

WORK RELATED MORTALITY FROM GASTROINTESTINAL DISEASES AND ALCOHOL AMONG SEAFARERS EMPLOYED IN BRITISH MERCHANT SHIPPING FROM 1939 TO 2002

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ABSTRACT

Objectives: To investigate work related mortality from gastrointestinal diseases and from alcohol among seafarers who were employed in British merchant shipping from 1939 to 2002.

Methods: A longitudinal study, based on official mortality files from 1976-2002 and official mortality returns from 1939-1975, with a population of 7.29 million seafarer-years at risk.

Results: From 1939 to 2002, there were 864 deaths from gastrointestinal diseases and 72 from alcoholism. Overall mortality from gastrointestinal diseases fell from 18.4 per 100,000 in 1939-49 to 9.3 in 1970-79 and 0.3 in 1990-2002. Mortality from alcoholism, and from alcohol-related diseases such as liver cirrhosis and diseases of the pancreas, increased up to the 1960s or 1970s, but fell thereafter. From 1950 to 1972, mortality from gastrointestinal diseases was 1.8 times higher among Asian seafarers compared to British seafarers, largely because of liver disease, peritonitis and peptic

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ulcer. At the time of the last censuses of seamen in 1961 and 1971, compared with the general British male working aged population, morality among British seafarers was greatly increased for peritonitis and alcoholism but not for most other gastrointestinal diseases.

Conclusions: Sharp reductions in mortality from gastrointestinal diseases and from alcoholism since the 1970s contrasts with increases among the general British population, and are largely because of the “flagging-out” of most British deep sea ships, and consequent reductions in long voyages, as well as reductions in alcohol consumption among seafarers at work. Largely because of the healthy worker effect, seafarers were usually only at increased risks from particularly acute diseases.

INTRODUCTION

Mortality rates for gastrointestinal diseases, otherwise known as diseases of the digestive system, have increased over time in Britain in the last 40 years.[1] Although there have been reductions over time in mortality from some digestive diseases such as peptic ulcer,[1] largely because of a decline in the prevalence of the helicobacter pylori infection, there have been sharp increases for alcohol related diseases such as liver cirrhosis,[2] and acute pancreatitis.[1,3] Although these diseases are sometimes caused by non-alcohol related factors, they are frequently associated with or caused by heavy alcohol use, and their increasing incidence has been linked to sharp increases in alcohol consumption in the UK in the last 40 years.[2,4-6]

For many years, diseases of the digestive system have been shown to be a major cause of morbidity and death among seafarers. A previous, related study found that digestive diseases were the second leading cause of death from disease, after cardiovascular disease, in British merchant shipping during the 20 year period 1976 to 1995.[7] An earlier study of the Swedish merchant fleet from 1945-54 reported an increased SMR (standardised mortality ratio) of 1.6 (compared to 1.0 in the general Swedish population) for digestive diseases, which was the second highest SMR of all major disease groupings after infectious disease.[8]

Digestive diseases was the most common cause of discharge from work in the Norwegian merchant fleet from 1977-79,[9] by far the most common cause of hospitalisation for disease in the South African fleet in the 1960s,[10] and the second leading cause of repatriation after trauma and injury among seafarers employed in British Cunard cargo ships in 1977.[11] More recently, Danish seafarers had an

increased hospitalisation rate, compared with that in the general population, for digestive diseases during the 1990s.[12]

In Northern Europe, at least, traditionally seafaring is an occupation that has been associated with heavy alcohol consumption. Several studies have reported of high levels of alcoholism,[8,13-15] psychoses and psychiatric morbidity,[15-17] and alcohol-related neoplasms, [18,19] while over 20% of seafarers who died from digestive diseases in the Swedish merchant fleet from 1945-54 were suffering from alcohol addiction.[8] Furthermore, the high fatal accident rates among European seafarers [8,20-23], have often been associated with alcohol consumption. For example, at least 85% of all off-duty drowning in docks in British merchant shipping from 1976-2002 refer to seafarers who had been drinking, often very heavily, before their deaths,[23] while about one third of all fatal accidents among Norwegian seafarers from 1957-64 were similarly alcohol related.[20]

The main aims of this study were to investigate work related mortality from digestive diseases and from alcoholism among seafarers who were employed in British merchant shipping from 1939 to 2002, with particular focus on investigating trends in mortality rates over the 64 year study period. Further aims were to compare mortality between British seafarers and Asian seafarers, who were signed on Asiatic agreements in the British fleet, and to compare mortality rates with those in the general population.

