

# Mortality in Commercial Fishing: a Proportionate Mortality Ratio Analysis of Two Fishing Ports in Massachusetts

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**Hypothesis:** Fishermen have a higher probability of dying from certain diseases than the standard population. Specifically, we expect accidental drownings, as well as suicides, liver disease, and narcotic overdoses, grouped together as diseases of despair, to occur in a greater proportion in fishermen than in the standard population.

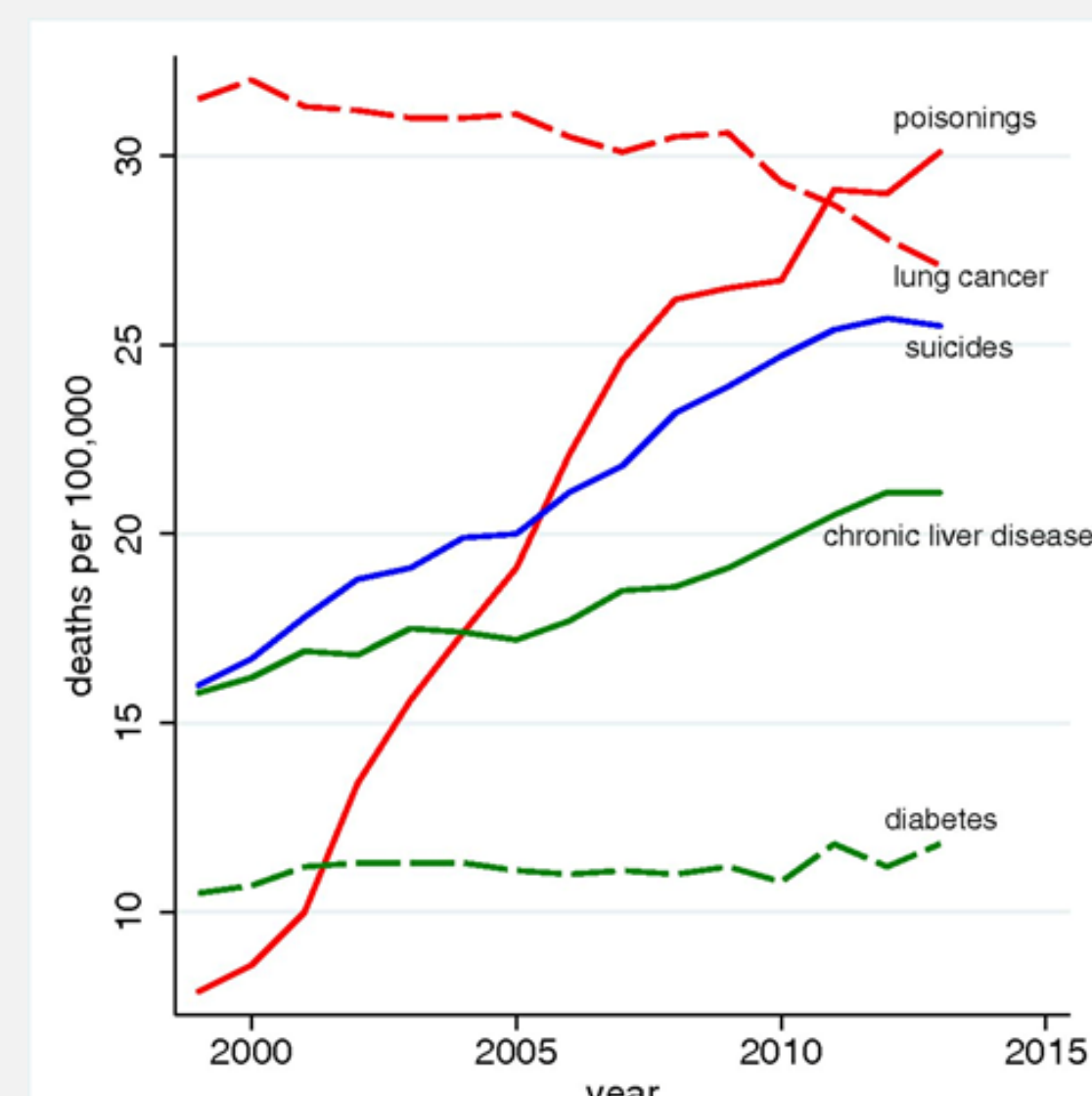
## BACKGROUND

**PMR**  
The Proportionate Mortality Ratio is an indirect method of standardization. It compares the observed number of deaths for a particular cause in a group with the expected number of deaths from that cause, based on the proportion of deaths due to that cause in a standard population, adjusting for common confounders. By comparing fishermen to non-fishermen from the same location, it can be assumed that potential unknown or unforeseen confounders would be controlled for.

