year)				
18-44	323(73.2)	265(82.0)	58(18.0)	0.712[c]
≥45	118(26.8)	95(80.5)	23(19.5)	
Marital status				
Married	329(74.6)	273(83.0)	56(17.0)	0.207[c]
Others	112(25.4)	87(77.7)	25(22.3)	
Education level				
High school and below	236(53.5)	192(81.4)	44(18.6)	0.343[c]
Junior college	172(39.0)	139(80.8)	33(19.2)	
Bachelor's degree or above	33(7.5)	29(87.9)	4(12.1)	
Income (RMB)				
≤10000	214(48.5)	168(78.5)	46(21.5)	0.308[c]
10001～20000	148(33.6)	123(83.1)	25(16.9)	
20001～30000	25(5.7)	21(84.0)	4(16.0)	
>30000	54(12.2)	48(88.9)	6(11.1)	
Position classes				
Ordinary crew	230(52.2)	183(79.6)	47(20.4)	0.269[d]
Senior officer	211(47.8)	177(83.9)	34(16.1)	
Self-rated health				
Good	292(66.2)	259(88.7)	33(11.3)	<.001[c]
Poor	149(33.8)	101(67.8)	48(32.2)	
Chronic disease				
Yes	18(4.1)	14(77.8)	4(22.2)	0.755[d]
No	423(95.9)	346(81.8)	77(18.2)	
Smoking status				
Yes	201(45.6)	160(79.6)	41(20.4)	0.326[d]
No	240(54.4)	200(83.3)	40(16.7)	
Drinking status				
Yes	319(72.3)	267(83.7)	52(16.3)	0.075[d]
No	122(27.7)	93(76.2)	29(23.8)	
LPE per week				
None	171(38.8)	124(72.5)	47(27.5)	<.001[c]
1~3	192(43.5)	165(85.9)	27(14.1)	

≥4	78(17.7)	71(91.0)	7(9.0)	
Sleep duration				
<6	15(3.4)	8(53.3)	7(46.7)	0.008[c]
6~8	181(41.0)	145(80.1)	36(19.9)	
>8	245(55.6)	207(84.5)	38(15.5)	
Sleep quality				
Poor	29(6.6)	18(62.1)	11(37.9)	<.001[c]
Fair	214(48.5)	163(76.2)	51(23.8)	
Good	198(44.9)	179(90.4)	19(9.6)	
Overtime work per week				
None	256(58.0)	224(87.5)	32(12.5)	0.001[c]
1~2	154(34.9)	115(74.7)	39(25.3)	
≥3	31(7.1)	21(67.7)	10(32.3)	
Self-perceived work stress				
Low	65(14.7)	60(92.3)	5(7.7)	<.001[c]
Intermediate	277(62.8)	232(83.8)	45(16.2)	
High	99(22.5)	68(68.7)	31(31.3)	
COVID-19 stress				
Low	54(12.2)	44(81.5)	10(18.5)	0.896[c]
Intermediate	154(34.9)	124(80.5)	30(19.5)	
High	233(52.8)	192(82.4)	41(17.6)	

Abbreviations: LPE, leisure time or physical exercise; COVID-19, coronavirus disease 2019.

[a] Data are presented as median (IQR).

[b] Mann-Whitney rank sum test conducted for significance testing

[c] Two-tailed χ^2 analysis conducted for significance testing

[d] Fisher's exact test conducted for significance testing

The distribution of depression symptoms was different in the epidemic-related categories of SRH, LPE per week, sleep duration, sleep quality, overtime work frequency per week, and self-perceived work-related stress (**Table 1**). Participants with severe depression reported experiencing a poorer SRH and engaging in less LPE per week (χ^2=28.78, P<0.001; χ^2=16.45, P<0.001, respectively). Seafarers with sleep duration <6h and having a poor sleep quality had higher percentage of reporting severely depression (χ^2=9.63, P=0.008; χ^2=21.82, P<0.001, respectively). Moreover, the distributions of depression symptoms within categories of overtime work frequency and self-rated work-related stress have different patterns. The more times of overtime work, the higher the depression level (χ^2=14.84, P=0.001). Seafarers in the high self-perceived work stress group had more severe depression symptoms

(χ^2=16.84, P<0.001). Other characteristics of seafarers had no difference in the distributions of depression symptoms (P>0.05).

Factors associated with depression symptoms

Poor SRH(OR,2.24; 95%CI, 1.22-4.11), LPE per week(for none vs ≥4: OR,3.93; 95%CI, 1.67-9.26), sleep quality(for poor vs good: OR,4.30; 95%CI, 1.65-11.24), frequency of overtime work per week(for ≥3 vs none: OR,2.49; 95%CI, 1.05-5.92), and self-perceived work stress(for high vs low: OR,3.83; 95%CI, 1.35-10.90) were associated with reporting severe depression symptoms(**Table 2**).

Table 2 Multivariable Regression Analysis of Factors Associated with Depression Symptoms

Variable	No. of Moderate/Severe (%)	OR (95%CI)	*P value* [a] Category	*P value* [a] Overall
Self-rated health				
Good	33(11.3)	1[reference]	NA	0.009
Poor	48(32.2)	2.24 (1.22,4.11)	0.009	
LPE per week				
≥4	7(9.0)	1[reference]	NA	
1~3	27(14.1)	1.72 (0.71,4.14)	0.229	0.001
None	47(27.5)	3.93 (1.67,9.26)	0.002	
Sleep quality				
Good	19(9.6)	1[reference]	NA	
Fair	27(14.1)	2.78 (1.54,5.01)	0.001	0.001
Poor	11(37.9)	4.30 (1.65,11.24)	0.003	
Overtime work per week				
None	32(12.5)	1[reference]	NA	
1~2	39(25.3)	1.82 (1.04,3.18)	0.035	0.041
≥3	10(32.3)	2.49 (1.05,5.92)	0.039	
Self-perceived work stress				
Low	5(7.7)	1[reference]	NA	
Intermediate	45(16.2)	2.06 (0.78,5.46)	0.147	0.019
High	31(31.3)	3.83 (1.35,10.90)	0.012	

Abbreviations: OR, odds ratio; LPE, leisure time or physical exercise.

[a] Category refers to the P value for each category vs the reference, while overall refers to the results of the logistic regression.

Less frequent leisure time or physical exercise was associated with more severe self-reported depression symptoms (1~3/week vs ≥4/week: OR,1.72; 95%CI,

0.711-4.14; none vs ≥4/week OR,3.93; 95%CI, 1.67-9.26). Having a poor sleep quality was associated with a higher likelihood of reporting severe depression (fair vs good: OR,2.78; 95%CI, 1.54-5.01; poor vs good: OR=4.30; 95%CI, 1.65-11.24). The more times seafarers work overtimes a week, the more likely they were to report severe depression symptoms (1~2/week vs none: OR,1.82; 95%CI, 1.04-3.18; ≥3/week vs none: OR,2.49; 95%CI, 1.05-5.92). An increased odd of severe depression was identified among seafarers with high perceived work stress (intermediate vs low: OR,2.06; 95%CI, 0.78-5.46; high vs low: OR=3.83; 95%CI, 1.35-10.90).

Discussion

A high prevalence of depression symptoms among Chinese seafarers was found during COVID-19 pandemic. Over 40% seafarers reported depression symptoms and around 9% of them had severe depressive symptoms. Poor SRH, poor sleep quality, less leisure time or physical exercise, more overtime work, and higher work stress were associated with experiencing severe depression symptoms. Our findings provide the latest profile of psychological status of seafarers during the COVID-19 pandemic. Seafarers' mental health may need more attention during COVID-19 epidemic.

Previous studies have shown a substantial burden of depression symptoms in general population following COVID-19.[18,20,21] A nationally representative study that was conducted among the US adults indicated that prevalence of depression symptom was higher during COVID-19 pandemic compared with before in every depression category(mild: 24.6% vs 16.2%; moderate: 14.8% vs 5.7%; moderately severe: 7.9% vs 2.1%; severe: 5.1% vs 0.7%).[18] Compared to the general Chinese population during COVID-19 pandemic, seafarers have excess prevalence of depression symptoms (41.72 vs 27.9%,[20] 41.72% vs 36.5%,[21] respectively).

Compared to one previous study that investigated seafarers' depression symptoms before the COVID-19 pandemic, our study showed a higher prevalence (41.72% vs 35.26%).[22] Also, compared to Mei's study, the rate of severe depression symptoms in

our study was much higher (9.07% vs 1.67%).[16] This findings support the hypothesis in previous study that the presence of major depressive disorder might increase during the COVID-19 pandemic.[18] A few reasons can explain the excess high prevalence of depression in seafarers during COVID-19 pandemic. Boring and enclosed working environment, high-intensity work, incomplete medical conditions and long-term separation from family members make seafarers have to bear more psychological pressure than other ordinary occupations. In addition, the rapid global spread of COVID-19 has brought seafarers into a dilemma, especially the overtime work caused by no crew changes aggravated the crew's poor mental health.

The present study identified several risk factors that contributed to severe depression symptoms. Seafarers with a poor SRH were 2-3-fold more likely to report severe depression symptoms. Our result is consistent with findings of previous research, which indicated that SRH can predict the risk of major depression in the future.[23] Moreover, our study found seafarers with less leisure time or physical exercise were susceptible to have severe depression symptoms. A review on psychological stress in seafarers reported that limited recreation activity was one of the most important factors associated with mental, psychosocial, and physical stressors of seafarers.[24] Another study also confirmed that moderate to vigorous physical activities reduce depression prevalence.[25] Our study also found that seafarers with poor sleep quality reported severe symptoms of depression. Sleep quality is an important risk factor for depression.[26] A large proportion of seafarers reported no good sleep or having sleep disruption, especially the seafarers on international voyages who often experience "jet lag".[27] In addition, seafarers' work requires a shift system, the overtime work resulted from crew change restriction during the global epidemic affects the quality of sleep, increasing the psychological burden and causing mental diseases.

Another prominent finding was the substantial impacts of overtime work and high perceived work stress on depression, which is consistent with prior studies.[28] Overtime work is often accompanied by decline of sleep quality, which is the major source of stress and chronic fatigue.[29] What's more, due to the restriction caused by

the epidemic, seafarers have to stay at sea for a long time, facing overload work. Overtime work, lack of safety in the workplace, and poor career prospects affect the mental health of seafarers. Previous studies have shown that seafarers are exposed to unique sources of work stress, such as special workplaces, monotonous work, climate change, long-term separation from family members.[30] These factors increase the anxiety and loneliness of seafarers, and lead to insomnia and emotional instability. The inability to change shifts in time due to the epidemic will gradually aggravate these bad mental states and cause severe depression symptoms.[31]

This study has several limitations. First, the participants are from Chinese seafarers, thus the extrapolate of the findings might be limited. Second, the status of depression symptoms was self-reported rather than clinical diagnoses. Third, the mental health status of seafarers before COVID-19 pandemic was not measured. Whether the observed high prevalence of depression was related to the COVID-19 cannot be evaluated. However, the prevalence of severe depression in seafarers was much higher than that reported before COVID-19, thus, we believed that the increased rate of severe depression symptoms is associated with COVID-19 pandemic. Fourth, the results may only reflect mental health status before one week of this survey, countries are currently taking measures to ease the dilemma of crew change, follow-up studies are needed to further investigate the long-term effect of COVID-19 pandemic.

Conclusions

In this study, Chinese seafarers reported high prevalence of symptoms of depression during the COVID-19 pandemic. Seafarers suffer various degrees of mental disorders. Poor self-rated health, less leisure time or physical exercise, poor sleep quality, more overtime work, and high perceived work stress are all linked to the report of depression symptoms. Special interventions that protecting the mental health of seafarers is even more critical in the context of a pandemic.

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REFERENCES

1 World Health Organization. WHO Director-General's opening remarks at the media briefing on COVID-19-11 March 2020. 2020. Available: https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020

2 World Health Organization. Coronavirus disease (COVID-19) pandemic. 2020. Available from: https://www.who.int/emergencies/diseases/novel-coronavirus-2019

3 Stannard S. COVID-19 in the maritime setting: the challenges, regulations and the international response. *Int Marit Health*. 2020;**71**:85-90. http://dx.doi.org/10.5603/IMH.2020.0016

4 Zarocostas J. UN leaders call for key worker recognition for seafarers. The Lancet, 2020, 396(10265): 1792. https://doi.org/10.1016/S0140-6736(20)32582-4

5 Doumbia-Henry C. Shipping and COVID-19: protecting seafarers as frontline workers. *WMU J Marit Aff*. 2020;*19*:279-93. https://doi.org/10.1007/s13437-020-00217-9

6 International Maritime Organization. Supporting seafarers on the frontline of COVID-19. 2020. Available from: https://www.imo.org/en/MediaCentre/HotTopics/Pages/Support-for-seafarers-during-COVID-19.aspx

7 Lee H L. Seafarers face 'mental health crisis', governments urged to take immediate actions. 2020. Available from: https://www.seatrade-maritime.com/casualty/seafarers-face-mental-health-crisis-governments-urged-take-immediate-actions

8 Claire P. Focus on seafarer wellbeing during Covid-19 pandemic. 2020. Available from: https://www.chirpmaritime.org/wp-content/uploads/2020/04/Covid-19-psycology-and-welfare-paper-April-2020-Final.pdf

9 Hakirevic N. COVID-19 agony: 2 more cruise ship crew members die while awaiting repatriation. 2020. Available: https://www.offshore-energy.biz/covid-19-agony-2-more-cruise-ship--crew-members-die-while-awaiting-repatriation/

10 Zhu L J, Ma H. Meta-Analysis on Mental Health of Chinese Seafarers. *Journal of Zhejiang Institute of Communications*. 2018;**19**:40-45.(In Chinese) https://doi.org/10.3969/j.issn.1671-234X.2018.04.008

11 Lefkowitz R Y, Slade MD. Seafarer Mental Health Study. 2019. Available: https://www.seafarerstrust.org/wp-content/uploads/2019/11/ST_MentalHealthReport_Final_Digital-1.pdf

12 Pierce M, Hope H, Ford T, Hatch S, Hotopf M, John A, et al. Mental health before and during the COVID-19 pandemic: a longitudinal probability sample survey of the UK population. *The Lancet Psychiatry*. 2020;**7**:883-92. https://doi.org/10.1016/S2215-0366(20)30308-4

13 Wathelet M, Duhem S, Vaiva G, Baubet T, Habran E, Veerapa E, et al. Factors Associated With Mental Health Disorders Among University Students in France Confined During the COVID-19 Pandemic. *JAMA Netw Open*. 2020;**3**:e2025591. https://doi.org/10.1001/jamanetworkopen.2020.25591

14 Lai J, Ma S, Wang Y, Cai Z, Hu J, Wei N, et al. Factors Associated With Mental Health Outcomes Among Health Care Workers Exposed to Coronavirus Disease 2019. *JAMA Netw Open*. 2020;**3**:e203976. https://doi.org/10.1001/jamanetworkopen.2020.3976

15 Xiong J, Lipsitz O, Nasri F, Lui LMW, Mcintyre RS. Impact of COVID-19 Pandemic on Mental Health in the General Population: A Systematic Review. *J Affect Disord*. 2020;**277**:55-64. https://doi.org/10.1016/j.jad.2020.08.001

16 Mei Y, Zhang J, Li F, Gao YX. Depression symptoms and associated factors among seamen undertaking international voyage. Chinese Journal of Public Health. 2015;**31**:954-7.(In Chinese) https://doi.org/10.11847/zgggws2015-31-07-28

17 ZUNG, William WK. A Self-Rating Depression Scale. *Arch Gen Psychiatry*. 1965;**12**:63-70. https://doi.org/10.1001/archpsyc.1965.01720310065008

18 Ettman CK, Abdalla SM, Cohen GH, Sampson L, Galea S. Prevalence of Depression Symptoms in US Adults Before and During the COVID-19 Pandemic. *JAMA Netw Open*. 2020;**3**:e2019686. https://doi.org/10.1001/jamanetworkopen.2020.19686

19 Fayers PM, Sprangres MAG. Understanding self-rated health. *Lancet*. 2002;**359**:187-8. https://doi.org/10.1016/S0140-6736(02)07466-4

