Prevalence of Adverse Health Behaviors and Conditions Among Maritime Workers, BRFSS 2014-2018, 38 states

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Abstract

Objective: To analyze health behaviors and conditions among maritime workers using Behavioral Risk Factor Surveillance System (BRFSS).

Methods: BRFSS data from 2014–2018 were used to calculate weighted prevalence estimates and adjusted prevalence ratios (aPRs) for 10 health behaviors and conditions. Logistic regression was used to compare aPRs between maritime workers and all other U.S. workers.

Results: Compared to other workers, maritime workers had higher weighted prevalence estimates for six of ten health behaviors and conditions: binge drinking, smoking, obese/ overweight, diabetes, cancer, and chronic obstructive pulmonary disease. Maritime workers had significantly higher aPRs for binge drinking (aPR=1.28) and smoking cigarettes (aPR=1.39) compared to all other U.S. workers.

Conclusions: This study uses BRFSS data to estimate the prevalence of adverse health conditions across maritime industries. This study can serve as the foundation for additional follow-on research.

Keywords

maritime workers; adverse health conditions; maritime industry; seafarers; mariners; chronic health; health behaviors

Background

Maritime industries in the U.S. employ more than 400,000 workers across the nation (1). These industries and occupations include commercial fishing, seafood processing, aquaculture, marine transportation, marine terminals and port operations, and commercial diving. Working in these maritime industries has been associated with an increased risk of

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non-fatal and fatal injuries (1–3). Maritime workers face many occupational hazards and exposures. In some settings, maritime employees live and work aboard vessels and may be at sea for long periods of time. Maritime workplaces often involve small businesses, multiple employers, seasonal employment, and operations in remote locations. Workers in these environments are exposed to numerous hazardous conditions due to the nature of their work and work environment, including poor weather and sea conditions, fatigue, social isolation, hazardous machinery and equipment, confined space entry, and chemical exposures. As a result, many of the studies on maritime industries focus on safety and health outcomes from occupational exposures instead of underlying health conditions present in this worker population. Maritime workers with underlying health conditions may have limited treatment options while at sea, and remote working locations may delay timely treatment. The stress and high demands of shipboard work can lead to fatigue and isolation which may have an impact on the health of onboard seafarers. Confined work and living environment also increase the likelihood that communicable diseases will spread among the crew.

The few studies that have examined health conditions and behaviors among maritime industries and occupations in the U.S. provide some information about the health status of these workers. A small sample of commercial fishermen in Alaska were found to have high prevalence of overweight and obesity, as well as reporting long working hours, limited sleep, and limited aerobic exercise during the fishing season (4). In Washington, fishing industry workers were more likely to smoke, use marijuana, and drink or binge drink alcohol than other populations. Additionally, they were found to have lower rates of health care coverage and less likely to have primary care physicians (5). Occupational asthma and respiratory symptoms have been identified in seafood processors, specifically those working with shellfish (6–8). U.S. domestic mariners were found to commonly have hypertension, obesity, sleeping disorders, smoking, alcohol consumption and symptoms of depression and anxiety. In one study, having a BMI >= 35 was significantly associated with an increased likelihood of work injuries (9). Common exposure to chemicals and ultraviolet (UV) have been observed in seafarers and shipyard workers (10, 11).

The aforementioned studies provide valuable insight into the health status of maritime workers. However, these studies are limited to small worker populations in various locales, making it difficult to systematically characterize health status among all maritime workers. For instance, there are considerable differences in study populations (e.g., sample size, industry or occupation, geographic region) that make comparisons and conclusions problematic. An overall health profile of these workers on a national level may help researchers, employers, and public health practitioners determine where to target efforts to improve the health and well-being of maritime workers.

The purpose of this study was to compare the prevalence of adverse health behaviors and conditions (binge drinking, smoking, COPD, asthma, flu shot, health insurance, overweight or obese, diabetes, depression, and cancer) in maritime workers with all other workers in the U.S. It is imperative to investigate the prevalence of underlying medical conditions within the maritime industry because these conditions could provide additional insight into why the risks of occupational injuries or illnesses are high compared to other industries. This study

examines the prevalence of health behaviors and conditions among maritime workers in the U.S. using BRFSS data during 2014–2018.

