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Social inequality and incidence of and survival from cancers of the mouth, pharynx and larynx in a population-based study in Denmark, 1994–2003

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ABSTRACT

We investigated the effects of socioeconomic, demographic and health-related indicators on the incidence of and survival from mouth, pharynx and larynx cancers diagnosed in 1994–2003 with follow-up through 2006 in Denmark using information from nationwide registers. The analyses were based on data on 3058 patients with mouth and pharynx cancer and 1799 with larynx cancer in a cohort of 3.22 million persons born between 1925 and 1973 and aged ⩾30 years. The incidences of all the three cancers increased with decreasing socioeconomic position, measured as disposable income, work market affiliation, social class, housing tenure, cohabiting status and type of district. Similar differences in survival persisted for all 5 years observed. Immigrants had better survival from larynx cancer than native Danes. We could not determine the effects of differences in tobacco and alcohol consumption or their multiplicative interactions.

1. Introduction

In Denmark in 2003 mouth and pharynx cancer was diagnosed in 488 persons (336 men and 152 women) and larynx cancer in 227 (190 men and 37 women).[1] Although cancers of mouth, pharynx and larynx are rarer than other tobacco-related cancers, they result in substantial avoidable morbidity and mortality, and the survival is poorer than that for non-tobacco-related cancers, such of the breast and prostate.[1–3] All the three cancer types are more prevalent in men,[1,2] and they are associated with tobacco use and heavy alcohol consumption as well as a poor diet.[4,5]

Increased risks for cancers of the mouth, pharynx and larynx have been associated with low socioeconomic position, being unmarried and poor dental care,[4] and being African–American or Hispanic in the United States.[6] Cancer of the mouth and pharynx was found to be associated with social disadvantage irrespective of the study population,[7] whereas in a study in Taiwan poorer survival from oral cancer was found for patients with no religious belief and amongst single, widowed or divorced patients.[8] Two studies of larynx cancer in the United States showed that the survival of patients with advanced disease was poorest amongst black Americans,[9] and that persons with no health insurance or

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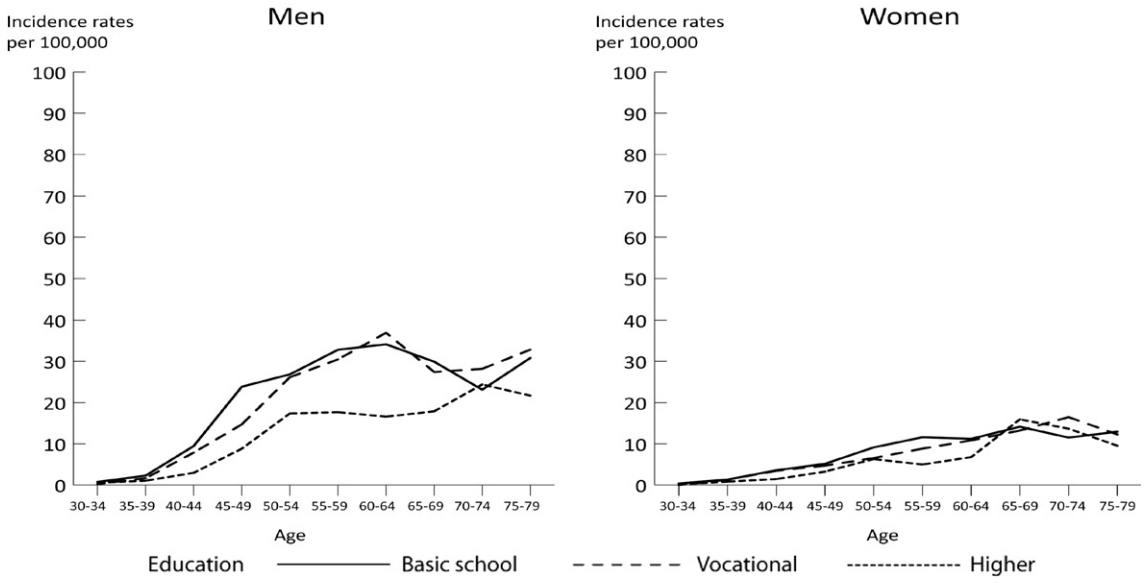
no Medicaid were at greatest risk of a diagnosis of advanced laryngeal cancer,[10] thus linking social and racial differences to limited access to health care.

Differences in tobacco and alcohol use are thought to be the main explanation for the disparities in risk for cancers of the mouth, pharynx and larynx according to socioeconomic position. A study of the risk factors for oral and pharyngeal cancer showed no effect of education or occupational status after adjustment for tobacco and alcohol use and poor dentition.[11] A recent study of oral and pharyngeal cancer in Italy showed that the social gradient observed in the 1980s had disappeared, and this result was attributed to changes in socioeconomic correlates, such as a general decrease in alcohol and tobacco consumption and more widespread availability of a varied, better diet.[12] A study of larynx cancer, however, showed that the social inequalities were not totally explained by alcohol and tobacco consumption but were probably partly attributable to occupational exposure.[13] A study that showed deprivation-associated negative prognostic effects in the early post-diagnostic period indicated a more complex aetiology, with different tumour types, more comorbidity and worse treatment.[14]

The purpose of this study was to examine the impact of socioeconomic position on the incidence of and survival from cancers of the mouth, pharynx and larynx in Denmark, as part of a rigorous, comprehensive analysis of the role of socioeconomic position in cancer incidence and survival.

2. Material and methods

The material and methods are described elsewhere.[15] Briefly, the study population comprised all 3.22 million Danish residents born between 1925 and 1973 without a previous incidence cancer and who entered the cohort at age 30 (see Fig. 1 in [15]). Information on socioeconomic, demographic and health-related indicators was obtained from various Danish registers based on administrative data.[15] Crude, age-specific and age-standardised incidence rates are presented for cancers of the mouth, pharynx and larynx (ICD-10 C03–06 + C46.2; C09–14; C32) diagnosed in the cohort in 1994–2003. The incidence rates were standardised by age (in 5-year age-groups) and period (in two 5-year periods), with the total study population as the standard.[16] Further, we used log-linear Poisson regression models to model incidence rate ratios (IRRs), first adjusted for period (in 5-year periods) and age (as a continuous variables: age and age^2 in years) and secondly by adding education and income to the models. For each level of each indicator, we conducted relative survival



Incidence rate	Men			Women		
	Basic school (n =879)	Vocational (n =894)	Higher (n =245)	Basic school (n =430)	Vocational (n =224)	Higher (n =96)
Crude	20	16	9	8	5	3
Standardised	19	17	10	7	6	5
Difference	9	7	0	2	1	0

Fig. 1 – Age-specific incidence rates per 100 000 person-years for mouth and pharynx cancer by education in persons born 1925–1973, Denmark, 1994–2003. Supplementary table shows the crude incidence rate and the incidence rate standardised by age (5-year age groups) and period (two 5-year periods) with the total study population as the standard and the incidence rate difference with basic education as the reference.