20 Shi L, Lu Z, Que J, Huang X, Liu L, Ran M, et al. Prevalence of and risk factors associated with mental health symptoms among the general population in China during the coronavirus disease 2019 pandemic. *JAMA Netw Open*. 2020;**3**:e2014053. https://doi.org/10.1001/jamanetworkopen.2020.14053

21 Dong P, Ni ZJ, Zhao KQ, Sun GQ, Sun HQ. Public depression status during the COVID 19 epidemic. Chinese Mental Health Journal. 2020;**34**:710-714. (In Chinese) https://doi.org/10.3639/j.issn.1000-6729.2020.8.014

22 Yang CG, Chen P, Nie WZ, Li DX, Zhao B, Yu CL, et al. A survey on the international crew's phychological health and the influence factors. Chinese Frontier Health Quarantine,. 2016;**39**:132-5. (In Chinese) https://doi.org/10.16408/j.1004-9770.2016.02.015

23 Badawi G, Pagé V, Smith KJ, Garie´G, Malla A, Wang J, et al. Self-rated health: A predictor for the three year incidence of majordepression in individuals with Type II diabetes. *J Affect Disord*. 2013;**145**:100-5. https://doi.org/10.1016/j.jad.2012.07.018

24 Carotenuto A, Molino I, Fasanaro AM, Amenta F. Psychological stress in seafarers: a review. *Int Marit Health*. 2012;**63**:188-94. PMID: 24595974

25 Currier D, Lindner R, Spittal MJ, Cvetkovski S, Pirkis J, English D. Physical activity and depression in men: Increased activity duration and intensity associated with lower likelihood of current depression. *J Affect Disord*. 2020;**260**:426-31. https://doi.org/10.1016/j.jad.2019.09.061

26 Hu Z, Zhu X, Kaminga AC, Zhu T, Xu H. Association between poor sleep quality and depression symptoms among the elderly in nursing homes in Hunan province, China: a cross-sectional study. *BMJ Open*. 2020;**10**:e036401. https://doi.org/10.1136/bmjopen-2019-036401

27 Allen P, Wadsworth E, Smith A. The prevention and management of seafarers' fatigue: a review. *Int Marit Health*. 2007;**58**:167-77. https://doi.org/10.1016/j.jweia.2007.02.019

28 Jing X, Binjun H, Huan S, Xiuli L, Jie Z, Yaqing Z, et al. Association between social support and health-related quality of life among Chinese seafarers: A cross-sectional study. *PLos one*. 2017;**12**:e0187275. https://doi.org/10.1371/journal.pone.0187275

29 Sąlyga J, Kušleikaitė M. Factors influencing psychoemotional strain and fatigue, and relationship of these factors with health complaints at sea among Lithuanian seafarers. *Medicina*. 2011;**47**:675-81. https://doi.org/10.3390/medicina47120099

30 Hjarnø L, Leppin A. A risky occupation? (Un)healthy lifestyle behaviors among Danish seafarers. *Health Promot Int*. 2014;**29**:720-9. https://doi.org/10.1093/heapro/dat024

31 Sliškovic A. Seafarers' well-being in the context of the COVID-19 pandemic: A qualitative study. Work, 2020 (Preprint): 1-11. https://doi.org/10.3233/WOR-203333

Footnotes

Contributors: WZ planned the study, conducted the analysis and wrote the pater while being supervised by SX*; LL, CF helped to plan the study, including the instrumentation, and to revise the manuscript; DS, PF, and SX accomplished the statistical analysis and contributed to revising the paper. All authors contributed to the discussion of the paper, read and approved the final manuscript.

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STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-7
Bias	9	Describe any efforts to address potential sources of bias	

Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8
		(*b*) Describe any methods used to examine subgroups and interactions	8
		(*c*) Explain how missing data were addressed	
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	6
		(*e*) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8
		(b) Indicate number of participants with missing data for each variable of interest	
Outcome data	15*	Report numbers of outcome events or summary measures	9
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8-12
		(*b*) Report category boundaries when continuous variables were categorized	8-12

		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	14
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12-14
Generalisability	21	Discuss the generalisability (external validity) of the study results	14
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Title Page

Prevalence and Risk Factors of Depression Symptoms among Chinese Seafarers During the COVID-19 Pandemic: a cross-sectional study

Wenzhe Qin[a]; Lei Li[b,c]; Dongshan Zhu[a], Chengfei Ju[c]; Pengfei Bi[c]; Shixue Li[a]

a. Centre for Health Management and Policy Research, School of Public Health, Cheeloo College of Medicine, Shandong University, Jinan, China; NHC Key Lab of Health Economics and Policy Research (Shandong University), Jinan, 250012, China.

b. Department of health quarantine, Jinan Airport Customs, Jinan, 250013, China

c. Department of health quarantine, Rongcheng Customs, Rongcheng, 264300, China

Corresponding author: Shixue Li, Professor

Centre for Health Management and Policy Research, School of Public Health, Cheeloo College of Medicine, Shandong University, Wenhuaxi Road44#, Jinan, Shandong, 250012, China.

Tel and fax: +86-0531-88382127. Email: shixueli@sdu.edu.cn

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Abstract

Background: To curb the spread of COVID-19, most countries have adopted measures of ports banning shore leave and placed restrictions on crew change. Seafarers may bear excess pressure during the COVID-19 pandemic. This study aimed to investigate the prevalence and risk factors associated with depression symptoms among Chinese seafarers during the COVID-19 pandemic.

Design: Cross-sectional study.

Methods: This field survey-based study was conducted in Rongcheng port, Shandong Province, China, from June 10, 2020 to July 25, 2020. Socio-demographic, occupational characteristics and health related behaviors were collected through a face-to-face questionnaire. Self-rating Depression Scale (SDS) was used to evaluate depression status during the preceding week. Logistic regression models were used to explore related factors of depression.

Results: 441 male Chinese seafarers were enrolled. Overall, the proportions of seafarers with low, moderate and severe depressive symptoms were 103 (23.35%), 41 (9.30%) and 40 (9.07%), respectively. Compared to those with a good self-rated health (SRH), seafarers with poor SRH had higher odds of depression (Odds ratio [OR],2.24; 95%CI,1.22-4.11). Less leisure time or physical exercise was associated with more severe self-reported depression symptoms (1~3/week vs ≥4/week: OR,1.72; 95%CI, 0.71-4.14; none vs ≥4/week OR,3.93; 95%CI, 1.67-9.26). Poor sleep quality was associated with a higher likelihood of reporting severe depression (fair vs good: OR,2.78; 95%CI, 1.54-5.01; poor vs good: OR,4.30; 95%CI, 1.65-11.24). The more times of working overtime a week, the higher likely to report severe depression symptoms (1~2/week vs none: OR,1.82; 95%CI, 1.04-3.18; ≥3/week vs none: OR,2.49; 95%CI, 1.05-5.92). Also, high perceived work stress was linked to higher odds of being depression (intermediate vs low: OR,2.06; 95%CI, 0.78-5.46; high vs low: OR,3.83; 95%CI, 1.35-10.90).

Conclusions: There is a high depression burden associated with the COVID-19

among seafarers. Special interventions that protecting the mental health of seafarers is even more critical in the context of a pandemic.

Key words: Depression; COVID-19; International voyage; Seafarers; Related factors

Strengths and limitations of this study:

- This is the first study that evaluated the depression status and related factors of seafarers during the COVID-19 pandemic.
- This study may provide important evidence to direct the promotion of mental wellbeing among seafarers.
- The mental health status of seafarers before COVID-19 pandemic was not measured.
- The participants are from Chinese seafarers, thus the extrapolate of the findings might be limited.

Introduction

On March 11, 2020, the World Health Organization declared the outbreak of the coronavirus disease 2019 (COVID-19) a global pandemic.[1] As of March 31 2021, there are more than 127 million confirmed cases and 2.7 million confirmed deaths worldwide.[2] In addition to causing serious illness, the pandemic also severely impacts the global economy and the global supply chain, including international shipping.

Shipping is the lifeblood of global supply chain and accounts for 90% of world trade.[3] Thus, ships continue sailing even in the COVID-19 pandemic. Seafarers play an essential role in maintaining the flow of vital goods, such as food, goods and medical supplies.[4] Globally, there are 2 million seafarers ensuring global needs of goods for daily life.[5]

To control the spread of COVID-19, most countries have adopted measures of ports banning shore leave and placed restrictions on crew change. As of December 2020, it is estimated that 400,000 seafarers are currently stranded on ships beyond the end of their original contracts and unable to be repatriated, due to COVID-related travel restrictions. A similar number of seafarers are stuck at home, unable to join ships and provide for their families.[6]

Long-term work at sea, in a relatively small and enclosed environment, boring amateur life and family separation, a total absence of shore leave, virus fears, a perceived lack of COVID-19 precautions on board vessels, and isolation on board may all naturally cause mental health crisis, such as emotional instability, anxiety, and depression.[7] Some organizations call for attention to the mental health of these seafarers 'trapped on board', unfortunately there still have been a number of reported suicides on board ships.[8,9]

Previous studies before COVID-19 pandemic have suggested that seafarers' mental health is poor. A meta-analysis of Chinese seafarers found that the mental health status of seafarers was worse than the Chinese general population, especially the

prevalence of depression.[10] One fourth seafarers were suffering from depression.[11] Evidence has shown COVID-19 has negative impact on the mental health.[12-15] Considering the specific working conditions of seafarers, we suppose that seafarers' mental health may deteriorate during the COVID-19 pandemic, and they may suffer high prevalence of depression.

The assessment for determinants of depression among working seafarers was a major goal of research. Previous studies had found that risk factors for depression in seafarers include baseline medical conditions (a history of high cholesterol, hypertension, sleep disturbances, diabetes, liver disease, and cancer, etc), demographic (age, gender, and region of origin, etc), occupational(rank, work experience, etc), work-related determinants (exposures to overtime work and work stress) and additional factors.[11,16] In this study, firstly, the baseline medical conditions including chronic disease, sleep duration/quality are going to be tested. We suppose that chronic disease and sleep disturbances are positively associated with depression symptoms. Secondly, demographic factors including age, marital status, education level and monthly income are going to be tested. We suppose that age, other marital status, low education level and low monthly income may have a positively effect on depression symptoms. Thirdly, occupational factors including position rank, sailing age are going to be tested. We suppose that high position rank and short sailing age are positively associated with depression symptoms. Fourthly, the work-related determinants including sailing duration, overtime work per week, COVID-19 related stress and perceived work stress are going to be tested. We suppose that long sailing duration, overtime work per week and high perceived work stress are positively associated with depression symptoms. Additionally, the self-rated health, health behaviors and frequency of exercise are also be tested. We suppose that the poor self-rated health, poor health behaviors and lack of exercise may have positively effect on depression symptoms.

Based on the above research background, we aim to evaluate prevalence of depression symptoms among international seafarers during COVID-19 pandemic, and to explore

potential risk factors associated with depression symptoms. This study may provide important evidence to direct the promotion of mental wellbeing among seafarers.

Methods

Study design and participants

A cross-sectional study was conducted in Rongcheng port, Shandong Province, China, from June 10, 2020 to July 25, 2020. To ensure the authenticity and reliability of data, the survey was anonymous, and all data was collected face-to-face by trained front-line quarantine officers of customs using a self-administered questionnaire (SAQ). A structured questionnaire packet that included five parts: socio-demographic information, occupational characteristics, health related behaviors, health condition and self-rating depression scale (SDS).

Eligible participants were Chinese seafarers. Two-stage sampling strategy was applied: in the first stage, a cluster random sampling method was employed to select the entry international ocean ships. The ship and crew information must be declared to the customs 24 hours before the entry of the ship, thus we coded the ship entering the next day in advance and select one ship by random number method. A total of 30 ships were selected. Second, all Chinese seafarers on the selected ship were interviewed. The target sample size of participants was determined using the formula $N=Z_{\alpha}^2P(1-P)/d^2$, in which α =0.05 and Z_{α}=1.96, and the estimated acceptable margin of error for proportion d was 0.05. The proportion of seafarers with depression symptoms was estimated at 50.76%, based on a previous study before the COVID-19 outbreak.[17] To improve the response rate, we amplified the sample size by 15% with a goal of at least 442 participants. A total of 450 seafarers were included during the actual investigation and 9 participants refused to participate in this survey. Finally, 441 individuals completed the survey.

Key Definitions

Self-rating Depression Scale (SDS)

The 20-item Zung Self-Rating Depression Scale (SDS) was used to evaluate the depression symptoms of seafarers.[18] Ten items are scored positively (e.g., "I feel downhearted and blue") and other ten scored negatively (e.g., "I still enjoy the things I used to do"). The seafarers were asked to rate how frequently they experienced each symptom during the past week. Responses were distributed on a 4-point Likert scale (1= a little of time, 2= some of the time, 3= good part of the time, 4= most of the time). The sum of the scores obtained on the 20 items were raw scores, and the raw scores are converted to a standard score (100-point scale) by multiplying by 1.25. A higher score indicates more severe depression symptoms. The severity of depression symptoms can be converted as follows: normal (≤49), mild (50-59), moderate (60-69), and severe (≥70). Previous study shows that the presence of major depressive disorder during the COVID-19 pandemic maybe need more concern.[19] We classified depression symptoms into two categories: 1=none/mild, 2=moderate/severe.[19] Binary classification of depression symptoms was defined by a score of 60 or greater. The SDS is widely used in previous studies and has a good reliability and validity. The Cronbach's α was 0.76 in this study.

Socio-demographic factors

Data on age, sailing age, gender, marital status, educational level and individual income. Age and sailing age were measured in chronological years; Gender was dichotomized; Marital status was categorized into married and others; education level was divided into three levels: high school or below, junior college, Bachelor's degree or above; Average monthly income prior to the study was collected.

Occupational characteristics

Occupation-related factors included sailing duration, type of working ship, position, night shift frequency per week, overtime work frequency per week, self-perceived work stress. Overtime work was defined as "work continuously for more than 10 hours one day". Frequency of overtime work per week was measured with three options: (1)none, (2)1-2, (3)⩾3. Respondents were asked to rate their work-related

stress with a question as “In general, how would you rate your recent work stress”. 3-point Likert scale were used: 3=high, 2=intermediate, 1=low.[20]

Health related data and health related behaviors

Health conditions was measured with self-rated health (SRH) and chronic disease. Previous studies have shown that SRH is an effective and reliable measure of health.[21] Five possible categories were provided: 5=excellent, 4=very good, 3=good, 2=fair, 1=poor. Because of the missing option, we recode SRH into a binary variable. “excellent”, “very good”, or “good” were regarded as health good, while “fair” or “poor” were regarded as health poor. Chronic disease was dichotomized according to their responses.

Health related behaviors including smoke, drink, sleep duration, self-rated sleep quality, leisure time or physical exercise (LPE) in the past month were measured. Sleep duration was measured with the number of hours sleep at night. Seafarers’ work requires a shift system, and it's difficult to accurately report the sleep duration per day. Thus, sleep duration is divided into three options in the questionnaire: (1)<6 hours, (2)6-8 hours, (3)>8 hours. Sleep quality was divided into three categories: 3=excellent, 2=fair, 1=poor. LPE was calculated as the frequency of engaging in leisure activities or physical exercise (such as walking, playing table tennis, or working out at a gym) per week on board, and divided into three categories: 0=none, 1-3=occasionally, ≥4=regularly. Chronic disease and self-rated health (SRH) were applied to represent health conditions.

COVID-19 stress

Seafarers were asked “In the current global outbreak of COVID-19, how would you rate the COVID-19-related stress on you and your relatives (such as be infected, lose job, have financial problems and so no)?” 3-point Likert scale were used: 3=high, 2=fair, 1=low.

Ethics statement

Written informed consent was received before the respondents began the questionnaire. This study was approved by the ethics committee of Shandong University, and which was performed in accordance with the Helsinki Declaration.

Statistical Analysis

Characteristics of seafarers by depression groups were described. Data are presented as mean (standard deviation, SD) for continuous variables and as the *n* (%) for categorical variables. Statistical differences of depression among subgroups were tested using independent sample t-tests (continuous variables) or $\chi 2$ tests (categorical variables). Multivariable logistic regression models were employed to estimate odds ratio (OR) and 95% CIs for the associations between risk factors and depression symptoms. All statistical tests were two-tailed, and the level of significance was set at 0.05. All analysis was performed using SPSS statistical software version 25.0 (IBM Corp).

