British Journal of Industrial Medicine 1990;47:498–501

Risk for commercial fishing deaths in Canadian Atlantic provinces

Paul Hasselback, C Ineke Neutel

Abstract

The risk of mortality related to occupation was determined for commercial fishermen in the Canadian Atlantic coast provinces of Nova Scotia, New Brunswick, and Prince Edward Island. The subjects were a cohort of 31 415 fishermen licensed by the Canadian Department of Fisheries during 1975–83. Mortality and cause of death were obtained from the Canada Mortality Data Base and the Marine Casualty Investigation Unit (MCI), and were confirmed by examination of death certificates. Eighty four deaths likely to be related to fishing were recorded over 183 378 person-years of exposure for an annual mortality of 45·8 (95% confidence interval (CI) 36·0–55·6) per 100 000 fishermen. The rate of potential years of life lost up to age 75 was 1583 per 100 000 person-years of exposure. Inclusion of 14 additional deaths, which were possibly related to occupation, would increase these rates further. Bias in this study is likely to underestimate the risks. It is concluded that fishing is one of the most hazardous occupations in terms of mortality related to work.

The risk of mortality related to occupation for fishermen received considerable attention in England in the early 1970s after the reports of Schilling and Moore, which assessed the risk of death for fishermen.[1–3] Reilley evaluated the efforts to improve safety in the UK fishing fleet after these reports and found that they had had no effect in reducing mortality related to occupation.[4] Some reports have considered this issue in other countries,[5,6] but to our knowledge no attempt has been made to study the safety of north American fishing fleets.

Commercial fishing in Canadian territorial waters is regulated by the federal government. People who work as commercial fishermen are required to purchase a licence at a nominal cost from the Department of Fisheries and Oceans. Licensing has been in effect since 1975 with a single year of interruption (1976). The Canadian fishing fleet consists of some 37 000 small vessels (less than 15 tons gross weight), 3500 medium sized vessels (15–150 tons), and 400 large vessels (over 150 tons).[7] The medium and large vessels land up to 60% of the total value of the catch in the Atlantic provinces of Nova Scotia, New Brunswick, and Prince Edward Island.[8] Eighty thousand persons participate annually in commercial fishing in the country[7] with 90% of licensed fishermen in the Atlantic area working on small vessels.[8] A study of the mortality of these fishermen identified a high rate for water transport accidents and drownings.[9] The purpose of the present study was to delineate the incidence of mortality related to occupation for fishermen in Canada.

Department of Community Medicine and Epidemiology, University of Ottawa, Ottawa, Ontario KIH 8M5, Canada
P Hasselback
Drugs Directorate, Health and Welfare Canada, Tunney's Pasture, Ottawa, Ontario KIA OL2, Canada
C I Neutel

Materials and methods

The Federal Department of Transport is mandated to regulate marine vessels in Canadian territorial waters. Since 1974 incidents in which damage to people or property occurred have been investigated by the Marine Casualty Investigations Unit (MCI) with the primary objective of determining the cause of these incidents. The registration of vital statistics is a provincial responsibility with aggregation occurring at the federal level. Provincial vital statistics registrars forward information from death certificates to Statistics Canada. This information includes personal identifiers, date of death, and cause of death. Statistics Canada maintains this information in a computerised record known as the Canada Mortality Data Base. A sophisticated process of computerised record linkage has been developed by Statistics Canada that is more accurate in follow up of cohorts than individual tracing.[10]

All men in the Atlantic provinces of Nova Scotia, New Brunswick, and Prince Edward Island who obtained commercial fishing licences during the years from 1975 to 1983 were entered into the study. The number of years of potential exposure was determined using the first year of registration with withdrawal by death only. A computerised record linkage procedure undertaken by Statistics Canada

linked this cohort of fishermen with the Canada Mortality Data Base.[11] Diagnoses of water transport accidents and drownings (ICD9 codes E830–838 and E910) were extracted as potential identifiers of mortality related to occupation. Death certificates of those with these diagnoses were reviewed to classify deaths not related to occupation, deaths that were questionable regarding occupational involvement, and deaths that were likely to be related to occupation.

