

ORIGINAL ARTICLE

## Trends in the survival of patients diagnosed with cancers in the respiratory system in the Nordic countries 1964–2003 followed up to the end of 2006

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### Abstract

**Background.** Previous studies have shown that there have been systematic differences between the Nordic countries in population-based relative survival of patients with respiratory cancer (lung, pleura, larynx, nose and sinuses). **Material and methods.** Relative survival of patients with respiratory cancer diagnosed in the Nordic countries in 1964–2003 and followed up to the end of 2006 was studied and contrasted with developments in incidence and mortality. **Results.** For cancer of the lung, relative survival is lower in Danish patients than in the other countries during the first months of follow-up after diagnosis. For cancer of pleura, the relative survival ratios indicate that there may be problems in the official coding of the causes of death in Denmark, Norway and Sweden. There has been little improvement in survival of patients with cancer of the respiratory organs in the Nordic countries over time. **Conclusions.** The slightly lower survival of Danish lung cancer patients may be related to a less favourable stage distribution and to an increased prevalence of causal factors, affecting the mortality due to competing risks of death. A reclassification of official causes of death at the cancer registry may be needed for cancer of the pleura in order to make the corresponding mortality rates comparable between countries.

**Key Words:** *relative survival, excess mortality, cancer registry, population-based, lung cancer*

Lung cancer is the second most common cancer in both men and women in the Nordic countries combined, with rates only superseded by prostate and breast cancer, respectively, while it is the most common cause of cancer death. The annual number of incident cancers in 1999–2003 was more than 11 000 and there were more than 10 000 deaths [1]. Of all cancer cases diagnosed in the Nordic countries (excluding non-melanoma skin) in 1999–2003, 11.1% in males and 7.4% in females were located at the lung. The main risk factor is tobacco smoking [2]. The age-standardised 5-year relative survival ratios have diverged 1958–1987 with the disparity in survival increasing in Denmark relative to the other countries [3]. The most important underlying factor for these differences is likely the unfavourable stage distribution in Denmark, but differences in comorbidity due to the high prevalence of smoking in

Denmark [2] could also play a role [4]. The recent EURO CARE-4 study showed that the 5-year relative survival ratios in Iceland and Sweden were amongst the highest in Europe, whereas the Danish patient survival was amongst the lowest [5–7].

Cancer of the pleura is one of the more rare cancer sites with 360 cases diagnosed per year in the Nordic countries in the period 1999–2003, constituting 0.5% of the male cancer cases and 0.1% of the female cancers. The numbers of deaths reported over the same period were 220 per year [1]. The main risk factor is asbestos with multiplicative effects in combination with tobacco smoking [8]. The cancer occurs commonly in older persons aged over 75, and is seldomly observed before the age of 50. There have been few sets of comparative Nordic relative survival data published. The EURO CARE-4 study reported that for patients diagnosed in 1995–1999,

the age-standardised 5-year relative survival ratios were 7.5% and 3.5% for Finland and Norway, respectively [7]. In Denmark and Sweden, only 1-year relative survival could be calculated due to few numbers across age strata. Overall, the European data reported low relative survival ratios that did not significantly differ by sex (6.5% in males, 10.1% in females).

Larynx cancer is a relatively rare cancer in the Nordic countries but one that is markedly more common among men than women. During the period 1999–2003, 1% of all new cancers were located at the larynx, with around 85% diagnosed among males. Rates in this period differed between the Nordic countries, with the highest incidence rates seen in men in Denmark (4.6 per 100 000) and women in Iceland (1.3) while the lowest rates were observed in Swedish men (2.0) and Finnish women (0.2) [1]. The main risk factors are tobacco smoking, alcohol drinking, and the interaction between these two habits [9]. The 5-year relative survival in patients diagnosed 1995–1999 varied considerably between the Nordic countries, from 58% in Iceland to 71% in Sweden [7]. In a Nordic study of relative survival trends 1958–1987, the 5-year age-standardised survival among male larynx cancer patients was close to 60% throughout the study period 1958–1987 except for a low Finnish estimate before 1968 [3].