Results

Demographic Characteristics

The demographic characteristics of seafarers showed in Table 1. The mean age was 37.54±9.74 years; the median sailing age was 8.0(3.0-13.0) years; 53.5% were high school or below and 7.5% were Bachelor's degree or above; 74.6% were married; 52.2% were ordinary crew. The ship types that seafarers work on are mainly cargo ships and bulk carriers. By the end of this survey, the median sailing duration was 7.0(5.0-9.0) months without disembark and traveling home. According to the contractual sailing duration stated by "The collective bargaining agreement for Chinese crew", 30.4% of seafarers have been on board for more than 8 months, 15% of them for more than 10 months, and 9.5% of seafarers for more than 12 months.

Prevalence of depression symptoms in seafarers

In 441 seafarers, the highest standard score of depression was 73, and the total mean standard score was 38.33±10.8. According to the standard score, a considerable

proportion of seafarers reported symptoms of depression (184 [41.7%]), of which 103 (23.35%), 41 (9.30%) and 40 (9.07%) categorized as having low, moderate and severe depressive symptoms, respectively. The demographic characteristics of seafarers was presented in **Table 1.**

Table 1 Characteristics of All Participants by Level of Depression Symptoms

Characteristic	Total, No. (%) (N=441)	Severity of depression, No. (%)		*P* value
		Normal/mild (n=360)	Moderate/Severe (n=81)	
Sailing age [a], year	8.0(3.0-13.0)	8.0(3.0-13.0)	8.0(2.0-12.0)	0.402[b]
Sailing duration [a], month	7.0(5.0-9.0)	7.0(5.0-9.0)	7.0(6.0-9.0)	0.432[b]
Age (year)				
18-44	323(73.2)	265(82.0)	58(18.0)	0.712[c]
≥45	118(26.8)	95(80.5)	23(19.5)	
Marital status				
Married	329(74.6)	273(83.0)	56(17.0)	0.207[c]
Others	112(25.4)	87(77.7)	25(22.3)	
Education level				
High school and below	236(53.5)	192(81.4)	44(18.6)	0.343[c]
Junior college	172(39.0)	139(80.8)	33(19.2)	
Bachelor's degree or above	33(7.5)	29(87.9)	4(12.1)	
Income (RMB)				
≤10000	214(48.5)	168(78.5)	46(21.5)	0.308[c]
10001～20000	148(33.6)	123(83.1)	25(16.9)	
20001～30000	25(5.7)	21(84.0)	4(16.0)	
>30000	54(12.2)	48(88.9)	6(11.1)	
Position classes				
Ordinary crew	230(52.2)	183(79.6)	47(20.4)	0.269[d]
Senior officer	211(47.8)	177(83.9)	34(16.1)	
Self-rated health				
Good	292(66.2)	259(88.7)	33(11.3)	<.001[c]
Poor	149(33.8)	101(67.8)	48(32.2)	
Chronic disease				
Yes	18(4.1)	14(77.8)	4(22.2)	0.755[d]
No	423(95.9)	346(81.8)	77(18.2)	
Smoking status				
Yes	201(45.6)	160(79.6)	41(20.4)	0.326[d]
No	240(54.4)	200(83.3)	40(16.7)	
Drinking status				
Yes	319(72.3)	267(83.7)	52(16.3)	0.075[d]
No	122(27.7)	93(76.2)	29(23.8)	
LPE per week				

None	171(38.8)	124(72.5)	47(27.5)	<.001[c]
1~3	192(43.5)	165(85.9)	27(14.1)	
≥4	78(17.7)	71(91.0)	7(9.0)	
Sleep duration				
<6	15(3.4)	8(53.3)	7(46.7)	0.008[c]
6~8	181(41.0)	145(80.1)	36(19.9)	
>8	245(55.6)	207(84.5)	38(15.5)	
Sleep quality				
Poor	29(6.6)	18(62.1)	11(37.9)	<.001[c]
Fair	214(48.5)	163(76.2)	51(23.8)	
Good	198(44.9)	179(90.4)	19(9.6)	
Overtime work per week				
None	256(58.0)	224(87.5)	32(12.5)	0.001[c]
1~2	154(34.9)	115(74.7)	39(25.3)	
≥3	31(7.1)	21(67.7)	10(32.3)	
Self-perceived work stress				
Low	65(14.7)	60(92.3)	5(7.7)	<.001[c]
Intermediate	277(62.8)	232(83.8)	45(16.2)	
High	99(22.5)	68(68.7)	31(31.3)	
COVID-19 stress				
Low	54(12.2)	44(81.5)	10(18.5)	0.896[c]
Intermediate	154(34.9)	124(80.5)	30(19.5)	
High	233(52.8)	192(82.4)	41(17.6)	

Abbreviations: LPE, leisure time or physical exercise; COVID-19, coronavirus disease 2019.

[a] Data are presented as median (IQR).

[b] Mann-Whitney rank sum test conducted for significance testing

[c] Two-tailed χ^2 analysis conducted for significance testing

[d] Fisher's exact test conducted for significance testing

The distribution of depression symptoms was different in the epidemic-related categories of SRH, LPE per week, sleep duration, sleep quality, overtime work frequency per week, and self-perceived work-related stress (**Table 1**). Participants with severe depression reported experiencing a poorer SRH and engaging in less LPE per week (χ^2=28.78, P<0.001; χ^2=16.45, P<0.001, respectively). Seafarers with sleep duration <6h and having a poor sleep quality had higher percentage of reporting severely depression (χ^2=9.63, P=0.008; χ^2=21.82, P<0.001, respectively). Moreover, the distributions of depression symptoms within categories of overtime work frequency and self-rated work-related stress have different patterns. The more times

of overtime work, the higher the depression level (χ^2=14.84, *P*=0.001). Seafarers in the high self-perceived work stress group had more severe depression symptoms (χ^2=16.84, *P*<0.001). Other characteristics of seafarers had no difference in the distributions of depression symptoms (*P*>0.05).

Factors associated with depression symptoms

Poor SRH(OR,2.24; 95%CI, 1.22-4.11), LPE per week(for none vs ≥4: OR,3.93; 95%CI, 1.67-9.26), sleep quality(for poor vs good: OR,4.30; 95%CI, 1.65-11.24), frequency of overtime work per week(for ≥3 vs none: OR,2.49; 95%CI, 1.05-5.92), and self-perceived work stress(for high vs low: OR,3.83; 95%CI, 1.35-10.90) were associated with reporting severe depression symptoms(**Table 2**).

Table 2 Multivariable Regression Analysis of Factors Associated with Depression Symptoms

Variable	No. of Moderate/Severe (%)	OR (95%CI)	*P value* [a] Category	*P value* [a] Overall
Self-rated health				
Good	33(11.3)	1[reference]	NA	0.009
Poor	48(32.2)	2.24 (1.22,4.11)	0.009	
LPE per week				
≥4	7(9.0)	1[reference]	NA	
1~3	27(14.1)	1.72 (0.71,4.14)	0.229	0.001
None	47(27.5)	3.93 (1.67,9.26)	0.002	
Sleep quality				
Good	19(9.6)	1[reference]	NA	
Fair	27(14.1)	2.78 (1.54,5.01)	0.001	0.001
Poor	11(37.9)	4.30 (1.65,11.24)	0.003	
Overtime work per week				
None	32(12.5)	1[reference]	NA	
1~2	39(25.3)	1.82 (1.04,3.18)	0.035	0.041
≥3	10(32.3)	2.49 (1.05,5.92)	0.039	
Self-perceived work stress				
Low	5(7.7)	1[reference]	NA	
Intermediate	45(16.2)	2.06 (0.78,5.46)	0.147	0.019
High	31(31.3)	3.83 (1.35,10.90)	0.012	

Abbreviations: OR, odds ratio; LPE, leisure time or physical exercise.

[a] Category refers to the P value for each category vs the reference, while overall refers to the results of the logistic regression.

Less frequent leisure time or physical exercise was associated with more severe self-reported depression symptoms (1~3/week vs ≥4/week: OR,1.72; 95%CI,

0.711-4.14; none vs ≥4/week OR,3.93; 95%CI, 1.67-9.26). Having a poor sleep quality was associated with a higher likelihood of reporting severe depression (fair vs good: OR,2.78; 95%CI, 1.54-5.01; poor vs good: OR=4.30; 95%CI, 1.65-11.24). The more times seafarers work overtimes a week, the more likely they were to report severe depression symptoms (1~2/week vs none: OR,1.82; 95%CI, 1.04-3.18; ≥3/week vs none: OR,2.49; 95%CI, 1.05-5.92). An increased odd of severe depression was identified among seafarers with high perceived work stress (intermediate vs low: OR,2.06; 95%CI, 0.78-5.46; high vs low: OR=3.83; 95%CI, 1.35-10.90).

Discussion

A high prevalence of depression symptoms among Chinese seafarers was found during COVID-19 pandemic. Over 40% seafarers reported depression symptoms and around 9% of them had severe depressive symptoms. Poor SRH, poor sleep quality, less leisure time or physical exercise, more overtime work, and higher work stress were associated with experiencing severe depression symptoms. Our findings provide the latest profile of psychological status of seafarers during the COVID-19 pandemic. Seafarers' mental health may need more attention during COVID-19 epidemic.

Previous studies have shown a substantial burden of depression symptoms in general population following COVID-19.[19,22,23] A nationally representative study that was conducted among the US adults indicated that prevalence of depression symptom was higher during COVID-19 pandemic compared with before in every depression category(mild: 24.6% vs 16.2%; moderate: 14.8% vs 5.7%; moderately severe: 7.9% vs 2.1%; severe: 5.1% vs 0.7%).[19] Compared to the general Chinese population during COVID-19 pandemic, seafarers have excess prevalence of depression symptoms (41.72 vs 27.9%,[22] 41.72% vs 36.5%,[23] respectively).

Compared to previous studies that investigated seafarers' depression symptoms before the COVID-19 pandemic, our study showed a higher prevalence ([41.72% vs 35.26%][24], [41.72% vs 20.26%][25], [41.72% vs 38.56%][26]). Also, compared to Mei's

study, although the overall detection rate of depressive symptoms in our study is lower than that in Mei's study (41.72% vs 50.77%), the rate of severe depression symptoms in our study was much higher (9.07% vs 1.67%).[17] These findings support the hypothesis in previous study that the presence of major depressive disorder might increase during the COVID-19 pandemic.[19]

The present study identified several risk factors that contributed to severe depression symptoms. Seafarers with a poor SRH were 2-3-fold more likely to report severe depression symptoms. Our result is consistent with findings of previous research, which indicated that SRH can predict the risk of major depression in the future.[27] Moreover, our study found seafarers with less leisure time or physical exercise were susceptible to have severe depression symptoms. A review on psychological stress in seafarers reported that limited recreation activity was one of the most important factors associated with mental, psychosocial, and physical stressors of seafarers.[28] Another study also confirmed that moderate to vigorous physical activities reduce depression prevalence.[29] Our study also found that seafarers with poor sleep quality reported severe symptoms of depression. Sleep quality is an important risk factor for depression.[30] A large proportion of seafarers reported no good sleep or having sleep disruption, especially the seafarers on international voyages who often experience "jet lag".[31] In addition, seafarers' work requires a shift system, the overtime work resulted from crew change restriction during the global epidemic affects the quality of sleep, increasing the psychological burden and causing mental diseases.

Another prominent finding was the substantial impacts of overtime work and high perceived work stress on depression, which is consistent with prior studies.[32] Overtime work is often accompanied by decline of sleep quality, which is the major source of stress and chronic fatigue.[33] What's more, due to the restriction caused by the epidemic, seafarers have to stay at sea for a long time, facing overload work. Overtime work, lack of safety in the workplace, and poor career prospects affect the mental health of seafarers. Previous studies have shown that seafarers are exposed to unique sources of work stress, such as special workplaces, monotonous work, climate

change, long-term separation from family members.[34] These factors increase the anxiety and loneliness of seafarers, and lead to insomnia and emotional instability. Especially the boredom on board caused by monotonous work, which is a important source of stress and addiction, according to data from the literature.[35] Jegaden's study found that there is a significant correlation between the boredom and depression among office staff and the seafarers, and boredom is an important factor that cannot be ignored.[36] Also, the inability to change shifts in time due to the epidemic will gradually aggravate these bad mental states and cause severe depression symptoms.[37]

According to previous literature and the issues noted in this paper, the government, the whole society, the shipping company and the seafarers themselves should work together to take different measures to mitigate the depression symptoms among seafarers. Firstly, enhancing the attention of the whole society to the seafarers, and gradually improve the social status of them. Secondly, the government should recognize seafarers as key workers and adopt urgently needed measures to enable crew changes. Thirdly, the shipping company should increase care for seafarers, and include the availability of some leisure activities, the encouragement of physical engagement, cultural projects, and the installation of shipboard telecommunication systems to contact families and friends. Better organization of working hours and work shifts should also be included. This would allow a longer and continuous period of sleep. Appropriate psycho education approaches could prepare seafarers to recognize job-specific stressors and implement suitable coping strategies. Finally, the seafarers themselves should adjust their mentality, look for happiness and satisfaction in their careers, broaden social interactions, obtain social support, and have the courage to seek professional psychological counseling and help.

This study has several limitations. First, the cross-sectional design brings question about interpretation of relation between some "risk factors" and depression. Second, the participants are from Chinese seafarers, thus the extrapolate of the findings might be limited; Also, the representativeness of obtained sample was not be checked, but in the process of sample size estimation and sampling design, we strictly follow the

principle of randomness to ensure that the sample acquisition is scientific. Third, the status of depression symptoms was self-reported rather than clinical diagnoses. Fourth, the mental health status of seafarers before COVID-19 pandemic was not measured. Whether the observed high prevalence of depression was related to the COVID-19 cannot be evaluated. However, the prevalence of severe depression in seafarers was much higher than that reported before COVID-19, thus, we believed that the increased rate of severe depression symptoms is associated with COVID-19 pandemic. In addition, the results may only reflect mental health status before one week of this survey, countries are currently taking measures to ease the dilemma of crew change, follow-up studies are needed to further investigate the long-term effect of COVID-19 pandemic.

Conclusions

In this study, Chinese seafarers reported high prevalence of symptoms of depression during the COVID-19 pandemic. Seafarers suffer various degrees of mental disorders. Poor self-rated health, less leisure time or physical exercise, poor sleep quality, more overtime work, and high perceived work stress are all linked to the report of depression symptoms. Special interventions that protecting the mental health of seafarers is even more critical in the context of a pandemic.