Table 1 – Incidence rate ratios (IRRs) with 95% confidence intervals (95% CIs) for mouth and pharynx cancer in Danish persons born 1925–1973 and aged ⩾30 years, by socioeconomic, demographic and health-related variables, Denmark, 1994–2003

	Men			Women		
	Obs	IRR[a] (95% CI)	Adjusted IRR[b] (95% CI)	Obs	IRR[a] (95% CI)	Adjusted IRR[b] (95% CI)
Level of education						
Basic or high school	879	1.00	1.00	430	1.00	1.00
Vocational education	894	0.92 (0.84–1.01)	1.00 (0.91–1.10)	224	0.89 (0.75–1.05)	0.98 (0.83–1.15)
Higher education	245	0.54 (0.47–0.63)	0.70 (0.60–0.81)	96	0.67 (0.53–0.84)	0.80 (0.64–1.02)
Unknown	63	1.72 (1.33–2.23)	1.75 (1.35–2.26)	25	2.76 (1.85–4.14)	2.87 (1.91–4.30)
Disposable income[c]						
Lowest (1st quartile)	767	1.78 (1.61–1.96)	1.74 (1.57–1.92)	264	1.27 (1.08–1.50)	1.25 (1.05–1.47)
Middle (2nd–3rd quartile)	928	1.00	1.00	383	1.00	1.00
Highest (4th quartile)	386	0.64 (0.56–0.72)	0.68 (0.60–0.77)	128	0.57 (0.46–0.70)	0.59 (0.48–0.72)
Affiliation to work market[d]						
Working	956	1.00	1.00	273	1.00	1.00
Unemployed or other	427	3.47 (3.09–3.90)	2.98 (2.63–3.37)	172	2.46 (2.02–2.99)	2.24 (1.83–2.75)
Early retirement pensioner	480	5.26 (4.70–5.88)	4.52 (4.01–5.11)	217	3.90 (3.22–4.72)	3.50 (2.85–4.29)
Social class[e]						
Creative core	69	0.44 (0.34–0.56)	0.69 (0.52–0.90)	11	0.70 (0.37–1.33)	1.04 (0.53–2.02)
Creative professional	224	0.50 (0.44–0.58)	0.65 (0.56–0.76)	48	0.60 (0.42–0.87)	0.79 (0.53–1.17)
Bohemian	20	1.43 (0.92–2.22)	1.80 (1.15–2.82)	1	0.47 (0.07–3.37)	0.60 (0.08–4.35)
Service	517	0.82 (0.74–0.91)	0.92 (0.83–1.03)	412	0.81 (0.63–1.04)	0.88 (0.69–1.14)
Manual	1022	1.00	1.00	74	1.00	1.00
Agricultural	47	0.34 (0.25–0.46)	0.31 (0.23–0.42)	2	0.12 (0.03–0.47)	0.12 (0.03–0.47)
Unknown	182	1.01 (0.86–1.18)	0.95 (0.81–1.12)	227	1.20 (0.92–1.57)	1.18 (0.91–1.55)
Housing tenure						
Owner-occupied	962	1.00	1.00	356	1.00	1.00
Rental	1068	3.12 (2.86–3.40)	2.83 (2.59–3.09)	407	2.37 (2.05–2.73)	2.19 (1.90–2.54)
Unknown	51	2.97 (2.24–3.93)	2.53 (1.91–3.36)	12	2.25 (1.26–4.00)	2.07 (1.17–3.69)
Size of dwelling (m^2)						
0–49	213	5.00 (4.27–5.85)	4.08 (3.47–4.79)	25	3.09 (2.04–4.67)	2.76 (1.82–4.17)
50–99	978	2.42 (2.18–2.68)	2.24 (2.02–2.49)	416	2.02 (1.72–2.38)	1.90 (1.61–2.24)
100–149	570	1.00	1.00	223	1.00	1.00
⩾150	320	0.81 (0.70–0.93)	0.85 (0.74–0.98)	111	0.80 (0.63–1.00)	0.85 (0.67–1.07)
Cohabiting status						
Married	1062	1.00	1.00	390	1.00	1.00
Cohabiting	194	1.80 (1.54–2.10)	1.76 (1.50–2.05)	71	1.96 (1.52–2.54)	1.97 (1.52–2.55)
Single	288	2.13 (1.87–2.43)	1.81 (1.58–2.07)	61	1.91 (1.45–2.50)	1.78 (1.35–2.35)
Widow or widower	68	1.84 (1.44–2.36)	1.67 (1.30–2.14)	102	1.64 (1.30–2.07)	1.54 (1.22–1.93)
Divorced	469	3.71 (3.33–4.14)	3.13 (2.80–3.51)	151	2.40 (1.99–2.90)	2.14 (1.76–2.59)
Type of district						
Capital area	907	1.00	1.00	329	1.00	1.00
Provincial city	881	0.57 (0.52–0.63)	0.52 (0.47–0.57)	333	0.62 (0.53–0.72)	0.57 (0.48–0.66)
Rural area	188	0.50 (0.43–0.59)	0.43 (0.37–0.51)	82	0.67 (0.52–0.85)	0.59 (0.47–0.76)
Peripheral rural area[f]	105	0.64 (0.52–0.78)	0.52 (0.43–0.64)	31	0.56 (0.39–0.81)	0.48 (0.33–0.70)
Ethnicity[g]						
Danish	2081	1.00	1.00	775	1.00	1.00
Immigrant or descendant from western country	61	1.37 (1.06–1.77)	1.29 (1.00–1.67)	23	1.19 (0.78–1.80)	1.15 (0.76–1.75)
Immigrant or descendant from non-western country	31	0.57 (0.40–0.81)	0.38 (0.27–0.55)	13	0.72 (0.42–1.25)	0.46 (0.25–0.83)
Charlson comorbidity index[h]						
None	1529	1.00	1.00	567	1.00	1.00
1	356	1.94 (1.73–2.18)	1.81 (1.61–2.04)	127	2.46 (2.02–2.99)	2.34 (1.93–2.85)
⩾2	196	2.36 (2.03–2.74)	2.17 (1.86–2.52)	81	2.88 (2.27–3.65)	2.75 (2.17–3.49)
Depression						
No	2019	1.00	1.00	737	1.00	1.00
Yes	62	1.80 (1.40–2.32)	1.64 (1.27–2.11)	38	1.64 (1.18–2.27)	1.55 (1.11–2.14)

Table 1 – *continued*

	Men			Women		
	Obs	IRR[a] (95% CI)	Adjusted IRR[b] (95% CI)	Obs	IRR[a] (95% CI)	Adjusted IRR[b] (95% CI)
Schizophrenia or other psychosis						
No	2054	1.00	1.00	766	1.00	1.00
Yes	27	1.28 (0.87–1.87)	1.09 (0.74–1.59)	9	0.96 (0.50–1.85)	0.87 (0.45–1.68)

a Adjusted for calendar period (in 5-year intervals) and age modelled as age and age^2 in years.
b Adjusted for calendar period and age (as above) and additionally for level of education and disposable income.
c Household income after taxation and interest, adjusted for number of persons in household; categorised by gender-specific distribution of household disposable income per person.
d For pensioners, work market affiliation before pension date was assigned and follow-up to age 69.
e Based on theory of creative class[21]: the creative core (e.g. researchers, designers, and architects), creative professionals (e.g. managers, business and finance, lawyers, and doctors), bohemians (e.g. artists and models), the service class (e.g. nurses, hairdressers, caterers), the manual class (e.g. construction workers, transport and production workers) and the agricultural class (e.g. farmers and fishermen).
f More than 40 km to a local centre with adequate possibilities for employment and not sharing a border with a centre municipality.
g Included as a separate indicator, but ethnic groups were excluded from the study population in all other analyses presented in this table, e.g. education and income.
h The presence of disorders, as defined in the Charlson index, was defined as an in- or outpatient contact with one of the diagnoses listed in Table 1 in[15] between 1978 and 2 years before the cancer diagnosis. Grouped according to the accumulated sum of scores.

