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Adding Insult to Injury: The Impact of Musculoskeletal Pain on Fishermen's Sleep Patterns

Julie A Sorensen [a], Paul Jenkins[b], Kimberly Gertz[a], Amanda Roome[a], Rebecca Weil[a], Judith Graham[a], Brian Quinn[a], Laurel Kincl [c], Jerry Dzugan[d], and Leigh McCue-Weil[e]

[a]Northeast Center for Occupational Health and Safety: Agriculture, Forestry, and Fishing, Cooperstown, NY, USA; [b]Bassett Healthcare Network, the Bassett Research Institute, Cooperstown, NY, USA; [c]College of Health, Oregon State University, Corvallis, OR, USA; [d]Alaska Marine Safety Education Association, Sitka, AK, USA; [e]Department of Mechanical Engineering, George Mason University, Fairfax, VA, USA

ABSTRACT

Objectives: Commercial fishing is one of the most dangerous industries in the United States, and although injuries have been a prominent focus for research, some health and safety risk factors such as sleep are understudied. In this paper, data from a multi-modal research study of sleep patterns, lifestyle factors, occupational exposures, medical histories, and health assessments in four U.S. fisheries are used to explore the connections between pain and sleep.

Methods: A mixture of randomized cluster sampling, study promotions, and dockside recruitment was utilized to gather a sufficient number of fishermen in the Alaska Salmon, Oregon Dungeness Crab, Massachusetts Scallop, and Massachusetts Lobster fisheries for the study. Fishermen were surveyed about sleep patterns, occupational exposures, and lifestyle factors. Surveyed fishermen were provided with free comprehensive health assessments by occupational health nurses and physicians or Advanced Practice Providers. Data were collected in REDCap and downloaded into SAS for analysis using a variety of analytic methods.

Results: A total of 262 surveys and 162 physical examinations were completed with captains and crew members in the four fisheries targeted for study. The average self-reported consecutive hours of sleep for fisheries workers that spend several days at sea (i.e. Crab, Scallop, and Salmon fisheries) were roughly 3.5 to 4.0 h in a 24-h period. Of particular note, the majority of fishermen, regardless of fishery, suffered from back pain, and roughly 40% of fishermen noted pain and discomfort significantly impede their ability to sleep.

Conclusions: This study underscores the connections between musculoskeletal pain and sleep, providing yet further impetus for preventing musculoskeletal injuries among fishermen. Given the ties between existing sleep debt in the industry and the health and safety risks posed by repeated exposure to insufficient sleep, this study highlights the need for the prevention of these injuries and potentially better treatment options for fishermen who suffer from musculoskeletal disorders.

KEYWORDS
Commercial fishing; health assessments; musculoskeletal pain; sleep patterns; sleep studies

Introduction

Commercial fishing is known to be one of the most dangerous occupations in the United States, with an industry fatality rate of 50.9 per 100,000 full-time equivalent workers or 13 times the average, all worker fatality rate.[1] Between the years 2000 and 2014, there were 693 commercial fishing fatalities in US fisheries.[2] Due to the harsh working conditions and strenuous physical demands, commercial fishing has been recognized in the literature as an occupation with an increased risk for musculoskeletal disorders.[3–5] A study investigating the prevalence of musculoskeletal pain in lobstermen in the Northeast region of the U.S. revealed half of the participants experienced low back pain attributed to, or exacerbated by, lobstering.[6] Of the study sample, 82% reported pain in at least one body segment, and reports of multiple locations of pain were common.[6] In a study evaluating chronic health risks before and during the fishing season in a sample of commercial fishermen in Alaska, 71% of fishermen reported musculoskeletal symptoms of the upper extremity interfering with work during the fishing season.[7] Further, the prevalence of hearing loss and upper extremity disorders were also higher than the general population both before and during the fishing season.[7] Additionally, 70% of the participants in the study were overweight or obese, increasing the risk of sleep apnea, which can in turn lead to sleep loss, as well as injury.[7]

CONTACT Julie A Sorensen julie.sorensen@bassett.org The Northeast Center for Occupational Health and Safety: Agriculture, Forestry and Fishing, 1 Atwell Road, Cooperstown, NY 13326, USA

