Educational inequalities in hospital care for mortally ill patients in Norway

Short title: Educational inequalities in hospital care

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Abstract

Aims: Health care should be allocated fairly, irrespective of patients' social standing. Previous research suggests that highly educated patients are prioritized in Norwegian hospitals. This study examines this contentious issue by a design which addresses two methodological challenges. Control for differences in medical needs is approximated by analyzing patients who died from same causes of death. Area fixed effects are used for avoiding that observed educational inequalities are contaminated by geographical differences.

Methods: Men and women who died 2009-2011 at age 55-94 were examined (N=103,000) with register data from Statistics Norway and Norwegian Patient Registry. Educational differences in quantity of hospital-based medical care during 12-24 months before death were analyzed, separate for main causes of death. Multivariate negative binomial regression models were estimated, with fixed effects for residential areas.

Results: High educated patients who died from cancers had significantly more out-patients consultations at somatic hospitals than low educated patients during an average observation period of 18 months prior to death. Similar, but weaker, educational inequalities appeared for out-patients visits for patients whose deaths were due to other causes. Also educational inequalities in number of hospital admissions were marked for those who died from cancers, but insignificant for patients who died from other causes.

Conclusions: Even when medical needs are similar for mortally ill patients, those with high education tend to receive more medical services in Norwegian somatic hospitals than patients with low education. The roles played by physicians and patients in generating these patterns should be explored further.

Keywords: Horizontal equity, specialist medical care, socioeconomic differences, care for dying patients

Introduction

Studies have found that survival from lethal diseases varies with socioeconomic status [1-7]. This could be due to patient characteristics, for instance if individuals of lower socioeconomic status delay seeking medical care [8,9] or are more afflicted by comorbidity [2,10-12]. Also health service factors could be involved. Previous research has suggested that educated and affluent patients get more appropriate medical care, even in the Nordic countries which have universal health insurance and a dominating public health care sector [1,2,13,14]. A recent Norwegian study of 25,000 lung cancer patients found that not only medical criteria stipulated by the Norwegian Directorate of Health, but also education, household income, and place of residence, predicted surgical treatment and radical radiotherapy [15]. Another Norwegian study of 100,000 patients with acute myocardial infarction found likewise that patients with higher education were more likely to receive coronary angiography and subsequent myocardial revascularisation than patients with low education [16].

Such findings indicate *horizontal inequity* [17], i.e. even when medical needs are similar, high status patients receive better treatment and more medical resources. In the Norwegian health care system, such educational inequalities will be due to physicians' decisions. Out-patient visits to hospital-based specialist physicians (low user fees) and overnight hospital stays (no fees) will practically always require a referral from the patient's regular General Practitioner or from another, usually specialist, physician [18]. Thus, in principle, physicians allocate hospital-based services, but patients will often, of course, try to influence decisions.

To what extent horizontal inequity actually exists is debatable, however. One issue is whether studies have controlled sufficiently for differences in medical needs. As to the lung cancer study [15], critics have pointed out that information about lung function was lacking [19], implying that the educational inequalities in treatment might be assessed as clinically justified if that had been considered. Another issue is that access to health care varies between regions, and treatment regime may differ between hospitals [14,20,21]. As educational and income levels are higher in urban areas than in rural districts, observed socioeconomic inequalities in medical care could be confounded by geographical differences.

The present study tries to consider these two issues. The hypothesis is that in Norwegian somatic hospitals, high educated patients tend to receive more specialist medical care than low educated patients, even when suffering from similar diseases of similar severity. Typically, studies on this topic compare patients with similar diagnoses and adjust for medical needs by controlling for disease stage, comorbidity, gender, age, and treatment history [15,16]. However, the debate referred to above [19] suggests that patient registers used by these studies may lack information on medical and biological criteria which clinicians consider relevant for treatment decisions. Biased conclusions may be drawn since patients assumed to be similar could actually have different medical needs. The present study attempts to circumvent this difficulty by analyzing patients who were similar not only as to diagnoses, but also because they *died* from the disease. The assumption is that when both outcome (death) and diagnosis (cause of death) are similar (given same gender, same age), also other disease-related conditions are likely to be similar, at least on average when large samples are compared. By analyzing patients who died, adjustment may therefore be obtained also for medical aspects not recorded in patient registers, implying that educational inequalities in medical care are unlikely to be justified by clinical criteria.