analyses, adjusting for population mortality amongst the incident cancer cases in 1994–2003, with follow-up through 2006.[15] Population mortality rates were stratified by age, period and the respective indicator. Except for the analyses of ethnicity, all analyses included only residents born in Denmark to at least one Danish-born parent with Danish citizenship.[15]

3. Results

In total, 3058 persons with cancer of the mouth and pharynx and 1799 with larynx cancer were included in the study during the period 1994–2003, constituting 75% and 73% of the total numbers of cases of those cancers, respectively, diagnosed in Denmark in that period. Amongst Danish persons, the male:female ratio for cancer of the mouth and pharynx was 2.6, and that for larynx cancer was 4.5. The age- and period-standardised incidence rates for cancer of the mouth and pharynx were 17 per 100,000 person-years for men and 6 per 100,000 person-years for women, and the rates for larynx cancer were 11 per 100,000 person-years for men and 2 per 100,000 person-years for women.

3.1. *Incidence of cancer of mouth and pharynx*

The age- and period-standardised incidence of mouth and pharynx cancer decreased in a stepwise fashion with increasing length of education for both men and women. The incidence rate difference between higher education and basic schooling was 9 per 100,000 for men and 2 per 100,000 for women (Fig. 1).

The IRRs for the socioeconomic and demographic variables, adjusted for age, period, education and income, showed a general pattern in both men and women of decreasing incidence with increasing social advantage, such as longer education, more income, closer affiliation to the work market, housing tenure and lager dwelling (Table 1). The IRR was significantly reduced for men in the agricultural class, creative core and creative professionals compared to the manual class, whereas higher IRRs were observed for 'bohemian' men, although the number of cases was small. Higher incidences were seen amongst men and women who cohabited or were single, widowed or divorced. Lower IRRs were observed amongst men and women living outside capital areas. Male and female immigrants and their descendants from western countries had increased IRRs, whilst those from non-western countries had significantly reduced IRRs. The IRR increased with increasing Charlson comorbidity index and depression, but was not associated with psychiatric disorders (Table 1).

3.2. *Relative survival from cancer of mouth and pharynx*

The 1-year relative survival of patients with mouth and pharynx cancer diagnosed during 1994–2003 was 70% for men and 73% for women, and the 5-year relative survival was 33% for men and 42% for women.

Fig. 2 shows the age-standardised relative survival of patients with mouth and pharynx cancer according to education. Survival was best for men with higher education, and men with vocational education had better survival than men with basic education, throughout the 5-year period. Women with higher education had the best survival, and women with basic education had better survival than women with vocational education. No clear trends in excess mortality rates were observed by education level in either men or women.

Better survival was associated with higher income (only in men), better affiliation to the labour market, housing tenure and larger dwelling (Table 2). Men who were divorced, widowed or single had considerably poorer 5-year survival than married and cohabiting men, with a similar but less pronounced pattern for women. Type of district had no effect on 5-year survival. Male native Danes had better survival than male immigrants and descendants from western countries.

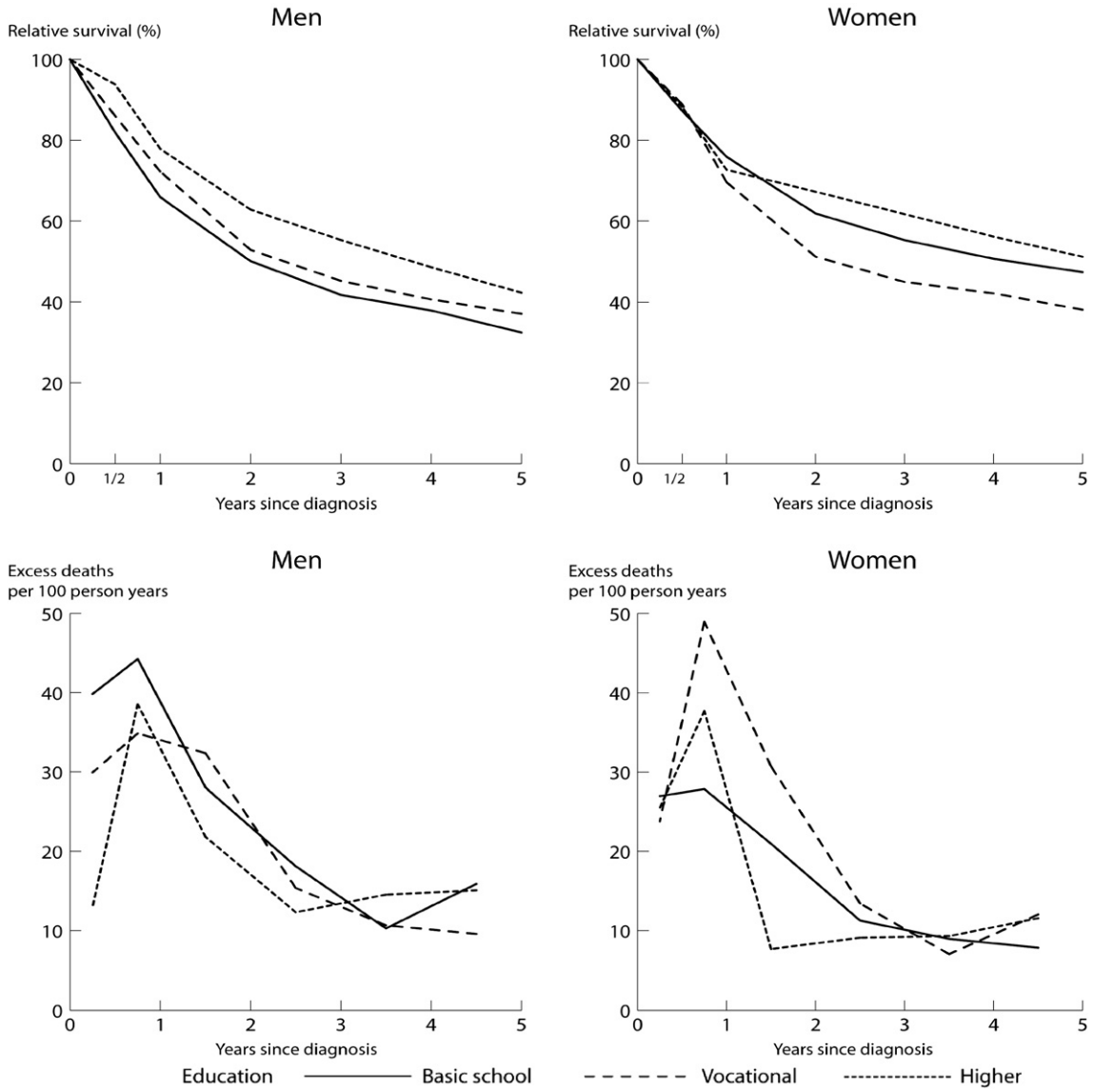


Fig. 2 – Age-standardised relative survival and excess mortality rates per 100 person-years by level of education in patients born 1925–1973, with mouth and pharynx cancer diagnosed in Denmark 1994–2003 and followed through 2006. Relative survival is the ratio of the observed survival of the cancer patients and the survival that would have been expected if the patients had had the same age-, period- and education-specific mortality as the total study population. Excess mortality is excess to the same population mortality and estimated in intervals since diagnosis. Estimates were standardised for age on the basis of the age distribution of all patients with mouth and pharynx cancer in the study cohort.