Research on chronic sleep deprivation points to the potential for increased risk of accidents while fishing and during navigation. Studies assessing the connections between sleep deprivation and cognition generally demonstrate that a lack of sleep impairs perception, memory, and executive functioning.[8] U.S. Coast Guard reports provide further evidence with fatigue cited as a factor contributing to numerous incidents, including collisions and groundings. For example, fatigue was cited as contributing to the grounding of the fishing vessel Tenacious Savannah Ray off Whittier, Alaska[9] and other deadly collisions in U.S. waters, such as the collision between Viking Storm and Maverick off La Push, Washington.[10]

While the U.S. Coast Guard has cited concerns regarding a variety of safety issues and commercial fishermen's lack of sleep while fishing,[11,12] occupational sleep studies examining the health and safety impacts of sleep deprivation in the fishing industry are rare. In a search of the literature, few studies were identified.[7,13–15] Meanwhile, the impacts of sleep loss on worker health and safety have been thoroughly studied in other industries. Medical service providers participating in shift work, and therefore working in a state of sleep deprivation, reported negative health trends such as poor diet, obesity, high blood pressure, abnormal low-density lipoprotein (LDL) levels, and excessive sleepiness.[16,17] A study of physician-diagnosed sleep apnea and injury outcomes in farmers found a consistent increase in occupational injury risk for those who reported loud snoring.[18] In a study of long-haul truckers, poor sleep quality was identified as a predictor of both cardiovascular and metabolic disease.[19] A meta-analytic review of experimentally manipulated sleep restriction on neurocognitive functioning found a "significant negative effect of sleep restriction on cognitive processing across cognitive domains".[20] Additionally, a 2018 study on chronic sleep deprivation found it impaired neurobehavioral performance and self-assessment of alertness.[21] The heightened risk for occupational injuries and fatalities in the commercial fishing industry, paired with the extensive research documenting the connection between sleep loss and workers' health and safety in other industries, highlights the need for more expansive studies on the impacts of sleep deprivation on the health and safety of commercial fishermen.

To address this gap, researchers at the Northeast Center for Occupational Health and Safety (NEC), in collaboration with researchers from Oregon State University, the Alaska Marine Safety Education Association, and George Mason University conducted a thorough sleep and health study. The study included fishermen from four industries and three coastal regions of the United States: Salmon (in Alaska), Dungeness crab (in Oregon), Scallop (in Massachusetts), and Lobster (in Massachusetts). By conducting comprehensive surveys combined with physical examinations, the research team collected data encompassing a wide range of physical health factors, occupational risk exposures, and lifestyle habits.

In this paper, the authors utilize the data from this sleep and health study to specifically explore the relationship between pain and sleep in multiple US fisheries. Sleep and pain data were collected from multiple sources, including surveys and health assessments, to assess the connection between pain and sleep and the subsequent health and safety implications.

Methods

Geographic study area and recruitment

Four US fisheries in Alaska, Oregon, and Massachusetts were sampled. These regions were selected to maximize demographic variation and fishery-sector representation. Salmon fishermen were recruited from Southeast Alaska. This commercial fishery population harvests fish using purse seines, trolling gear, and drift gill nets.[22] Crews range in size from three to six members, trips range from 1 to 3 days at sea (DAS), and workdays range from 14 to 20 hours.[23] In Oregon, we recruited participants from the Dungeness crab fishery. In this fishery, crews harvest their catch with crab pots. Crew size varies from two to four crew members with DAS ranging from 1 to 7, and workdays typically ranging from 12 to 20 hours in length.[24–26] Scallop fishermen from Massachusetts who harvest using dredges were also recruited. Crew sizes for this fishery are typically 6 to 10 crew members with DAS between

10 and 14, although vessels are now limited to roughly 20 DAS for the entire year.[27,28] The average workday length is around 12 h.[29,30]

In Massachusetts, most inshore lobster fishermen typically leave and return to port after a 6–10-h day and fish with lobster traps. Crews are typically one to two members, while some fishing vessel captains fish without a crew. This fishery was included because fishing trips of multiple days do not typically occur. These lobstermen, therefore, served as a comparator arm for the other three fisheries who typically work overnight on their vessels.