As to the second issue – ensuring that observed socioeconomic differences in medical care are not contaminated by geographical variations – the present study utilizes multilevel models which assign a fixed effect to the geographical district where the patient lives. Such models give estimates based on the associations between education and medical care within each residential area. Ideally, fixed effects should be assigned to each hospital, but as hospital identifiers were unavailable in the data, an acceptable proxy is residential area.

The analyses will also consider gender differences, and age, marital status and immigrant background will be used as controls because these factors are often associated with education.

Methods

The data file used by this study has information for 2008-2011 from practically all somatic hospitals in Norway, obtained from the Norwegian Patient Registry. Using an encrypted version of the personal identification number assigned to all registered inhabitants, hospital information was linked to sociodemographic data from Statistics Norway. Men and women who died in 2009, 2010, and 2011, with age of death ranging from 55 to 94 years, were selected. Using Statistics Norway's educational register, the sample of deceased individuals was classified into basic education (normally seven years schooling for the relevant birth cohorts); secondary low (usually 8-9 years); secondary high (10-12 years), and college or university education.

The Patient Registry provided information on out-patient consultations with somatic hospital specialist physicians for examination and/or day-time treatment, and over-night admissions to hospitals for examination, observation and treatment. The two outcome variables, *out-patient visits* and *hospital admissions*, refer to the number of these events in the year the person died and the immediate preceding year. Thus, for those who died in 2009, the variables refer to the number of out-patient visits and hospital admissions, respectively, recorded during 2008 and 2009; and similar for those who died in 2010 and 2011. Number of months during which visits/admissions were observed in the sample will vary from 12 to 24 months, but this is inconsequential for the present study which focuses on *average* amount of hospital-based medical services received in each educational category. Deaths will be spread across months in similar ways in each educational level, and average exposure time will be close to 18 months for each educational category.

Causes of death were registered by 3-digit codes in the International Classification of Diseases, 10th version [22]. In order to make analyzed samples sufficiently large, a grouped classification was constructed by pooling categories in the European Shortlist for death causes [23]. About 4.0% had died from accidents or suicide; these individuals were excluded from the sample since the study focuses on deaths from disease.

Other variables include gender, age, immigrant background (both 1st and 2nd generation), and marital status and residential area at the start of the year preceding death. Missing values were negligible except that 0.9% lacked educational information and were pooled with the basic education category.

After describing the data, mean number of out-patient visits and hospital admissions in the four educational levels are shown for main causes of death, separately for men and women. The educational pattern appearing in this descriptive analysis does not take into account how educational categories could vary in age, marital status, residential area, and more specified causes of death, however. The subsequent multivariate analyses are performed by means of multilevel models with fixed effects assigned to each residential area (municipalities, groups of small municipalities, or sub districts in large cities). In 62% of the 136 areas, total populations were in the 15,000–60,000 range, implying that the inhabitants will normally belong to the same hospital catchment area. In the multivariate analyses, men and women are pooled. This is justified since test analyses showed that the pattern of educational differences was similar for men and women (only in one of eight test analyses, the interaction between gender and education was significant, p-value=0.017). An advantage of gender-pooled analyses is that gender differences are clearly displayed.

Since the outcome variables are grossly overdispersed (i.e. variance much larger than the mean), negative binomial regression is more appropriate than the Poisson models often used when analyzing health care utilization [24]. The regression analyses, with fixed effects for residential areas, were performed with the Stata program *xtnbreg*, option *fe*, with *oim* (observed information matrix) standard errors [24]. Coefficients are reported as incidence-rate ratios (IRR).

Results

Nearly 50,000 men and 53,000 women who died 2009-2011 were included in the analyses (Table I). More than half of them were born before 1930 (median age when passing away was 80 for men and 85 for women), and a large percentage had only basic education. In the year preceding death, 56% of the men and 25% of the women were married. Only 3% were immigrants, reflecting the limited migration to Norway until recent decades. About one third died because of cardiovascular diseases, and deaths from ischaemic disease alone constituted 15% and 12% of all deaths among men and women, respectively. Cancer deaths were almost as numerous as cardiovascular deaths among men, but fewer among women. Respiratory disease was the cause of around 10% of the deaths. Remaining deaths were distributed across many infrequent causes.