Methods

BRFSS Study

The Behavioral Risk Factor Surveillance System (BRFSS) survey is designed by BRFSS state coordinators and Centers for Disease Control and Prevention (CDC) staff. It is intended to collect information on health-related risk behaviors, chronic health conditions, and use of preventative services of U.S. citizens. This survey contains data from all 50 states, as well as the District of Columbia and three U.S. territories. There are three primary components to the survey: (1) the core component, consisting of the fixed core, rotating, and emerging core questions; (2) optional modules; and (3) state-added questions. One of the optional components is the Industry and Occupation (IO) module, which was sponsored by the National Institute for Occupational Safety and Health (NIOSH) and implemented in 2013. It is intended to provide a new perspective on BRFSS data and demonstrate the value of work as a core demographic variable for public health research, policy, and practice (12). For states adopting the IO module, participants who were employed (or unemployed for <1 year) were asked the following questions: (1) "What kind of business or industry do you work in (for example, hospital, elementary school, clothing manufacturing, restaurant)?" and (2) "What kind of work do you do (for example, registered nurse, janitor, cashier, auto mechanic)?" The open-ended responses for industry and occupation given by the participants were coded using the 2002 and 2010 U.S. Census Bureau IO codes. Coding was completed by NIOSH using the NIOSH Industry and Occupation Computerized Coding System (NIOCCS) and human coders. The Census Bureau codes were then grouped into broader categories using the National Health Interview Survey (NHIS) simple and detailed recodes.

Study Population

From 2014 to 2018, a total of 38 states included the optional IO module in at least 1 year of their BRFSS. The study population of interest for this study was adults reporting that they were employed for wages, self-employed, or out of work for less than 1 year. Those unemployed for under 1 year were included to account for high turnover and seasonal employment that occurs in some maritime industries. From the 1 million BRFSS respondents, only 563,086 (~50%) were asked the IO module questions. Of those who answered one or more of the questions, 84,169 (15.0%) were missing North American Industry Classification System (NAICS) codes, 75,244 (13.4%) Standard Occupational Classification (SOC), 9,378 (1.67%) race/ethnicity, 1,474 (0.26%) education level, and 296 (0.05%) sex.

Because the maritime workforce comprises a variety of industries and occupations, multiple NAICS and SOC codes were used to identify the study population. The NAICS codes did not always contain 6-digit values; therefore, the NAICS variable was used to subset by the number of NAICS digits present (i.e. 3-, 4-, 5, and 6-digits). All the NAICS and SOC codes used to identify maritime workers can be found in Supplemental Table 1.

Outcome Variables

The health behaviors and conditions analyzed included the following: binge drinking, current smoker, chronic obstructive pulmonary disease (COPD), asthma, overweight/obese, diabetes, depression, cancer, flu shot, and health insurance (Supplemental Table 2). BRFSS contains many potential health indicators for analysis. We selected these 10 from the standard module to broadly examine overall health status, from respiratory health to mental health, risky behaviors to disparities in healthcare.

The proportion of respondents with missing data on the health behavior and conditions ranged from 5.22% to 6.35% for binge drinking; 2.75% to 4.27% for current smoking; 0.21% to 0.59% for asthma 0.30% to 0.64% for COPD; 0.01% to 0.15% for diabetes; 0.33% to 0.35% for health insurance; 5.29% to 6.94% for flu shot; 0.21% to 0.28% for cancer; 3.67% to 8.20% for overweight/obese; and 0.21% to 0.37% for depression.

Statistical Analysis

To account for the survey's complex design, all analyses were conducted using sample weights and survey procedures in STATA 14 (StataCorp 2015. Stata Statistical Software: Release 14. College State, TX: StataCorp LP). Counts, weighted proportions of sample population, and 95% confidence intervals (CIs) were calculated by demographic groups within maritime workers and all other workers. Pearson correlations were used to determine if there were any significant differences between the two groups for all 10 health behaviors/ conditions. Adjusted prevalence ratios were calculated for maritime workers and compared to all other workers. Logistic regression was used to evaluate if the prevalence of health behaviors and conditions were different in maritime workers than all other US workers. Covariates included age, sex, race/ethnicity, and education level.

