Mortality from lung cancer and other diseases related to smoking among fishermen in north east Italy

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Abstract

Objectives—To study the mortality of fishermen. This was suggested by a cluster of cases of lung cancer in Chioggia, a large fishing harbour in the Veneto. The aim was to weight occupation against smoking with respect to risk of lung cancer.

Methods—7530 fishermen registered in the 1971-86 port authority registers of Chioggia and Venice were followed up for mortality from 1971 to 1989. Of 475 causes of death, 460 were traced. Standardised mortality ratio (SMR) was calculated with the regional population as a reference. A nested case-control study was carried out in Chioggia decedents only by interviewing next of kin. Complete data were obtained in 172 (70% response). Cases (lung cancer deaths) and controls (other causes of death) were compared for smoking and occupation, as a group of non-fishermen was available in the cohort. Logistic regression analysis was used to adjust for confounding factors.

Results—SMRs were high for lung cancer but low for other diseases related to smoking: circulatory and respiratory disease, tumours of the mouth, pharynx, oesophagus, and bladder. Likewise, SMRs were high for liver cancer but low for other diseases related to alcohol: digestive and circulatory disease, buccal, pharyngeal, and oesophageal tumours. In the case-control study, the risk of lung cancer was found to be related to smoking, and there was no interaction between occupation and smoking. When adjusted for age and smoking, the occupational indicators had no influence on the risk of mortality from lung cancer.

Conclusions—Among fishermen in north east Italy the greatest health hazard is lung cancer, and the factor involved in this risk is smoking, not occupation. Smoking, however, was linked with long hours at sea in another study.

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Keywords: fishermen; smoking; mortality

An extensive evaluation of the mortality in deep sea fishermen has been made in only three studies: on British¹ and Swedish Baltic Sea fishermen,² and on Canadian commercial fishermen.³ It has been found that fishermen tend to be heavy smokers,^{1,2} but to our know-

ledge no studies have weighed the occupation itself against smoking. The paucity of information points to the need for more consistent and comprehensive data collection that would allow a clear identification of risk factors linked to the occupation or to the particular lifestyle of these workers.

Chioggia (53 570 inhabitants in 1981) is one of the largest fishing harbours in Italy, where fishermen make up about 11% of the male workforce. The mortality from lung tumours in men who reside in the health district of Chioggia is the highest of all the health districts in the whole of Italy.⁴ We therefore decided to carry out a mortality study among these fishermen. To make a more reliable risk assessment, however, the study was extended to all deep sea fishermen on the north east coast (Veneto region) of Italy.

Materials and methods

In Italy all deep sea fishermen must be entered (Act No 963 of 1965) in the port authority registers. We therefore made a cohort study for which the subjects were traced in the 1971 to 1986 registers of the Port Authorities of Chioggia (4870) and Venice (2660), the only two port authorities in the Veneto. The vital status of the 7530 cohort members was ascertained through the registry offices of the last municipality of residence in the observation period (1 January 1971 to 31 December 1989). Death certificates were obtained from the registry office of the locality where the death occurred in 460 of the 475 deaths. The cause of death was coded according to the revision of the International Classification of Diseases (ICD) effective at the time of death. The person-years were calculated by a computer program from the date of registration as date of entry in the cohort to death or the end of follow up as the exit date. The expected mortality was the product of the person-years and the Veneto mortality by cause, taking into account age (five year groups), sex, changes in ICD codes, and calendar periods (1970-2, 1973-5, 1976-8, 1979-81, 1982-4, 1985-6, 1987-9). Due to incomplete regional data, mortality figures for the period 1972 to 1986 were also applied during the period 1987 to 1989. The standardised mortality ratio (SMR) was the ratio between observed and expected deaths. Two tailed 95% confidence intervals (95% CIs) for the SMR were calculated on the assumption of a Poisson distribution of observed cases.