The descriptive analyses in Table II show that men who died from cardiovascular disease had, on average, 4.8 out-patient specialist visits and 2.6 admissions to somatic hospitals during the observation periods. Among women who died from cardiovascular diseases, both out-patient visits and admissions were fewer. Average number of visits and admissions among those who died from cancers were around thrice as high as for cardiovascular disease. Table II suggests furthermore that patients with college or university education had more out-patient visits and hospital admissions than those with basic education, in particular when cancer was the cause of death. Educational differences were small or absent for those who died from respiratory diseases, and relatively small among women who died from cardiovascular disease. Standard deviations for out-patient visits and hospital admissions were always larger – often much larger – than the means for these variables, underlining that analyses by negative binomial regression methods are preferable.

Table III (out-patient visits) and Table IV (hospital admissions) report the results from eight negative binomial regression analyses, with fixed effects for residential areas, controlling for gender, age (and age squared), immigrant background, and marital status. In order to adjust for differences between educational levels in specific death causes, dummy variables were added for ischaemic disease, cerebrovascular disease, and other heart disease when analyzing cardiovascular deaths; similar adjustments were made when analyzing deaths from cancers and from respiratory diseases.

Table III indicates a marked educational gradient in number of out-patient visits for those who died from cancers. Compared to the reference basic education, the estimated incidence-rate ratio (IRR) increased for each step upwards on the educational ladder: 1.10 for those with secondary lower education, 1.14 for secondary higher education, and 1.29 (95%CI 1.24-1.33) for college or university education. The 95% confidence intervals overlapped, however, between the three higher educational levels. Weaker, although statistically significant, educational differences in out-patient visits appeared also for deaths from cardiovascular disease, from respiratory diseases, and the residual cause of death category.

As to number of hospital admissions (Table IV), however, the hypothesized educational differences appeared only for cancer deaths. For deaths due to cardiovascular, respiratory, and other diseases, number of hospital admissions varied only insignificantly between educational levels.

In addition to the educational differences which are the focus of the present study, also other noteworthy patterns are displayed in Table III and Table IV. Women who died from cardiovascular, respiratory, or other diseases, tended to have fewer out-patient visits and fewer hospital admissions than men; for cancer deaths, however, no gender differences emerged. All analyses indicated that the amount of hospital care received before death declined with rising age. Immigrants (only 3% of the sample) and native Norwegians had similar levels of hospital care prior to death (exception: fewer hospital admissions among immigrants for the residual causes of death category); most immigrants in the sample were of Nordic or Western origin, however. A consistent pattern in all eight analyses was that not married individuals had significantly lower utilization before death than married individuals, suggesting that having close relatives enhances access to health care.

Discussion

This study indicates that when critically ill, a larger amount of specialist hospital-based medical care was allocated to those with higher education than to those with basic education, even when medical needs were similar. This pattern was particularly marked for patients suffering from fatal cancers, both as to out-patient visits to specialists working in somatic hospitals, and as to hospital admissions. Similar, although smaller, educational differences were found for out-patient visits for those who died from cardiovascular diseases, from respiratory diseases, and from the remaining causes of death. As to number of hospital admissions, however, the educational gradient appeared only for those who died from cancers, but not for other death causes.

Thus, educational inequalities were particularly evident for cancer patients, and also visible for cardiovascular deaths. These two disease categories cause the majority of deaths in the analyzed age categories (66% among men, 61% among women). Overall, the findings are in line with the horizontal inequity hypothesis that when afflicted by comparable lethal diseases, patients with higher education receive, on average, more hospital-based medical resources than patients with basic education. It should be noted, however, that this was a consistent pattern only for out-patient specialist consultations; for hospital admissions, the educational inequalities appeared only for cancer patients, but not for other disease categories.

The formal authority for allocating hospital-based resources lies with physicians. In this sense, they are responsible for the horizontal inequity which may occur. However, the processes which generate the observed patterns can be complex. One possibility is that physicians tend to prioritize highly educated patients, either consciously or without being aware of it. The reasons that General Practitioners and hospital-based specialist physicians ordain, on average, more intensive follow-ups (i.e. more out-patient visits) when the patient has higher education, could be that physicians are more concerned about the fate of high-status than low-status patients, or more motivated to ensure good care for well-educated patients. An alternative explanation is that high-educated patients (or their relatives) exert their networks, bureaucratic competence, and other resources in order to convince or pressurize their physicians into prescribing more care. It has been suggested that "... patients with high education or high income are better informed about their treatment options, and may be more active in the decision making process .." [15]. Unfortunately, the data material used in this study does not allow for a further exploration of the respective roles of physicians, patients, and patients' relatives.