METHODS

Since the British Birth and Death Registration Act of 1854, deaths at sea in British merchant ships have been registered at the Registrar General for Shipping and Seamen (RGSS), rather than with local registrars of deaths. In this study, details of the causes and circumstances of all work related deaths from digestive diseases and from alcoholism from 1976 to 2002 were collected from official documents held in mortality files at the RGSS. For the earlier period 1939 to 1975, details of the deaths from digestive diseases and alcoholism were obtained from annual deaths returns that were based on the files at the RGSS, and published by the Ministry of Transport (for the years 1939-1963), the Board of Trade (1964-1968) and the Department of Trade and Industry (1969-1975). Details of each ship that the deceased had been employed on board at the time of death from 1976 to 2002 were obtained from Lloyd's Register of Shipping vessel records [24], and vessel registry records at the RGSS.

INCLUSION CRITERIA

This study included work related deaths from digestive diseases and from alcoholism that occurred among seafarers who were signed on the articles of agreement and employed on board British merchant ships of 100 gross tonnes or more. From 1976 to 2002, the study included deaths that occurred at work or within 30 days of any discharge ashore through sickness. Before 1976, the study included deaths that occurred at work or following discharge ashore to a hospital in a foreign country, but usually excluded deaths that occurred after discharge to a British hospital.

The study excluded deaths that occurred among noncrew members such as passengers, stowaways, harbour pilots and cargo inspectors, as well deaths among the crew of small merchant ships of under 100 gross tonnes, and deaths among the crew of fishing vessels and yachts. The study period was from January 1st 1939 to December 31st 2002.

POPULATIONS AT RISK AND MORTALITY RATES

The populations of seafarers annually employed in the British merchant fleet from 1939 to 2002 were obtained from official government publications, produced by the Ministry of Transport (for the years 1939-1963), the Board of Trade (1964-1968), the Department of Trade and Industry (1969-1975), the Department of Trade (1976-1981), the Department of Transport (1982-1988), the Marine Accident Investigation Branch (1989-1995) and the Maritime and Coastguard Agency from 1996-2002 (25-32). The number of seafarers employed in the British merchant fleet, 192 375 in 1938, increased to 197 000 in 1957 before falling to less than 25 000 in 2002; with an aggregated total of 7.29 million seafarers at risk from 1939 to 2002.

From 1939 to 1972, the number of seafarers who were signed on Asiatic agreements in the British fleet was provided annually and separately from the number of other (mainly British) seafarers. The total population of seafarers on Asiatic agreements from 1939-1972 was 1.40 million seafarer-years at risk, compared to 4.43 million for the other seafarers from 1939-72. Since the last censuses of seamen for the British fleet in 1961 and in 1971 showed that respectively, 86.0% and 92.4% of the non-Asiatic

agreement seafarers who were at sea on the census dates were British seafarers[33], for convenience they have been labelled as “British” seafarers in this study. Similarly, the seafarers on Asiatic agreements have been labelled as “Asian” seafarers.

Mortality rates were calculated using deaths from various digestive diseases, recorded as the underlying cause of death, and the populations at risk; while relative risks were used to compare mortality rates. To compare mortality among British seafarers with that in the general British population, standardised mortality ratios (SMRs) were calculated using the indirect method, and by applying the age and sex specific mortality rates in the general male working aged population of England & Wales to the numbers of British seafarers in the British merchant fleet in the corresponding age groups. SMRs were calculated for the periods 1958-64 and 1968-74; and were based on the last censuses of seamen, as well as the mortality rates in the general population, in the years 1961 and 1971, respectively. Mortality rates in the general population were calculated from death and population information published by the Office for National Statistics[34,35].