Survival decreased with increasing Charlson comorbidity index. The presence of psychosis shortened survival for men and lengthened it for women, but there was no clear association between depression and survival (Table 2).

3.3. *Incidence of larynx cancer*

A stepwise decrease in the age- and period-standardised incidence rate of larynx cancer was seen with increasing length of education in both men and women, with an incidence rate difference between those with higher education and those with basic schooling of 7 per 100,000 for men and 2 per 100,000 for women (Fig. 3).

The IRRs for the socioeconomic and demographic variables, adjusted for age, period, education and income, showed a general pattern in both men and women of decreasing incidence with increasing social advantage, such as higher education level, more income, better affiliation to the work market, housing tenure and larger dwelling (Table 3). The IRR was reduced for men in the creative class (creative core and professionals) and the agricultural class compared to the manual class. A similar trend was observed for women, but some associations were inconclusive owing to small numbers of cases. Persons who cohabited or were single, widowed or divorced had higher incidences of larynx cancer than married persons. Furthermore, lower IRRs were

Table 2 – 1-year and 5-year relative survival[a] (%) with 95% confidence interval (95% CI) by socioeconomic, demographic and health variables in patients aged ⩾30 years born 1925–1973, with mouth and pharynx cancer diagnosed in Denmark between 1994 and 2003 and followed through 2006

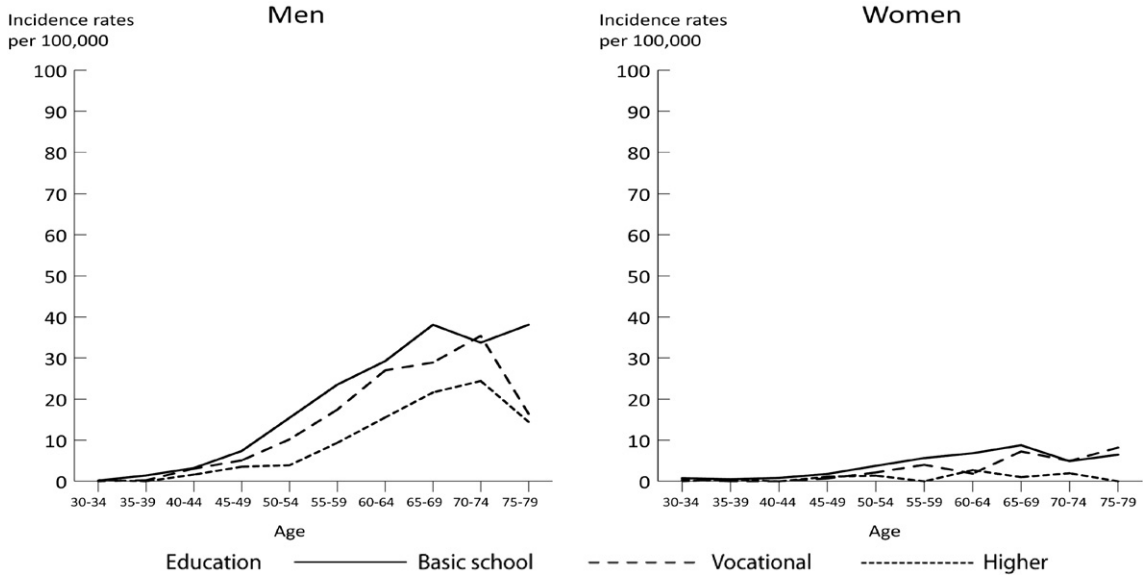
	Men					Women				
	No.	1-year survival		5-year survival		No.	1-year survival		5-year survival	
		%	95% CI	%	95% CI		%	95% CI	%	95% CI
Level of education										
Basic or high school	878	66	63–69	30	27–34	430	76	72–80	44	40–50
Vocational education	893	72	69–75	34	31–38	224	70	64–76	35	29–42
Higher education	245	78	73–84	39	33–47	96	73	64–83	47	38–60
Unknown	63	65	55–78	28	19–40	25	65	52–83	47	31–69
Disposable income[b]										
Lowest (1st quartile)	767	66	62–69	25	22–29	264	68	62–75	42	35–50
Middle (2nd–3rd quartile)	926	70	67–73	33	30–36	383	74	70–79	42	37–48
Highest (4th quartile)	386	80	76–84	46	41–52	128	73	65–82	43	35–52
Affiliation to work market[c]										
Working	955	82	79–84	46	43–50	273	85	81–89	55	49–61
Unemployed or other	427	69	64–73	27	23–32	172	67	60–76	40	32–49
Early retirement pensioner	479	64	60–68	27	23–32	217	63	56–70	35	29–44
Social class[d]										
Creative core	69	74	65–85	39	28–53	11	64	49–85	48	37–64
Creative professional	223	73	68–79	43	37–50	48	82	71–93	46	34–62
Bohemian	20	66	49–89	27	13–55	1	0	–	0	–
Service	517	72	68–76	32	28–36	412	76	72–80	45	40–50
Manual	1021	69	66–72	32	29–35	74	75	65–86	43	32–57
Agricultural	47	76	64–89	38	25–56	2	100	100–100	0	–
Unknown	182	64	57–71	26	20–34	227	67	61–74	35	29–43
Housing tenure										
Owner-occupied	961	78	75–81	38	35–41	356	76	72–80	45	40–51
Rental	1067	64	61–67	30	27–33	407	72	68–77	41	37–47
Unknown	51	49	36–67	21	10–42	12	57	37–87	9	1–81
Size of dwelling (m^2)										
0–49	213	56	50–64	21	15–28	25	81	70–95	29	13–65
50–99	977	66	63–69	30	27–33	416	71	67–76	40	36–46
100–149	570	77	74–81	38	34–42	223	76	70–82	44	38–52
⩾150	319	78	74–83	42	37–48	111	77	70–86	50	41–61
Cohabiting status										
Married	1061	76	73–78	40	37–43	390	78	74–82	46	41–52
Cohabiting	194	74	67–81	37	30–46	71	68	56–82	45	34–59
Single	288	56	49–63	16	12–23	61	63	50–78	44	31–62
Widow/widower	68	48	36–63	9	4–19	102	77	67–88	38	26–55
Divorced	468	64	60–69	27	23–32	151	69	62–76	39	31–47
Type of district										
Capital area	907	69	66–72	31	28–35	329	69	65–75	40	35–46
Provincial city	880	69	66–72	35	32–39	333	78	73–82	45	39–51
Rural area	187	75	68–82	30	23–37	82	67	58–78	33	24–46
Peripheral rural area[e]	105	79	71–87	29	21–40	31	86	76–97	61	43–88
Ethnicity[f]										
Danish	2079	70	68–72	33	31–35	775	73	70–77	42	39–46
Immigrant or descendant from western country	60	59	49–72	25	16–39	23	76	62–94	49	33–73
Immigrant or descendant from non-western country	31	78	63–96	27	14–53	13	100	–	40	23–70
Charlson comorbidity index[g]										
None	1527	73	71–75	35	33–38	567	78	75–82	46	42–51
1	356	66	62–71	27	22–32	127	65	57–74	36	28–46
⩾2	196	58	52–66	27	20–35	81	64	54–75	29	19–43
Depression										
No	2017	70	68–72	33	31–35	737	74	70–77	42	39–46
Yes	62	70	60–82	31	20–47	38	72	59–88	37	24–56