Records of the MCI for the years 1975–83 were searched by computer for fishing incidents with at least one death or missing person in the Atlantic region (including the provinces of Newfoundland and Quebec). Manual linkage was performed between the MCI records and the Department of Fisheries cohort using name, date of birth, last year of registration, and home port. Original MCI incident reports for these cases were manually reviewed. Manual record linkage was carried out between the two derived files using name, date of birth, date of death, location of death, and home port. Records registered in both data bases were identified.

The incidence and 95% CI for mortality related to occupation were determined using the numbers of identified cases and the potential years of exposure of the cohort. Potential years of life lost to the age of 75 were calculated and the rate of potential years of life was calculated per 100 000 person-years. Death rates were calculated for age groups of 15–34, 35–54, and 55–74.

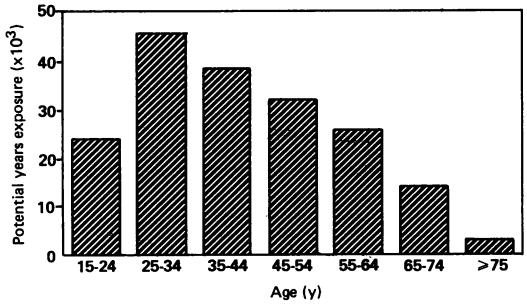
Results

Files of the Department of Fisheries enumerated 31 415 registered fishermen. Table 1 lists the annual numbers of registrants and the number of new registrants entering the study. The figure shows the contribution of the cohort members to person-years of exposure by age distribution.

As the mortality records were searched up to the end of 1983, the potential for exposure was assumed to exist throughout the period unless withdrawn because of death. Licensing occurred at the beginning of each year. Thus, each living licensee contributed a full year of potential exposure. Deaths were calculated as if occurring in mid-year. By this process 183 378 potential years of exposure were identified.

Table 1 Annual fishermen licensing in Nova Scotia, New Brunswick, and Prince Edward Island

Year of registration	*No of licensees*	*No of new registrants (% of total)*
1975	12 606	first year
1977	13 335	3900 (29·0)
1978	16 842	4500 (26·7)
1979	18 096	3250 (18·0)
1980	19 481	3100 (15·9)
1981	19 449	2500 (12·9)
1982	18 949	2250 (11·9)
1983	18 212	3200 (17·6)



Potential years of exposure by age of licensed fishermen in Nova Scotia, New Brunswick, and Prince Edward Island.

Statistics Canada record linkage identified 1289 deaths among this cohort. Ninety five of these were classified as potentially due to water transport accidents or drownings. After the review of death certificates, 23 (including recreational boating accidents (seven), recreational swimming (six), falling through ice (three)) were classified as definitely not related to occupation. An additional 14 deaths were identified where the cause of death either occurred from the land or might have been recreational—namely, falling from dock (11), scuba diving (two), and crushed by a boat while working underneath (one). Fifty eight deaths occurred at sea. Of these 58 deaths related to occupation, the causes of death were watercraft accidents that resulted in submersion (E830; 22 cases); other accidental submersions (E832; 28 cases); machinery accidents (E836; six cases); drowning (E910.2, E910.9; four cases); and other unspecified water transport accidents (E838; five cases). One hundred and forty one cases of persons missing or dead were identified from the computerised records of the MCI. Forty two members of the fishermen's cohort were identified. Sixteen matches were obtained from linking the MCI cases with the 58 probable occupational deaths. No linkages were made with deaths previously classified as non-occupational or questionable as to whether they were related to occupation. Eighty four unique events involving deaths probably related to occupation were identified through this

Table 2 Age specific death rates and numbers of deaths

Age group	*No of deaths**	*Death rate (/100 000/y)*
15–34	39	55·7 (38·3–73·2)
35–54	31	43·7 (28·3–59·1)
55–74	12	30·2 (13·1–47·4)
⩾75	1	34·8 (0–103)

*Age unknown in one case.

process. The mortality was 45·8 (95% CI 36·0–55·6) deaths per 100 000 fishermen per year. This was increased to 53·4 (42·8–64·0) by including the 14 deaths possibly related to occupation. The rate of potential years of life lost to age 75 was 1583 per 100 000 person-years. Table 2 provides the absolute numbers of deaths and death rates for different age groups.