RESULTS

From 1939-2002, there were a total of 864 deaths from diseases of the digestive system and 72 from alcoholism among all seafarers who were employed in British merchant shipping, with corresponding mortality rates of 11.9 and 1.0 per 100 000 seafarer-years at risk respectively. The main causes of death from digestive diseases were peptic ulcer (207 deaths), peritonitis (152), cirrhosis of the liver (103) and appendicitis (64; Table 1). Diseases of the stomach and duodenum accounted for 252 deaths, diseases of the liver (174) and other digestive diseases (438).

Table 1 Mortality rates, per 100,000 seafarer-years, for diseases of the digestive system and for alcoholism among seafarers in British merchant shipping, 1939-2002

Digestive disease	ICD-9 code	No. of deaths	Mortality rate per 100,000
Diseases of the stomach & duodenum:	531-537	252	3.5
Peptic ulcer	531-534	207	10.1
Other diseases of the stomach & duodenum	535-537	45	0.6
Diseases of the liver:	570-573	174	2.4
Cirrhosis of the liver	571	103	1.4
Liver abscess	572.0	23	0.3
Other diseases of the liver	570, 572.1-573	48	0.7
Chronic enteritis & ulcerative colitis *	555-558	43	0.6
Diseases of the pancreas *	577	48	0.7
Peritonitis	567	152	2.1
Appendicitis	540-543	64	0.9
	520-530, 550-553,		
All other digestive diseases	560-566, 568, 569, 574-576, 578, 579	144	2.0
All diseases of the digestive system	520-579	864	11.9
Alcoholism	303.9	72	1.0

* From 1939-49, chronic enteritis and ulcerative colitis was included as “enteritis and diarrhoea”, and diseases of the pancreas as “pancreatitis”, in the Ministry of Transport’s annual deaths returns.

TRENDS IN MORTALITY RATES

Table 2 shows trends in mortality rates for the different causes of death across six, mainly decennial time periods from 1939 to 2002. The overall mortality rate for digestive diseases fell from 18.4 per 100 000 seafarer-years in 1939-1949 to 10.9 per 100 000 in 1950-59, it then levelled off to 9.3 in 1970-79, before falling sharply to 5.2 in 1980-89 and 0.3 in 1990-2002 (Table 2; Figure 1a, shown as smoothed annual mortality rates using five year moving averages).

There were increases in mortality rates over time for liver cirrhosis and for diseases of the pancreas up to 1970-79, and for peritonitis and alcoholism from 1950-59 to 1960-69, but subsequent reductions in mortality thereafter (Table 2). Mortality from peptic ulcer fell sharply from 1950-59 onwards, while mortality from all diseases of the stomach and duodenum fell continuously from 1939-49 onwards. Mortality from enteritis and diarrhoea was quite common from 1939-49, but mortality from chronic enteritis and ulcerative colitis was rare from 1950 onwards, while mortality from appendicitis and from other digestive diseases fell fairly continuously throughout the study period. There were highly significant negative correlations for annual mortality rates over time for digestive diseases overall (Spearman's rank correlation coefficient (SR) = -0.86, for alcoholism (SR = -0.26), and for all individual digestive diseases investigated here, except diseases of the pancreas which had no significant correlation with time.

Table 2 Trends in mortality rates per 100,000 seafarer-years at risk, and Spearman's rank correlation coefficients for annual mortality rates, for diseases of the digestive system and for alcoholism among seafarers in British merchant shipping, 1939-2002