Human Subjects Research approval was received from the Mary Imogene Bassett Hospital Institutional Review Board under protocol #1481898. All recruited fishermen signed a consent form to participate in the research and discussed the study process and their rights as research subjects with the study team.

Research team

The formation of the research team emphasized a transdisciplinary approach and included an epidemiologist and statistician who have worked together for over 15 years with lobster fishermen in the Northeast developing and evaluating worker safety interventions for this industry. A second investigator who specializes in occupational safety and ergonomics was also included, along with a former fisherman and international marine safety instructor. Finally, a pulmonologist with training in sleep disorders partnered with a mechanical engineer to provide expertise on tracking sleep duration at sea.

Sampling and recruitment for the general sleep and health survey

The sampling frame for the salmon, Dungeness crab, and lobster fisheries consisted of a list of permit holders within each of these three fisheries. The original sampling plan was to distribute these surveys completely at random to individual permit holders using a combination of email, post, and telephone (provided a telephone number was available). In cases where the permit holder did not provide his/her telephone number, the Alaska Marine Safety and Education Association (AMSEA) trainees list was cross-checked to gather this information, or internet searches were conducted to locate phone numbers. As planning progressed, it became clear the wide geographic dispersal of the fishermen had to be taken into account. Therefore, the randomization scheme was revised to focus on randomly selecting fishermen in specific locations, typically ports that contained relatively high concentrations of fishermen (cluster sampling). Fishermen were randomly selected in these ports to participate in the survey and health assessments. This allowed healthcare workers to travel and administer the in-person health assessment.

Because an all-inclusive permit list (0 both crew and captains) did not exist for the scallop fishermen, they were recruited by contacting scallop settlement houses. These settlement houses provide administrative assistance to both captains and crew members who specifically harvest scallops. Services include processing pay checks, handling mail, and providing industry updates. Some settlement houses agreed to distribute surveys by putting a paper copy in each scalloper's mailbox. Officials at the settlement houses also informed the scallopers of the study by posting information signs near fishermen's mailboxes, as well as verbally describing the study. Fishermen could either complete the paper survey and return it or call a toll-free number to complete the survey with a study team member.

Sampling and recruitment for the health assessment

As explained above, the research design called for completing health assessments with all subjects who had completed the survey. However, an adequate sample size for the health assessments could not be recruited using only these subjects because not every subject completing the survey was able to or had agreed to completing a health assessment. Therefore, it was necessary to solicit additional health assessment subjects using radio, social media, partner promotions, word of mouth, and dockside engagement with fishermen. Fishermen expressing an interest via these recruitment methods were sent information on the study

by mail or email and followed up with via phone calls, texts, or email. One example of media outreach that was particularly helpful in increasing interest in the study was an article in National Fisherman Magazine.[31]

Survey instrument/data collection

The survey instrument captured self-reported data on demographics, vessel type and size, work role, sleep schedules, self-reported general health, alcohol and tobacco use, caffeine intake, information on diet, and sleep (including factors that affect sleep), as well as physical, emotional, and financial health. Data on prior fishing-related injuries were also captured. Anyone who completed the survey was then invited to complete a thorough occupational health assessment. Survey data gathered by telephone were entered directly into the REDCap database system. In cases where survey data were captured during dockside recruitment, the data were entered on paper for subsequent data entry in REDCap.

In the survey, participants were asked to share their least total hours of sleep, average consecutive hours of sleep, and least consecutive hours of sleep per 24-h period. They were also asked to provide the number of consecutive days with the least hours of sleep.

There were two questions that specifically addressed the extent to which pain interfered with sleep:

> To what extent has significant pain and discomfort interfered with your sleep in the last 12 months?
>
> On a scale of one to ten, (one being the least and ten being the most), to what extent do the following factors affect your sleep while fishing?