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Table 1 Distribution of person-years by age and calendar year of the Veneto fishermen at entry to the study

Calendar year	Age (y)			Total
	< 24	25-44	45-64	
1971-5	6789	28 804	17 027	52 620
1976-80	9152	6317	3457	18 926
1981-6	9081	3037	912	13 030
Total	25 022	38 158	21 396	84 576

Table 2 Mortality by cause in the cohort of Veneto fishermen

Cause of death	O	E	SMR	95% CI
All causes	460	430.9	1.07	(0.92-1.10)
Infective	1	3.7	0.27	(0.01-1.50)
Tumours:	230	150.9	1.53	(1.33-1.73)
Buccal or pharynx	6	10.2	0.59	(0.22-1.23)
Oesophagus	6	7.5	0.82	(0.30-1.79)
Stomach	13	10.4	1.25	(0.67-2.14)
Colon and rectum	14	9.6	1.45	(0.79-2.44)
Liver, biliary	17	7.4	2.31	(1.35-3.70)
Pancreas	6	5.6	1.07	(0.39-2.33)
Other digestive	1	1.9	0.53	(0.01-2.95)
Larynx	12	7.2	1.66	(0.86-2.91)
Lung	105	52.8	1.99	(1.63-2.41)
Other respiratory	2	1.7	0.58	(0.07-2.09)
Bone	3	1.0	2.89	(0.60-8.44)
Connective tissue	1	0.3	2.99	(0.08-16.7)
Melanoma	2	1.5	1.33	(0.16-4.80)
Other skin	1	0.5	2.22	(0.06-12.4)
Prostate	4	3.1	1.29	(0.35-3.30)
Bladder	3	6.9	0.51	(0.11-1.49)
Kidney	5	3.3	1.52	(0.49-3.54)
Brain	5	3.6	1.38	(0.45-3.22)
Thyroid gland	1	0.4	2.54	(0.06-14.2)
Lymphosarcoma	2	2.5	0.79	(0.10-2.85)
Hodgkin's	1	1.5	0.65	(0.02-3.62)
Myeloma	3	1.2	2.52	(0.52-7.36)
All leukaemias	1	3.2	0.31	(0.01-1.73)
Other and unspecific	16	7.6	2.11	(1.21-3.42)
Endocrine	3	5.8	0.51	(0.11-1.49)
Blood	1	0.8	1.24	(0.03-6.91)
Mental	1	3.0	0.34	(0.01-1.89)
Nervous system	2	6.0	0.33	(0.04-1.19)
Circulatory system	107	122.4	0.87	(0.72-1.06)
Respiratory system	10	16.7	0.60	(0.29-1.10)
Digestive system	40	47.4	0.84	(0.60-1.14)
Genitourinary	2	3.3	0.60	(0.07-2.17)
Congenital	2	1.0	2.07	(0.25-7.47)
Ill defined symptoms	11	3.4	3.27	(1.63-5.83)
Accidents	50	66.2	0.75	(0.56-0.99)

O = observed; E = expected.

Table 3 Joint classification by smoking and occupation as deep sea fishermen (RR for one factor adjusted for age and the effect of the other factor)

	Deep sea fishermen		RR adjusted for age and occupation†
	No	Yes	
Smoking:			
No† case/control	0/10	2/32	1.00
Yes case/control	11/26	27/64	8.87*
Age and smoking adjusted RR‡	1.00	1.00	—

*P < 0.005; †non-smokers, and ex-smokers more than 15 years since end of smoking; ‡logistic regression analysis.

The port authority registers did not supply information on smoking or any changes in occupation. So a further case-control study was made within the cohort. For economic reasons the study was limited to 247 deceased Chioggia residents. The widow or other next of kin (name and address obtained at the Registry Office of the Commune of Chioggia) filled in a questionnaire on the work of the decedents (age at the beginning and end of work, and work duration) and on smoking (age started, duration, number of cigarettes, and age stopped, if pertinent). The questionnaires were posted, and interviewees who did not reply were searched for at their homes.

