The role of hypothermia and drowning in commercial fishing deaths in Alaska, 1990-2002

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ABSTRACT

Objectives. To describe the patterns associated with cold-water immersion and drowning in commercial fishermen in Alaska from 1990 through 2002. Study Design. This is a retrospective study using data from the Alaska Occupational Surveillance System (AOISS), a database with records from all occupational mortalities occurring in Alaska from 1990 on. Methods. We extracted and analyzed all records describing deaths from drowning or hypothermia to commercial fishermen in Alaska from 1990 through 2002 that were registered within AOISS. We also used a subset of records from AOISS to compare use of Personal Flotation Devices (PFDs) between the target population and survivors of fatal events. Results. There were 228 deaths resulting from cold-water immersion and subsequent drowning in the target population for the time period studied. Victims were far less likely to have used PFDs than were survivors of events where cold-water drowning occurred. Conclusion. The strong protective association seen with the use of PFDs, particularly immersion suits, in surviving cold-water events indicates that many of the events that led to deaths in the target population could well have been survivable.

Keywords: Cold-water immersion, Drowning, Commercial Fishermen

INTRODUCTION

Commercial fishing is one of the world’s most dangerous occupations. According to the Food and Agriculture Organization of the United Nations, 24,000 fatalities occur throughout the world each year to commercial fishermen. Internationally, fatality rates for commercial fishermen far exceed national average rates for all occupational deaths; these commercial fishing-specific fatality rates range from 3.5 times the national average (Canada) to 40 times the national average fatality rate (U.S.) Even in the Nordic countries with well-regulated fisheries, where frequent safety training and inspections occur, the FAO reports that the fatality rates for commercial fishermen vary between 90 and 150 per 100,000 (1).

The dangers associated with commercial fishing deaths are primarily related to the risk of drowning, either from vessels capsizing, or crew who fall overboard. When these events occur, crews usually have only themselves to rely on during the crucial window of opportunity for rescue. Fishermen who become immersed in water in colder climates usually have an additional risk of hypothermia, a condition that results when core body temperature drops below 35°C (2).

Hypothermia may at times play a protective role in survival for near-drowning victims in cold water (defined as water at or below 20°C), especially in children, partially due to the activating of a mammalian dive reflex that significantly slows down brain and respiratory activity (2), which can allow for longer periods in which to provide cardiopulmonary resuscita-
tion. However, hypothermia is also associated with accelerated muscle fatigue, decreased mental acuity, and, in extreme cases, arrhythmia, and, eventually, cardiac arrest, in victims who are immersed in cold water (3). Delayed rescue of fishermen immersed in cold water, as is the case when fishing vessels must take several minutes to reverse course to reach over-board crew members, can result in fatal outcomes which draws cold water in and which subsequently prohibits victims from getting ‘clear air’ (4). As victims struggle to stay afloat and to breathe, they lose more body heat, and, if not wearing appropriate survival gear, they often lose the ability to remain above water (4).

Cold water is an inescapable component of the environment in which commercial fishing takes place in Alaska. Average surface water temperatures in Alaska rarely, if ever, exceed 15°C (5). In order to prevent hypothermia and/or cold water drowning, commercial fishermen must use safety gear that not only helps them remain afloat, but that also helps them maintain core body temperatures. The U.S. Coast Guard requires that all commercial fishermen working on documented vessels seaward of Boundary line and north of 32°N be equipped with immersion suits of the proper size (6). Properly fitted immersion suits have been associated with improved outcomes after immersion in cold water (7).

METHODS
Due to the elevated risk for occupational fatalities to workers in commercial fisheries in Alaska, we collaborated on a research project to describe the patterns associated with cold-water drowning in this population. We extracted all records describing deaths from drowning or hypothermia to commercial fishermen in Alaska from 1990 through 2002 that were registered within the Alaska Occupational Injury Surveillance System (AOISS), a database that contains the records of all occupational fatalities occurring in Alaska (8). We then stratified deaths in this target population by demographic factors, including gender, race, and age; type of fishery in which the worker died; and use of personal flotation devices by victim (when known.)

RESULTS
There were 131 separate events that resulted in the deaths of 228 commercial fishermen. The number of deaths annually ranged from a high of 35 in 1992, to a low of 2 in 1997, with both number of deaths and number of events involving cold-water drowning of commercial fishermen trending downward. (Figure 1) Victims were primarily male, (n=221, 96%) and white, (n=192, 83 %.) The ages of victims ranged from ten (two minors in two separate incidents who were killed working aboard family-owned fishing vessels) to 67, with the average age being 33 years. The most common scenario for drowning occurred when fishermen fell overboard while fishing for shellfish in the far northern waters of Alaska. (Table I)

A separate analysis was conducted to determine the use of Personal Floating Devices (PFD) in the population of interest, and to compare this
use to another population, that of crewmates who survived an event where fatalities had occurred. Of the 228 fatalities to commercial fishermen, there were 144 cases where PFD use was known, which we termed the "Documented Fatalities Group." In this Documented Fatalities Group, only 23 (16%) were wearing PFDs, with 120 victims (84% of the documented fatality group) having no PFD use at all. In this fatalities group, only 19 of the victims were wearing full-body immersion suits, with four other victims wearing other types of PFDs. In the survivor group, there were 54 cases where documented PFD use had occurred. We termed this comparison group the "Survivors Group." In the Survivors Group, 37 people (69% of documented survivors) were shown to use some form of PFD, with 17 survivors using no gear. In this survivor group, 36 of the 37 cases with documented PFD use were shown to have used immersion suits. The use of PFDs was demonstrated in this analysis to be strongly associated with better outcomes in commercial fishermen who are immersed in cold water (Table II). The odds ratio for survival was 11.35 times higher when PFDs were used when compared to those who did not use them (95% CI, 5.4-23.4).

**DISCUSSION**
The interplay between cold-water immersion, hypothermia and death by drowning to commercial fishermen in Alaska is complex. The protective role seen in the use of PFDs, particularly immersion suits, in surviving cold-water events indicates that many of the events that led to death in the target population could well have been survivable. Although the Coast Guard requires that most commercial fishing vessels in Alaska waters have proper-sized immersion suits for each crew member, and for crews to receive survival training, this study provides evidence that some crew members may have been wearing other types of PFDs, or have not been able to access and/or properly put on immersion suits before cold water immersions occurred. In order to improve survivability for crew members, however, two critical issues must be addressed: first, there must be sufficient numbers of adequate PFD gear to equip each crew member aboard a fishing vessel working in Alaska waters, and second, there must be adequate training for each crew member on how to properly suit up with survival gear. Adequate PFD gear should be viewed as that type of PFD that not only helps immersed crew members remain afloat, but that also helps crew members avoid hypothermia. Only full-body immersion suits are able to provide this type of thermal protection (9,10).

**CONCLUSIONS**
While the occupational fatality rate for Alaska workers remains high overall, the trend for total numbers of cold-related drowning deaths to commercial fishermen has moved downward, due in part to concerted federal, state and local
collaborations to improve worker safety in fisheries. Along with an increased regulatory emphasis on fishing safety, there has been a considerable effort by regional non-profit organizations, such as the Alaska Marine Safety Education Association and the North Pacific Fishing Vessel Owners Association, to train crew members on the use of PFDs and other survival skills. The growing emphasis on fishing safety by national and state governments, non-profit organizations and by the owners, operators and crew members of commercial fishing vessels should help this downward trend in drowning fatalities to commercial fishermen in Alaska continue.

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