The second of these two questions specifically addressed the relationship between pain and sleep while fishing. Due to the fact that lobster fishermen do not sleep on their boats (with rare exceptions), this question did not form the basis for a contrast among all four fisheries. For this reason, the more general question relating to sleep in the past 12 months was used for pain and sleep comparisons between fisheries. A more specific analysis that compares factors that impact sleep while fishing between the three remaining fisheries (salmon, crab, and scallop) will be reported in a separate manuscript.

Health assessments included a survey where fishermen self-reported health data and a physical examination where health endpoints were directly measured. A pre-health assessment questionnaire was also administered just prior to the examination and captured information on medical history and recent injuries. In the initial assessment, an occupational technician measured height, weight, and waist circumference (with body mass index also calculated), Snellen visual acuity, peak flow respiratory measurement, exhaled carbon monoxide (CO), blood pressure, random glucose, cholesterol, Framingham scores,[32] urinalysis, the short blessed test (which measures early cognitive impairment),[33] post-traumatic stress disorder screener,[34] and the Epworth Sleepiness Scale.[35] Following this, an occupational physician or nurse practitioner conducted a full physical examination that covered Mallampati scores (to predict the likelihood of sleep apnea),[36] ENT (ears, nose, and throat), skin, neurological function, musculoskeletal issues, and hand-grip strength. Fishermen were also asked in the health assessment questionnaire "Do any of the following medical conditions or treatments apply to you?" with "arthritis", "back pain", or "chronic pain" being listed as potential responses. Responses were grouped into "yes" or "no" based on whether they had pain in the past or currently (categorized as "yes") or whether they had never had pain (categorized as "no").

All health assessment data, including both self-report and physical examination data, were recorded on paper copies and then entered into the REDCap database system.

Data analysis

Comparison of sleep variables between fisheries

Continuous variables reflecting hours of sleep while fishing were compared between the fisheries using 1×3 analysis of variance (ANOVA). Any significant omnibus F results were explored further with pairwise comparisons using Scheffe's test. Variables compared in this model included hours of sleep while fishing for the three fisheries

that have multiple DAS (salmon, Dungeness crab, and scallop).

Binary data were summarized using proportions at 95% confidence intervals (CI). Normally distributed continuous data were summarized using means and standard deviations. In cases of continuous data that demonstrated extreme skew to either the right or the left, the median and inter-quartile range was used. Categorical data with more than two levels was summarized using frequency distributions.

Analyses of chronic pain

The first set of the univariate analyses compared levels of variables thought to be relevant for their relationship to pain and sleep between the four fisheries. Categorical variables were compared between the fisheries using chi-square tests or Fisher's Exact Test in cases where the data were too sparse for chi-square. Continuous variables were compared between the fisheries using a 1 by 4 Kruskal–Wallis nonparametric analysis of variance. In the second step, any variable whose levels differed significantly between the fisheries, were then tested for a significant relationship to the subjects' self-reported relationship between pain and sleep. Categorical variables were tested for their relationship to binary sleep outcomes using chi-square or Fishers Exact Test. For sleep variables with more than two levels the relationship was tested using Spearman's Rank-Order Correlation Coefficients (Spearman's Rho). Continuous variables were compared between levels of binary sleep variables using the Wilcoxon Rank–Sum Test and were tested for their relationship to sleep variables with more than two levels using Spearman's Rho.

The variables tested included gender, self-reported health, smoking, nicotine use, coffee, tea, energy drinks, diet, financial issues, work schedule, work relationships, boat noise, stress, family relationships, regulations, crew reliability, weather, total cholesterol, high-density lipoprotein, Mallampati score, blood pressure, body mass index, and post-traumatic stress disorder. Any variable whose levels differed significantly between the fisheries and that was also related to the subjects' self-reported association between pain and sleep were entered into a five-level, ordinal logistic regression equation to identify independent predictors of this outcome.