(continued on next page)

Table 2 – *continued*

	Men					Women				
	No.	1-year survival		5-year survival		No.	1-year survival		5-year survival	
		%	95% CI	%	95% CI		%	95% CI	%	95% CI
Schizophrenia or other psychosis										
No	2052	70	68–72	33	31–35	766	74	70–77	42	38–46
Yes	27	66	47–92	7	1–33	9	64	43–95	69	47–102

a Ratio of observed survival of cancer patients and survival that would have been expected if the patients had had the same age-, period-, socioeconomic, demographic or health-related indicator-specific mortality as the total study population; for 'social class' and 'ethnicity', expected survival is adjusted only for age, not period, because of low power.
b Household income after taxation and interest, adjusted for number of persons in household; categorised by gender-specific distribution of household disposable income per person.
c For pensioners, work market affiliation before pension date was assigned and follow-up to age 69.
d Based on theory of creative class[21]: the creative core (e.g. researchers, designers, and architects), creative professionals (e.g. managers, business and finance, lawyers, and doctors), bohemians (e.g. artists and models), the service class (e.g. nurses, hairdressers, and caterers), the manual class (e.g. construction workers, transport and production workers) and the agricultural class (e.g. farmers and fishermen).
e More than 40 km to a local centre with adequate possibilities for employment and not sharing a border with a centre municipality.
f Excluded from the study population in all other analyses presented in this table.
g The presence of disorders, as defined in the Charlson index, was defined as an in- or outpatient contact with one of the diagnoses listed in Table 1 in[15] between 1978 and 2 years before the cancer diagnosis. Grouped according to the accumulated sum of scores.



Incidence rate	Men			Women		
	Basic school	Vocational	Higher	Basic school	Vocational	Higher
	(*n* =687)	(*n* =534)	(*n* =140)	(*n* =215)	(*n* =69)	(*n* =18)
Crude	15	10	5	4	2	1
Standardised	14	11	7	3	2	1
Difference	7	4	0	2	1	0

Fig. 3 – Age-specific incidence rates per 100 000 person-years for larynx cancer by education in persons born 1925–1973, Denmark, 1994–2003. Supplementary table shows the crude incidence rate and the incidence rate standardised by age (5-year age groups) and period (two 5-year periods) with the total study population as the standard and the incidence rate difference with basic education as the reference.

Table 3 – Incidence rate ratios (IRRs) with 95% confidence intervals (95% CIs) for larynx cancer in Danish persons born 1925–1973 and aged ⩾30 years, by socioeconomic, demographic and health-related variables, Denmark, 1994–2003

	Men			Women		
	Obs	IRR[a] (95% CI)	Adjusted IRR[b] (95% CI)	Obs	IRR[a] (95% CI)	Adjusted IRR[b] (95% CI)
Level of education						
Basic or high school	687	1.00	1.00	215	1.00	1.00
Vocational education	534	0.80 (0.71–0.90)	0.85 (0.76–0.96)	69	0.58 (0.44–0.77)	0.62 (0.47–0.82)
Higher education	140	0.47 (0.39–0.57)	0.60 (0.49–0.72)	18	0.28 (0.17–0.45)	0.31 (0.19–0.52)
Unknown	33	1.29 (0.91–1.83)	1.34 (0.94–1.90)	2	0.46 (0.12–1.87)	0.48 (0.12–1.92)
Disposable income[c]						
Lowest (1st quartile)	509	1.29 (1.14–1.45)	1.23 (1.09–1.39)	111	1.29 (0.99–1.67)	1.18 (0.91–1.53)
Middle (2nd–3rd quartile)	666	1.00	1.00	144	1.00	1.00
Highest (4th quartile)	219	0.53 (0.45–0.61)	0.58 (0.50–0.68)	49	0.60 (0.43–0.83)	0.72 (0.51–1.00)
Affiliation to work market[d]						
Working	643	1.00	1.00	118	1.00	1.00
Unemployed or other	226	2.22 (1.90–2.59)	1.96 (1.67–2.30)	52	1.43 (1.03–2.01)	1.19 (0.84–1.67)
Early retirement pensioner	256	3.34 (2.88–3.87)	2.75 (2.35–3.21)	88	2.82 (2.10–3.80)	2.15 (1.57–2.93)
Social class[e]						
Creative core	34	0.35 (0.25–0.49)	0.57 (0.39–0.83)	2	0.38 (0.09–1.59)	0.98 (0.22–4.29)
Creative professional	158	0.55 (0.46–0.65)	0.73 (0.60–0.88)	13	0.46 (0.24–0.88)	0.91 (0.45–1.82)
Bohemian	8	0.89 (0.44–1.79)	1.16 (0.57–2.34)	1	1.32 (0.18–9.69)	2.42 (0.33–17.92)
Service	333	0.80 (0.70–0.91)	0.89 (0.78–1.01)	160	0.85 (0.57–1.27)	1.07 (0.71–1.60)
Manual	690	1.00	1.00	28	1.00	1.00
Agricultural	52	0.49 (0.37–0.65)	0.46 (0.35–0.61)	3	0.43 (0.13–1.42)	0.43 (0.13–1.42)
Unknown	119	0.88 (0.72–1.07)	0.85 (0.70–1.04)	97	1.21 (0.79–1.85)	1.26 (0.82–1.94)
Housing tenure						
Owner-occupied	709	1.00	1.00	143	1.00	1.00
Rental	662	2.50 (2.24–2.78)	2.27 (2.04–2.52)	158	2.19 (1.74–2.75)	2.02 (1.60–2.54)
Unknown	23	1.87 (1.23–2.83)	1.66 (1.10–2.52)	3	1.33 (0.42–4.18)	1.24 (0.39–3.89)
Size of dwelling (m^2)						
0–49	93	3.02 (2.41–3.77)	2.57 (2.05–3.23)	3	0.89 (0.28–2.83)	0.81 (0.26–2.57)
50–99	663	2.02 (1.79–2.28)	1.87 (1.65–2.11)	162	1.83 (1.41–2.37)	1.71 (1.32–2.22)
100–149	432	1.00	1.00	91	1.00	1.00
⩾150	206	0.71 (0.60–0.84)	0.77 (0.65–0.91)	48	0.87 (0.61–1.23)	0.97 (0.69–1.39)
Cohabiting status						
Married	812	1.00	1.00	163	1.00	1.00
Cohabiting	137	2.04 (1.70–2.45)	1.94 (1.62–2.33)	28	2.07 (1.38–3.10)	2.02 (1.35–3.04)
Single	136	1.56 (1.30–1.87)	1.31 (1.09–1.58)	18	1.43 (0.88–2.34)	1.48 (0.90–2.43)
Widow or widower	56	1.40 (1.07–1.85)	1.31 (0.99–1.72)	41	1.35 (0.94–1.93)	1.26 (0.88–1.80)
Divorced	253	2.75 (2.39–3.17)	2.41 (2.08–2.78)	54	2.06 (1.52–2.81)	1.96 (1.43–2.68)
Type of district						
Capital area	519	1.00	1.00	114	1.00	1.00
Provincial city	656	0.74 (0.66–0.83)	0.66 (0.59–0.74)	139	0.74 (0.58–0.95)	0.65 (0.50–0.83)
Rural area	145	0.67 (0.56–0.80)	0.57 (0.47–0.69)	32	0.75 (0.51–1.12)	0.62 (0.42–0.92)
Peripheral rural area[f]	74	0.75 (0.59–0.96)	0.62 (0.49–0.79)	19	0.98 (0.60–1.59)	0.78 (0.48–1.28)
Ethnicity[g]						
Danish	1394	1.00	1.00	304	1.00	1.00
Immigrant or descendant from western country	26	0.96 (0.65–1.41)	0.96 (0.65–1.42)	6	0.78 (0.35–1.75)	0.85 (0.38–1.92)
Immigrant or descendant from non-western country	26	0.85 (0.57–1.25)	0.64 (0.43–0.96)	5	0.79 (0.33–1.92)	0.60 (0.23–1.56)
Charlson comorbidity index[h]						
None	1011	1.00	1.00	217	1.00	1.00
1	247	1.64 (1.42–1.88)	1.54 (1.34–1.78)	53	2.53 (1.87–3.44)	2.35 (1.74–3.20)
⩾2	136	1.88 (1.57–2.26)	1.74 (1.45–2.09)	34	2.97 (2.06–4.30)	2.76 (1.91–3.99)
Depression						
No	1359	1.00	1.00	289	1.00	1.00
Yes	35	1.43 (1.02–1.99)	1.32 (0.95–1.85)	15	1.59 (0.94–2.67)	1.50 (0.89–2.53)