Discussion

As most smaller fishing vessels are considered as individual businesses the health and safety of the workers on these vessels is rarely brought to rigorous evaluation. Most fishing accidents do not qualify for coverage under the workers compensation boards and are not included in their statistics. Schilling in 1966 identified fishing as a high risk occupation in Great Britain.[2] His observations from 1948 to 1964 found that the death rate related to fishing varied from 26 to 247 per 100 000 fishermen a year and he commented that unpublished data from Norway showed an occupational risk of death for the years 1960–62 of 60 per 100 000 fishermen a year. These findings prompted a major review of trawler safety, which reported its findings in 1969.[12] In the same year Moore found that among a cohort of 3365 fishermen, derived from log books of trawler ships, six accidental deaths occurred, giving a rate of 180 per 100 000 fishermen a year.[3] Reilley, in attempting to evaluate the improvement in safety within the industry after the government report and implementation of its recommendations, found that the average death rate for the years 1968–80 in the United Kingdom was 93 per 100 000 fishermen a year.[4]

The estimation of the risk for mortality depends on the information used in deriving these risks. Risks produced for occupations in Canada using workers' compensation board claims for deaths have developed estimates of mortality for various industries.[13] The three top listed risks were for forestry (54·3 deaths (95% CI 41·4–70·0) per 100 000 workers a year), mining 50·5 (43·3–58·5) and construction 16·9 (15·1–18·9). The authors of this report noted the limitations of the data sources in calculating such risks. With a much broader definition of "job related" deaths, United States occupations have been ranked according to annual probabilities of death based on reports from 11 states. Forestry work was also the top of this list with an annual risk of death of 129 per 100 000 workers a year. Asbestos workers, structural metal workers, electric power line and cable installers and repairers, and firefighters were the only other occupations of the 347 ranked that had higher annual mortality risks than 45·8 per 100 000 a year.[14] Neither of these studies ranked fishermen. None the less, by comparison, fishing ranks as one of the most hazardous industries.

By contrast to these studies, our results are likely to be lower than the actual rate, the determination of which depends on accurate information concerning both the denominator and the numerator. Inaccuracies in determining the denominator in this study have been carefully evaluated. The problem of unrecovered bodies not being registered in the mortality files was mentioned in 1885 by Ogle and reexamined by Schilling; the effect of missing bodies on the estimate of the occupational risk was noted in 1966 to be almost 400%.[2] In our study the inclusion of missing persons increased the estimate by 48%. These findings emphasise the importance of not depending exclusively on routinely collected mortality data in estimating mortality risk.

In deriving the denominator two biases exist that tend to increase the actual risk for fishermen. The first is that the licensing procedure is required equally by all fishermen regardless of the number of working hours spent fishing. The fishing seasons vary in accordance with the type of catch, and a lobster fisherman, for example, may only work in this profession for a few hours a day during two or three months of the year, meanwhile maintaining another full time occupation. In our study we have assumed that the number of years of exposure contributed by a full time fisherman is the same for a part time fisherman. Reilley attempted to correct for this artifact in his study on fishermen in the United Kingdom by applying an arbitrary 0·5 weighting to part time fishermen.[4] The data sources in our study provide limited information regarding the extent of fishing expected for any particular licensee; and there is no evidence to determine if the annual risk to seasonal workers is different from full time fishermen. Information from the MCI, however, supports the contention of a seasonal variation, with an appreciable summer peak in the number of deaths related to fishing.[15] Previous studies have noted slight differences in rates between "inshore" (more likely seasonal) and "offshore" (more likely full time) fisheries.[1 2 4]

The second bias arises from the dynamic aspect of the cohort. Because of the design of the linkage, all persons remain in the cohort once they have been licensed, irrespective of their status as fishermen. Failure to reregister in a subsequent year may have been because of departure from the Atlantic fishing fleet or because a fisherman failed to obtain a licence. Ten of the 84 deaths occurred among individuals who were not currently licensed but who were actively fishing at the time of their death. If mortality was determined solely by using currently licensed fishermen it was increased slightly, to 48·1 (95% CI 36·6–59·8) deaths per 100 000 fishermen. This method misses fishermen who intended to licence in a particular year but died before obtaining a licence.