Results

Subject recruitment

Out of 577 attempted contacts, the study obtained 185 completed surveys. To calculate a response rate, 75 cases were removed from the denominator for the following reasons: "no number listed, $n = 7$", "number disconnected, $n = 8$", "number not in service, $n = 33$", and "wrong number, $n = 27$". This yielded a survey response rate, for the initial cluster sampling, of 185/502 = 36.9%. As explained above, the study originally intended to provide physical examinations to every subject who completed the survey. However, only 85 such examinations were completed for those original 185 surveyed individuals. This was attributable to the difficulty subjects experienced attending the physical examinations. Given the rural nature of the work, subjects often would be required to fly to the examination locations or were not available given the fishing season. Therefore, to ensure a sufficient sample size for physical examinations, 77 subjects were recruited (51 dockside, 18 through local promotions, and 8 from unknown sources). In addition to attending the physical examination, all 77 subjects also completed a survey, which resulted in a total 262 completed surveys and 162 completed physical examinations. Given the challenges of tracking promotional and dockside recruiting, it was difficult to calculate an exact numerical response rate for the physical examinations; however, few among those who were invited to participate in an examination via these dockside recruitment efforts refused.

Comparison of sleep variables between fisheries

Significant differences were seen between the fisheries for the least total hours of sleep ($p < .0001$) and the least consecutive hours of sleep ($p = .001$) (See Table 1). The main contributor to these two significant differences was the considerably limited hours of sleep on both endpoints observed in the Dungeness crab fishery.

Assessment of chronic pain

It is noteworthy that the majority of fishermen in all four fisheries indicated back pain, with a prevalence ranging from 55.6% to 71.2%. As shown in Table 2, there was a significant difference in the prevalence of arthritis in these fisheries with

Table 1. Mean (standard deviation) sleep duration for overnight fishing trips*.

	Salmon	Scallop	Crab	Omnibus p-value
Least total hours sleep	1.55 hrs (±1.58) n = 85	2.59 hrs (±2.31) n = 49	1.1 hrs (±1.86) n = 72	**p<.0001** (1)
Average consecutive hours sleep	4.01 hrs (±1.79) n = 82	3.7 hrs (±1.05) n = 45	3.48 hrs (±1.87) n = 71	p=.147
Least consecutive hours sleep	1.43 hrs (±1.48) n = 82	2.17 hrs (±1.75) n = 47	1.01 hrs (±1.75) n = 70	**p=.001** (2)
Consecutive days least hours	4.43 days (±8.55) n = 83	5.22 days (±5.41) n = 43	3.9 days (±5.71) n = 71	p=.620

(1) Both salmon and Dungeness crab fishermen have significantly less "least total hours of sleep" than scallop fishermen at $p < .01$.
(2) Both Dungeness crab ($p = .001$) and salmon ($p = .052$) fishermen have significantly less "least consecutive hours of sleep" time than scallop fishermen.
*lobster fishermen were not included, as their fishing trips did not include overnight stays on vessels.

Table 2. Comparison of chronic conditions between fisheries.

	Salmon	Lobster	Scallop	Crab	Omnibus P-value
Chronic pain	21.2% (11/52)	28% (7/25)	17.2% (5/29)	13.3% (6/45)	0.49%
Back pain	71.2% (37/52)	55.6% (15/27)	60.7% (17/28)	69.6% (32/46)	0.47%
Arthritis	20% (9/45)	45.5% (10/22)	32% (8/25)	13.9% (5/36)	0.04%

the highest level being among the lobstermen. However, after adjusting for age, fishery was no longer a significant predictor in any of the three pain endpoints.

Measurement of the relationship between pain and sleep

Fishermen were also asked "To what extent has significant pain and discomfort interfered with your sleep in the last 12 months?" Responses were rated on a 5-point Likert scale as follows: 1 (not at all), 2 (slightly), 3 (moderately), 4 (quite a bit), and 5 (extremely). Although the average rating was similar across fisheries, the average response to this question among all fisheries was 2.3. Further, 102 (39.8%) of the respondents checked 3, 4, or 5 indicating the considerable impact that pain has on their ability to sleep.

Univariate analyses were conducted to identify predictors of the extent to which pain interfered with sleep, which was measured as described above. Among the candidate variables considered were the subject's: 1) work schedules, 2) work relationships, 3) boat noise, 4) pain, 5) stress, 6) family/relationship concerns, 7) financial concerns, 8) regulations, 9) reliability of crew/captain, 10) weather, and 11) safety. All these 11 variables were measured on a scale of 1 to 10, with 1 being the least, and 10 being the most. Additional tests were done to measure the relationship of this variable to the number of years the subject had been fishing and to whether or not they had experienced a work-related injury in the last 12 months. Finally, another variable measuring the subject's ability to control the important things in life (measured as a 5-point variable) was also included in the analyses.