Cancers of the nose, nasal cavities, middle ear and accessory sinuses are collectively a rare cancer form in most western countries, with world age-standardised rates in the Nordic countries less than 1 per 100 000. In 1999–2003, these cancers constituted about 0.2% in males and females in the Nordic countries. The incidence is lower among women than men [1], possibly a result of a differential in the prevalence of certain occupational and lifestyle exposures including wood dust and cigarette smoke; ionising radiation (thorotrast and radon) may also elevate the risk [10]. Five-year relative survival compilations of European survival for patients diagnosed during the years 1995–1999 have reported large variations in the Nordic countries, with ratios ranging from 41% in Finland through to 61% in Sweden [7].

In this study, the relative survival and excess mortality observed in the Nordic patients in 1964–2003 is contrasted with developments seen in the incidence and mortality rates over the same period. The aim is to provide some insight into the developments observed.

## Material and methods

Lung cancer was defined as the ICD-10 code C33–34, cancer of the pleura as C38, cancer of the larynx as C32 and that of the nose and sinuses as

C30–31. The materials and methods are described in detail in an earlier article in this issue [11]. In brief, the NORDCAN database contains comparable data on cancer incidence and mortality in the Nordic countries, as delivered by the national cancer registries, with follow-up information on death or emigration for each cancer patient available up to and including 2006.

Sex-specific 5-year relative survival was calculated for each of the diagnostic groups in each country for eight 5-year periods from 1964–1968 to 1999–2003. For the last 5-year period, so-called hybrid methods were used. Country-specific population mortality rates were used for calculating the expected survival. Age-standardisation used the weights of the International Cancer Survival Standard (ICSS) cancer patient populations [12]. We present age-standardised (World) incidence and mortality rates, 5-year relative survival, and excess mortality rates for the follow-up periods of within one month, 1–3 months and 2–5 years following diagnosis, as well as age-specific 5-year relative survival by country, sex and 5-year period.

## Results

### *Cancer of the lung*

*Incidence and mortality.* Denmark had the highest age-standardised incidence (45 per 100 000) in males in 2003, after a large reduction in incidence in Finland from 79 in 1970 to 36 per 100 000 three decades later (Figure 1). The most recent incidence rates place Sweden as the lowest risk country. The incidence rates in males have been decreasing in Finland since 1970, in Denmark since 1985, and in Sweden since 1980, whereas the rates have, after an initial increase remained stable in Iceland and Norway since the mid-1980s. The incidence rates in females have increased in each of the Nordic countries. The increase is strongest in Denmark and Iceland and weakest in Finland. The mortality trends closely followed those of incidence reflecting the very unfavourable survival of the patients in general (Figure 1).

*Survival.* There were few differences in the age-standardised 5-year relative survival ratios between countries (Figure 1, Table I). The Danish ratios were inferior to those in the other Nordic countries, particularly in females. The ratios were slightly higher in females than in males and in general they increased slowly over time. In the last 15 years, however, no change in survival could be observed for males in Finland or Iceland.

The improvement in relative survival was partly attributable to a decrease in the excess death rates of