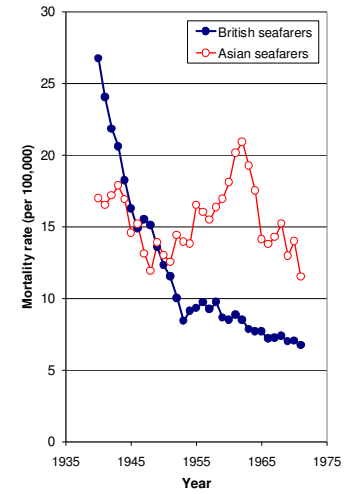
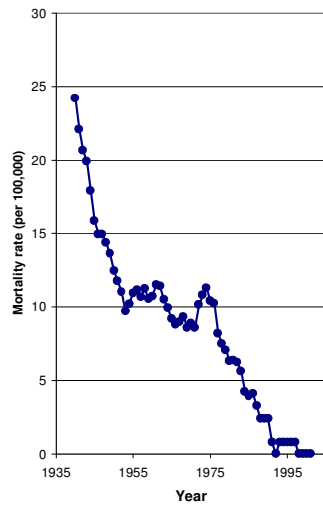
Digestive disease	Time period										1939-2002			
	1939-49		1950-59		1960-69		1970-79		1980-89				1990-2002	
	No. of deaths	(Mortality rate per 100,000)	No. of deaths	(Mortality rate per 100,000)	No. of deaths	(Mortality rate per 100,000)	No. of deaths	(Mortality rate per 100,000)	No. of deaths	(Mortality rate per 100,000)	No. of deaths	(Mortality rate per 100,000)	Annual correlation of mortality rates	(P-value)
Diseases of the stomach & uodenum:	98	(4.8)	79	(4.1)	42	(2.7)	25	(2.5)	8	(1.7)	0	(0.0)	-0.80	(<0.001)
Peptic ulcer	70	(3.4)	73	(3.8)	40	(2.6)	18	(1.8)	6	(0.8)	0	(0.0)	-0.76	(<0.001)
Other diseases of the stomach & duodenum	28	(1.4)	6	(0.3)	2	(0.1)	7	(0.7)	2	(0.4)	0	(0.0)	-0.47	(<0.001)
Diseases of the liver:	57	(2.8)	32	(1.7)	53	(3.4)	31	(3.1)	0	(0.0)	1	(0.3)	-0.48	(<0.001)
Cirrhosis of the liver	22	(1.1)	28	(1.5)	28	(1.8)	24	(2.4)	0	(0.0)	1	(0.3)	-0.28	(<0.01)
Liver abscess	14	(0.7)	2	(0.1)	7	(0.4)	0	(0.0)	0	(0.0)	0	(0.0)	-0.54	(<0.001)
Other diseases of the liver	21	(1.0)	2	(0.1)	18	(1.2)	7	(0.7)	0	(0.0)	0	(0.0)	-0.41	(<0.001)
Chronic enteritis & ulcerative colitis *	38	((1.9)	1	(0.1)	3	(0.2)	1	(0.1)	0	(0.0)	0	(0.0)	-0.50	(<0.001)
Diseases of the pancreas *	3	(0.1)	9	(0.5)	8	(0.5)	11	(1.1)	4	(0.8)	0	(0.0)	0.02	(0.90)
Peritonitis	63	(3.1)	33	(1.7)	42	(2.7)	12	(1.2)	2	(0.4)	0	(0.0)	-0.71	(<0.001)
Appendicitis	38	(1.9)	17	(0.9)	4	(0.3)	4	(0.4)	1	(0.2)	0	(0.0)	-0.54	(<0.001)
Other digestive diseases	80	(3.9)	36	(1.9)	9	(0.6)	9	(0.9)	10	(2.1)	0	(0.0)	-0.64	(<0.001)
All diseases of the digestive system	377	(18.4)	207	(10.9)	161	(10.3)	93	(9.3)	25	(5.2)	1	(0.3)	-0.86	(<0.001)
Alcoholism	21	(1.0)	10	(0.5)	26	(1.7)	13	(1.3)	1	(0.2)	1	(0.3)	-0.26	(<0.01)

From 1939-49, chronic enteritis and ulcerative colitis was included as “enteritis and diarrhoea”, and diseases of the pancreas as “pancreatitis”, in the Ministry of Transport’s annual deaths returns.