Due to the low number of respondents identified as maritime workers, age, education and race/ethnicity were recategorized into smaller groups. Age was categorized into six age groups: less than 25 years; 25–34 years; 35–44 years; 45–54 years; 55–64 years; and 65 years or older. Race/ethnicity was modified to only include two categories: non-Hispanic white and non-white Hispanic or other. Education was simplified into three categories: less than high school education; graduated high school; and attended or graduated college. Statistical significance level was set at alpha = 0.05

Results

Of the 563,086 BRFSS participants who answered IO module questions, 1,417 (0.25%) were identified as maritime workers using NAICS and SOC codes. The sample represents 272,720 maritime workers (0.2%) and 123,690,675 non-maritime workers (99.8%) among the 38 states surveyed from 2014 to 2018. Of the 1,417 maritime workers, 322 (22.7%) were ship and boat building workers, 303 (21.4%) were identified as commercial fishing workers, 282 (19.9%) were water transportation workers, and 510 (36.0%) constituted all other maritime. Figure 1 shows the distribution of workers in the maritime industries and all other industries.

The unweighted frequency, weighted prevalence and 95% CI of demographic characteristics for maritime and non-maritime workers can be found in Table 1. Compared with all other workers, maritime workers had higher proportions of male workers and workers identifying as non-Hispanic white, and lower proportions of workers with a college education. Overall, the weighted percentage of workers by age group was relatively similar.

The unweighted frequency, weighted prevalence, and 95% CI for adverse health behaviors and conditions for maritime and non-maritime workers can be found in Table 2. The estimated prevalence of binge drinking (32.8%), current smoker (27.7%), obese or overweight (73.0%), diabetes (9.0%), cancer (10.3%) and COPD (4.6%) for maritime workers were significantly higher when compared to non-maritime workers. Of the health behaviors and conditions examined, differences between weighted prevalence estimates for binge drinking and current smoker were the most significant (p<0.001) when comparing maritime and non-maritime workers.

Adjusted prevalence ratios and 95% CI can be found in Table 3. Compared to non-maritime workers, maritime workers were significantly more likely to binge drink or smoke when adjusting for age, sex, education level, and race/ethnicity. Maritime workers were approximately 28% more likely to binge drink and 39% more likely to smoke when compared to non-maritime workers. All other health behavior and condition prevalence ratios were found to not be significantly different between the two groups.

Discussion

This study found that maritime workers had significantly higher unadjusted weighted prevalence estimates than non-maritime workers for six of ten adverse health behaviors/conditions: binge drinking, smoking, overweight/obese, diabetes, cancer, and COPD. Although the small number of maritime workers limited our ability to evaluate the prevalence of these adverse health conditions among specific maritime occupations, the overall results provide valuable insight into maritime worker health status. When age, education, race/ethnicity, and sex were taken into account, the aPR of adverse health conditions were similar to the weighted prevalence estimates. Overall, maritime workers had higher aPRs for all the adverse health conditions except depression, asthma, and flu shot.

Compared to all other workers, maritime workers were significantly more likely to binge drink and smoke cigarettes. These results are similar to the findings of the 2020 study of BRFSS data in Washington state, where they found that fishing industry participants were more likely to smoke, use marijuana, and drink or binge drink alcohol (5). A study of survey data from US domestic mariners also found that smoking and alcohol consumption were more common in this population (9). Commercial fisherman were also found to have a higher prevalence of smoking and secondhand smoke exposure compared to U.S. agricultural and all workers (13). Globally, two different reviews found high prevalence of tobacco use and alcohol consumption among seafarers (14, 15). Similarly, a study of French fishermen in the South Atlantic region found that a third of fishermen are at risk for excessive drinking (16). There are a limited number of studies that examine the smoking and

alcohol consumption practices of maritime workers and the possible explanations for why they appear to be more commonly used among maritime workers. Stress, pain, and social and cultural norms could be predictors of these activities in the maritime industries. We also found a higher prevalence of COPD among maritime workers, for which smoking is a risk factor.