The results of these univariate analyses identified five variables whose levels differed significantly between the fisheries and were related to the response about pain and sleep. These five variables were captured in responses to the following questions:

(1) How often have you felt that you were unable to control the important things in your life? [Never, almost never, sometimes, fairly often, often]

(2) Have you had any work-related fishing injury/injuries in the last 12 months? [Yes/no]
(3) On a scale of one to ten (one being the least and ten being the most), to what extent do the following factors affect your sleep while fishing? [Work schedule]
(4) On a scale of one to ten (one being the least and ten being the most), to what extent do the following factors affect your sleep while fishing? [Weather]
(5) How many years have you been a commercial fisherman? [Continuous variable]

These five variables were included, along with the subjects' fishery, in a five-level ordinal logistic regression model to predict the extent to which pain interfered with sleep. The significant predictors were the inability to control important things in life (OR = 1.44, 95% CI 1.16–1.79, $p = .001$), having a work-related fishing injury in the last 12 months (OR = 2.12, 1.22–3.69, $p = .008$) and years in the fishing industry (OR = 1.02, 1.01–1.04, $p = .013$). Also, marginally significant in this model was the degree to which weather interfered with sleep (OR = 1.10, 1.00–1.20, $p = .056$). When the model was adjusted for this covariate set, the subject's fishery was not a significant predictor of this outcome.

Discussion

Our study investigated the impact of pain on sleep among commercial fisheries workers in three distinct regions of the United States. The results of our study mirror the conclusions from other published studies on the degree to which musculoskeletal injuries are affecting this population. However, one of the most interesting findings from our study is the degree to which pain further limits the already limited sleep opportunities of these workers.

Looking at the results of our study and similar studies of musculoskeletal disorders among fishermen, the links between fisheries work and the heightened risk of musculoskeletal injury are clear. In a systematic literature review conducted by Remeen et al, authors found that the prevalence of musculoskeletal disorders in fisheries studies ranged widely from 15% to 93%.[3] While the authors noted that these differences were likely related to differences in research methodology, musculoskeletal injuries were a consistent theme regardless.

In a study conducted by one of the coauthors of this article (LK), biomechanical assessments conducted with Dungeness crab fishers in Oregon demonstrated repeated exposures to harmful postures and the potential for repetitive use injuries. In particular, researchers noted "the low back compression, shear force and flexion movement about the shoulders and low back" on crabbing vessels create conditions that increase the risk of injury among crab harvesters.[37] The results from our study point to the validity of these findings in Oregon's Dungeness crab fisheries workers.

Studies conducted with fishermen in North Carolina also identified concerns relating to musculoskeletal injury among "fish harvesters". Data collected through fieldwork observations and ethnographic interviews indicated that 38.5% of participants had experienced pain so severe it interfered with work.[38] As in our study, lower back pain was the most commonly identified issue, although part-time workers were more likely to report chronic pain issues than their full-time counterparts. While data on fisheries and non-fisheries work was reported by each of the participants in our study, classifying workers as working "part-time" or "full-time" was difficult given the complexity of work patterns in fisheries workers, in general. In a similar study conducted with fishermen in North Carolina, researchers noted considerable variability in hazardous postures and repetitive use injury exposures based on crew positions on the boat, i.e. captain, trap haulers, and packers.[39]

While many of the previously cited studies focus on occupational injury and musculoskeletal assessments of fishermen in U.S. fisheries, similar observations relating to increased risk of musculoskeletal injuries have been noted in Danish,[40] Brazilian artisanal,[41] Sri Lankan,[42] Indian,[43] Greek,[44] Swedish,[45] and Norwegian fisheries.[46] It is important to note a particularly interesting study of fisheries workers in Norway. In this

study, researchers utilized hospitalization and outpatient care data from the Norwegian Patient Registry. Data from fishermen were age- and gender-matched to control populations and results indicated fishermen had significantly higher rates of sick leave when compared to their age- and gender-matched cohorts. The most common cause of sick leave was related to musculoskeletal injuries in both populations; however, fishermen had a higher number of hospitalizations, and the number of days in medical care facilities was higher when compared to controls.[46]