Figure 1 Trends in mortality from diseases of the digestive system, per 100,000 seafarer-years, in British merchant shipping for:

a) All seafarers (1939-2002)

b) British and Asian seafarers (1939-1972)



MORTALITY AMONG BRITISH AND ASIAN SEAFARERS

Due to unavailability of separate population counts of British and Asian seafarers after 1972, it was possible only to compare mortality rates between British and Asian seafarers during the period from 1939 to 1972. Figure 1b show that mortality rates for digestive diseases overall, shown as smoothed five year moving averages, were higher among British seafarers during the first few years of the study period. Mortality rates were then comparable between the two populations of seafarers from the mid 1940s to the early 1950s, but they were substantially higher among the Asian seafarers from the early 1950s to 1972 (Figure 1b).

During the earliest years of the study from 1939 to 1949, the mortality rate for digestive diseases overall was slightly higher among British (19.5 per 100 000 seafarer-years) than Asian (15.2 per 100 000) seafarers. Mortality rates were similar between the two groups of seafarers for most of the individual digestive diseases, although mortality from peptic ulcer and from all diseases of the stomach and duodenum was significantly higher among British seafarers, while mortality from liver abscess was higher among Asian seafarers. During these eleven years, alcoholism was the cause of 21 deaths among British seafarers but none among Asian seafarers.

During the later period from 1950 to 1972, mortality from digestive diseases overall was significantly higher among Asian seafarers (15.8 per 100 000) than among British seafarers (8.7; relative risk = 1.8). The increased mortality among Asian seafarers was mainly from liver disease overall (relative risk = 2.2), especially other diseases of the liver (4.3) and liver abscess (2.6), as well as from peritonitis (2.0) and peptic ulcer (1.5). Mortality from alcoholism was non-significantly higher among British seafarers (relative risk = 1.9).

Table 3 Numbers of deaths and mortality rates (per 100,000 seafarer-years), together with relative risks of mortality for Asian:British seafarers, for diseases of the digestive system and for alcoholism among British and Asian seafarers employed in British merchant shipping, 1939-59 and 1960-72

Digestive diseases	1939-1949					1950-1972				
	British seafarers		Asian seafarers			British seafarers		Asian seafarers		
	No. of deaths	Deaths per 100,000	No. of deaths	Deaths per 100,000	Relative risk Asian:British Seafarers (95% CI)	No. of deaths	Deaths per 100,000	No. of deaths	Deaths per 100,000	Relative risk Asian:British seafarers (95% CI)
Diseases of the stomach & duodenum:	88	(5.7)	10	(2.0)	0.3 (0.2, 0.7)	86	(3.0)	42	(4.7)	1.6 (1.1, 2.3)
Peptic ulcer	63	(4.1)	7	(1.4)	0.3 (0.2, 0.7)	80	(2.8)	38	(4.2)	1.5 (1.0, 2.3)
Other diseases of the stomach & duodenum	25	(1.6)	3	(0.6)	0.4 (0.1, 1.2)	6	(0.2)	4	(0.4)	2.2 (0.6, 7.6)
Diseases of the liver:	38	(2.5)	19	(3.7)	1.5 (0.9, 2.6)	52	(1.8)	36	(4.0)	2.2 (1.5, 3.4)
Cirrhosis of the liver	17	(1.1)	5	(1.0)	0.9 (0.3, 2.4)	38	(1.3)	20	(2.2)	1.7 (1.0, 2.9)
Liver abscess	6	(0.4)	8	(1.6)	4.0 (1.4, 11.6)	5	(0.2)	4	(0.4)	2.6 (0.7, 9.6)
Other diseases of the liver	15	(1.0)	6	(1.2)	1.2 (0.5, 3.1)	9	(0.3)	12	(1.3)	4.3 (1.8, 10.2)
Chronic enteritis & ulcerative colitis	29	(1.9)	9	(1.8)	0.9 (0.4, 2.0)	1	(0.0)	3	(0.3)	9.7 (1.0, 93.1)
Diseases of the pancreas	3	(0.2)	0	(0.0)	0.0	15	(0.5)	8	(0.9)	1.7 (0.7, 4.1)
Peritonitis	50	(3.3)	13	(2.6)	0.8 (0.4, 1.4)	49	(1.7)	31	(3.5)	2.0 (1.3, 3.2)
Appendicitis	28	(1.8)	10	(2.0)	1.1 (0.5, 2.2)	15	(0.5)	7	(0.8)	1.5 (0.6, 3.7)
Other digestive diseases	64	(4.2)	16	(3.2)	0.8 (0.4, 1.3)	34	(1.2)	15	(1.7)	1.4 (0.8, 2.6)
All diseases of the digestive system	300	(19.5)	77	(15.2)	0.8 (0.6, 1.0)	252	(8.7)	142	(15.8)	1.8 (1.5, 2.2)
Alcoholism	21	(1.4)	0	(0.0)	0.0	36	(1.2)	6	(0.7)	0.5 (0.2, 1.3)

