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Original Article

Musculoskeletal Disorders in Northeast Lobstermen

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ABSTRACT

Background: The objective of this study was to report on the prevalence of musculoskeletal pain in lobstermen in the northeast USA.
Methods: Crews were randomly selected from those licensed to fish in Maine and Massachusetts and followed prospectively. The survey used a Nordic Musculoskeletal Questionnaire format to characterize musculoskeletal disorders.
Results: A total of 395 individuals participated. One half of the respondents reported low back pain. Back pain was attributed to or exacerbated by lobstering. Low back pain was prevalent among both captains and sternmen, while sternmen reported more hand/wrist pain than captains. Multiple locations for pain were common in individual participants.
Conclusion: Equipment or technology to assist material handling should be a priority, as the body segments with high prevalence of pain (back, hand/wrists, shoulders, knees) are all affected by the repetitive and forceful handling of the lobster traps.
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1. Introduction

This study examines musculoskeletal pain among lobstermen in the USA. Lobstering is an important commercial fishery based on the size of the effort and the importance of the product to the region's economy [1]. To our knowledge, no investigations to date have examined occupationally-related health outcomes specifically within the lobster industry. Our objective was to calculate prevalence densities for musculoskeletal pains within a sample population of lobstermen. The data presented in this report were collected in the first 2 years of a 4-year exposure period completed at the end of 2015. The prospective investigation was initiated to collect original data for the purpose of estimating total occupational exposure (full-time equivalents) as a denominator for determining rates of morbidity and mortality in lobstering.

A commercial fishery is defined and determined by some authority as an entity engaged in raising or harvesting food from a marine environment. Lobster harvesting, or *lobstering*, is a commercial and recreational fishery of the American Lobster species found in saltwater shoreline areas from maritime Canada to the state of North Carolina (NC). They are most prevalent in the shoreline areas of the Gulf of Maine. In the USA, both federal and state governmental level offices have authority to determine the commercial parameters of the fishery because the American Lobster species is found in federal and state territorial waters. Individual state governments regulate within a 12-mile (19.3-km) boundary from their coastline, and the federal government regulates from there to the full extent of the country's 200-mile (322-km) economic exclusivity zone. Most other fisheries in the region are only federally-regulated.

Lobstering can be qualitatively understood as a set of routine tasks reiterated on a boat equipped for the operation of removing the lobster from baited traps (pots) set on, and hauled up from, the bottom of the ocean in areas relatively near the coastline. In northeast USA, the governing authorities allow access to the fishery throughout the year. Hauling pots is prohibited during nonsunlit hours, so boats typically leave their moorings very early, ensuring time enough to haul hundreds of pots, avoid potentially rougher weather at the end of the day, and still have time to sell the day's catch to a dealer. Lobstering equipment is low technology, including wire pots, rope lines, hydraulic haulers, block and tackle, and containers. There is little regulation of this equipment; there are limits on the number of pots and, in some areas, how they are linked by a line to the surface. Pots range from 0.9 m to 1.5 m long,

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usually up to 0.6 m wide, and about 0.3 m tall. Total weight is about 9 kg after they are weighted with bricks so they do not move on the ocean floor. One of the main exposures for lobstermen is then the repetitive hauling of these weighted pots. There are also hand intensive tasks, most notably the banding of the lobsters' claws, using a pliers-like tool to stretch the thick rubber bands.

Despite increasing attention to commercial fishing as an industry with high risk, critical gaps in the occupational health research literature in commercial fishing across the USA remain [2]. Matheson et al [3] analyzed these gaps for fisheries in general and found two predominant methodological difficulties for making comparable analyses: an uncertain population denominator, and inconsistent or insensitive numerator data collection systems. In addition to the methodological difficulties for determining the comparable magnitude of observable health effects in the industry, the specificity and diversity of the fisheries has been recognized as essential knowledge for the implementation of safety and health measures [4–7]. This report is focused on the data corresponding to the second classic design gap pointed out by Matheson et al [3] with respect to outcomes of nonacute, nonspecific pain attributable to lobstering, and with the additional objective of characterizing the profile of musculoskeletal disorders to inform measures for prevention.

At the time of the investigation, in the USA, the only reportable data mandated for occupationally-related health outcomes were registered with the US Coast Guard. Their data are limited to vessel-related casualties and events that required medical attention, so musculoskeletal disorders are not usually recorded.