These biases tend to underestimate the rate of mortality related to occupation. None the less, a rate

of 45·8 per 100 000 fishermen annually should be considered a significant risk. The rate of potential years of life lost to age 75 of 1583 per 100 000 person-years highlights the impact of occupational mortality on the fishermen of the region studied.

To look at the issue more completely a careful study of a well defined cohort of fishermen, dealing with each incident in a prospective manner, would be ideal. It should not be necessary, however, to postpone the attempt to reduce the hazards of this industry until more research is completed.

We express our gratitude to E Coppock, G Quesnel, and P Lalonde of the Occupational and Environmental Health Research Section of Statistics Canada for their help in the record linkage procedure and to the Health Division of Statistics Canada for the use of the Canadian Mortality Data Base; the provincial vital statistics registrars for the use of the death records; S Lavoie and the Marine Casualty Investigations Unit of the Department of Transport for their help and use of their records; the Department of Fisheries and Oceans for the use of their registration files; and the Health Protection Branch of Health and Welfare Canada for initiating this study.

Requests for reprints to: Dr Paul Hasselback, Department of Community Medicine and Epidemiology, University of Ottawa, Ottawa, Ontario K1H 8M5, Canada.

1 Schilling RSF. Hazards of deep-sea fishing. *Br J Ind Med* 1971;**28**:27–35.
2 Schilling RSF. Trawler fishing: an extreme occupation. *Proceedings of the Royal Society of Medicine* 1966;**59**:405–10.
3 Moore SRW. The mortality and morbidity of deep sea fishermen sailing from Grimsby in one year. *Br J Ind Med* 1969;**26**: 25–46.
4 Reilley MSJ. Mortality from occupational accidents to United Kingdom fishermen 1961–80. *Br J Ind Med* 1985;**42**:806–14.
5 Debes Joensen AH. Arbejdsmiljoskader inden for fisherierh-vervet. *Ugeskr Laeger* 1979;**141**:3396–400.
6 Goethe H, Vuksanovic P. Distribution of diagnoses, diseases, unfitness for duty and accidents among seamen and fishermen. *Bulletin of the Institute of Medicine at Morskiej* 1974;**2**:133–51.
7 Canadian Coast Guard. *A coast guard study into fishing vessel safety*. Ottawa: Transport Canada, 1987.
8 Davies A, Thiessen V. Public policy and social control in the Atlantic provinces. *Canadian Public Policy* 1988;**14**:66–77.
9 Neutel CI. Mortality in commercial fishermen of Atlantic Canada. *Can J Public Health* 1989;**80**:375–9.
10 Shannon HS, Jamieson E, Walsh C, Julian JA, Fair ME, Buffet A. Comparison of individual follow-up and computerized record linkage using the Canadian mortality data base. *Can J Public Health* 1989;**80**:54–7.
11 Smith ME, Newcombe HB. Use of the Canadian mortality data base for epidemiological follow-up. *Can J Public Health* 1982;**73**:39–46.
12 Holland-Martin D. *Trawler safety: the final report of the Committee of Inquiry into Trawler Safety*. London: HMSO, 1969. (Cmnd 4114.)
13 Forbes WF, Thompson ME. The quantitative evaluation of risks: unresolved problems. *Can J Public Health* 1989;**80**: 282–90.
14 Leigh JP. Estimates of the probability of job-related death in 347 occupations. *J Occup Med* 1987;**29**:510–9.
15 Marine Casualty Investigations. *Death by accident on fishing vessels in Canadian waters*. Ottawa: Transport Canada, 1987.

Accepted 4 December 1989