MORTALITY COMPARED WITH THE GENERAL POPULATION

Table 4 shows SMRs for British seafarers, compared with the general male working aged population of England & Wales in two time periods, 1958-64 and 1968-74. In the first time period, mortality from digestive diseases overall was significantly reduced among the seafarers (SMR = 0.7; 95% CI = 0.4-0.9), but in 1968-74 it was similar to that in the general population.

In both time periods there was a very large excess of mortality from alcoholism (SMRs of 5.5 and 10.0 in 1958-64 and 1968-74, respectively) and from peritonitis (SMRs of 18.4 and 11.6) among the British seafarers. In 1958-64, there was also significantly increased mortality from liver abscess (SMR=6.3) and from "all other digestive diseases" (SMR=4.1). Mortality from peptic ulcer, from all diseases of the stomach and duodenum, and from appendicitis were significantly reduced in 1958-64, but were more similar to that in the general population in 1968-74.

Table 4 Numbers of deaths and standardised mortality ratios (SMRs) for diseases of the digestive system and alcoholism among British seafarers employed in British merchant shipping, 1958-1964 and 1968-1974

	1958-1964			1968-1974		
	No. of deaths	SMR	(95% CI)	No. of deaths	SMR	(95% CI)
Diseases of the stomach & duodenum:	29	0.7	(0.4, 0.9)	14	0.8	(0.4, 1.3)
Peptic ulcer	29	0.7	(0.5, 1.0)	11	0.7	(0.4, 1.2)
Other diseases of the stomach & duodenum	0			3	1.5	(0.3, 3.7)
Diseases of the liver:	23	1.1	(0.7, 1.5)	13	1.0	(0.5, 1.6)
Cirrhosis of the liver	16	1.0	(0.6, 1.5)	9	0.8	(0.4, 1.5)
Liver abscess	3	6.3	(1.2, 15.4)	0		
Other diseases of the liver	4	0.9	(0.2, 1.9)	4	2.0	(0.5, 5.4)
Chronic enteritis & ulcerative colitis	0			1		
Diseases of the pancreas	5	1.1	(0.3, 2.2)	5	1.4	(0.4, 2.9)
Peritonitis	18	18.4	(10.7, 28.2)	11	11.6	(5.8, 19.5)
Appendicitis	2	0.3	(0.0, 0.7)	3	1.6	(0.3, 3.8)
Other digestive diseases	6	4.1	(1.5, 8.0)	2	1.4	(0.1, 4.1)
All diseases of the digestive system	83	0.5	(0.4, 0.6)	49	0.5	(0.4, 0.6)
Alcoholism	8	5.5	(2.4, 10.0)	14	10.0	(5.4, 15.9)

DISCUSSION

This study found sharp reductions over time since the 1970s in work related mortality from diseases of the digestive system overall, for most of the individual gastrointestinal diseases, and for alcoholism. These reductions are largely because of two factors. Firstly, most British large deep sea ships, that were engaged in inter-continental trading, were re-registered with flags of convenience registries from the late 1970s through to the early 1990s. For example, the number of bulk carriers, container ships and tankers in the British fleet fell from 904 in 1976 to 136 in 1997, although there has since been an increase to 208 in 2002 [36,37]. Consequently there has been a large reduction over time in seafarers spending long periods of time at sea. In recent years, since most seafarers in the British fleet have not been signed on ships' articles for more than a few days at a time, there is much less likelihood of them suffering a fatal, work related chronic or even acute gastrointestinal disease.