**Surveillance**  
Specific causality for mortality in fishing found in occasional MMWR reports of fishermen:

- Drownings (Case 2018)
- Asphyxiation (Ford 1978)

## Diseases of Despair in USA



Mortality by cause, white non-Hispanics ages 45-54  
Anne Case, and Angus Deaton PNAS 2015;112:15078-15083

## METHODS

**Data collection**

- Obtained death certificate data from the Mass Dept. Vital Records and Statistics
- All deaths in Gloucester, New Bedford, 2000-14 (largest fishing ports in MA)

**Data management, cleaning**

- Categorized deaths into fishing/non-fishing by occupation code
- Reformatted data into consistent codes and merged files
- Excluded non-occupied population

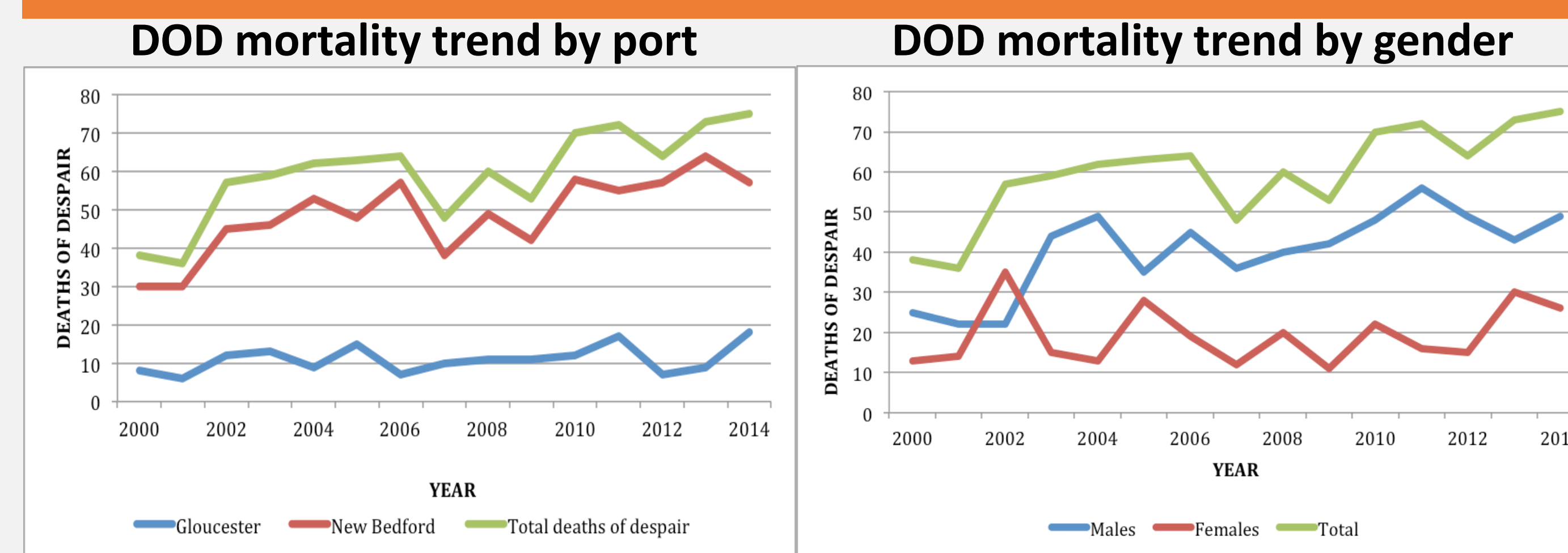
**Proportionate Mortality Ratio**

- Variables of interest: fishing (occupation), age, gender, primary cause of death