The conclusion about horizontal inequity relies on the assumption that sufficient adjustment for differences in medical needs is achieved when the analyzed patients had not only similar diagnoses, but even the same outcome, i.e. death. Since the disease turned out to be fatal, the assumption is that also unobserved disease-related conditions (i.e. unrecorded in the patient register) were similar on average – an idea illustrated by the 18th-century essayist Samuel Johnson: "Disease generally begins that equality which death completes…" [25]. Empirical validation of this assumption is difficult. However, to challenge the conclusion about horizontal inequity, one has to assume that highly educated patients received more hospital-based care because they had, on average, more severe diseases which required more treatment. This does not seem plausible, for instance because delayed seeking of medical care is found to be more widespread among low status patients [8,9].

A competing interpretation is that more out-patient visits among patients with high education were not due to the specific disease which led to death, but to a long-term habit of frequent contacts with medical specialists. This interpretation seems unlikely since test analyses (not shown) indicated relatively small educational differences in utilization of hospital services two years before death, but marked inequalities during the year of death.

Strengths and limitations

One strength of the present study is an unbiased sample: all deaths due to disease during 2009-2011 in the selected age categories were examined. It is moreover unlikely that errors in hospitals' reporting of consultations and admissions, or the recording of causes of death in the mortality register, could have biased the results. Information on consultations with private specialist physicians was not available, however. Since patients with higher education are more likely to visit such physicians [26], it is not probable that the exclusion of visits to private specialists from the analyzed material challenges the conclusion.

However, this study has not examined the quality of medical care, but only quantities in terms of number of out-patient consultations and hospital admissions during an observation period which averaged 18 months. A reasonable conjecture is nevertheless that quantity corresponds, at least to some extent, with quality.

A methodological issue is how to model such extremely skewed outcome variables. For hospital admissions, for instance, the average was 3.6 (men and women pooled), but a tiny minority of 0.4% had more than 50 admissions. In such cases, negative binomial regression is recommended [24]. However, the same pattern of results appeared in fixed-effects multilevel Poisson regressions with robust standard errors, after excluding those with more than 70 out-patients visits (tables available from author). Using bootstrap standard errors gave estimates of statistical significance similar to those reported in Table III and Table IV.

Adjusting for residential area was essential. In single-level analyses of the entire sample, without taking into account that the deceased individuals lived in different districts and belonged to different hospital catchment areas, the educational inequalities turned out to be clearly larger than those displayed in Table III and Table IV. This underlines the need for spatial adjustments when studying socioeconomic differences in medical care; if this is not done, findings of educational differences may partly be by-products of area differences.

Conclusion

This study indicates that in Norwegian somatic hospitals, high educated patients tend to receive more hospital-based specialist medical services than patients with lower education, during the last 12-24 months before death, even when their diseases and medical needs are similar. The educational inequalities were particularly marked for patients suffering from fatal cancers. Similar, but weaker, educational differences were also found for out-patient visits when suffering from cardiovascular diseases or from other diseases, but not for hospital admissions when the death cause was something else than cancers. Overall, the results indicate tendencies that highly educated patients are favoured in Norwegian hospital care. Whether these patterns are generated by physicians' priorities or by patient influence (or by both) should be a topic for future studies.

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Conflict of interest

The author declares no conflict of interest.

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Table I. Description of study samples, men and women who died 2009-2011, age 55-94

	Men		Women	
	Number	%		
Total number individuals, death years 2009-2011	49,686	100.0	52,733	100.0
Basic education	21,062	42.4	29,252	55.5
Secondary, lower level	14,070	28.3	16,774	31.8
Secondary, higher level	7,827	15.8	2,760	5.2
College, university	6,727	13.5	3.947	7.5
Married (start of year preceding death)	27,755	55.9	12,958	24.6
Not married	21,931	44.1	39,775	75.4
Immigrant background	1,474	3.0	1,530	2.9
Cause of death (ICD 10th version codes)				
All cardiovascular diseases (I00-I99)	16,735	33.7	18,572	35.2
- (ischaemic heart disease I20-I25)	(7,494)	(15.1)	(6,402)	(12.1)
- (cerebrovascular disease I60-I69)	(3,740)	(7.5)	(5,118)	(9.7)
- (other heart diseases I39-I33 + I39-I52)	(3,090)	(6.2)	(4,171)	(7.9)
- (all other cardiovascular diseases)	(2,411)	(4.9)	(2,881)	(5.5)
All cancers (C00-D48)	16,131	32.5	13,622	25.8
- (lung/trachea/bronchus, and larynx C32-C34)	(3.578)	(7.2)	(2,463)	(4.7)
- (breast C50)	-	-	(1,553)	(2.9)
- (stomach, colon, rectum, anus C16, C18-C21)	(2.728)	(5.5)	(2.652)	(5.0)
- (prostate C61)	(3,035)	(6.1)	-	-
- (all other cancers)	(6,775)	(13.6)	(6.954)	(13.2)
Respiratory diseases (J00-J99)	5,404	10.9	5,441	10.3
- (chronic lower respiratory J40-J47)	(2,994)	(6.0)	(2,777)	(5.3)
- (all other respiratory diseases)	(2,410)	(4.9)	(2.664)	(5.1)
All other diseases	11,416	23.0	15,098	28.6
Mean death age (SD)	78.2	(9.8)	82.0	(9.4)
Median death age	80.0		85.0	