Secondly, there has been a reduction over time in the culture of heavy alcohol consumption among seafarers, which is probably linked to several factors; including the reduction in long voyages to foreign continents, reductions in ship crewing numbers and the increased use of multinational crews, largely from Asian countries where alcohol use tends to be far lower than in Northern Europe, together with faster turnaround times in port, whereby seafarers have increasingly spent more of their time at sea rather than ashore. It is thought that, traditionally, drinking was greater ashore, especially when seafarers had plenty of leisure time to socialise with fellow crew in foreign countries [38]. Development of major ports and terminals over time has also led to ships being located more remotely from the cities, with fewer opportunities for seafarers to socialise ashore. In recent years, the reduction in alcohol use at sea has been further linked to alcohol screening, which was introduced after the grounding of the tanker Exxon Valdez caused a major oil pollution disaster in 1989. The reductions over time in heavy alcohol consumption among seafarers would therefore explain part of the decline in work related mortality from alcohol related digestive diseases and from alcoholism.

The reductions over time in mortality among seafarers for certain gastrointestinal diseases, such as peptic ulcer, are consistent with declining mortality rates in the general British population. For peptic ulcer, the reduction is mainly because of a decline in incidence following reductions in the prevalence of the helicobacter pylori infection. However, the reductions in mortality among seafarers from alcohol related gastrointestinal diseases such as liver cirrhosis and diseases of the pancreas contrast with increases among the general British population. The reductions among the seafarers are partly because of declining alcohol consumption, at least at work, while

the increases in the general population are linked to increases in per capita alcohol consumption.

There are several limitations of this study that should be acknowledged. Firstly, there is uncertainty as to the reliability of the cause of death certification for some of the 936 deaths included in this study. Death certification for these gastrointestinal diseases would have improved over time, but it may be quite unreliable in the earlier years of the study; when sea burials were quite common, particularly on long inter-continental voyages, and when more of the deaths occurred in foreign continents with less chance of an autopsy being undertaken. There have also been substantial improvements in diagnostic techniques over time, leading to improved disease detection and better cause of death certification for some of the gastrointestinal diseases, which may also affect interpretation of trends in mortality from gastrointestinal diseases over time.

Secondly, the ages of the populations of seafarers at risk were not known for most years of the study period. It was therefore not possible to age standardise mortality rates when investigating trends in mortality over time, or when comparing mortality between British and Asian seafarers. However, with a continuously high recruitment of young seafarers and drop-out of older seafarers in the British fleet, it is not thought that the ages of the populations of seafarers at risk would have altered greatly over the study period. For example, from the two censuses of seamen employed on board British ships in 1961 and 1971, 63% and 59% respectively were aged under 35 years [33]. It is also worth noting that, compared to many other diseases, mortality from many gastrointestinal diseases is often not particularly age-related; so that minor changes in the ages of the populations of seafarers at risk over time should not have a strong impact on mortality rates.

A further study limitation for the sections on long term trends in mortality is that there have been minor changes in the study inclusion criteria over the 64 year study period; for example, as to the inclusion of deaths that occur following discharge ashore to a hospital in the UK. However, these changes are probably insufficient to have affected the trends in mortality substantially.

This study found quite similar rates of mortality from gastrointestinal disease among British and Asian seafarers during the 1940s. However from 1950 to 1972 mortality rates were much higher among the Asian seafarers, particularly for peptic ulcer, liver disease and peritonitis. The reasons for the increased mortality among the Asian seafarers are not fully clear, although they may be related to a higher prevalence of helicobacter pylori and hepatitis infections among the Asian seafarers. However, a possibly older population of Asian seafarers at risk, compared with the British seafarers, cannot be ruled out as a contributory factor to the higher mortality. Mortality from

alcoholism was higher among British seafarers, although this difference narrowed over time from 1939 to 1972.