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REFERENCES

1 World Health Organization. WHO Director-General's opening remarks at the media briefing on COVID-19-11 March 2020. 2020. Available: https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020

2 World Health Organization. Coronavirus disease (COVID-19) pandemic. 2020. Available from: https://www.who.int/emergencies/diseases/novel-coronavirus-2019

3 Stannard S. COVID-19 in the maritime setting: the challenges, regulations and the international response. *Int Marit Health*. 2020;**71**:85-90. http://dx.doi.org/10.5603/IMH.2020.0016

4 Zarocostas J. UN leaders call for key worker recognition for seafarers. The Lancet, 2020, 396(10265): 1792. https://doi.org/10.1016/S0140-6736(20)32582-4

5 Doumbia-Henry C. Shipping and COVID-19: protecting seafarers as frontline workers. *WMU J Marit Aff*. 2020;*19*:279-93. https://doi.org/10.1007/s13437-020-00217-9

6 International Maritime Organization. Supporting seafarers on the frontline of COVID-19. 2020. Available from: https://www.imo.org/en/MediaCentre/HotTopics/Pages/Support-for-seafarers-during-COVID-19.aspx

7 Lee H L. Seafarers face 'mental health crisis', governments urged to take immediate actions. 2020. Available from: https://www.seatrade-maritime.com/casualty/seafarers-face-mental-health-crisis-governments-urged-take-immediate-actions

8 Claire P. Focus on seafarer wellbeing during Covid-19 pandemic. 2020. Available from: https://www.chirpmaritime.org/wp-content/uploads/2020/04/Covid-19-psycology-and-welfare-paper-April-2020-Final.pdf

9 Hakirevic N. COVID-19 agony: 2 more cruise ship crew members die while awaiting repatriation. 2020. Available: https://www.offshore-energy.biz/covid-19-agony-2-more-cruise-ship--crew-members-die-while-awaiting-repatriation/

10 Zhu L J, Ma H. Meta-Analysis on Mental Health of Chinese Seafarers. *Journal of Zhejiang Institute of Communications*. 2018;**19**:40-45.(In Chinese) https://doi.org/10.3969/j.issn.1671-234X.2018.04.008

11 Lefkowitz R Y, Slade MD. Seafarer Mental Health Study. 2019. Available: https://www.seafarerstrust.org/wp-content/uploads/2019/11/ST_MentalHealthReport_Final_Digital-1.pdf

12 Pierce M, Hope H, Ford T, Hatch S, Hotopf M, John A, et al. Mental health before and during the COVID-19 pandemic: a longitudinal probability sample survey of the UK population. *The Lancet Psychiatry*. 2020;**7**:883-92. https://doi.org/10.1016/S2215-0366(20)30308-4

13 Wathelet M, Duhem S, Vaiva G, Baubet T, Habran E, Veerapa E, et al. Factors Associated With Mental Health Disorders Among University Students in France Confined During the COVID-19 Pandemic. *JAMA Netw Open*. 2020;**3**:e2025591. https://doi.org/10.1001/jamanetworkopen.2020.25591

14 Lai J, Ma S, Wang Y, Cai Z, Hu J, Wei N, et al. Factors Associated With Mental Health Outcomes Among Health Care Workers Exposed to Coronavirus Disease 2019. *JAMA Netw Open*. 2020;**3**:e203976. https://doi.org/10.1001/jamanetworkopen.2020.3976

15 Xiong J, Lipsitz O, Nasri F, Lui LMW, Mcintyre RS. Impact of COVID-19 Pandemic on Mental Health in the General Population: A Systematic Review. *J Affect Disord*. 2020;**277**:55-64. https://doi.org/10.1016/j.jad.2020.08.001

16 Sliš ković A, Penezić Z. Lifestyle factors in Croatian seafarers as relating to health and stress on board. *Work*, 2017, **56**: 371-380. https://doi.org/10.3233/WOR-172501

17 Mei Y, Zhang J, Li F, Gao YX. Depression symptoms and associated factors among seamen undertaking international voyage. Chinese Journal of Public Health. 2015;**31**:954-7.(In Chinese) https://doi.org/10.11847/zgggws2015-31-07-28

18 ZUNG, William WK. A Self-Rating Depression Scale. *Arch Gen Psychiatry*. 1965;**12**:63-70. https://doi.org/10.1001/archpsyc.1965.01720310065008

19 Ettman CK, Abdalla SM, Cohen GH, Sampson L, Galea S. Prevalence of Depression Symptoms in US Adults Before and During the COVID-19 Pandemic. *JAMA Netw Open*. 2020;**3**:e2019686. https://doi.org/10.1001/jamanetworkopen.2020.19686

20 Oldenburg M, Jensen H J, Wegner R. Burnout syndrome in seafarers in the merchant marine service. *Int Arch Occup Environ Health* , 2013;**86**:407-416. https://doi.org/10.1007/s00420-012-0771-7

21 Fayers PM, Sprangres MAG. Understanding self-rated health. *Lancet*. 2002;**359**:187-8. https://doi.org/10.1016/S0140-6736(02)07466-4

22 Shi L, Lu Z, Que J, Huang X, Liu L, Ran M, et al. Prevalence of and risk factors associated with mental health symptoms among the general population in China during the coronavirus disease 2019 pandemic. *JAMA Netw Open*. 2020;**3**:e2014053. https://doi.org/10.1001/jamanetworkopen.2020.14053

23 Dong P, Ni ZJ, Zhao KQ, Sun GQ, Sun HQ. Public depression status during the COVID 19 epidemic. Chinese Mental Health Journal. 2020;**34**:710-714. (In Chinese) https://doi.org/10.3639/j.issn.1000-6729.2020.8.014

24 Yang CG, Chen P, Nie WZ, Li DX, Zhao B, Yu CL, et al. A survey on the international crew's phychological health and the influence factors. Chinese Frontier Health Quarantine,. 2016;**39**:132-5. (In Chinese) https://doi.org/10.16408/j.1004-9770.2016.02.015

25 Li Y, Investigation mental health state of shipping seamen. *China Journal of Health Psychology*. 2007;**15**:727-728. (In Chinese) http://dx.chinadoi.cn/10.3969/j.issn.1005-1252.2007.08.030

26 Guo JX. Investigation of the Mental Health Status of Seafarers and Mental Health Management Measures. *Shipping Management*. 2020;**417**:25-27. (In Chinese)

27 Badawi G, Pagé V, Smith KJ, Garie´G, Malla A, Wang J, et al. Self-rated health: A predictor for the three year incidence of majordepression in individuals with Type II diabetes. *J Affect Disord*. 2013;**145**:100-5. https://doi.org/10.1016/j.jad.2012.07.018

28 Carotenuto A, Molino I, Fasanaro AM, Amenta F. Psychological stress in seafarers: a review. *Int Marit Health*. 2012;**63**:188-94. PMID: 24595974

29 Currier D, Lindner R, Spittal MJ, Cvetkovski S, Pirkis J, English D. Physical activity and depression in men: Increased activity duration and intensity associated with lower likelihood of current depression. *J Affect Disord*. 2020;**260**:426-31. https://doi.org/10.1016/j.jad.2019.09.061

30 Hu Z, Zhu X, Kaminga AC, Zhu T, Xu H. Association between poor sleep quality and depression symptoms among the elderly in nursing homes in Hunan province, China: a cross-sectional study. *BMJ Open*. 2020;**10**:e036401. https://doi.org/10.1136/bmjopen-2019-036401

31 Allen P, Wadsworth E, Smith A. The prevention and management of seafarers' fatigue: a review. *Int Marit Health*. 2007;**58**:167-77. https://doi.org/10.1016/j.jweia.2007.02.019

32 Jing X, Binjun H, Huan S, Xiuli L, Jie Z, Yaqing Z, et al. Association between social support and health-related quality of life among Chinese seafarers: A cross-sectional study. *PLos one*. 2017;**12**:e0187275. https://doi.org/10.1371/journal.pone.0187275

33 Sąlyga J, Kušleikaitė M. Factors influencing psychoemotional strain and fatigue, and relationship of these factors with health complaints at sea among Lithuanian seafarers. *Medicina*. 2011;**47**:675-81. https://doi.org/10.3390/medicina47120099

34 Hjarnø L, Leppin A. A risky occupation? (Un)healthy lifestyle behaviors among Danish seafarers. *Health Promot Int*. 2014;**29**:720-9. https://doi.org/10.1093/heapro/dat024

35 Fisherl C D. Boredom at work: A neglected concept[J]. *Human Relations*, 1993,**46**:395-417. https://doi.org/10.1177%2F001872679304600305

36 Jegaden D, Menaheze M, Lucas D, Lodd é B, Dewitte J. Don't forget about seafarer's boredom. *Int Marit Health*, 2019,**70**:82-87. https://doi.org/10.5603/IMH.2019.0013

37 Sliš kovi ć A. Seafarers' well-being in the context of the COVID-19 pandemic: A qualitative study. Work, 2020 (Preprint): 1-11. https://doi.org/10.3233/WOR-203333

Footnotes

Contributors: WZ planned the study, conducted the analysis and wrote the pater while being supervised by SX*; LL, CF helped to plan the study, including the instrumentation, and to revise the manuscript; DS, PF, and SX accomplished the statistical analysis and contributed to revising the paper. All authors contributed to the discussion of the paper, read and approved the final manuscript.

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STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-7
Bias	9	Describe any efforts to address potential sources of bias	

Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8
		(*b*) Describe any methods used to examine subgroups and interactions	8
		(*c*) Explain how missing data were addressed	
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	6
		(*e*) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8
		(b) Indicate number of participants with missing data for each variable of interest	
Outcome data	15*	Report numbers of outcome events or summary measures	9
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8-12
		(*b*) Report category boundaries when continuous variables were categorized	8-12

		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	14
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12-14
Generalisability	21	Discuss the generalisability (external validity) of the study results	14
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Prevalence and Risk Factors of Depression Symptoms among Chinese Seafarers During the COVID-19 Pandemic: a cross-sectional study

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Title Page

Prevalence and Risk Factors of Depression Symptoms among Chinese Seafarers During the COVID-19 Pandemic: a cross-sectional study

Wenzhe Qin[a,b]; Lei Li[c,d]; Dongshan Zhu[a,b], Chengfei Ju[d]; Pengfei Bi[d]; Shixue Li[a]

a. Centre for Health Management and Policy Research, School of Public Health, Cheeloo College of Medicine, Shandong University, Jinan, China;

b. NHC Key Lab of Health Economics and Policy Research (Shandong University), Jinan, 250012, China.

c. Jinan Airport Customs, Jinan, 250013, China

d. Rongcheng Customs, Rongcheng, 264300, China

Corresponding author: Shixue Li, Professor

Centre for Health Management and Policy Research, School of Public Health, Cheeloo College of Medicine, Shandong University, Wenhuaxi Road44#, Jinan, Shandong, 250012, China.

Tel and fax: +86-0531-88382127. Email: shixueli@sdu.edu.cn

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Abstract

Background: To curb the spread of COVID-19, most countries have adopted measures of ports banning shore leave and placed restrictions on crew change. Seafarers may bear excess pressure during the COVID-19 pandemic. This study aimed to investigate the prevalence and risk factors associated with depression symptoms among Chinese seafarers during the COVID-19 pandemic.

Design: Cross-sectional study.

Methods: This field survey-based study was conducted in Rongcheng port, Shandong Province, China, from June 10, 2020 to July 25, 2020. Socio-demographic, occupational characteristics and health related behaviors were collected through a face-to-face questionnaire. Self-rating Depression Scale (SDS) was used to evaluate depression status during the preceding week. Logistic regression models were used to explore related factors of depression.

Results: 441 male Chinese seafarers were enrolled. Overall, the proportions of seafarers with low, moderate and severe depressive symptoms were 103 (23.35%), 41 (9.30%) and 40 (9.07%), respectively. Compared to those with a good self-rated health (SRH), seafarers with poor SRH had higher odds of depression (Odds ratio [OR],2.24; 95%CI,1.22-4.11). Less leisure time or physical exercise was associated with more severe self-reported depression symptoms (1~3/week vs ≥4/week: OR,1.72; 95%CI, 0.71-4.14; none vs ≥4/week OR,3.93; 95%CI, 1.67-9.26). Poor sleep quality was associated with a higher likelihood of reporting severe depression (fair vs good: OR,2.78; 95%CI, 1.54-5.01; poor vs good: OR,4.30; 95%CI, 1.65-11.24). The more times of working overtime a week, the higher likely to report severe depression symptoms (1~2/week vs none: OR,1.82; 95%CI, 1.04-3.18; ≥3/week vs none: OR,2.49; 95%CI, 1.05-5.92). Also, high perceived work stress was linked to higher odds of being depression (intermediate vs low: OR,2.06; 95%CI, 0.78-5.46; high vs low: OR,3.83; 95%CI, 1.35-10.90).

Conclusions: There is a high depression burden associated with the COVID-19

among seafarers. Special interventions that protecting the mental health of seafarers is even more critical in the context of a pandemic.

Key words: Depression; COVID-19; International voyage; Seafarers; Related factors

Strengths and limitations of this study:

- This is the first study that evaluated the depression status and related factors of seafarers during the COVID-19 pandemic.
- This study may provide important evidence to direct the promotion of mental wellbeing among seafarers.
- The mental health status of seafarers before COVID-19 pandemic was not measured.
- The participants are from Chinese seafarers, thus the extrapolate of the findings might be limited.

Introduction

On March 11, 2020, the World Health Organization (WHO) declared the coronavirus disease 2019 (COVID-19) a pandemic.[1] As of March 31 2021, there have been more than 127 million confirmed cases and 2.7 million confirmed deaths worldwide.[2] In addition to pose stress to health system, the pandemic also severely impacts the global economy and the global supply chain, including international shipping.

Around 90% of global trade is transported by sea.[3] During COVID-19 pandemic, sea logistics networks is more important than ever for global supply chains. Seafarers play an essential role in maintaining the flow of vital goods, such as food, goods and medical supplies.[4] Globally, there are 2 million seafarers ensuring global needs of goods for daily life.[5]

COVID-19 has triggered many governments to prevent the transfer of seafarers through their territories to and from their home countries and vessels. This has left some seafarers stranded and others unable to join vessels to earn income. As of December 2020, over 400,000 seafarers were stranded on ships and had to extend their contract due to crew change issue. On the other hand, similar number of seafarers were stuck at home, unable to join ships.[6] Also, to avoid imported cases of COVID-19, most countries have adopted measures of ports banning shore leave.

Long-term working in an enclosed environment, absolute absence of shore leave, boredom of monotonous work, fears of being infected, and lack of emotional support from families, all of these may cause mental health crisis, such as emotional instability, anxiety, and depression.[7] Thus, organizations (such as International Chamber of Shipping, ICS) have called for attention to the mental health of these seafarers 'trapped on board', as there have been several cases of suicides among seafarers.[8,9]

Previous studies before COVID-19 pandemic have suggested a poor mental health status in seafarers. A meta-analysis of Chinese seafarers found that compared to

general population, seafarers had poor mental health status and higher prevalence of depression.[10,11] Evidence has shown COVID-19 has negative impact on mental health.[12-15] Considering the special working conditions of seafarers, we predict that seafarers' mental health status may deteriorate even more during the COVID-19 pandemic, and especially the prevalence of depression among them might be even higher than usual.

Previous studies had found that risk factors for depression in seafarers include baseline medical conditions (a history of high cholesterol, hypertension, sleep disturbances, diabetes, liver disease, and cancer, etc), demographic (age, gender, and region of origin, etc), occupational(rank, work experience, etc), work-related determinants (exposures to overtime work and work stress) and additional factors.[11,16] In this study, firstly, the baseline medical conditions including chronic disease, sleep duration/quality are going to be tested. We predict that there is a positive correlation between chronic disease and sleep disturbances and depression symptoms. Secondly, demographic factors including age, marital status, education level and monthly income are going to be tested. We predict that age, other marital status, low education level and low monthly income may positively associated with depression symptoms. Thirdly, occupational factors including position rank, sailing age are going to be tested. We predict that high position rank and short sailing age may have positive relationship with depression symptoms. Fourthly, the work-related determinants including sailing duration, overtime work per week, COVID-19 related stress and perceived work stress are going to be tested. We predict that there are positive correlations between long sailing duration, overtime work per week and high perceived work stress and depression symptoms. Additionally, the self-rated health, health behaviors and frequency of exercise are also be tested. We predict that the poor self-rated health, poor health behaviors and lack of exercise may have positively association with depression symptoms.

In this study, we aim to evaluate prevalence of depression symptoms among Chinese seafarers during COVID-19 pandemic, and to explore potential risk factors (including

medical history, demographic factors, work-related determinants, and self-rated health) associated with depression symptoms. This study may provide important evidence to direct the promotion of mental wellbeing among seafarers.

Methods

Study design and participants

A cross-sectional study was conducted in Rongcheng port, Shandong Province, China, from June 10, 2020 to July 25, 2020. To ensure the authenticity and reliability of data, anonymous, face-to-face interviews with seafarers were conducted by trained investigators from Rongcheng custom, using a self-administered questionnaire (SAQ). The SAQ was structured including five parts of socio-demographic information, occupational characteristics, health related behaviors, health condition and self-rating depression scale.

Eligible participants were Chinese seafarers who remained onboard when the investigation was conducted. Two-stage sampling strategy was applied. First, a cluster random sampling method was employed to select the entry international ocean ships. All ships were required to declare entry information 24 hours in advance before their arrived. Thus, we randomly selected one ship from ships that will arrive the next day, based on their declared information. A total of 30 ships were selected during the study period. Second, all Chinese seafarers on the selected ship were interviewed. The target sample size of participants was determined using a formula $N=Z_{\alpha}^2P(1-P)/d^2$ (α =0.05, Z_{α}=1.96, and d=0.05). The prevalence of depression symptoms in seafarers was 50.76%, based on a study carried out before the COVID-19 outbreak.[17] To improve the response rate, we amplified the sample size by 15% with a goal of at least 442 participants. A total of 450 seafarers were included during the actual investigation and 9 participants refused to participate in this survey. Finally, 441 individuals completed the survey.