Table II. Mean number of out-patient consultations and hospital admissions, men and women, four educational levels, four main causes of death categories

	Men				Women			
	Out-patient		Admissions		Out-patient		Admissions	
	Mean	SD[1]	Mean	SD	Mean	SD	Mean	SD
Cardiovascular diseases[3]								
Basic (primary) education	4.41	17.9	2.43	6.2	2.66	11.6	1.88	4.3
Secondary, lower level	4.94	17.1	2.53	5.9	3.12	12.6	1.96	4.6
Secondary, higher level	5.11	16.3	2.72	6.6	2.77	8.4	1.88	3.2
College, university	5.83	19.2	2,.80	6.8	3.44	10.0	2.10	3.7
All educational levels	4.84	17.6	2.55	6.2	2.86	11.7	1.92	4.3
P-value[2]	0.002		0.019		0.031		0.094	
Cancers								
Basic (primary) education	12.35	18.4	6.16	8.5	10.18	15.8	5.23	7.2
Secondary, lower level	15.14	20.5	7.13	9.3	14.63	19.9	6.69	9.3
Secondary, higher level	17.38	20.3	8.21	10.2	18.64	22.8	8.18	10.9
College, university	20.58	24.4	8.78	11.2	21.20	22.1	8.88	10.5
All educational levels	15.31	20.6	7.21	9.5	13.47	18.9	6.32	8.7
P-value	<0.001		<0.001		<0.001		<0.001	
Respiratory diseases								
Basic (primary) education	3.36	10.0	2.78	3.9	2.66	8.9	2.32	4.2
Secondary, lower level	4.01	11.0	3.12	5.9	2.58	4.8	2.20	2.9
Secondary, higher level	4.63	11.1	3.11	4.1	3.01	5.2	2.15	2.9
College, university	4.84	11.0	2.95	4.7	3.77	11.7	2.35	4.3
All educational levels	3.86	10.5	2.94	4.6	2.71	8.0	2.28	3.8
P-value	0.003		0.403		0.053		0.907	
All other death causes								
Basic (primary) education	4.84	20.2	2.45	7.1	2.71	12.9	1.68	4.6
Secondary, lower level	5.84	21.7	2.89	8.6	3.60	15.9	1.97	5.6
Secondary, higher level	5.84	20.2	3.05	9.1	3.62	14.3	1.93	5.0
College, university	7.13	24.4	3.40	10.1	4.33	16.6	2.08	5.2
All educational levels	5.59	21.3	2.80	8.3	3.15	14.3	1.81	5.0
P-value	<0.001		<0.001		<0.001		0.007	

[1] SD = standard deviation. [2]P-values for difference basic education vs. college/university. [3]ICD codes in Table I.

Table III. Negative binomial regression analyses of number of out-patient visits, men and women pooled, four main causes of death, fixed effects for 136 areas