(continued on next page)

Table 3 – *continued*

	Men			Women		
	Obs	IRR[a] (95% CI)	Adjusted IRR[b] (95% CI)	Obs	IRR[a] (95% CI)	Adjusted IRR[b] (95% CI)
Schizophrenia or other psychosis						
No	1379	1.00	1.00	301	1.00	1.00
Yes	15	1.19 (0.72–1.99)	1.01 (0.61–1.69)	3	0.82 (0.26–2.55)	0.73 (0.24–2.29)

a Adjusted for calendar period (in 5-year intervals) and age modelled as age and age^2 in years.
b Adjusted for calendar period and age (as above) and additionally for level of education and disposable income.
c Household income after taxation and interest, adjusted for number of persons in household; categorised by gender-specific distribution of household disposable income per person.
d For pensioners, work market affiliation before pension date was assigned and follow-up to age 69.
e Based on theory of creative class[21]: the creative core (e.g. researchers, designers, and architects), creative professionals (e.g. managers, business and finance, lawyers, and doctors), bohemians (e.g. artists and models), the service class (e.g. nurses, hairdressers, and caterers), the manual class (e.g. construction workers, transport and production workers) and the agricultural class (e.g. farmers and fishermen).
f More than 40 km to a local centre with adequate possibilities for employment and not sharing a border with a centre municipality.
g Included as a separate indicator, but ethnic groups were excluded from the study population in all other analyses presented in Table 1, e.g. education and income.
h The presence of disorders, as defined in the Charlson index, was defined as an in- or outpatient contact with one of the diagnoses listed in Table 1 in[15] between 1978 and 2 years before the cancer diagnosis. Grouped according to the accumulated sum of scores.

observed for people living outside the capital areas, and larger IRRs were observed with increasing Charlson comorbidity index. Smaller IRRs were observed for immigrants or their descendents from non-western countries as compared to native Danes, and higher IRRs were found in the presence of depression, although these were not statically significant (Table 3). No effect of schizophrenia or other psychoses was observed on the incidence of larynx cancer.

3.4. *Relative survival from larynx cancer*

The 1-year relative survival of patients in whom larynx cancer was diagnosed during 1994–2003 was 85% for men and 81% for women, and the relative 5-year survival was 54% and 56%, respectively. Fig. 4 shows the age-standardised relative survival from larynx cancer according to education. The survival curve was almost linear for men in all the three groups, with consistently better relative survival amongst men with higher education, resulting in 4% and 7% better relative survival after 1 year and 5 years in men with higher education as compared with men with basic and vocational education, respectively (Table 4). In women, the survival curves by education crossed over for the first 2 years, and an advantage for women with higher education became apparent only in the last 3 years of follow-up, the observed relative 5-year survival in highly educated women being 65% and those in women with basic and vocational education being 54% and 59%, respectively (Table 4). No clear trends in excess mortality rates were observed by education level (Fig. 4).

There were indications of socioeconomic gradients in the age-standardised relative survival of both men and women from larynx cancer, as measured by the socioeconomic and demographic indicators (Table 4). In general, both short-term and longer-term survival tended to be better in groups at greater advantage with respect to education, income, affiliation to the work market and housing tenure and size. The creative social class (creative core and professionals) had better 5-year survival than other social classes (except women in the agricultural class, but with very few cases). Married men and single women had the best 5-year relative survival, whilst no clear pattern was seen in survival by type of district. Immigrants from both western and non-western countries had better relative survival than Danish patients. Finally, better survival was associated with schizophrenia or other psychoses in both men and women.

4. Discussion

As reported previously,[4] the incidences of mouth, pharynx and larynx cancer increased with decreasing social advantage, as measured by occupation, work market affiliation, housing and cohabitation status, both before and after adjustment for education and disposable income. The differences in survival between socioeconomic and demographic groups persisted for all 5 years of follow-up. Most previous studies addressed socioeconomic disparities in larynx cancer incidence and survival amongst different racial groups, such as black Americans and Hispanics.[6,9] Analyses by race and ethnicity were not possible in our study, but we observed better survival amongst immigrants from both western and non-western countries as compared to native Danes. This may implicate lifestyle (tobacco and alcohol consumption, diet) factors in the observed social disparities. We were unable to determine the extent to which the observed social inequalities in risk and survival were due to differences in tobacco and alcohol consumption, their multiplicative interactions and other risk factors. The evidence with regard to smoking is comprehensive and unambiguous, demonstrating that there is no harmless level of smoking in relation to cancers of the mouth, pharynx and larynx,[17] whilst the evidence for other risk factors, such as alcohol intake, diet, oral hygiene, infection, is less clear.[18–20]