From the limited census based comparisons that could be made with the general population, work related mortality among the British seafarers in 1958-64 and in 1968-74 was significantly reduced for all gastrointestinal diseases combined. This is largely because of the healthy worker effect among active seafarers. Most seafarers in the later stages of chronic long term digestive diseases would have probably been too sick to work at sea, and would therefore have not been included in the population at risk. This contrasts with increased mortality from digestive diseases among the population of temporarily inactive British seafarers ashore; for example when seafarers were ashore through shore leave or through sickness. Gastrointestinal mortality was significantly increased by six-fold among ratings and by three-fold among officers who were ashore in Britain in 1979-80 and 1982-83 [39]. Although the earlier study of seafarers actively employed in the Swedish merchant fleet from 1945-54 reported an increased SMR of 1.6 for digestive diseases [8], a recent cohort study reported reduced mortality from digestive diseases among Italian seafarers [40].

This study found that, compared to the corresponding general population, mortality among British seafarers was significantly increased for alcoholism (by six-fold in 1958-64 and 10-fold in 1968-74) and peritonitis (by 18 and 12-fold respectively). The extent of the increases for peritonitis is perhaps surprising, but the increased mortality from alcoholism is consistent with other studies that have reported of high rates of alcoholism among Northern European seafarers [8,13-15].

Although there was also marginally increased mortality from liver abscess and from the residual category of digestive disease, reflecting the healthy worker effect, there was no increased mortality in this study from liver cirrhosis and peptic ulcer. Successive Registrar General decennial supplements have reported greatly increased mortality from both liver cirrhosis and peptic ulcer among British seafarers ashore in the UK [39,41]. For example, in 1979-80 and 1982-83 the SMR for liver cirrhosis was 8.7 for ratings and 4.2 for officers, while the corresponding SMRs for peptic ulcer were 4.6 and 2.2 [39]. A recent cohort study also reported increased mortality from liver cirrhosis for a general population of Danish seafarers [18].

There was a very strong reduction in work related mortality from gastrointestinal diseases in the British fleet throughout most of the 64 year study period. The study of mortality by a fleet surgeon in Swedish merchant shipping from 1945-54 reported that high mortality from digestive diseases among seafarers was linked to two main factors [8]. Firstly, for acute diseases, such as haemorrhaging oesophageal varices, or for haemorrhaging or perforated peptic ulcers, most seafarers would have been unable to get access to the necessary medical assistance; especially when at sea on long voyages.

Secondly, since one fifth of the seafarers who died from digestive diseases had alcohol addictions, high alcohol consumption also played a major role in the high levels of gastrointestinal mortality in the Swedish fleet. The reductions over time in both long voyages, through the flagging-out of most British deep sea trading ships, coupled with reductions in alcohol consumption have therefore resulted in sharp reductions in mortality from gastrointestinal diseases in British shipping since the 1970s.

Since most deep sea trading ships are registered with flags of convenience, it is difficult to assess the current levels of mortality from gastrointestinal diseases among seafarers. In the last few years, the deep sea British fleet has begun to increase quite considerably [34]. It therefore remains to be seen whether this will result in future increases in mortality from gastrointestinal diseases.

KEY POINTS

- 1) Work related mortality from gastrointestinal diseases among seafarers employed in British merchant shipping declined from 1939 to the early 1950s, it then levelled off until the mid 1970s, but has fallen sharply since.
- 2) Much of the decline in mortality in the last 30 years is because of the re-registering of most British deep-sea ships with flags of convenience registries, leading to a decline in long voyages in British shipping, and also because of reductions in alcohol consumption among seafarers at work.
- 3) Mortality from gastrointestinal diseases was similar among British and Asian seafarers in the British fleet during the 1940s, but it was almost twice as high among Asian seafarers from 1950-1972.
- 4) Compared with the general British male working aged population, British seafarers were at increased risks of death from peritonitis and alcoholism, but not for most other gastrointestinal diseases.

ACKNOWLEDGMENTS

The author is grateful to the Registrar General for Shipping and Seamen for providing access to their mortality files, and to John Crilley of Lloyd's Register-Fairplay for advice about classifications of ships.

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