Key Definitions

Self-rating Depression Scale (SDS)

The 20-item Zung Self-Rating Depression Scale (SDS) was used to evaluate the depression symptoms of seafarers.[18] Ten items are scored positively (e.g., "I feel downhearted and blue") and other ten scored negatively (e.g., "I still enjoy the things I used to do"). The seafarers were asked to rate how frequently they experienced each symptom during the past week. Responses were distributed on a 4-point Likert scale (1= a little of time, 2= some of the time, 3= good part of the time, 4= most of the time). The sum of the scores obtained on the 20 items were raw scores, and the raw scores are converted to a standard score (100-point scale) by multiplying by 1.25. A higher score indicates more severe depression symptoms. The severity of depression symptoms can be converted as follows: normal (≤49), mild (50-59), moderate (60-69), and severe (≥70). Moderate and/or severe depression were related to impaired daily functioning, reduced quality of life, and even self-harm or suicide in some cases.[19] The presence of major depressive disorder during the COVID-19 pandemic might need more concern.[20] In this study, we focused on seafarers with moderate and severe depression symptoms, and classified depression symptoms into two categories: 1=none/mild (a score<60), 2=moderate/severe (a score≥60).[20] The SDS is widely used in previous studies and has a good reliability and validity. The Cronbach's α was 0.76 in this study.

Socio-demographic factors

Socio-demographic factors included age, sailing age, gender, marital status, educational level and individual income. Age and sailing age were measured in chronological years. Gender was dichotomized. Marital status was categorized into married and others. Education level was divided into three levels: high school or below, junior college, Bachelor's degree or above. Self-reported monthly income in recent one year was collected. Most of the seafarers had been on board before the COVID-19 pandemic, and their contracted income was hardly affected by the COVID-19 pandemic.

Occupational characteristics

Occupation-related factors included sailing duration, type of ship, working position, night shift frequency per week, overtime work frequency per week, and self-perceived work stress. Overtime work was defined as "work continuously for more than 10 hours one day". Frequency of overtime work per week was categorized as none, 1-2 times, and 3 times or more. Respondents were asked to rate their work-related stress with a question of "In general, how would you rate your recent work stress", and seafarers stress level was categorized as low, intermediate, and high.[21]

Health status and health related behaviors

Health status included self-rated health (SRH) and history of chronic disease. SRH is an effective and reliable measure of health,[22] and was grouped as good SRH and poor SRH in present study. Presence of a certain chronic diseases was categorized as Yes or No.

Health related behaviors included cigarette exposure, alcohol consumption, sleep duration, self-rated sleep quality, leisure time or physical exercise (LPE) in the past month were measured. Sleep duration was measured as the number of hours sleep at night. Seafarers' work requires a shift system. Thus, sleep duration included sleep time during day and night, and categorized as: <6 hours, 6-8 hours and >8 hours. Sleep quality was divided into three categories: excellent, fair, and poor. LPE was calculated as the frequency of engaging in leisure activities or physical exercise (such as walking, playing table tennis, or working out at a gym) per week on board, and divided into three categories: none, 1-3=occasionally, ≥4=regularly.

COVID-19 stress

Seafarers were asked "In the current global outbreak of COVID-19, how would you rate the COVID-19-related stress on you and your relatives (such as fears of being infected, worries about losing job, have financial problems and so on)?" to evaluate their stress from COVID-19, and a 3-point Likert scale was used: 3=high, 2=fair,

1=low.

Ethics statement

Written informed consent was received before the respondents began the questionnaire. This study was approved by the ethics committee of Shandong University, and which was performed in accordance with the Helsinki Declaration.

Statistical Analysis

Characteristics of seafarers by depression groups were described. Data are presented as mean (standard deviation, SD) for continuous variables and as the *n* (%) for categorical variables. Statistical differences of depression among subgroups were tested using independent sample t-tests (continuous variables) or $\chi 2$ tests (categorical variables). Multivariable logistic regression models were employed to estimate odds ratio (OR) and 95% CIs for the associations between risk factors and depression symptoms. All statistical tests were two-tailed, and the level of significance was set at 0.05. All analysis was performed using SPSS statistical software version 25.0 (IBM Corp).

Results

Demographic Characteristics

The demographic characteristics of seafarers showed in Table 1. The mean age was 37.54±9.74 years; the median sailing age was 8.0(3.0-13.0) years; 53.5% were high school or below and 7.5% were Bachelor's degree or above; 74.6% were married; 52.2% were ordinary crew. The ship types that seafarers work on are mainly cargo ships and bulk carriers. By the end of this survey, the median sailing duration was 7.0(5.0-9.0) months without disembark and traveling home. According to the contractual sailing duration stated by "The collective bargaining agreement for Chinese crew", 30.4% of seafarers have been on board for more than 8 months, 15% of them for more than 10 months, and 9.5% of seafarers for more than 12 months.

Prevalence of depression symptoms in seafarers

In 441 seafarers, the highest standard score of depression was 73, and the total mean standard score was 38.33±10.8. According to the standard score, a considerable proportion of seafarers reported symptoms of depression (184 [41.7%]), of which 103 (23.35%), 41 (9.30%) and 40 (9.07%) categorized as having low, moderate and severe depressive symptoms, respectively. The demographic characteristics of seafarers was presented in **Table 1.**

Table 1 Characteristics of All Participants by Level of Depression Symptoms

Characteristic	Total, No. (%) (N=441)	Severity of depression, No. (%)		*P* value
		Normal/mild (n=360)	Moderate/Severe (n=81)	
Sailing age [a], year	8.0(3.0-13.0)	8.0(3.0-13.0)	8.0(2.0-12.0)	0.402[b]
Sailing duration [a], month	7.0(5.0-9.0)	7.0(5.0-9.0)	7.0(6.0-9.0)	0.432[b]
Age (year)				
18-44	323(73.2)	265(82.0)	58(18.0)	0.712[c]
≥45	118(26.8)	95(80.5)	23(19.5)	
Marital status				
Married	329(74.6)	273(83.0)	56(17.0)	0.207[c]
Others	112(25.4)	87(77.7)	25(22.3)	
Education level				
High school and below	236(53.5)	192(81.4)	44(18.6)	0.343[c]
Junior college	172(39.0)	139(80.8)	33(19.2)	
Bachelor's degree or above	33(7.5)	29(87.9)	4(12.1)	
Income (RMB)				
≤10000	214(48.5)	168(78.5)	46(21.5)	0.308[c]
10001～20000	148(33.6)	123(83.1)	25(16.9)	
20001～30000	25(5.7)	21(84.0)	4(16.0)	
>30000	54(12.2)	48(88.9)	6(11.1)	
Position classes				
Ordinary crew	230(52.2)	183(79.6)	47(20.4)	0.269[d]
Senior officer	211(47.8)	177(83.9)	34(16.1)	
Self-rated health				
Good	292(66.2)	259(88.7)	33(11.3)	<.001[c]
Poor	149(33.8)	101(67.8)	48(32.2)	
Chronic disease				
Yes	18(4.1)	14(77.8)	4(22.2)	0.755[d]
No	423(95.9)	346(81.8)	77(18.2)	
Smoking status				
Yes	201(45.6)	160(79.6)	41(20.4)	0.326[d]

No	240(54.4)	200(83.3)	40(16.7)	
Drinking status				
Yes	319(72.3)	267(83.7)	52(16.3)	0.075[d]
No	122(27.7)	93(76.2)	29(23.8)	
LPE per week				
None	171(38.8)	124(72.5)	47(27.5)	<.001[c]
1~3	192(43.5)	165(85.9)	27(14.1)	
≥4	78(17.7)	71(91.0)	7(9.0)	
Sleep duration				
<6	15(3.4)	8(53.3)	7(46.7)	0.008[c]
6~8	181(41.0)	145(80.1)	36(19.9)	
>8	245(55.6)	207(84.5)	38(15.5)	
Sleep quality				
Poor	29(6.6)	18(62.1)	11(37.9)	<.001[c]
Fair	214(48.5)	163(76.2)	51(23.8)	
Good	198(44.9)	179(90.4)	19(9.6)	
Overtime work per week				
None	256(58.0)	224(87.5)	32(12.5)	0.001[c]
1~2	154(34.9)	115(74.7)	39(25.3)	
≥3	31(7.1)	21(67.7)	10(32.3)	
Self-perceived work stress				
Low	65(14.7)	60(92.3)	5(7.7)	<.001[c]
Intermediate	277(62.8)	232(83.8)	45(16.2)	
High	99(22.5)	68(68.7)	31(31.3)	
COVID-19 stress				
Low	54(12.2)	44(81.5)	10(18.5)	0.896[c]
Intermediate	154(34.9)	124(80.5)	30(19.5)	
High	233(52.8)	192(82.4)	41(17.6)	

Abbreviations: LPE, leisure time or physical exercise; COVID-19, coronavirus disease 2019.

[a] Data are presented as median (IQR).

[b] Mann-Whitney rank sum test conducted for significance testing

[c] Two-tailed χ^2 analysis conducted for significance testing

[d] Fisher's exact test conducted for significance testing

The distribution of depression symptoms was different in the epidemic-related categories of SRH, LPE per week, sleep duration, sleep quality, overtime work frequency per week, and self-perceived work-related stress (**Table 1**). Participants with severe depression reported experiencing a poorer SRH and engaging in less LPE per week (χ^2=28.78, P<0.001; χ^2=16.45, P<0.001, respectively). Seafarers with sleep duration <6h and having a poor sleep quality had higher percentage of reporting

severely depression (χ^2=9.63, P=0.008; χ^2=21.82, P<0.001, respectively). Moreover, the distributions of depression symptoms within categories of overtime work frequency and self-rated work-related stress have different patterns. The more times of overtime work, the higher the depression level (χ^2=14.84, P=0.001). Seafarers in the high self-perceived work stress group had more severe depression symptoms (χ^2=16.84, P<0.001). Other characteristics of seafarers had no difference in the distributions of depression symptoms (P>0.05).

Factors associated with depression symptoms

Poor SRH(OR,2.24; 95%CI, 1.22-4.11), LPE per week(for none vs ≥4: OR,3.93; 95%CI, 1.67-9.26), sleep quality(for poor vs good: OR,4.30; 95%CI, 1.65-11.24), frequency of overtime work per week(for ≥3 vs none: OR,2.49; 95%CI, 1.05-5.92), and self-perceived work stress(for high vs low: OR,3.83; 95%CI, 1.35-10.90) were associated with reporting severe depression symptoms(**Table 2**).

Table 2 Multivariable Regression Analysis of Factors Associated with Depression Symptoms

Variable	No. of Moderate/Severe (%)	OR (95%CI)	*P value* [a] Category	*P value* [a] Overall
Self-rated health				
Good	33(11.3)	1[reference]	NA	0.009
Poor	48(32.2)	2.24 (1.22,4.11)	0.009	
LPE per week				
≥4	7(9.0)	1[reference]	NA	
1~3	27(14.1)	1.72 (0.71,4.14)	0.229	0.001
None	47(27.5)	3.93 (1.67,9.26)	0.002	
Sleep quality				
Good	19(9.6)	1[reference]	NA	
Fair	27(14.1)	2.78 (1.54,5.01)	0.001	0.001
Poor	11(37.9)	4.30 (1.65,11.24)	0.003	
Overtime work per week				
None	32(12.5)	1[reference]	NA	
1~2	39(25.3)	1.82 (1.04,3.18)	0.035	0.041
≥3	10(32.3)	2.49 (1.05,5.92)	0.039	
Self-perceived work stress				
Low	5(7.7)	1[reference]	NA	
Intermediate	45(16.2)	2.06 (0.78,5.46)	0.147	0.019
High	31(31.3)	3.83 (1.35,10.90)	0.012	

Abbreviations: OR, odds ratio; LPE, leisure time or physical exercise.

[a] Category refers to the P value for each category vs the reference, while overall refers to the results of the logistic regression.

Less frequent leisure time or physical exercise was associated with more severe self-reported depression symptoms (1~3/week vs ≥4/week: OR,1.72; 95%CI, 0.711-4.14; none vs ≥4/week OR,3.93; 95%CI, 1.67-9.26). Having a poor sleep quality was associated with a higher likelihood of reporting severe depression (fair vs good: OR,2.78; 95%CI, 1.54-5.01; poor vs good: OR=4.30; 95%CI, 1.65-11.24). The more times seafarers work overtimes a week, the more likely they were to report severe depression symptoms (1~2/week vs none: OR,1.82; 95%CI, 1.04-3.18; ≥3/week vs none: OR,2.49; 95%CI, 1.05-5.92). An increased odd of severe depression was identified among seafarers with high perceived work stress (intermediate vs low: OR,2.06; 95%CI, 0.78-5.46; high vs low: OR=3.83; 95%CI, 1.35-10.90).

Discussion

A high prevalence of depression symptoms among Chinese seafarers was found during COVID-19 pandemic. 40.72% seafarers reported depression symptoms and around 9% of them had severe depressive symptoms. Poor SRH, poor sleep quality, less leisure time or physical exercise, more overtime work, and higher work stress were associated with experiencing severe depression symptoms. Our findings provide the latest profile of psychological status of seafarers during the COVID-19 pandemic. Seafarers' mental health may need more attention during COVID-19 epidemic.

Previous studies have shown a substantial burden of depression symptoms in general population following COVID-19 pandemic.[20,23,24] A nationally representative study of American adults indicated that compared with the same period before COVID-19, prevalence of depression symptom was much higher during COVID-19 pandemic (mild: 24.6% vs 16.2%; moderate: 14.8% vs 5.7%; moderately severe: 7.9% vs 2.1%; severe: 5.1% vs 0.7%).[20] Compared to the general Chinese population during COVID-19 pandemic, we found seafarers have excess prevalence of depression symptoms (41.72 vs 27.9%,[23] 41.72% vs 36.5%,[24] respectively).

Compared to previous studies that investigated seafarers' depression symptoms before the COVID-19 pandemic, our study showed a higher prevalence ([41.72% vs 35.26%][25], [41.72% vs 20.26%][26], [41.72% vs 38.56%][27]). Also, compared to Mei et al.'s study, although the overall detection rate of depressive symptoms in our study is lower than that in Mei et al.'s study (41.72% vs 50.77%), the rate of severe depression symptoms in our study was much higher (9.07% vs 1.67%).[17]

The present study identified several risk factors that contributed to severe depression symptoms. Seafarers with a poor SRH were two or three times more likely to report severe depression symptoms. Our result is consistent with findings of previous research, which indicated that SRH can predict the risk of major depression in the future.[28] Moreover, our study found seafarers with less leisure time or physical exercise were susceptible to have severe depression symptoms. A review on psychological stress in seafarers reported that limited recreation activity was one of the most important factors associated with mental, psychosocial, and physical stressors of seafarers.[29] Another study also confirmed that moderate to vigorous physical activities reduce depression prevalence.[30] Our study also found that seafarers with poor sleep quality reported severe symptoms of depression. Sleep quality is an important risk factor for depression.[31] A large proportion of seafarers reported no good sleep or having sleep disruption, especially the seafarers on international voyages who often experience "jet lag".[32] In addition, seafarers' work requires a shift system, the overtime work resulted from crew change restriction during the global epidemic affects the quality of sleep, increasing the psychological burden and causing mental diseases.