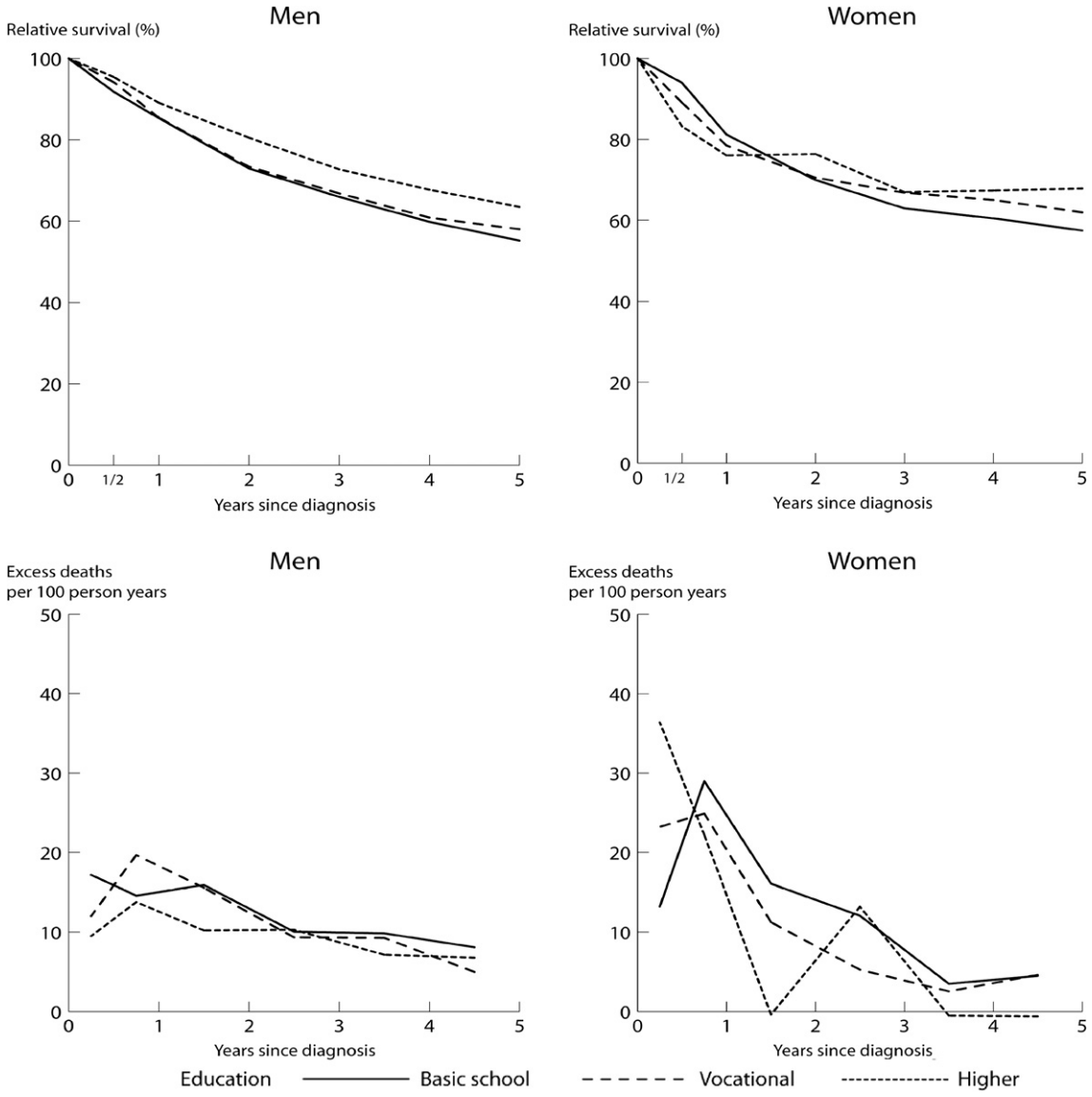


Fig. 4 – Age-standardised relative survival and excess mortality rates per 100 person-years by level of education in patients born 1925–1973, with larynx cancer diagnosed in Denmark 1994–2003 and followed through 2006. Relative survival is the ratio of the observed survival of the cancer patients and the survival that would have been expected if the patients had had the same age-, period- and education-specific mortality as the total study population. Excess mortality is excess to the same population mortality and estimated in intervals since diagnosis. Estimates were standardised for age on the basis of the age distribution of all patients with larynx cancer in the study cohort.

Table 4 – 1-year and 5-year relative survival[a] (%) with 95% confidence interval (95% CI) by socioeconomic, demographic and health variables in patients aged ⩾30 years born 1925–1973, with larynx cancer diagnosed in Denmark between 1994 and 2003 and followed through 2006

	Men					Women				
	No.	1-year survival		5-year survival		No.	1-year survival		5-year survival	
		%	95% CI	%	95% CI		%	95% CI	%	95% CI
Level of education										
Basic or high school	687	85	83–88	52	48–57	214	81	76–87	54	47–61
Vocational education	533	85	82–89	55	50–60	69	78	69–89	59	47–73
Higher education	140	89	84–95	59	51–70	18	76	57–101	65	44–97
Unknown	33	81	69–94	41	27–61	2	101	–	104	–

(*continued on next page*)

Table 4 – *continued*

	Men					Women				
	No.	1-year survival		5-year survival		No.	1-year survival		5-year survival	
		%	95% CI	%	95% CI		%	95% CI	%	95% CI
Disposable income[b]										
Lowest (1st quartile)	509	81	77–84	45	40–50	110	77	69–86	50	40–61
Middle (2nd–3rd quartile)	665	86	83–89	56	52–60	144	81	75–88	55	47–64
Highest (4th quartile)	219	94	89–99	63	55–72	49	90	80–101	71	58–87
Affiliation to work market[c]										
Working	643	90	88–92	59	55–63	118	91	86–96	73	66–82
Unemployed or other	225	77	72–83	46	40–54	52	79	68–92	56	43–73
Early retirement pensioner	256	80	75–86	40	34–48	87	70	60–81	38	28–52
Social class[d]										
Creative core	34	95	87–103	83	70–97	2	101	–	59	59–59
Creative professional	158	90	85–95	63	56–72	13	100	–	82	59–114
Bohemian	8	92	79–108	19	7–48	1	0	–	0	–
Service	333	87	83–90	53	48–60	160	79	73–86	55	47–64
Manual	689	83	80–86	52	48–56	28	69	58–83	49	34–69
Agricultural	52	91	83–100	55	41–73	3	100	–	101	–
Unknown	119	86	80–93	49	40–61	96	83	75–91	53	43–66
Housing tenure										
Owner–occupied	709	90	88–92	60	56–64	143	79	72–86	57	49–66
Rental	661	81	78–85	48	44–53	157	82	75–88	54	46–63
Unknown	23	77	61–97	41	23–73	3	100	–	102	–
Size of dwelling (m^2)										
0–49	93	79	70–88	38	27–52	3	102	–	55	22–137
50–99	662	81	78–84	48	44–53	162	81	75–88	52	44–61
100–149	432	91	88–94	61	56–66	90	75	66–85	57	47–69
⩾150	206	93	89–97	65	58–72	48	90	82–98	68	54–87
Cohabiting status										
Married	812	90	88–92	61	57–65	163	82	75–88	56	49–64
Cohabiting	137	90	84–96	52	43–63	27	73	58–93	59	42–83
Single	136	70	61–81	43	32–57	18	94	82–107	67	42–105
Widow/widower	55	70	54–91	43	28–67	41	77	63–94	51	35–73
Divorced	253	77	72–83	37	31–44	54	78	67–90	41	29–58
Type of district										
Capital area	519	83	79–86	50	46–55	114	77	70–86	53	44–64
Provincial city	655	88	85–90	56	52–60	138	86	80–92	57	49–67
Rural area	145	86	81–92	55	47–64	32	71	57–90	64	48–85
Peripheral rural area[e]	74	85	77–94	55	43–70	19	75	56–101	49	28–84
Ethnicity[f]										
Danish	1393	85	84–87	54	51–57	303	81	76–85	56	50–62
Immigrant or descendant from western country	26	97	90–104	83	67–103	6	82	61–110	85	64–113
Immigrant or descendant from non-western country	26	101	–	95	83–108	5	101	–	79	52–120
Charlson comorbidity index[g]										
None	1010	88	86–90	56	53–60	216	79	74–85	58	52–66
1	247	86	81–91	56	49–63	53	87	78–97	44	32–61
⩾2	136	73	66–81	38	30–50	34	75	61–92	61	44–85
Depression										
No	1358	85	84–87	54	51–57	288	81	76–86	56	50–63
Yes	35	86	74–100	52	35–77	15	77	60–99	57	39–85
Schizophrenia or other psychosis										
No	1378	85	83–87	53	51–56	300	80	76–85	55	50–61
Yes	15	95	81–111	77	52–114	3	104	–	121	–