Based on our sample, about 73% of maritime workers were overweight or obese and 9% reported diabetes, higher than other workers. While these differences were not statistically significant after adjusting for age, sex, and race/ethnicity, this high prevalence is concerning. Overweight/obesity has been linked to an increase risk of a plethora of adverse health conditions such as hypertension, coronary heart disease, diabetes, stroke, sleep apnea, respiratory issues, cancers, and mental health issues (17). Overweight/obesity and diabetes can both contribute to high direct and indirect health care costs. Interventions to treat overweight/obesity and diabetes include lifestyle changes, such as improving diet and increasing exercise (17, 18). Mariners, particularly those who work and live on vessels, may have difficulty incorporating such changes.

Our results did not indicate significant differences in depressive disorders, consistent with some other studies (19–22). However, there may be differences when examining individual industries/occupations. For instance, increases in workplace suicides have been observed in commercial fishing (23). Fishermen deal with many work-related psychosocial stressors that may contribute to mental health disorders, including isolation, fatigue, sleep deprivation, environmental challenges, and unpredictable harvests resulting in financial stress (24). Traditional workplace health programs, such as employee assistance programs, may not be relevant for the fishing industry, and unique interventions must be considered.

Although we found no significant differences for cancer or asthma, there are unique work-related hazards and exposures that maritime workers face that may not be captured by the BRFSS standard questionnaire or optional modules. Additionally, the development of chronic health conditions from work-related exposures may occur over longer periods of time and would thus not be prevalent in the working population. Recent studies from researchers in Norway, Greenland, and Sweden found that bioaerosol exposures from seafood processing facilities can contain endotoxins which could impact respiratory health (25). Additionally, Wisconsin and Minnesota shipyard workers were found to have high blood lead levels (26), and lead has been identified as a probable carcinogen (27). Some maritime workers are also commonly exposed to exhausts, oils, and dusts while working (28). While exposure to chemicals or biohazards at the workplace can be common for some types of maritime workers, we found no associations with respiratory illnesses or cancer.

Since 1977, there have been 27 maritime health hazard evaluations (HHEs) conducted by the National Institute for Occupational Safety and Health (NIOSH) in the U.S. Only four of these HHEs have taken place in the last 20 years. Of the four HHEs, one occurred in workers in shipyards, two in marine terminals, and one in water transportation (29–32). One HHE examined outdoor abrasive blasting where coal slag was used in Louisana shipyard workers, one investigated possible health problems related to mold exposure in a variety of port workers in Maine, one surveyed air pollution in California and Washington port

workers, and the last HHE evaluated worker health when exposed to stagnant water and decaying marine life in New York lock maintenance workers. The last HHE in maritime industries was conducted in 2012. The evaluations contributed greatly to the knowledge of occupational hazards and exposures in maritime workplaces; however, there is overall little research that has occurred as a result. NIOSH now has a specific health and safety research program developed in 2015 to focus on these maritime industries. By partnering with academia, regulators, and maritime companies, the Center for Maritime Safety and Health Studies (CMSHS) conducts and supports research to improve safety and health for maritime workers. One relevant CMSHS research objective is to assess and promote effective safety and health programs that address hazards associated from with a workplace having multiple employers and work arrangements, multi-language work settings, fatigue, and stress (33). By providing a snapshot of health status among maritime workers, this study can help CMSHS researchers and maritime stakeholders prioritize, develop, and evaluate health promotion interventions for these workers.

Implications for Occupational Health Practice

This study highlighted the differences in adverse health conditions and behaviors for maritime workers when compared to non-maritime workers. Identifying the types of health conditions and behaviors that are more prevalent in this industry is an important first step is addressing and eventually decreasing these disparities. Our findings pertaining to smoking and drinking are concerning. It is not unusual for maritime workers to have long hours, grueling work, and big paydays. Some workers might turn to alcohol or drugs to cope with injuries, reduce stress, combat fatigue, or relax after their shift. Research and public health practice should focus on identifying the factors contributing to tobacco use and excessive drinking, as well as developing and evaluating interventions to limit the use of addictive substances.