Another prominent finding was the substantial impacts of overtime work and high perceived work stress on depression, which is consistent with previous studies.[33] Overtime work is often accompanied by decline of sleep quality, which is the major source of stress and chronic fatigue.[34] What's more, due to the restriction caused by the epidemic, seafarers have to stay at sea for a long time, facing overload work. Overtime work, lack of safety in the workplace, and poor career prospects affect the

mental health of seafarers. Previous studies have shown that seafarers are exposed to unique sources of work stress, such as special workplaces, monotonous work, climate change, long-term separation from family members.[35] These factors increase the anxiety and loneliness of seafarers, and lead to insomnia and emotional instability. Especially the boredom on board caused by monotonous work, which is an important source of stress and addiction, according to data from the literature.[36] Jegaden et al.'s study found that there is a significant correlation between the boredom and depression among office staff and the seafarers, and boredom is an important factor that cannot be ignored.[37] Also, the inability to change shifts in time due to the epidemic will gradually aggravate these bad mental states and cause severe depression symptoms.[38]

According to previous literature and the issues noted in our study, there needs to be a unified approach which looks at protecting the mental health of seafarers at government level, organizational level and the individual level. To facilitate movement, seafarers should be recognized as key workers and provided with documentation to demonstrate that status. Also, to mitigate the crew change crisis, it is necessary to release a crew change framework endorsed by the International Maritime Organization (IMO), and authorities are encouraged to implement these proposals. Thirdly, the shipping company should increase care for seafarers, and include the availability of some leisure activities, the encouragement of physical engagement, and the installation of shipboard telecommunication systems to contact families and friends. Better organization of working hours and work shifts should also be included. This would allow a longer and continuous period of sleep. Appropriate psychological health education could prepare seafarers to recognize job-specific stressors and implement suitable coping strategies. Finally, the seafarers themselves should adjust their mentality, look for happiness and satisfaction in their careers, broaden social interactions, obtain social support, and have the courage to seek professional psychological counseling and help.

This study has several limitations. First, the cross-sectional design brings question about interpretation of relation between some "risk factors" and depression. Second,

the participants are from Chinese seafarers, thus the extrapolate of the findings might be limited; Third, the status of depression symptoms was self-reported rather than clinical diagnoses. Fourth, the mental health status of seafarers before COVID-19 pandemic was not measured. Whether the observed high prevalence of depression was related to the COVID-19 cannot be evaluated. However, the prevalence of severe depression in seafarers was much higher than that reported before COVID-19, thus, we believed that the increased rate of severe depression symptoms is associated with COVID-19 pandemic. Countries are currently taking measures to ease the dilemma of crew change, and follow-up studies are needed to further investigate the long-term effect of COVID-19 pandemic.

Conclusions

The COVID-19 crisis may have posed extra mental health problems, especially depression to seafarers. Poor self-rated health, less leisure time or physical exercise, poor sleep quality, more overtime work, and high perceived work stress are all linked to the report of depression symptoms.

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REFERENCES

1 World Health Organization. WHO Director-General's opening remarks at the media briefing on COVID-19-11 March 2020. 2020. Available: https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020

2 World Health Organization. Coronavirus disease (COVID-19) pandemic. 2020. Available from: https://www.who.int/emergencies/diseases/novel-coronavirus-2019

3 Stannard S. COVID-19 in the maritime setting: the challenges, regulations and the international response. *Int Marit Health*. 2020;**71**:85-90. http://dx.doi.org/10.5603/IMH.2020.0016

4 Zarocostas J. UN leaders call for key worker recognition for seafarers. The Lancet, 2020, 396(10265): 1792. https://doi.org/10.1016/S0140-6736(20)32582-4

5 Doumbia-Henry C. Shipping and COVID-19: protecting seafarers as frontline workers. *WMU J Marit Aff*. 2020;*19*:279-93. https://doi.org/10.1007/s13437-020-00217-9

6 International Maritime Organization. Supporting seafarers on the frontline of COVID-19. 2020. Available from: https://www.imo.org/en/MediaCentre/HotTopics/Pages/Support-for-seafarers-during-COVID-19.aspx

7 Lee H L. Seafarers face 'mental health crisis', governments urged to take immediate actions. 2020. Available from: https://www.seatrade-maritime.com/casualty/seafarers-face-mental-health-crisis-governments-urged-take-immediate-actions

8 Claire P. Focus on seafarer wellbeing during Covid-19 pandemic. 2020. Available from: https://www.chirpmaritime.org/wp-content/uploads/2020/04/Covid-19-psycology-and-welfare-paper-April-2020-Final.pdf

9 Hakirevic N. COVID-19 agony: 2 more cruise ship crew members die while awaiting repatriation. 2020. Available: https://www.offshore-energy.biz/covid-19-agony-2-more-cruise-ship--crew-members-die-while-awaiting-repatriation/

10 Zhu L J, Ma H. Meta-Analysis on Mental Health of Chinese Seafarers. *Journal of Zhejiang Institute of Communications*. 2018;**19**:40-45.(In Chinese) https://doi.org/10.3969/j.issn.1671-234X.2018.04.008

11 Lefkowitz R Y, Slade MD. Seafarer Mental Health Study. 2019. Available: https://www.seafarerstrust.org/wp-content/uploads/2019/11/ST_MentalHealthReport_Final_Digital-1.pdf

12 Pierce M, Hope H, Ford T, Hatch S, Hotopf M, John A, et al. Mental health before and during the COVID-19 pandemic: a longitudinal probability sample survey of the UK population. *The Lancet Psychiatry*. 2020;**7**:883-92. https://doi.org/10.1016/S2215-0366(20)30308-4

13 Wathelet M, Duhem S, Vaiva G, Baubet T, Habran E, Veerapa E, et al. Factors Associated With Mental Health Disorders Among University Students in France Confined During the COVID-19 Pandemic. *JAMA Netw Open*. 2020;**3**:e2025591. https://doi.org/10.1001/jamanetworkopen.2020.25591

14 Lai J, Ma S, Wang Y, Cai Z, Hu J, Wei N, et al. Factors Associated With Mental Health Outcomes Among Health Care Workers Exposed to Coronavirus Disease 2019. *JAMA Netw Open*. 2020;**3**:e203976. https://doi.org/10.1001/jamanetworkopen.2020.3976

15 Xiong J, Lipsitz O, Nasri F, Lui LMW, Mcintyre RS. Impact of COVID-19 Pandemic on Mental Health in the General Population: A Systematic Review. *J Affect Disord*. 2020;**277**:55-64. https://doi.org/10.1016/j.jad.2020.08.001

16 Sliš ković A, Penezić Z. Lifestyle factors in Croatian seafarers as relating to health and stress on board. *Work*, 2017, **56**: 371-380. https://doi.org/10.3233/WOR-172501

17 Mei Y, Zhang J, Li F, Gao YX. Depression symptoms and associated factors among seamen undertaking international voyage. Chinese Journal of Public Health. 2015;**31**:954-7.(In Chinese) https://doi.org/10.11847/zgggws2015-31-07-28

18 ZUNG, William WK. A Self-Rating Depression Scale. *Arch Gen Psychiatry*. 1965;**12**:63-70. https://doi.org/10.1001/archpsyc.1965.01720310065008

19 Soria-Saucedo R, Lopez-Ridaura R, Lajous M, Wirtz V. The prevalence and correlates of severe depression in a cohort of Mexican teachers. *J Affect Disord*, 2018;**234**:109-116. https://doi.org/10.1016/j.jad.2018.02.036

20 Ettman CK, Abdalla SM, Cohen GH, Sampson L, Galea S. Prevalence of Depression Symptoms in US Adults Before and During the COVID-19 Pandemic. *JAMA Netw Open*. 2020;**3**:e2019686. https://doi.org/10.1001/jamanetworkopen.2020.19686

21 Oldenburg M, Jensen H J, Wegner R. Burnout syndrome in seafarers in the merchant marine service. *Int Arch Occup Environ Health* , 2013;**86**:407-416. https://doi.org/10.1007/s00420-012-0771-7

22 Fayers PM, Sprangres MAG. Understanding self-rated health. *Lancet*. 2002;**359**:187-8. https://doi.org/10.1016/S0140-6736(02)07466-4

23 Shi L, Lu Z, Que J, Huang X, Liu L, Ran M, et al. Prevalence of and risk factors associated with mental health symptoms among the general population in China during the coronavirus disease 2019 pandemic. *JAMA Netw Open*. 2020;**3**:e2014053. https://doi.org/10.1001/jamanetworkopen.2020.14053

24 Dong P, Ni ZJ, Zhao KQ, Sun GQ, Sun HQ. Public depression status during the COVID 19 epidemic. Chinese Mental Health Journal. 2020;**34**:710-714. (In Chinese) https://doi.org/10.3639/j.issn.1000-6729.2020.8.014

25 Yang CG, Chen P, Nie WZ, Li DX, Zhao B, Yu CL, et al. A survey on the international crew's phychological health and the influence factors. Chinese Frontier Health Quarantine,. 2016;**39**:132-5. (In Chinese) https://doi.org/10.16408/j.1004-9770.2016.02.015

26 Li Y, Investigation mental health state of shipping seamen. *China Journal of Health Psychology*. 2007;**15**:727-728. (In Chinese) http://dx.chinadoi.cn/10.3969/j.issn.1005-1252.2007.08.030

27 Guo JX. Investigation of the Mental Health Status of Seafarers and Mental Health Management Measures. *Shipping Management*. 2020;**417**:25-27. (In Chinese)

28 Badawi G, Pagé V, Smith KJ, Garie´G, Malla A, Wang J, et al. Self-rated health: A predictor for the three year incidence of majordepression in individuals with Type II diabetes. *J Affect Disord*. 2013;**145**:100-5. https://doi.org/10.1016/j.jad.2012.07.018

29 Carotenuto A, Molino I, Fasanaro AM, Amenta F. Psychological stress in seafarers: a review. *Int Marit Health*. 2012;**63**:188-94. PMID: 24595974

30 Currier D, Lindner R, Spittal MJ, Cvetkovski S, Pirkis J, English D. Physical activity and depression in men: Increased activity duration and intensity associated with lower likelihood of current depression. *J Affect Disord*. 2020;**260**:426-31. https://doi.org/10.1016/j.jad.2019.09.061

31 Hu Z, Zhu X, Kaminga AC, Zhu T, Xu H. Association between poor sleep quality and depression symptoms among the elderly in nursing homes in Hunan province, China: a cross-sectional study. *BMJ Open*. 2020;**10**:e036401. https://doi.org/10.1136/bmjopen-2019-036401

32 Allen P, Wadsworth E, Smith A. The prevention and management of seafarers' fatigue: a review. *Int Marit Health*. 2007;**58**:167-77. https://doi.org/10.1016/j.jweia.2007.02.019

33 Jing X, Binjun H, Huan S, Xiuli L, Jie Z, Yaqing Z, et al. Association between social support and health-related quality of life among Chinese seafarers: A cross-sectional study. *PLos one*. 2017;**12**:e0187275. https://doi.org/10.1371/journal.pone.0187275

34 Sąlyga J, Kušleikaitė M. Factors influencing psychoemotional strain and fatigue, and relationship of these factors with health complaints at sea among Lithuanian seafarers. *Medicina*. 2011;**47**:675-81. https://doi.org/10.3390/medicina47120099

35 Hjarnø L, Leppin A. A risky occupation? (Un)healthy lifestyle behaviors among Danish seafarers. *Health Promot Int*. 2014;**29**:720-9. https://doi.org/10.1093/heapro/dat024

36 Fisherl C D. Boredom at work: A neglected concept[J]. *Human Relations*, 1993,**46**:395-417. https://doi.org/10.1177%2F001872679304600305

37 Jegaden D, Menaheze M, Lucas D, Lodd é B, Dewitte J. Don't forget about seafarer's boredom. *Int Marit Health*, 2019,**70**:82-87. https://doi.org/10.5603/IMH.2019.0013

38 Sliš kovi ć A. Seafarers' well-being in the context of the COVID-19 pandemic: A qualitative study. Work, 2020 (Preprint): 1-11. https://doi.org/10.3233/WOR-203333

Footnotes

Contributors: WZ planned the study, conducted the analysis and wrote the pater while being supervised by SX*; LL, CF helped to plan the study, including the instrumentation, and to revise the manuscript; DS, PF, and SX accomplished the statistical analysis and contributed to revising the paper. All authors contributed to the discussion of the paper, read and approved the final manuscript.

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STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-7
Bias	9	Describe any efforts to address potential sources of bias	

Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8
		(*b*) Describe any methods used to examine subgroups and interactions	8
		(*c*) Explain how missing data were addressed	
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	6
		(*e*) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8
		(b) Indicate number of participants with missing data for each variable of interest	
Outcome data	15*	Report numbers of outcome events or summary measures	9
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8-12
		(*b*) Report category boundaries when continuous variables were categorized	8-12

		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	14
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12-14
Generalisability	21	Discuss the generalisability (external validity) of the study results	14
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Title Page

Prevalence and Risk Factors of Depression Symptoms among Chinese Seafarers During the COVID-19 Pandemic: a cross-sectional study

Wenzhe Qin[a]; Lei Li[b,c]; Dongshan Zhu[a], Chengfei Ju[c]; Pengfei Bi[c]; Shixue Li[a]

a. Centre for Health Management and Policy Research, School of Public Health, Cheeloo College of Medicine, Shandong University, Jinan, China; NHC Key Lab of Health Economics and Policy Research (Shandong University), Jinan, 250012, China.

b. Jinan Airport Customs, Jinan, 250013, China

c. Rongcheng Customs, Rongcheng, 264300, China

Corresponding author: Shixue Li, Professor

Centre for Health Management and Policy Research, School of Public Health, Cheeloo College of Medicine, Shandong University, Wenhuaxi Road44#, Jinan, Shandong, 250012, China.

Tel and fax: +86-0531-88382127. Email: shixueli@sdu.edu.cn

Key words: COVID-19; Depression symptoms; International voyage; Seafarers

Word count:

Abstract

Background: To curb the spread of COVID-19, most countries have adopted measures of ports banning shore leave and placed restrictions on crew change. Seafarers may bear excess pressure during the COVID-19 pandemic. This study aimed to investigate the prevalence and risk factors associated with depression symptoms among Chinese seafarers during the COVID-19 pandemic.

Design: Cross-sectional study.

Methods: This field survey-based study was conducted in Rongcheng port, Shandong Province, China, from June 10, 2020 to July 25, 2020. Socio-demographic, occupational characteristics and health related behaviors were collected through a face-to-face questionnaire. Self-rating Depression Scale (SDS) was used to evaluate depression status during the preceding week. Logistic regression models were used to explore related factors of depression.

Results: 441 male Chinese seafarers were enrolled. Overall, the proportions of seafarers with low, moderate and severe depressive symptoms were 23.35%, 9.30% and 9.07%, respectively. Compared to those with a good self-rated health (SRH), seafarers with poor SRH had higher odds of depression (Odds ratio[OR], 2.24; 95%CI, 1.22-4.11). Less leisure time or physical exercise was associated with severer self-reported depression symptoms (1~3/week vs ≥4/week: OR, 1.72; 95%CI, 0.71-4.14; none vs ≥4/week OR, 3.93; 95%CI, 1.67-9.26). Poor sleep quality was associated with a higher likelihood of reporting severe depression (fair vs good: OR, 2.78; 95%CI, 1.54-5.01; poor vs good: OR, 4.30; 95%CI, 1.65-11.24). The more times of working overtime a week, the higher likely to report severe depression symptoms (1~2/week vs none: OR, 1.82; 95%CI, 1.04-3.18; ≥3/week vs none: OR, 2.49; 95%CI, 1.05-5.92). Also, high perceived work stress was linked to higher odds of being depression (intermediate vs low: OR, 2.06; 95%CI, 0.78-5.46; high vs low: OR, 3.83; 95%CI, 1.35-10.90).

Conclusions: There is a high depression burden associated with the COVID-19 among seafarers. Special interventions that protect the mental health of seafarers are more critical than ever in the context of pandemic.

Key words: Depression; COVID-19; International voyage; Seafarers; Related factors

Strengths and limitations of this study:

- This is the first study that evaluated the depression status and related factors of seafarers during the COVID-19 pandemic.
- This study may provide important evidence to promote mental wellbeing among seafarers.
- The mental health status of seafarers before COVID-19 pandemic has not been measured.
- The participants are from Chinese seafarers, thus the extrapolation of the findings might be limited.

Introduction

On March 11, 2020, World Health Organization (WHO) declared the coronavirus disease 2019 (COVID-19) a pandemic.[1] As of May 24st, 2021, there have been more than 166 million confirmed cases and 3.4 million confirmed deaths worldwide.[2] In addition to stress posed to health systems, the pandemic also severely impacts the global economy and the global supply chain, especially international shipping.

