Injury, Illness, and Mental Health Risks in United States Domestic Mariners

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Objective: Describe health conditions and injury and illness rates in a population of United States mariners, an understudied workforce vital to economic security. **Methods:** In this survey study, mariner health data was collected and analyzed to provide injury and illness rates (including mental health conditions) and associated risk factors. **Results:** In this mariner population of highly tenured vessel masters and pilots, hypertension, obesity, sleep disorders, smoking, alcohol consumption, and symptoms of depression and anxiety were common. BMI $\geq$35 was associated with increased likelihood of work injury (OR 5.7; 95%CI 1.01, 32.59). **Conclusions:** The mariners were in poor overall health, raising public health and safety concerns in this population of essential transportation workers. Follow-up studies including a wider distribution of domestic mariners (deck hands, engineers) would further characterize occupational risks.

Keywords: mariner, mental health, occupational injury, prevention

Marine transportation is an essential and efficient mode of transportation throughout the world, relying on the work of both international seafarers and domestic mariners. Much of the limited research on marine transport workers has been centered on the international seafarers and focused mainly on injuries, but there is much less about the domestic mariners, who are also very important and different population. In contrast to international seafarers, who are mainly from developing countries and protected by international treaties as well as laws of the flag state while at sea, domestic mariners are a largely native workforce protected by their local labor laws, such as the Jones Act in the United States. In the wake of recent maritime accidents in major port and bridges, questions have been raised regarding the impact of mariner health on public safety. In addition, there is increasing concern regarding mental health and suicides in international seafarers[1] but mental health in domestic mariners has not been investigated. This study of 233 working domestic mariners aimed to meet this research gap by describing the baseline health characteristics, injury and illness rates, and prevalence of depression and anxiety symptoms in working mariners and assess demographic and occupational risk factors. It is anticipated that these findings may help map areas of particular concern for this essential workforce and potential public safety issues surrounding domestic maritime transport work.

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Clinical significance: Domestic mariners are a critical transportation workforce. Despite the essential nature of their work, there is little research on domestic mariners' baseline health characteristics, injury and illness incidence, and mental health. The poor overall health observed in the mariners presents public health and safety concerns warranting further attention.

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METHODS

In collaboration with Seamen's Church Institute, a US-based mariner chaplaincy and support organization, we performed an anonymous, voluntary paper survey study of 233 working US domestic shipping vessel masters (captains) and pilots at two vessel piloting training centers in the US from September 2018 through February 2019. The survey included questions on demographic, baseline medical, and occupational characteristics of interest as well as questions regarding alcohol and tobacco use, sleep, and mental health. All surveys included the 9-Item Patient Health Questionnaire (PHQ-9) to screen for depression[2] and the 7-Item Generalized Anxiety Disorder Questionnaire (GAD-7) to screen for anxiety.[3] For these mental health questions, cutoff scores of 5 were used to define the presence of at least mild depression or anxiety symptoms.[2,3] The Sleep Condition Indicator (SCI) was used to assess sleep quality, with SCI score $\leq$16 defining poor sleep quality.[4] Body mass-index (BMI) was calculated using the self-reported heights and weights. The study was approved by the Yale IRB and Southern Illinois University IRB.

The surveys were collected at the mariner training centers and input into an electronic database for analysis. Descriptive characteristics and survey scores were calculated. Differences in the distribution of categorical variables were detected using the Chi-square or Exact tests as appropriate. Logistic regression was used to model unadjusted and adjusted odds ratios of depressive symptoms and injury or illness incidence. All data analyses were performed using SAS v9.4 (Copyright SAS Institute Inc., Cary, NC, USA).

RESULTS

Characteristics of the 233 surveyed vessel masters and pilots are displayed in Table 1, which presents a picture of overall poor health. The mariner average age was 46 years old (SD = 11), with an average tenure of 24 years (SD = 12). The majority were obese (61%); another 33% were overweight leaving just over 5% of mariners with a normal BMI. Problems with sleep were reported by 30% of mariners, and 13% likely had a sleep condition by the SCI (score $\leq$16). Medication use was commonly reported for hypertension (28%), hyperlipidemia (18%) and diabetes (11%), and 24% were current smokers (42% former smokers).

Drinking alcohol was highly prevalent at 68%. Those who drink alcohol reported being able to drink an average of a 10 drinks (SD = 6) before losing consciousness. 12% of mariners reported forgetting things after drinking binges, and 12% of mariners felt the need to cut down on drinking. A smaller minority reported friends or relatives were worried about their drinking (4%) or admitted to drinking upon awakening in the morning (2.5%).

The 1-year incidence of illness at work (25%) was higher than that of injuries (3%), with a substantial proportion of illnesses requiring admission to a hospital or emergency room (14%). In

TABLE 1. Characteristics of Surveyed Domestic Mariners

Category	Level	*n*	%
Age group (y)	18–30	20	9
	31–40	63	28
	41–50	64	28
	≥51	82	36
Race	Caucasian	217	93
	Other	16	7
Education level	High school or less	149	65
	Some college	69	30
	Bachelor's degree or higher	14	6
Income	≥ $100,000	206	92
	< $100,000	19	8
Job	Master	149	64
	Pilot	84	36
Tenure (years)	0–10	29	12
	11–20	80	34
	21–30	55	24
	31+	69	30
Shift	12 hours on/ 12 off	26	11
	6 hours on / 6 off	190	82
	Other	16	7
BMI category	Normal	12	5
	Overweight (BMI 25–29.9)	76	33
	Obese (BMI ≥ 30)	140	61
In general, how would you say your health is?	Excellent	7	3
	Very good	55	24
	Good	134	59
	Fair or poor	35	15
PHQ-9 score	0–4	175	84
	5–9	22	11
	10–14	6	2
	15–27	5	3

PHQ-9, Patient Health Questionnaire.

contrast, only 2 injury cases were reported to require emergency room or hospital care.