Strengths and Limitations

The intent of this study was to examine prevalence rates of common adverse health behaviors and conditions in maritime workers to identify disparities between this population and other workers. The study identified significant differences which future research should explore and attempt to explain. BRFSS data is collected via self-reporting which may introduce a source of potential bias. Participants and interviewers could misinterpret the questions or answers during the interview process. Additionally, participants may incorrectly report behaviors or conditions due to recollection or social desirability bias. Further, all of the participant responses to the IO questions are coded for NAICS and SOC based on these responses. This was done using NIOCCS and human coders, which could lead to misclassification of industry or occupation.

While the proportion of maritime workers included in this study (~0.25%) is similar to the proportion of maritime workers in total U.S. employment, not all states were included and thus the findings may not be nationally representative. Specifically, some coastal states that have a significant maritime workforce, such as Alaska, Maine, and Virginia, were not included. The relatively small sample size of maritime workers led to wider confidence intervals than other groups and limited statistical power to detect differences. The low

number also made examining specific maritime industries difficult, so the decision was made to group all maritime industries together. Maritime workplaces vary in operations, size, location (at sea vs. on shore), unionization, and a host of other factors. Because we categorized all maritime workers from different industries into one group, additional industry/occupation-specific research is warranted using other study designs.

Applying Research to Practice

The findings of this study illustrate that maritime workers have higher prevalence estimates than all other workers for smoking tobacco, obese or overweight, diabetes, cancer, COPD, and binge drinking. Weighted, adjusted prevalence ratios showed that maritime workers had significantly higher levels of binge drinking and smoking tobacco than all other U.S. workers. Additional research is needed to better understand the differences in adverse health conditions between maritime workers and groups of workers. Identifying these disparities in the maritime workforce could be used to inform future studies or interventions to address the underlying causes of these conditions.

Conclusion

This study uses BRFSS data to examine maritime workers and estimate the prevalence of 10 different adverse health behaviors and conditions. This study gives occupational health researchers and practitioners an overview of who is working in the maritime industries and their health status. This study can serve as the foundation for additional follow-on research, as well as aid researchers and companies in developing prevention or educational materials to improve the health and wellness of this workforce.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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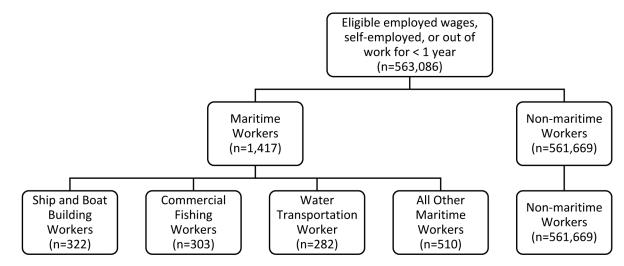
Figure 1:

Breakdown of participants by maritime industries and all other industries

Table 1:

Demographics of Maritime and All Other Workers, 2014–2018 BRFSS, 38 States

Characteristic	Maritime Workers (n=1,417)			All Other Workers (n=561,669)		
	Unweighted Frequency	Weighted prevalence	95% CI	Unweighted Frequency	Weighted prevalence	95% CI
Sex						
Male	1,242	90.6%	85.7–93.9	280,800	55.1%	54.6–55.5
Female	175	9.4%	6.1–14.3	280,573	44.9%	44.5–45.4
Education						
Less than High School	118	12.3%	9.0–16.5	27,275	10.6%	10.3–11.0
Graduated High School	519	42.1%	35.9–48.6	132,939	25.6%	25.3–26.0
Attended or Graduated College	775	45.6%	39.5–51.9	399,986	63.8%	63.3–64.2
Age (years)						
Less than 25	69	7.8%	5.3–11.5	33,672	11.7%	11.4–12.1
25–34	219	24.4%	19.1–30.6	87,452	22.9%	22.5–23.2
35–44	220	19.4%	14.5–25.4	101,530	21.9%	21.6–22.3
45–54	335	19.5%	15.8–24.0	133,593	21.6%	21.2–21.9
55–64	398	20.4%	16.0–25.5	141,737	16.4%	16.1–16.7
More than 64	176	8.5%	5.2–13.5	60,685	5.5%	5.3–5.7
Race/Ethnicity						
Non-Hispanic White	1,091	72.1%	65.3–78.0	421,915	60.5%	60.1–61.0
Non-White Hispanic or Other	309	27.9%	22.0–34.7	130,393	39.5%	39.0–39.9