There have been only a limited number of studies that have looked at musculoskeletal disorders in the fishing industry. Lipscomb et al [8] found that symptoms causing work interference in the past 12 months were reported by 38.5% of their cohort of NC fishermen. They also found that low back symptoms were the most common cause of work impairment (17.7%) followed by pain in the hands/wrists (7%) or shoulders (7%). Kaerlev et al [9] found high relative risk of rotator cuff, shoulder lesions, carpal tunnel syndrome, and hip arthrosis associated with fishing in Denmark. Lawrie et al [10] found musculoskeletal disorders to be a leading complaint in a survey of Scottish fisherman.

Some studies have reported profiles of nonacute injury outcomes as rates. Bull et al [11] looked at the exposure–outcome relationship in commercial fishing in Norway using utilization data, and the highest rates of injuries were to the fingers/hands/wrists. Studies of Scandinavian fishermen [12–14] were notable for investigating nonfatal injuries as well as exposure to risk for musculoskeletal disorders, potential interventions to reduce the exposures, and analysis of the factors determining the implementation of known preventive safety techniques. Norrish and Cryer [15] examined work-related injuries in New Zealand commercial fishermen using three different data sources. Strains and sprains accounted for 45% of the workers' compensation claims, of which two-thirds were back injuries due to manual material handling. Compensation costs for these injuries were higher than for other injuries. Strains of the knees, shoulders, and forearms were also common. Kucera et al [16] used original data from observations and interviews of southeastern US fishermen to calculate injury rates per 1000 fishing days, incidence rate ratios under various conditions, and proportions of injuries in the sample. Sprains and strains accounted for 18% of the injuries, with almost half of these occurring to the low back.

2. Materials and methods

The objective of this study was to calculate the prevalence of musculoskeletal pain in lobstermen. The term *musculoskeletal disorders* (MSDs) can be used to mean various presentations of musculoskeletal health outcomes. In this study, we sought subjective reports of pain. Such reports could describe acute pain, nonacute or chronic pain, pain with indefinite onset, cumulative trauma, and nonspecific or unidentified pain. We used the terms *pain* or *disorder* to describe any of these presentations. Unlike the National Institute for Occupational Safety and Health definition of MSDs, we allowed subjective reports of acute pain even if they were associated with fractures, contusions, or lacerations.

This paper was based on data from a broader study on the total work exposure of lobstermen [17] in which two survey instruments were employed. The first was designed to collect data on work exposure and acute injuries, and was administered quarterly via phone interview with the captain. This paper reports on results from the second instrument which was designed to collect data on any musculoskeletal pains including cumulative trauma or aches and pains with temporally nonspecific origins.

2.1. Definitions

The individual identified on each state's permit list was referred to as the *permit holder*. The person who was in command of the vessel while it was engaged in actual lobstering (typically, but not necessarily the permit holder) was referred to as the *captain*. Any individual who worked on the vessel while it was actively engaged in lobstering during the previous 3-month quarter who was not the captain was referred to as a *sternman*. Collectively, the captain and any sternmen were referred to as the *crew*.

2.2. Study population

The study population was defined as the crews of all vessels that held a state-based permit to harvest lobsters commercially within the 3-mile (4.8-km) coastal waters (inshore) of Maine (ME) and Massachusetts (MA). These two states represented over 90% of the estimated state-licensed individuals in the northeast lobster industry at the time of the study design (2010–2011). Other northeast states, therefore, were excluded to balance a rigorous study design with the feasibility of covering such a large geographical area.

2.3. Sampling frame and exclusion criteria

The contact information for the lobster permit holders was available electronically for a small fee from the state offices for licensing commercial fishing. A random sample of permit holders was selected from each state's list. Lobstermen who were only licensed to fish beyond the 12-mile state territorial limit (offshore) were excluded because these *offshore* lobstermen typically remain for several days at sea without returning to harbor. Thus, the metric *length of trip* in the calculation of total exposure would not be a logically consistent measure when multiplied by number of days fished per week, as was the case with the *inshore* lobstermen included in the cohort. Further exclusions included seasonal, student, age < 18 years, apprentice, and recreational licenses, or any plan to not engage fully in the fishery, such as retirement.

2.4. Sample size calculations

Using estimates of average crew size and the number of trips per week from the Gulf of Maine Research Institute's [1] study of the ME lobster industry, a sample size of 120 boats in each state (ME and MA) was chosen so that the margin of error for a 95% confidence interval for any binary outcome was $< 10\%$. In order to allow for 15% participant attrition, 138 permit holders from each state were targeted for enrollment. According to the state licensing

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