Occupation	Cause of Death		
	Cause of interest	All other causes	All causes
Fishing	A	B	N1
Not fishing	C	D	N2
All occupations	M1	M2	T

Observed no. of deaths (O) = A  
Expected no. of deaths (E) =  $N1(M1/T)$   
 $PMR = O/E$   
Statistical significance at the 0.05 level  
 $95\% CI = PMR \pm 1.96 \times se \text{ of } PMR$

## RESULTS



## PMRs in fishermen by cause

CAUSE	NO. OF DEATHS			
	OBSERVED	EXPECTED	PMR	95% CI
Suicides	7	6	1.14	0.29-1.98
Chronic Liver Diseases	14	9	1.59	0.76-2.43
Poisonings	66	15	4.37*	3.32-5.42
Accidents(including opioid poisoning)	73	23	3.12*	2.41-3.84
Accidents(excluding opioid poisoning)	28	18	1.54*	1.12-1.96
Lung cancer	44	37	1.19	0.84-1.54
Ischemic Heart Diseases	45	68	0.66	0.47-0.85
MI, Cardiac Arrest, Heart Failure	48	53	0.90	0.65-1.16

## PMRs for Diseases of Despair in manual occupations

OCCUPATION	NO. OF DEATHS			
	OBSERVED	EXPECTED	PMR	95% CI
Fishing	87	43	2.03*	1.60-2.46
Construction	139	87	1.61*	1.21-1.70
Installation and Repair	28	17	1.69*	1.06-2.31
Production	117	268	0.49*	0.41-0.57

## Age trend in DOD deaths

OCCUPATION	PMR BY AGE GROUP			95% CI
	18-35 years	36-50 years	51-110 years	
FISHING	1.96	1.94	2.30	1.60-2.46
CONSTRUCTION	1.59	1.20	2.72	1.21-1.70

\* Significant at the 0.05 level

## DISCUSSION

This study shows a ratio of higher than expected proportion of death caused by diseases of despair in Massachusetts fishermen. The growth in these deaths in the general population may be related to socioeconomic and occupationally-related exposures. Fishing exposes the population to both areas of risk.

This study also found a higher proportion of accidental fatalities in Massachusetts fishermen than the standard population. Of a total of 13 deaths from accidental drowning in the population, 8 were in fishermen.

In combination with studies on injury, mortality studies can illustrate steps in the occupationally-related pathway of diseases of despair. For example, the pathway from exposure to risk for injury in hospital work to fatal outcome from opioid overdose was quantified from risk estimates taken from prior literature, conservatively estimated 5 fatal opioid overdoses would have occurred strictly from exposure to patient handling work (Franklin 2009, Cheng 2013, Dunn 2010, 2014, Chaudhary 2017, Adejumo et al 2017) in the US.

Several prior studies have contributed to a better understanding of this pathway in fishing.

- The Healthy Worker Effect must be recognized. Jaremin (2003), Poland fishermen have reduced MI: SMR = 0.46 (1985-1994). This is consistent with current study and indicative of HWE.
- Fishing in US is an aging population. Neutel (1990) showed age in fishing affected mortality differently than the standard population. No similar effect has been observed in US fisheries.
- A Standardized Mortality Ratio, seen in Schilling (1969), may give a better indication of expected deaths, but SMRs require the exposed denominator.
- Different trends in UK fishing mortality were reported by Roberts (2007) linked to distance traveled at sea. Most of the deaths were caused by ischemic heart disease followed by other circulatory diseases, respiratory and gastrointestinal diseases.
- The increasing trend of mortality due to DOD in American, White, Non-Hispanics must be understood as a context for public health and occupationally-related interventions in commercial fishing (Walter 2018).

## Strengths/weaknesses

- A death of one cause of death changes proportion to another cause, regardless of the actual mortality rate of either cause.
- Death certificates are commonly available (Wang 1982, Moyer 1989)
- Fishing deaths at sea introduce questions of validity (Mathieson 2004)

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