One hundred and eighty nine questionnaires were completed, but full information was obtained for only 172 subjects (70% of the total). For another two, the cause of death was unknown. Notwithstanding all the efforts made, 31 (12.6%) of the subjects were not traced, and 25 (10.1%) refused to cooperate. The subjects who had died from lung tumours were considered to be cases, and those who had died from other causes were considered to be controls. Then age (always expressed as an interval variable), smoking, and occupation were used in a stepwise logistic regression to calculate the relative risk (RR) of lung cancer from each variable, taking into account the effects of the other variables.⁵

Results

Table 1 shows the distribution of the person-years in the cohort of the registered Veneto fishermen at entry to the study. Table 2 shows the observed and expected mortality in this cohort, and the SMR for each cause of death. The considerable increase in lung cancer (SMR = 1.99, 105 observed) is accompanied by an unexpected reduction in other diseases related to smoking: tumours of the mouth, pharynx, oesophagus, and bladder, as well as circulatory and respiratory diseases. Pancreas, kidney, and larynx tumours, which are also related to smoking, were only slightly increased. Likewise, the significant excess of liver cancer (SMR = 2.31, 17 observed) is contrasted with the reduction in other causes of death related to alcohol: tumours of the mouth, pharynx, and oesophagus, digestive diseases, and external causes. On the other hand, there were two deaths certified as cancer of ill defined sites of the respiratory system (neither was mesothelioma), and an excess mortality from myeloma and from thyroid gland tumour, although this was not significant. Out of 50 external causes of death, there were 14 cases of accidents at sea (water transport accidents or drowning, not shown in table 2), which give an absolute rate of 16.6/10⁵ person-years.

Table 3 shows the distribution of the 172 subjects in the case-control study, according to the dichotomous variables—smoking and occupation as fishermen. In table 3, former smokers with ≤ 15 years of abstinence from smoking were included as current smokers; those with > 15 years were grouped with the life-long non-smokers. Table 3 also shows the RRs for one factor, adjusted for age and for the effect of the other factor by the logistic regression. These show that smoking carries the increased risk of lung cancer. Smoking and occupation are used as dichotomous variables in this analysis. Their interaction (smoking × occupation), which was further introduced into the logistic regression, was not significant and did not change the previous RR estimates.

Table 4 shows the RR of lung cancer, estimated according to three models by means of logistic regression. In model 1, smoking duration and age are significant predictors of the

Table 4 Three models of logistic regression analysis

Variables	F	DF	DF	RR	(95% CI)
Model 1:					
Smoking duration (y)	9.08**	1	142	1.15	(1.04–1.29)
Age (y)	4.71*	1	142	0.90	(0.81–1.00)
Work duration (y)	1.73	1	142	—	—
Constant	0.25	1	142	—	—
Model 2:					
Time since start of smoking (y)	6.07*	1	156	1.16	(1.02–1.33)
Age (y)	3.89*	1	156	0.88	(0.77–1.01)
Time since start of work (y)	0.95	1	156	—	—
Constant	0.00	1	156	—	—
Model 3:					
Age (y)	0.03	1	87	—	—
Time since end of smoking	0.66	1	87	—	—
Time since end of work	0.61	1	87	—	—
Constant	12.86**	1	87	0.45	(0.28–0.69)

*P < 0.05; **P < 0.01.
F = statistics to enter or remove variables; DF = degrees of freedom; 95% CI = 95% CI of RR.

Table 5 Prevalences of smoking in decedents and active fishermen in Chioggia, and in a sample of men from the general Veneto population

	n	Non-smokers	Ex-smokers	Current smokers (cigarettes/day)	
				< 20	≥ 20
Dead fishermen	172	0.17	0.22	0.20	0.31
Active fishermen	139	0.30	0.07	0.31	0.32
Veneto	1881	0.46	0.19	—	0.32

risk of lung cancer; work duration and the constant are not. For non-significant variables, the analysis does not provide an RR estimate. The product of the significant RRs of lung cancer is the “net” excess risk of lung cancer, due, for example, to a one year increase in the duration of smoking, taking into account a one year variation in age. In model 2, the period since the start of smoking to death significantly increased the risk of lung cancer; the influence of age was of borderline significance. In model 3, age, stopping smoking, or the end of work had no influence on the risk of death from lung cancer. In all the models, interval variables were used. The total degrees of freedom in table 4 vary because the data required were not always forthcoming.