Cause of death, main grouping	Cardiovascular			Cancers			Respiratory			All other diseases		
	IRR[1]	P[2]	95%CI	IRR	P	95%CI	IRR	P	95%CI	IRR		95%CI
Basic education (reference)	1			1			1			1		
Secondary, lower level	1.077	***	1.045-1.110	1.103	***	1.076-1.131	1.046	ns	0.992-1.102	1.080	***	1.041-1.121
Secondary, higher level	1.082	***	1.033-1.134	1.140	***	1.103-1.178	1.101	*	1.019-1.190	1.082	**	1.024-1.144
College, university	1.134	***	1.082-1.188	1.285	***	1.244-1.326	1.191	***	1.092-1.299	1.105	***	1.047-1.166
Gender (ref: males)	0.927	***	0.900-0.955	0.994	ns	0.971-1.017	0.924	**	0.881-0.970	0.896	***	0.865-0.927
Age at death, years, centered	0.981	***	0.980-0.983	0.952	***	0.951-0.954	0.974	***	0.971-0.977	0.975	***	0.973-0.977
Age at death, squared	0.999	***	0.998-0.999	0.999	***	0.999-0.999	0.999	***	0.999-0.999	0.999	***	0.999-0.999
Immigrant (ref: natives)	0.995	ns	0.918-1.079	0.992	ns	0.938-1.049	1.045	ns	0.904-1.209	0.927	ns	0.848-1.014
Not married (ref: married)	0.823	***	0.799-0.847	0.794	***	0.777-0.812	0.787	***	0.750-0.826	0.788	***	0.762-0.816
Ref: Other cardiovascular[3]	1											
- ischaemic heart disease	0.897	***	0.864-0.932									
- cerebrovascular disease	0.756	***	0.725-0.789									
- other heart disease	0.897	***	0.859-0.937									
Ref: Other cancers				1								
- lung/trachea/bronchus, larynx				0.991	ns	0.964-1.019						
- stomach, colon, rectum, anus				1.146	***	1.114-1.180						
- prostate				1.304	***	1.257-1.354						
- breast				1.377	***	1.316-1.441						
Ref: Other respiratory disease							1					
- chronic lower respiratory							1.172	***	1.117-1.230			
Constant	0.526	***	0.503-0.549	0.691	***	0.670-0.711	0.573	***	0.537-0.612	0.370	***	0.356-0.386
Number of deaths		35,307			29,747			10,845			26,511	

[1]IRR = incidence-rate ratio. [2]P=p-values; ***<0.001, **<0.01, *<0.05, ns>0.05. [3]See Table I for ICD codes.

Table IV. Negative binomial regression analyses of number of hospital admissions, men and women pooled, four main causes of death, fixed effects for 136 areas

Cause of death, main grouping	Cardiovascular			Cancers			Respiratory			All other diseases		
	IRR[1]	P[2]	95%CI	IRR	P	95%CI	IRR	P	95%CI	IRR		95%CI
Basic education (reference)	1			1			1			1		
Secondary, lower level	1.014	ns	0.986-1.043	1.055	***	1.030-1.080	1.013	ns	0.968-1.060	1.037	*	1.001-1.074
Secondary, higher level	1.013	ns	0.970-1.059	1.091	***	1.057-1.126	0.981	ns	0.915-1.051	1.006	ns	0.954-1.062
College, university	1.021	ns	0.976-1.067	1.139	***	1.104-1.176	0.992	ns	0.916-1.075	1.022	ns	0.970-1.076
Gender (ref: males)	0.946	***	0.920-0.972	0.987	ns	0.966-1.010	0.905	***	0.868-0.944	0.880	***	0.852-0.910
Age at death, years, centered	0.993	***	0.991-0.994	0.965	***	0.963-0.966	0.976	***	0.974-0.979	0.982	***	0.980-0.984
Age at death, squared	0.999	***	0.999-0.999	0.999	***	0.999-0.999	0.999	***	0.999-1.000	0.999	***	0.999-0.999
Immigrant (ref: natives)	0.948	ns	0.878-1.025	0.974	ns	0.922-1.028	1.063	ns	0.937-1.207	0.893	*	0.818-0.975
Not married (ref: married)	0.875	***	0.851-0.899	0.855	***	0.837-0.873	0.820	***	0.786-0.855	0.838	***	0.810-0.866
Ref: Other cardiovascular[3]	1											
- ischaemic heart disease	0.916	***	0.884-0.949									
- cerebrovascular disease	0.824	***	0.792-0.857									
- other heart disease	0.963	ns	0.925-1.002									
Ref: Other cancers				1								
- lung/trachea/bronchus, larynx				0.957	**	0.933-0.983						
- stomach, colon, rectum, anus				1.026	ns	0.998-1.054						
- prostate				1.092	***	1.053-1.133						
- breast				1.019	ns	0.973-1.067						
Ref: Other respiratory disease							1					
- chronic lower respiratory							1.388	***	1.330-1.449			
Constant	0.936	**	0.896-0.977	1.074	***	1.042-1.106	1.062	ns	0.996-1.132	0.642	***	0.616-0.669
Number of deaths	35,307			29,747			10,845			26,511		

[1]IRR = incidence-rate ratio. [2]P=p-values; ***<0.001, **<0.01, *<0.05, ns>0.05. [3]See Table I for ICD codes.