While these studies share fairly conclusive evidence of the connections between fisheries' work and musculoskeletal injury, as well as concerns about fishermen's ability to work and hospitalizations, none of them discuss the potential impact of musculoskeletal pain on sleep. Connections between pain and sleep have also surprisingly not been explored in the few studies examining sleep deprivation in fisheries.[7,13,14] This is particularly interesting given the potential for pain to regularly disrupt sleep, either by making it difficult to fall asleep, causing frequent awakenings, and overall reduced sleep quality. Since conditions in commercial fisheries generally call for long workdays, significant physical exertion, and disturbances related to irregular sleep patterns, pain-related sleep disturbances add further insult to injury in an already sleep-deprived population. In addition to quantifying the relationship between sleep and pain, this study sought to establish whether the relationship between these factors differs across fisheries. It was hypothesized that one of the variables that would be responsible for the differences between fisheries was their disparate work schedules. However, rather than the individual fishery and work schedules being independently predictive of sleep and pain issues, it was the variables that were common to all fisheries, such as weather, years fishing, the inability to control the important things in life, and having a work-related injury that was the driver of this relationship.

Further, lack of adequate sleep has been shown to lead to impaired recovery, cognitive functioning, neurological health, and an increased risk of vessel accidents. For example, clinical studies have shown pain affects sleep by disrupting normal circadian rhythms and increasing inflammation, which can worsen both pain and sleep disorders.[47] Sleep quality has also been found to predict next-day pain, while short-term improvements in sleep have been found to lead to long-term clinical benefits for chronic pain patients.[47]

Given these observations, the prevalence of reported back or chronic pain among fishermen emphasizes the importance of addressing musculoskeletal disorders in the commercial fishing industry for a variety of reasons. Chronic pain not only affects fishermen's quality of life, but also has implications for their safety and productivity at sea. Access to healthcare is another barrier for fishermen, and many fishermen noted the value of dockside physical examinations. While interventions aimed at preventing musculoskeletal disorders should be prioritized, identifying ways for fishermen to productively manage existing pain to promote their health and safety appears equally as important. Sleep is intertwined with many health outcomes, and pain is one aspect relevant to fishermen, but there are also other factors to support better sleep in this industry to mitigate fatigue.

Limitations

As noted in the methods section, researchers used a combination of random recruitment, recruiting through promotional materials, and dockside recruiting. Given these various methods, it is impossible to say whether the results gathered in these surveys and health assessments are entirely representative of the general population of fishermen. Complex weighting schemes were considered in combining the results obtained from the various recruiting methods, but they were found to be infeasible. Additionally, survey responses were self-reported, which raises the possibility of subject bias and incomplete recollection of events, a study limitation associated with many survey results. Despite these limitations, it is worth noting that the data captured in this study appear to be the most comprehensive set of health and survey data on fisheries sleep patterns and health outcomes in the U.S. and most importantly demonstrate that sleep studies in this population are indeed possible. Additionally, data were collected to assess commercially available hardware for use in sleep monitoring at sea during this study (publication in progress).

Conclusion

In conclusion, our study highlights the need for broader strategies to address the impact of musculoskeletal disorders and sleep deprivation in the commercial fishing industry. Our study underscores the need for future longitudinal studies exploring the connections between sleep, pain, and long-term health outcomes for fishermen. Additionally, targeted interventions focused on identifying productive pain management and effective treatment for musculoskeletal injuries for workers who lack access to sick time and insurance coverage is also imperative.

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Disclosure statement

No potential conflict of interest was reported by the authors.

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Data availability statement

The data from this study is stored in a secured REDCap database that is managed by the Northeast Center for Occupational Health and Safety. Due to the personal health information contained in this dataset a link or access to this data cannot be shared.

ORCID

Julie A Sorensen http://orcid.org/0000-0002-8787-3837
Laurel Kincl http://orcid.org/0000-0003-1883-9456

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