Table 4 – *continued*

a Ratio of observed survival of cancer patients and survival that would have been expected if the patients had had the same age-, period-, socioeconomic, demographic or health-related indicator-specific mortality as the total study population; for 'social class' and 'ethnicity', expected survival is adjusted only for age, not period, because of low power.
b Household income after taxation and interest, adjusted for number of persons in household; categorised by gender-specific distribution of household disposable income per person.
c For pensioners, work market affiliation before pension date was assigned and follow-up to age 69.
d Based on theory of creative class[21]: the creative core (e.g. researchers, designers, and architects), creative professionals (e.g. managers, business and finance, lawyers, and doctors), bohemians (e.g. artists and models), the service class (e.g. nurses, hairdressers, and caterers), the manual class (e.g. construction workers, transport and production workers) and the agricultural class (e.g. farmers and fishermen).
e More than 40 km to a local centre with adequate possibilities for employment and not sharing a border with a centre municipality.
f Excluded from the study population in all other analyses presented in Table 2.
g The presence of disorders, as defined in the Charlson index, was defined as an in- or outpatient contact with one of the diagnoses listed in Table 1 in[15] between 1978 and 2 years before the cancer diagnosis. Grouped according to the accumulated sum of scores.

Conflict of interest statement

None declared.

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REFERENCES

1. Engholm G, Storm H, Ferlay J, et al. *NORDCAN: cancer incidence, mortality and prevalence in the Nordic countries, version 3.1*. Association of Nordic Cancer Registries. Danish Cancer Society; 2008 http://www.ancr.nu.
2. Jemal A, Siegel R, Ward E, et al. Cancer statistics 2006. *CA Cancer J Clin* 2006;**56**:106–30.
3. Ries LAG, Harkins D, Krapcho M, et al. editors. *SEER cancer statistics review, 1975–2004*. Bethesda (MD): National Cancer Institute. <http://seer.cancer.gov/csr/1975_2004/>, based on November 2006 SEER data submission, posted to the SEER web site 2007.
4. Elwood JM, Pearson JC, Skippen DH, Jackson SM. Alcohol, smoking, social and occupational factors in the aetiology of cancer of the oral cavity, pharynx and larynx. *Int J Cancer* 1984;**34**:603–12.
5. Blot WJ, McLaughlin JK, Winn DM, et al. Smoking and drinking in relation to oral and pharyngeal cancer. *Cancer Res* 1988;**48**:3282–7.
6. Shavers VL, Harlan LC, Winn D, Davis WW. Racial/ethnic patterns of care for cancers of the oral cavity, pharynx, larynx, sinuses, and salivary glands. *Cancer Metast Rev* 2003;**22**:25–38.
7. Kogevinas M, Porta M. Socioeconomic differences in cancer survival: a review of the evidence. In: *Social inequalities and cancer*. In: Kogevinas M, Pearce N, Susser M, Boffetta P, editors. *IARC Scientific Publications*, vol. 138. Lyon: International Agency for Research on Cancer; 1997. p. 177–206.
8. Wong YK, Tsai WC, Lin JC, et al. Socio-demographic factors in the prognosis of oral cancer patients. *Oral Oncol* 2006;**42**:893–906.
9. Chen AY, Halpern M. Factors predictive of survival in advanced laryngeal cancer. *Arch Otolaryngol Head Neck Surg* 2007;**133**:1270–6.
10. Chen AY, Schrag NM, Halpern MH, Stewart A, Ward EM. Health insurance and stage at diagnosis of laryngeal cancer: does insurance type predict stage at diagnosis? *Arch Otolaryngol Head Neck Surg* 2007;**133**:784–90.
11. Greenberg RS, Haber MJ, Clark WS, et al. The relation of socioeconomic status to oral and pharyngeal cancer. *Epidemiology* 1991;**2**:194–200.
12. Bosetti C, Franceschi S, Negri E, Talamini R, Tomei F, La Vecchia C. Changing socioeconomic correlates for cancers of the upper digestive tract. *Ann Oncol* 2001;**12**: 327–30.
13. Menvielle G, Luce D, Goldberg P, Leclerc A. Smoking, alcohol drinking, occupational exposures and social inequalities in hypopharyngeal and laryngeal cancer. *Int J Epidemiol* 2004;**33**:799–806.
14. Paterson IC, John G, Adams JD. Effect of deprivation on survival of patients with head and neck cancer: a study of 20,131 cases. *Clin Oncol (R Coll Radiol)* 2002;**14**:455–8.
15. Dalton SO, Steding-Jessen M, Gislum M, et al. Social inequality and incidence of and survival from cancer in a population-based study in Denmark, 1994–2003: Background, aims, material and methods. *Eur J Cancer* 2008;**44**:1938–49.
16. Boyle P, Parkin DM. Statistical methods for registries. In: Jensen DM, Parkin DM, MacLennan R, Muir CS, Skeet RG, editors. *Cancer registration principles and methods*. Lyon: International Agency for Research on Cancer; 1991. p. 126–58.
17. Polesel J, Talamini R, La Vecchia C, et al. Tobacco smoking and the risk of upper aero-digestive tract cancers: a reanalysis of case-control studies using spline models. *Int J Cancer* 2008;**122**:2398–402.
18. Lissowska J, Pilarska A, Pilarski P, et al. Smoking, alcohol, diet, dentition and sexual practices in the epidemiology of oral cancer in Poland. *Eur J Cancer Prev* 2003;**12**:25–33.
19. Sanchez MJ, Martinez C, Nieto A, et al. Oral and oropharyngeal cancer in Spain: influence of dietary patterns. *Eur J Cancer Prev* 2003;**12**:49–56.
20. Kjaerheim K, Gaard M, Andersen A. The role of alcohol, tobacco, and dietary factors in upper aerogastric tract cancers: a prospective study of 10,900 Norwegian men. *Cancer Causes Control* 1998;**9**:99–108.
21. Florida R. *The rise of the creative class*. New york: Basic Books; 2002.