Around 90% of global trade is transported by sea.[3] During COVID-19 pandemic, sea logistics networks are more important than ever for global supply chains. Seafarers play an essential role in maintaining the flow of vital goods, such as food, goods and medical supplies.[4] Globally, there are 2 million seafarers ensuring global needs of goods for daily life.[5]

COVID-19 has triggered many governments to prevent the transfer of seafarers through their territories to and from their home countries and vessels. This has left some seafarers stranded and others unable to join vessels to earn income. As of December 2020, over 400,000 seafarers were stranded on ships and had to extend their contract due to crew change issue. On the other hand, similar number of seafarers were stuck at home, unable to join ships.[6] Also, to avoid imported cases of COVID-19, most countries have adopted measures of ports banning shore leave.

Long-term working in an enclosed environment, absolute absence of shore leave, boredom of monotonous work, fears of being infected, and lack of emotional support from families may cause mental health crisis, such as emotional instability, anxiety, and depression.[7] Thus, organizations (such as International Chamber of Shipping, ICS) have called for attention to the mental health of these seafarers "trapped on board", as there have been several cases of suicides among seafarers.[8,9]

Previous studies before COVID-19 pandemic have suggested a poor mental health status in seafarers. A meta-analysis of Chinese seafarers found that compared to general population, seafarers had poor mental health status and higher prevalence of

depression.[10,11] Evidence has shown COVID-19 has negative impact on mental health.[12-15] Considering the special working conditions of seafarers, we predict that seafarers' mental health status may deteriorate even more during the COVID-19 pandemic, and especially the prevalence of depression among them might be even higher than usual.

Previous studies had found that risk factors for depression in seafarers include baseline medical conditions (a history of high cholesterol, hypertension, sleep disturbances, diabetes, liver disease, and cancer, etc), demographic (age, gender, and region of origin, etc), occupational(rank, work experience, etc), work-related determinants (exposures to overtime work and work stress) and additional factors.[11,16] In this study, firstly, the baseline medical conditions including chronic disease, sleep duration/quality were tested. We predicted that there would be a positive correlation between chronic disease and sleep disturbances and depression symptoms. Secondly, demographic factors including age, marital status, education level and monthly income were tested. We predicted that age, other marital status, low education level and low monthly income might be positively associated with depression symptoms. Thirdly, occupational factors including position rank, sailing age were tested. We predicted that high position rank and short sailing age might have positive relationships with depression symptoms. Fourthly, the work-related determinants including sailing duration, overtime work per week, COVID-19 related stress and perceived work stress were tested. We predicted that there would be positive correlations between long sailing duration, overtime work per week and high perceived work stress and depression symptoms. Additionally, the self-rated health, health behaviors and frequency of exercise were also tested. We predicted that the poor self-rated health, poor health behaviors and lack of exercise might have positive associations with depression symptoms.

In this study, we aimed to evaluate prevalence of depression symptoms among Chinese seafarers during COVID-19 pandemic, and to explore potential risk factors (including medical history, demographic factors, work-related determinants, and

self-rated health) associated with depression symptoms. This study may provide important evidence to promote mental wellbeing among seafarers.

Methods

Study design and participants

A cross-sectional study was conducted in Rongcheng port, Shandong Province, China, from June 10th, 2020 to July 25th, 2020. To ensure the authenticity and reliability of data, anonymous, face-to-face interviews with seafarers were conducted by trained investigators from Rongcheng custom, using a self-administered questionnaire (SAQ). The SAQ was structured including five parts of socio-demographic information, occupational characteristics, health related behaviors, health condition and self-rating depression scale.

Eligible participants were Chinese seafarers who remained onboard when the investigation was conducted. Two-stage sampling strategy was applied. First, a cluster random sampling method was employed to select the entry international ocean ships. All ships were required to declare entry information 24 hours in advance before their arrived. Thus, we randomly selected one ship from ships that will arrive the next day, based on their declared information. A total of 30 ships were selected during the study period. Second, all Chinese seafarers on the selected ship were interviewed. The target sample size of participants was determined using a formula $N=Z_{\alpha}^{2}P(1-P)/d^{2}$ (α =0.05, Z_{α}=1.96, and d=0.05). The prevalence of depression symptoms in seafarers was 50.76%, based on a study conducted before the COVID-19 pandemic.[17] To improve the response rate, we amplified the sample size by 15% with a goal of at least 442 participants. A total of 450 seafarers were included during the actual investigation and 9 participants refused to participate in this survey. Finally, 441 individuals completed the survey.

Key Definitions

Self-rating Depression Scale (SDS)

The 20-item Zung Self-Rating Depression Scale (SDS) was used to evaluate the depression symptoms of seafarers.[18] Ten items are scored positively (e.g., "I feel downhearted and blue"), and other ten scored negatively (e.g., "I still enjoy the things I used to do"). The seafarers were asked to rate how frequently they experienced each symptom during the past week. Responses were distributed on a 4-point Likert scale (1= a little of time, 2= some of the time, 3= good part of the time, 4= most of the time). The sum of the scores obtained on the 20 items were raw scores, and the raw scores were converted to a standard score (100-point scale) by multiplying by 1.25. A higher score indicates more severe depression symptoms. The severity of depression symptoms can be converted as follows: normal (≤49), mild (50-59), moderate (60-69), and severe (≥70). Moderate and/or severe depression were related to impaired daily functioning, reduced quality of life, and even self-harm or suicide in some cases.[19] The presence of major depressive disorder during the COVID-19 pandemic might need more attention.[20] In this study, we focused on seafarers with moderate and severe depression symptoms, and classified depression symptoms into two categories: 1=none/mild (a score<60), 2=moderate/severe (a score≥60).[20] The SDS has been widely used in previous studies and is of good reliability and validity. The Cronbach's α was 0.76 in this study.

Socio-demographic factors

Socio-demographic factors included age, sailing age, gender, marital status, educational level and individual income. Age and sailing age were measured in chronological years. Gender was dichotomized. Marital status was categorized into married and others. Education level was divided into three levels: high school or below, junior college, bachelor's degree or above. Self-reported monthly income in recent one year was collected. Most of the seafarers had been on board before the COVID-19 pandemic, and their contracted income was hardly affected by the COVID-19 pandemic.

Occupational characteristics

Occupation-related factors included sailing duration, type of ship, working position, night shift frequency per week, overtime work frequency per week, and self-perceived work stress. Overtime work was defined as "work continuously for more than 10 hours one day". Frequency of overtime work per week was categorized as none, 1-2 times, and 3 times or more. Respondents were asked to rate their work-related stress with a question of "In general, how would you rate your recent work stress", and seafarers stress level was categorized as low, intermediate, and high.[21]

Health status and health related behaviors

Health status included self-rated health (SRH) and history of chronic disease. SRH is an effective and reliable measure of health,[22] and has been grouped as good SRH and poor SRH in present studies. Presence of a certain chronic diseases was categorized as Yes or No.

Health related behaviors included cigarette exposure, alcohol consumption, sleep duration, self-rated sleep quality, leisure time or physical exercise (LPE) in the past month were measured. Sleep duration was measured as the number of hours sleep at night. Seafarers' work requires a shift system. Thus, sleep duration included sleep time during day and night, and categorized as: <6 hours, 6-8 hours and >8 hours. Sleep quality was divided into three categories: excellent, fair, and poor. LPE was calculated as the frequency of engaging in leisure activities or physical exercise (such as walking, playing table tennis, or working out at a gym) per week on board, and divided into three categories: none, 1-3=occasionally, ≥4=regularly.

COVID-19 stress

Seafarers were asked "In the current global outbreak of COVID-19, how would you rate the COVID-19-related stress on you and your relatives (such as fears of being infected, worries about losing job, have financial problems and so on)?" to evaluate their stress from COVID-19, and a 3-point Likert scale was used: 3=high, 2=fair, 1=low.

Ethics statement

Written informed consent was received before the respondents began the questionnaire. This study was approved by the ethics committee of Shandong University and performed in accordance with the Helsinki Declaration.

Statistical Analysis

Characteristics of seafarers by depression groups were described. Data were presented as mean (standard deviation, SD) for continuous variables and as the *n* (%) for categorical variables. Statistical differences of depression among subgroups were tested using independent sample t-tests (continuous variables) or $\chi 2$ tests (categorical variables). Multivariable logistic regression models were employed to estimate odds ratio (OR) and 95% CIs for the associations between risk factors and depression symptoms. All statistical tests were two-tailed, and the level of significance was set at 0.05. All analysis was performed using SPSS statistical software version 25.0 (IBM Corp).

Results

Demographic Characteristics

The demographic characteristics of seafarers showed in Table 1. The mean age was 37.54±9.74 years; the median sailing age was 8.0(3.0-13.0) years; 53.5% were high school or below and 7.5% were bachelor's degree or above; 74.6% were married; and 52.2% were ordinary crew. The ship types that seafarers work on were mainly cargo ships and bulk carriers. By the end of this survey, the median sailing duration was 7.0(5.0-9.0) months without disembark and traveling home. According to the contractual sailing duration stated by "The collective bargaining agreement for Chinese crew", 30.4% of seafarers have been on board for more than 8 months, 15% of them for more than 10 months, and 9.5% of seafarers for more than 12 months.

Prevalence of depression symptoms in seafarers

In 441 seafarers, the highest standard score of depression was 73, and the total mean standard score was 38.33±10.8. According to the standard score, a considerable proportion of seafarers reported symptoms of depression (41.7% [184]), of which 23.35% (103), 9.30% (41) and 9.07% (40) were categorized as having low, moderate and severe depressive symptoms, respectively. The demographic characteristics of seafarers were presented in **Table 1.**

Table 1 Characteristics of All Participants by Level of Depression Symptoms

Characteristic	Total, No. (%) (N=441)	Severity of depression, No. (%)		*P* value
		Normal/mild (n=360)	Moderate/Severe (n=81)	
Sailing age [a], year	8.0(3.0-13.0)	8.0(3.0-13.0)	8.0(2.0-12.0)	0.402[b]
Sailing duration [a], month	7.0(5.0-9.0)	7.0(5.0-9.0)	7.0(6.0-9.0)	0.432[b]
Age (year)				
18-44	323(73.2)	265(82.0)	58(18.0)	0.712[c]
≥45	118(26.8)	95(80.5)	23(19.5)	
Marital status				
Married	329(74.6)	273(83.0)	56(17.0)	0.207[c]
Others	112(25.4)	87(77.7)	25(22.3)	
Education level				
High school and below	236(53.5)	192(81.4)	44(18.6)	0.343[c]
Junior college	172(39.0)	139(80.8)	33(19.2)	
Bachelor's degree or above	33(7.5)	29(87.9)	4(12.1)	
Income (RMB)				
≤10000	214(48.5)	168(78.5)	46(21.5)	0.308[c]
10001～20000	148(33.6)	123(83.1)	25(16.9)	
20001～30000	25(5.7)	21(84.0)	4(16.0)	
>30000	54(12.2)	48(88.9)	6(11.1)	
Position classes				
Ordinary crew	230(52.2)	183(79.6)	47(20.4)	0.269[d]
Senior officer	211(47.8)	177(83.9)	34(16.1)	
Self-rated health				
Good	292(66.2)	259(88.7)	33(11.3)	<.001[c]
Poor	149(33.8)	101(67.8)	48(32.2)	
Chronic disease				
Yes	18(4.1)	14(77.8)	4(22.2)	0.755[d]
No	423(95.9)	346(81.8)	77(18.2)	
Smoking status				
Yes	201(45.6)	160(79.6)	41(20.4)	0.326[d]
No	240(54.4)	200(83.3)	40(16.7)	
Drinking status				

Yes	319(72.3)	267(83.7)	52(16.3)	0.075[d]
No	122(27.7)	93(76.2)	29(23.8)	
LPE per week				
None	171(38.8)	124(72.5)	47(27.5)	<.001[c]
1~3	192(43.5)	165(85.9)	27(14.1)	
≥4	78(17.7)	71(91.0)	7(9.0)	
Sleep duration				
<6	15(3.4)	8(53.3)	7(46.7)	0.008[c]
6~8	181(41.0)	145(80.1)	36(19.9)	
>8	245(55.6)	207(84.5)	38(15.5)	
Sleep quality				
Poor	29(6.6)	18(62.1)	11(37.9)	<.001[c]
Fair	214(48.5)	163(76.2)	51(23.8)	
Good	198(44.9)	179(90.4)	19(9.6)	
Overtime work per week				
None	256(58.0)	224(87.5)	32(12.5)	0.001[c]
1~2	154(34.9)	115(74.7)	39(25.3)	
≥3	31(7.1)	21(67.7)	10(32.3)	
Self-perceived work stress				
Low	65(14.7)	60(92.3)	5(7.7)	<.001[c]
Intermediate	277(62.8)	232(83.8)	45(16.2)	
High	99(22.5)	68(68.7)	31(31.3)	
COVID-19 stress				
Low	54(12.2)	44(81.5)	10(18.5)	0.896[c]
Intermediate	154(34.9)	124(80.5)	30(19.5)	
High	233(52.8)	192(82.4)	41(17.6)	

Abbreviations: LPE, leisure time or physical exercise; COVID-19, coronavirus disease 2019.

[a] Data are presented as median (IQR).

[b] Mann-Whitney rank sum test conducted for significance testing

[c] Two-tailed χ^2 analysis conducted for significance testing

[d] Fisher's exact test conducted for significance testing

The distribution of depression symptoms was different in the epidemic-related categories of SRH, LPE per week, sleep duration, sleep quality, overtime work frequency per week, and self-perceived work-related stress (**Table 1**). Participants with severe depression reported experiencing a poorer SRH and engaging in less LPE per week (χ^2=28.78, P<0.001; χ^2=16.45, P<0.001, respectively). Seafarers with sleep duration <6h and having a poor sleep quality had higher percentage of reporting severely depression (χ^2=9.63, P=0.008; χ^2=21.82, P<0.001, respectively). Moreover, the distributions of depression symptoms within categories of overtime work frequency and self-rated work-related stress had different patterns. The more times of

overtime work, the higher the depression level (χ^2=14.84, P=0.001). Seafarers in the high self-perceived work stress group had more severe depression symptoms (χ^2=16.84, P<0.001). Other characteristics of seafarers had no difference in the distributions of depression symptoms (P>0.05).

Factors associated with depression symptoms

Poor SRH(OR, 2.24; 95%CI, 1.22-4.11), LPE per week(for none vs ≥4: OR, 3.93; 95%CI, 1.67-9.26), sleep quality(for poor vs good: OR, 4.30; 95%CI, 1.65-11.24), frequency of overtime work per week(for ≥3 vs none: OR, 2.49; 95%CI, 1.05-5.92), and self-perceived work stress(for high vs low: OR, 3.83; 95%CI, 1.35-10.90) were associated with reporting severe depression symptoms(**Table 2**).

Table 2 Multivariable Regression Analysis of Factors Associated with Depression Symptoms

Variable	No. of Moderate/Severe (%)	OR (95%CI)	*P value* [a] Category	*P value* [a] Overall
Self-rated health				
Good	33(11.3)	1[reference]	NA	0.009
Poor	48(32.2)	2.24 (1.22,4.11)	0.009	
LPE per week				
≥4	7(9.0)	1[reference]	NA	
1~3	27(14.1)	1.72 (0.71,4.14)	0.229	0.001
None	47(27.5)	3.93 (1.67,9.26)	0.002	
Sleep quality				
Good	19(9.6)	1[reference]	NA	
Fair	27(14.1)	2.78 (1.54,5.01)	0.001	0.001
Poor	11(37.9)	4.30 (1.65,11.24)	0.003	
Overtime work per week				
None	32(12.5)	1[reference]	NA	
1~2	39(25.3)	1.82 (1.04,3.18)	0.035	0.041
≥3	10(32.3)	2.49 (1.05,5.92)	0.039	
Self-perceived work stress				
Low	5(7.7)	1[reference]	NA	
Intermediate	45(16.2)	2.06 (0.78,5.46)	0.147	0.019
High	31(31.3)	3.83 (1.35,10.90)	0.012	

Abbreviations: OR, odds ratio; LPE, leisure time or physical exercise.

[a] Category refers to the P value for each category vs the reference, while overall refers to the results of the logistic regression.