Among mariners who completed the PHQ-9 questionnaire ($n = 209$), 16% had scores consistent with depressive symptoms. Anxiety symptoms by the GAD-7 highly correlated with depressive symptoms ($\chi^2 = 244.1$; $P < 0.0001$), and so only the outcome of depressive symptoms was used in the analyses. Higher BMI (35 or greater) was associated with higher prevalence of symptoms of mild depression ($\chi^2 = 9.6$, $P = 0.002$). Although not statistically significant, depressive symptoms were more prevalent in younger and shorter-tenured mariners.

Mariners with depressive symptoms were disproportionally more likely to report a work injury in the past year; 50% of mariners with depressive symptoms reported a work injury compared to 15% of mariners without any depressive symptoms ($P_{exact} = 0.05$). Depressive symptoms were also associated with poor sleep quality as measured by the SCI (score ≤16); 45% of mariners with poor sleep had depressive symptoms, compared to 14% without poor sleep ($P_{exact} = 0.001$).

Bivariate modeling found that the presence of depressive symptoms (OR 5.8; 95%CI 1.12, 30.11) and BMI ≥35 (OR 7.0; 95%CI 1.32, 37.16) were significant determinants of mariner work injury in the past year, with BMI ≥35 remaining significant in multivariate analysis (OR 5.7; 95%CI 1.01, 32.59). In terms of depressive symptoms risk, the adjusted model incorporating all demographic, occupational, and reported health data (BMI, sleep quality, self-reported health, smoking and tobacco use) demonstrated a significant effect of poor sleep quality (OR 6.9; 95%CI 2.19, 21.51) and BMI ≥35 (OR 5.2; 95%CI 1.96, 13.87) on likelihood of depressive symptoms.

DISCUSSION

This is a study of US domestic mariners, a large and economically important working population with substantial impact on public health and safety and only limited applicable research to-date. While the initial focus of the study was mental health, it was also apparent that these workers were not in a good overall health state as demonstrated by a majority with high rates of obesity, alcohol consumption, and smoking. This raises safety and security concerns, considering the nature of domestic mariners often working proximal to land-based facilities, among passenger and recreational vessels, or even terrestrial vehicles (by bridges and ports).

It is very hard to compare our findings to other research as so few population studies of maritime workers have been performed, and the few existing studies have generally examined injuries as opposed to medical conditions. Compared to the one other study which also found high rates of obesity, hypertension, dyslipidemia, and elevated fasting glucose in a chart review of marine pilots,[5] we additionally found high rates of illness while working on the vessels, sleep disturbance, alcohol and tobacco use, and symptoms of depression and anxiety. In addition, the mariners reported lower self-rated health than observed in a standard US population study,[6] and lower self-rated health has been correlated in numerous studies with poor health and increased mortality.

Our unique dataset, although small and limited to tenured marine pilots and masters, found significant rates of illness and depressive symptoms; there is little literature available for comparison. The finding of 16% of mariners having mild depressive symptoms is similar to the prevalence recently reported in oil and gas industry workers.[7] It is possible that this similarity is related to certain shared demographic (gender, age, and race) and occupational factors (including work/sleep schedules, living on the job site). While only a small percentage of the studied mariners (5%) reported symptoms at a level meeting the higher threshold more closely correlating with clinically recognized depression (PHQ-9 score ≥10), it is plausible that depression is more common and/or severe in the wider domestic mariner population (including younger, shorter-tenured deckhands), and that the lower observed rates in the study population is due to a healthy worker effect in these seasoned, well-compensated, US vessel masters and pilots. In addition, it is possible that a response bias led to underestimation of the true rate of depressive symptoms in the mariners, perhaps due to fear of repercussions; indeed, there was more reluctance to answer the mental health questions (11% did not respond to the PHQ-9).

Significant factors associated with depressive symptoms included high BMI and poor sleep. Illness at work (25% of mariners) was more commonly reported than work injury (3%) in the past year. Despite the low prevalence of injury, the adjusted model found mild depression symptoms to be a significant predictor of work injury. As sleep quality was identified as a determinant of both depression symptoms and injury risk, larger follow-up studies of factors related to sleep quality, shift scheduling, and injury/illness risk (including mental health risks) in a broader mariner population may help inform future maritime policy. Maritime policy implications, including public health, transportation safety, and economic impacts, support the need for further characterization and reduction of health risks in this essential workforce.

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REFERENCES

1. Mellbye A, Carter T. Seafarers' depression and suicide. *Int Marit Health*. 2017;68:108–114.
2. Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. *J Gen Intern Med*. 2001;16:606–613.
3. Spitzer RL, Kroenke K, Williams JB, Löwe B. A brief measure for assessing generalized anxiety disorder: the GAD-7. *Arch Intern Med*. 2006;166:1092–1097.
4. Espie CA, Kyle SD, Hames P, Gardani M, Fleming L, Cape J. The Sleep Condition Indicator: a clinical screening tool to evaluate insomnia disorder. *BMJ Open*. 2014;4:e004183.
5. Scovill S, Roberts T, McCarty D. Health characteristics of inland waterway merchant marine captains and pilots. *Occup Med*. 2012;62:638–641.
6. Zajacova A, Dowd JB. Reliability of self-rated health in US adults. *Am J Epidemiol*. 2011;174:977–983.
7. Pavičić Žeželj S, Cvijanović Peloza O, Mika F, Stamenković S, Mahmutović Vranić S, Šabanagić Hajrić S. Anxiety and depression symptoms among gas and oil industry workers. *Occup Med*. 2019;69:22–27.