Participating states: AL, CA, CO, CT, DE, FL, GA, HI, ID, IL, IA, KS, LA, MD, MA, MI, MN, MS, MO, MT, NE, NH, NJ, NM, NY, NC, ND, OR, PA, RI, SC, TN, TX, UT, VT WA, WV, and WI.

Table 2:

Weighted Prevalence of Adverse Health Behaviors and Conditions Among Maritime Workers and All Other Workers, 2014–2018 BRFSS, 38 States

Health Behavior & Condition	Maritime Workers (n=1,417)			All Other Workers (n=561,669)		
	Unweighted Frequency	Weighted prevalence	95% CI	Unweighted Frequency	Weighted prevalence	95% CI
Binge Drinking **	368	32.8%	26.3–38.0	99,923	21.5%	21.2–21.9
Current Smoker **	333	27.7%	22.5–33.7	80,458	16.2%	15.9–16.5
Obese or Overweight *	986	73.0%	67.1–78.2	345,302	66.3%	65.9–66.7
Diabetes *	149	9.0%	6.5–12.2	41,071	6.5%	6.3–6.7
Depression	154	11.1%	7.8–15.5	86,437	14.4%	14.1–14.7
Asthma	128	10.1%	6.3–16.0	66,848	12.6%	12.3–12.9
Cancer *	159	10.3%	7.1–14.7	55,132	6.6%	6.5–6.8
COPD *	76	4.6%	3.1–6.6	20,047	3.1%	3.0–3.2
Insurance	1,229	85.5%	80.9–89.2	505,041	85.8%	85.5–86.1
Flu Shot	380	26.7%	21.0–33.4	199,610	31.6%	31.2–32.0

Participating states: AL, CA, CO, CT, DE, FL, GA, HI, ID, IL, IA, KS, LA, MD, MA, MI, MN, MS, MO, MT, NE, NH, NJ, NM, NY, NC, ND, OR, PA, RI, SC, TN, TX, UT, VT, WA, WV, and WI.

*
p-value<0.05

**
p-value<0.001

Table 3:

Adjusted[†] Prevalence Ratios (aPR) with 95% CI of Health Behaviors and Conditions Among Maritime Workers and All Other Workers, 2014–2018 BRFSS, 38 States

Health Behavior/ Condition	Maritime Workers (n=1,417)		All Other Workers (n=561,669)
	aPR	95% CI	aPR
Binge Drinking [*]	1.28	1.06–1.53	1.0 (ref.)
Current Smoker [*]	1.39	1.15–1.69	1.0 (ref.)
Obese or Overweight	1.03	0.97–1.11	1.0 (ref.)
Diabetes	1.09	0.80–1.51	1.0 (ref.)
Depression	0.99	0.70–1.39	1.0 (ref.)
Asthma	0.96	0.60–1.52	1.0 (ref.)
Cancer	1.34	0.92–1.97	1.0 (ref.)
COPD	1.40	0.96–2.05	1.0 (ref.)
Insurance	1.00	0.98–1.03	1.0 (ref.)
Flu Shot	0.94	0.75–1.18	1.0 (ref.)

[*] p-value<0.05

[†] Adjusted for age, education, race/ethnicity, and sex

Participating states: AL, CA, CO, CT, DE, FL, GA, HI, ID, IL, IA, KS, LA, MD, MA, MI, MN, MS, MO, MT, NE, NH, NJ, NM, NY, NC, ND, OR, PA, RI, SC, TN, TX, UT, VT WA, WV, and WI.