Table 5 shows data on smoking in decedents in the case-control study, active Chioggia fishermen in a cross sectional study made by us in 1986–7,⁶ and an ISTAT sample of the general male population in the Veneto in a study made in 1986–7.⁷ Data obtained by interviews of next of kin are comparable with those from direct interview and they show that fishermen smoke much more than the general population of the Veneto. The percentage of ex-smokers in the group of active fishermen was 7%, and in decedents it was 22%. In the decedents the mean (SD) period since the end of smoking was 7.6 (7.7) years and the mean age at which they stopped smoking was 51.5 (11.6).

Discussion

We applied to port authorities for their lists as they were the most complete: fishermen who fail to register with them are liable to prosecution (Law No 963 of 1965). Yet the port authorities do not require notification of termination of occupation because of death,

retirement, or change of work. So subjects registered are never cancelled. This explains why 47 of 172 subjects (27.3%) had never been deep sea fishermen although they appeared in the list of the port authority (table 3). The rate of 16.6/10⁵ deaths from accidents at sea in 1972–89 was lower than the 49.5 observed in Swedish fishermen in 1944–87,² the 45.8 reported in Canadian fishermen in 1975–83,⁸ the 260 in New Zealand fishermen in 1975–84,⁹ and the 140 to 320 in British fishermen in 1958–67.¹ The lower risk is partly due to a bias from the presence of non-fishermen in our cohort, and also to the fact that our subjects fish at a lower latitude and nearer the shore.

In fishermen, unlike in commercial seamen,^{10–11} no cases of mesothelioma, a “sentinel health event” of asbestos exposure, were found. Unlike exposure to asbestos and smoking,¹² work as fishermen and smoking had no multiplicative effect on the risk of lung cancer. It is therefore reasonable to assume that any exposure to asbestos in this category is not involved in excess mortality from lung cancer. With the case-control approach, which is the most accurate method available for controlling the influence of smoking,¹³ we showed that the increased risk of lung cancer found in fishermen was probably due to their smoking habit, not to their occupation (tables 3–4). In a cross sectional study on Chioggia fishermen, a significant association was found between cigarettes a day and workshift hours.⁶ Smoking therefore reflects an important occupational feature of these subjects.

Despite the high tobacco consumption,^{1–2} a decrease in mortality from cardiovascular disease was found by Hagmar *et al* in Swedish Baltic Sea fishermen,² by Neutel in Canadian east coast fishermen,³ and also by us in this study. Hagmar *et al* suggested the reduction might be due to high fish consumption, with an increased uptake of n-3 polyunsaturated fatty acids and selenium.² The fish consumption hypothesis, however, explains neither the reduction in mortality from respiratory disease found among our subjects and Canadian fishermen,³ nor the decrease in mortality from several cancers related to smoking, found in the study of Hagmar *et al*² and in our cohort. Among decedents in our case-control study, 22% had stopped smoking. The effects of stopping smoking have not been well documented. It is well known that mortality from both cardiovascular disease and cancer in subjects who never smoked is similar to that of former smokers after 10 to 14 years from the end of smoking.¹⁴ In the first years after stopping smoking, however, various diseases may have different temporal patterns of decreasing mortality. Circulatory disease, for example, may be the most readily reversible adverse effect of smoking: in one study, a 24% reduction in risk of mortality for cardiovascular disease was found in former smokers within two years of stopping smoking.¹⁴ On the other hand, according to a large study, age when smoking stopped has a greater impact on subsequent risk of lung cancer than years since stopping.¹⁵

Possibly, old age at cessation, few years of abstinence, and heavy past consumption of tobacco do not elicit a decrease in mortality from lung cancer.

An excess of liver cancer was also found in our cohort. It is known that high alcohol consumption increases the risk of liver cancer,¹⁶ and fishermen tend to be heavy drinkers.¹⁷ Gathering information on the smoking habits of decedents is difficult, but it may be an even more delicate matter obtaining information on alcohol consumption. We therefore decided to avoid asking for information from next of kin about their deceased relatives' alcohol consumption.

Conclusions

Lung and liver cancer are the most frequent health hazards among Veneto deep sea fishermen. Smoking, not occupation, is the main risk factor in the mortality from lung cancer. Another study, however, suggested that cigarette smoking increased with workshift hours at sea. A high percentage of decedents were ex-smokers, and probably the low mortality from diseases related to smoking other than lung cancer may be due to the early effect of stopping smoking.

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