Less frequent leisure time or physical exercise were associated with more severe self-reported depression symptoms (1~3/week vs ≥4/week: OR, 1.72; 95%CI,

0.711-4.14; none vs ≥4/week OR, 3.93; 95%CI, 1.67-9.26). Having a poor sleep quality was associated with a higher likelihood of reporting severe depression (fair vs good: OR, 2.78; 95%CI, 1.54-5.01; poor vs good: OR, 4.30; 95%CI, 1.65-11.24). The more times seafarers worked overtimes a week, the more likely they were to report severe depression symptoms (1~2/week vs none: OR, 1.82; 95%CI, 1.04-3.18; ≥3/week vs none: OR, 2.49; 95%CI, 1.05-5.92). An increased odd of severe depression was identified among seafarers with high perceived work stress (intermediate vs low: OR, 2.06; 95%CI, 0.78-5.46; high vs low: OR, 3.83; 95%CI, 1.35-10.90).

Discussion

A high prevalence of depression symptoms among Chinese seafarers was found during COVID-19 pandemic. 40.72% seafarers reported depression symptoms and around 9% of them had severe depressive symptoms. Poor SRH, poor sleep quality, less leisure time or physical exercise, more overtime work, and higher work stress were associated with experiencing severe depression symptoms. Our findings provide the latest profile of psychological status of seafarers during the COVID-19 pandemic. Seafarers' mental health may need more attention during COVID-19 pandemic.

Previous studies have shown a substantial burden of depression symptoms in general population following COVID-19 pandemic.[20,23,24] A nationally representative study of American adults indicated that compared with the same period before COVID-19, prevalence of depression symptom was much higher during COVID-19 pandemic (mild: 24.6% vs 16.2%; moderate: 14.8% vs 5.7%; moderately severe: 7.9% vs 2.1%; severe: 5.1% vs 0.7%).[20] Compared to the general Chinese population during COVID-19 pandemic, we found seafarers have excessive prevalence of depression symptoms (41.72 vs 27.9%,[23] 41.72% vs 36.5%,[24] respectively).

Compared to previous studies that investigated seafarers' depression symptoms before the COVID-19 pandemic, our study showed a higher prevalence ([41.72% vs 35.26%][25], [41.72% vs 20.26%][26], [41.72% vs 38.56%][27]). Also, compared to Mei et

al.'s study, although the overall detection rate of depressive symptoms in our study is lower than that in Mei et al.'s study (41.72% vs 50.77%), the rate of severe depression symptoms in our study was much higher (9.07% vs 1.67%).[17]

The present study identified several risk factors that contributed to severe depression symptoms. Seafarers with a poor SRH were two or three times more likely to report severe depression symptoms. Our result is consistent with findings of previous research, which indicated that SRH can predict the risk of major depression in the future.[28] Moreover, our study found seafarers with less leisure time or physical exercise were susceptible to severe depression symptoms. A review on psychological stress in seafarers reported that limited recreation activity was one of the most important factors associated with mental, psychosocial, and physical stressors of seafarers.[29] Another study also confirmed that moderate to vigorous physical activities reduce depression prevalence.[30] Our study also found that seafarers with poor sleep quality reported severe symptoms of depression. Sleep quality is an important risk factor for depression.[31] A large proportion of seafarers reported no good sleep or having sleep disruption, especially the seafarers on international voyages who often experience "jet lag".[32] In addition, seafarers' work requires a shift system, the overtime work resulted from crew change restriction during the global epidemic affects the quality of sleep, increasing the psychological burden and causing mental diseases.

Another prominent finding was the substantial impacts of overtime work and high perceived work stress on depression, which is consistent with previous studies.[33] Overtime work is often accompanied by decline of sleep quality, which is the major source of stress and chronic fatigue.[34] What's more, due to the restriction caused by the epidemic, seafarers have to stay at sea for a long time, facing overload work. Overtime work, lack of safety in the workplace, and poor career prospects affect the mental health of seafarers. Previous studies have shown that seafarers are exposed to unique sources of work stress, such as special workplaces, monotonous work, climate change, long-term separation from family members.[35] These factors increase the

anxiety and loneliness of seafarers, and lead to insomnia and emotional instability. Especially the boredom on board caused by monotonous work, which is an important source of stress and addiction, according to data from the literature.[36] Jegaden et al.'s study found that there is a significant correlation between the boredom and depression among office staff and the seafarers, and boredom is an important factor that cannot be ignored.[37] Also, the inability to change shifts in time due to the epidemic will gradually aggravate these bad mental states and cause severe depression symptoms.[38]

According to previous literature and the issues noted in our study, there needs to be a unified approach which looks at protecting the mental health of seafarers at government level, organizational level and the individual level. To facilitate movement, seafarers should be recognized as key workers and provided with documentation to demonstrate that status. Also, to mitigate the crew change crisis, it is necessary to release a crew change framework endorsed by the International Maritime Organization (IMO), and authorities are encouraged to implement these proposals. Thirdly, the shipping company should increase care for seafarers, including the availability of some leisure activities, the encouragement of physical engagement, and the installation of shipboard telecommunication systems to contact families and friends. Better organization of working hours and work shifts should also be included. This would allow a longer and continuous period of sleep. Appropriate psychological health education could prepare seafarers to recognize job-specific stressors and implement suitable coping strategies. Finally, the seafarers themselves should adjust their mentality, look for happiness and satisfaction in their careers, broaden social interactions, obtain social support, and have the courage to seek professional psychological counseling and help.

This study has several limitations. First, the cross-sectional design brings question about interpretation of relationships between some "risk factors" and depression. Second, the participants are from Chinese seafarers, thus the extrapolation of the findings might be limited; Third, the status of depression symptoms was self-reported rather than clinical diagnosed. Fourth, the mental health status of seafarers before

COVID-19 pandemic was not measured. Whether the observed high prevalence of depression was related to the COVID-19 cannot be evaluated. However, the prevalence of severe depression in seafarers was much higher than that reported before COVID-19, thus, we believed that the increased rate of severe depression symptoms is associated with COVID-19 pandemic. Countries are currently taking measures to ease the dilemma of crew change, and follow-up studies are needed to further investigate the long-term effect of COVID-19 pandemic.

Conclusions

The COVID-19 crisis may have led to extra mental health problems, especially depression to seafarers. Poor self-rated health, less leisure time or physical exercise, poor sleep quality, more overtime work, and high perceived work stress are all linked to the report of depression symptoms.

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REFERENCES

1 World Health Organization. WHO Director-General's opening remarks at the media briefing on COVID-19-11 March 2020. 2020. Available: https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020

2 World Health Organization. Coronavirus disease (COVID-19) pandemic. 2020. Available from: https://www.who.int/emergencies/diseases/novel-coronavirus-2019

3 Stannard S. COVID-19 in the maritime setting: the challenges, regulations and the international response. *Int Marit Health*. 2020;**71**:85-90. http://dx.doi.org/10.5603/IMH.2020.0016

4 Zarocostas J. UN leaders call for key worker recognition for seafarers. The Lancet, 2020, 396(10265): 1792. https://doi.org/10.1016/S0140-6736(20)32582-4

5 Doumbia-Henry C. Shipping and COVID-19: protecting seafarers as frontline workers. *WMU J Marit Aff*. 2020;*19*:279-93. https://doi.org/10.1007/s13437-020-00217-9

6 International Maritime Organization. Supporting seafarers on the frontline of COVID-19. 2020. Available from: https://www.imo.org/en/MediaCentre/HotTopics/Pages/Support-for-seafarers-during-COVID-19.aspx

7 Lee H L. Seafarers face 'mental health crisis', governments urged to take immediate actions. 2020. Available from: https://www.seatrade-maritime.com/casualty/seafarers-face-mental-health-crisis-governments-urged-take-immediate-actions

8 Claire P. Focus on seafarer wellbeing during Covid-19 pandemic. 2020. Available from: https://www.chirpmaritime.org/wp-content/uploads/2020/04/Covid-19-psycology-and-welfare-paper-April-2020-Final.pdf

9 Hakirevic N. COVID-19 agony: 2 more cruise ship crew members die while awaiting repatriation. 2020. Available: https://www.offshore-energy.biz/covid-19-agony-2-more-cruise-ship--crew-members-die-while-awaiting-repatriation/

10 Zhu L J, Ma H. Meta-Analysis on Mental Health of Chinese Seafarers. *Journal of Zhejiang Institute of Communications*. 2018;**19**:40-45.(In Chinese) https://doi.org/10.3969/j.issn.1671-234X.2018.04.008

11 Lefkowitz R Y, Slade MD. Seafarer Mental Health Study. 2019. Available: https://www.seafarerstrust.org/wp-content/uploads/2019/11/ST_MentalHealthReport_Final_Digital-1.pdf

12 Pierce M, Hope H, Ford T, Hatch S, Hotopf M, John A, et al. Mental health before and during the COVID-19 pandemic: a longitudinal probability sample survey of the UK population. *The Lancet Psychiatry*. 2020;**7**:883-92. https://doi.org/10.1016/S2215-0366(20)30308-4

13 Wathelet M, Duhem S, Vaiva G, Baubet T, Habran E, Veerapa E, et al. Factors Associated With Mental Health Disorders Among University Students in France Confined During the COVID-19 Pandemic. *JAMA Netw Open*. 2020;**3**:e2025591. https://doi.org/10.1001/jamanetworkopen.2020.25591

14 Lai J, Ma S, Wang Y, Cai Z, Hu J, Wei N, et al. Factors Associated With Mental Health Outcomes Among Health Care Workers Exposed to Coronavirus Disease 2019. *JAMA Netw Open*. 2020;**3**:e203976. https://doi.org/10.1001/jamanetworkopen.2020.3976

15 Xiong J, Lipsitz O, Nasri F, Lui LMW, Mcintyre RS. Impact of COVID-19 Pandemic on Mental Health in the General Population: A Systematic Review. *J Affect Disord*. 2020;**277**:55-64. https://doi.org/10.1016/j.jad.2020.08.001

16 Sliš ković A, Penezić Z. Lifestyle factors in Croatian seafarers as relating to health and stress on board. *Work*, 2017, **56**: 371-380. https://doi.org/10.3233/WOR-172501

17 Mei Y, Zhang J, Li F, Gao YX. Depression symptoms and associated factors among seamen undertaking international voyage. Chinese Journal of Public Health. 2015;**31**:954-7.(In Chinese) https://doi.org/10.11847/zgggws2015-31-07-28

18 ZUNG, William WK. A Self-Rating Depression Scale. *Arch Gen Psychiatry*. 1965;**12**:63-70. https://doi.org/10.1001/archpsyc.1965.01720310065008

19 Soria-Saucedo R, Lopez-Ridaura R, Lajous M, Wirtz V. The prevalence and correlates of severe depression in a cohort of Mexican teachers. *J Affect Disord*, 2018;**234**:109-116. https://doi.org/10.1016/j.jad.2018.02.036

20 Ettman CK, Abdalla SM, Cohen GH, Sampson L, Galea S. Prevalence of Depression Symptoms in US Adults Before and During the COVID-19 Pandemic. *JAMA Netw Open*. 2020;**3**:e2019686. https://doi.org/10.1001/jamanetworkopen.2020.19686

21 Oldenburg M, Jensen H J, Wegner R. Burnout syndrome in seafarers in the merchant marine service. *Int Arch Occup Environ Health* , 2013;**86**:407-416. https://doi.org/10.1007/s00420-012-0771-7

22 Fayers PM, Sprangres MAG. Understanding self-rated health. *Lancet*. 2002;**359**:187-8. https://doi.org/10.1016/S0140-6736(02)07466-4

23 Shi L, Lu Z, Que J, Huang X, Liu L, Ran M, et al. Prevalence of and risk factors associated with mental health symptoms among the general population in China during the coronavirus disease 2019 pandemic. *JAMA Netw Open*. 2020;**3**:e2014053. https://doi.org/10.1001/jamanetworkopen.2020.14053

24 Dong P, Ni ZJ, Zhao KQ, Sun GQ, Sun HQ. Public depression status during the COVID 19 epidemic. Chinese Mental Health Journal. 2020;**34**:710-714. (In Chinese) https://doi.org/10.3639/j.issn.1000-6729.2020.8.014

25 Yang CG, Chen P, Nie WZ, Li DX, Zhao B, Yu CL, et al. A survey on the international crew's phychological health and the influence factors. Chinese Frontier Health Quarantine,. 2016;**39**:132-5. (In Chinese) https://doi.org/10.16408/j.1004-9770.2016.02.015

26 Li Y, Investigation mental health state of shipping seamen. *China Journal of Health Psychology*. 2007;**15**:727-728. (In Chinese) http://dx.chinadoi.cn/10.3969/j.issn.1005-1252.2007.08.030

27 Guo JX. Investigation of the Mental Health Status of Seafarers and Mental Health Management Measures. *Shipping Management*. 2020;**417**:25-27. (In Chinese)

28 Badawi G, Pagé V, Smith KJ, Garie´G, Malla A, Wang J, et al. Self-rated health: A predictor for the three year incidence of majordepression in individuals with Type II diabetes. *J Affect Disord*. 2013;**145**:100-5. https://doi.org/10.1016/j.jad.2012.07.018

29 Carotenuto A, Molino I, Fasanaro AM, Amenta F. Psychological stress in seafarers: a review. *Int Marit Health*. 2012;**63**:188-94. PMID: 24595974

30 Currier D, Lindner R, Spittal MJ, Cvetkovski S, Pirkis J, English D. Physical activity and depression in men: Increased activity duration and intensity associated with lower likelihood of current depression. *J Affect Disord*. 2020;**260**:426-31. https://doi.org/10.1016/j.jad.2019.09.061

31 Hu Z, Zhu X, Kaminga AC, Zhu T, Xu H. Association between poor sleep quality and depression symptoms among the elderly in nursing homes in Hunan province, China: a cross-sectional study. *BMJ Open*. 2020;**10**:e036401. https://doi.org/10.1136/bmjopen-2019-036401

32 Allen P, Wadsworth E, Smith A. The prevention and management of seafarers' fatigue: a review. *Int Marit Health*. 2007;**58**:167-77. https://doi.org/10.1016/j.jweia.2007.02.019

33 Jing X, Binjun H, Huan S, Xiuli L, Jie Z, Yaqing Z, et al. Association between social support and health-related quality of life among Chinese seafarers: A cross-sectional study. *PLos one*. 2017;**12**:e0187275. https://doi.org/10.1371/journal.pone.0187275

34 Sąlyga J, Kušleikaitė M. Factors influencing psychoemotional strain and fatigue, and relationship of these factors with health complaints at sea among Lithuanian seafarers. *Medicina*. 2011;**47**:675-81. https://doi.org/10.3390/medicina47120099

35 Hjarnø L, Leppin A. A risky occupation? (Un)healthy lifestyle behaviors among Danish seafarers. *Health Promot Int*. 2014;**29**:720-9. https://doi.org/10.1093/heapro/dat024

36 Fisherl C D. Boredom at work: A neglected concept[J]. *Human Relations*, 1993,**46**:395-417. https://doi.org/10.1177%2F001872679304600305

37 Jegaden D, Menaheze M, Lucas D, Lodd é B, Dewitte J. Don't forget about seafarer's boredom. *Int Marit Health*, 2019,**70**:82-87. https://doi.org/10.5603/IMH.2019.0013

38 Sliš kovi ć A. Seafarers' well-being in the context of the COVID-19 pandemic: A qualitative study. Work, 2020 (Preprint): 1-11. https://doi.org/10.3233/WOR-203333

Footnotes

Contributors: WZ planned the study, conducted the analysis and wrote the pater while being supervised by SX*; LL, CF helped to plan the study, including the instrumentation, and to revise the manuscript; DS, PF, and SX accomplished the statistical analysis and contributed to revising the paper. All authors contributed to the discussion of the paper, read and approved the final manuscript.

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Data sharing statement: No additional unpublished data.

Funding statement: None.

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-7
Bias	9	Describe any efforts to address potential sources of bias	

Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8
		(*b*) Describe any methods used to examine subgroups and interactions	8
		(*c*) Explain how missing data were addressed	
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	6
		(*e*) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8
		(b) Indicate number of participants with missing data for each variable of interest	
Outcome data	15*	Report numbers of outcome events or summary measures	9
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8-12
		(*b*) Report category boundaries when continuous variables were categorized	8-12

		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	14
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12-14
Generalisability	21	Discuss the generalisability (external validity) of the study results	14
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.