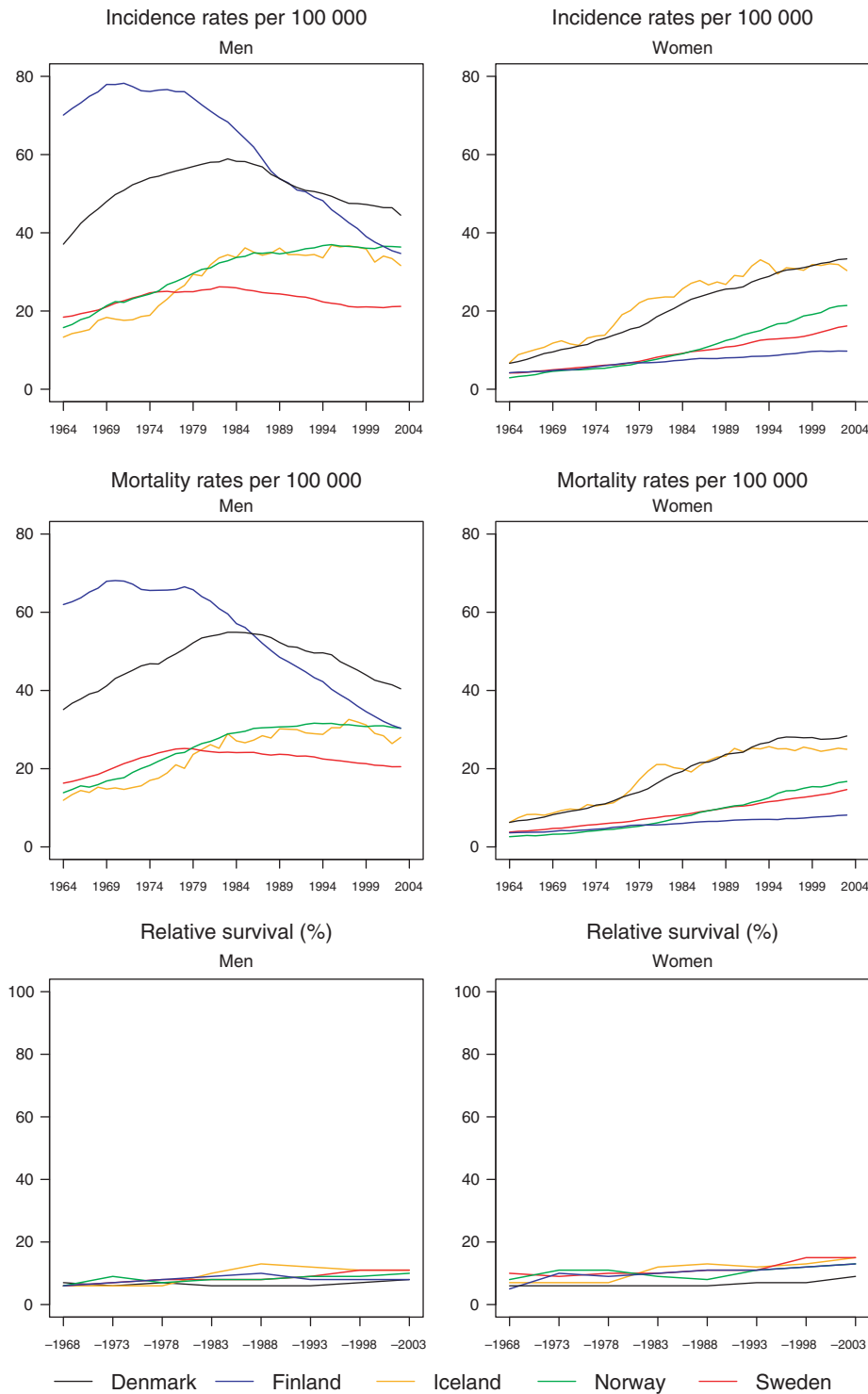


Figure 1. Trends in age-standardised (World) incidence and mortality rates per 100 000 and age-standardised (ICSS) 5-year relative survival for patients of lung cancer by sex and country. Nordic cancer survival study 1964–2003.

the patients during the first three months after diagnosis (Figure 2). The inter-country differences were also partially explained by survival differences in these early months of follow-up. The 5-year relative survival was markedly higher in younger patients irrespective of population (Table II). In general, few notable changes were observable over time.

#### Cancer of the pleura

**Incidence and mortality.** There has been a strong increase in the incidence in males in all countries, whereas female rates have been fairly constant over the last two decades (Figure 3). Of the Nordic countries, cancer of the pleura has tended to be

Table I. Trends in survival for lung cancer by sex and country. Number of tumours (N) included and the 5-year age-standardised (ICSS) relative survival in percent with 95% confidence intervals (RS (CI)). Nordic cancer survival study 1964–2003.

	Denmark		Finland		Iceland		Norway		Sweden	
	N	RS (CI)	N	RS (CI)	N	RS (CI)	N	RS (CI)	N	RS (CI)
<b>Men</b>										
1964–1968	6 289	7 (6–8)	8 024	6 (5–6)	64	6 (3–11)	2 263	6 (5–7)	5 742	6 (6–7)
1969–1973	8 395	6 (6–7)	9 062	7 (6–7)	86	6 (3–11)	3 005	9 (8–11)	7 205	7 (7–8)
1974–1978	9 751	7 (6–7)	9 554	8 (7–9)	125	6 (3–12)	3 897	7 (6–8)	7 656	8 (7–8)
1979–1983	10 670	6 (5–7)	9 550	9 (8–9)	190	10 (7–16)	4 741	8 (7–8)	7 786	8 (8–9)
1984–1988	10 586	6 (5–6)	9 100	10 (9–11)	232	13 (8–21)	5 521	8 (7–9)	8 173	8 (7–9)
1989–1993	9 877	6 (6–7)	8 070	8 (7–9)	264	12 (8–18)	5 694	9 (8–9)	8 071	9 (8–10)
1994–1998	9 681	7 (6–7)	7 918	8 (8–9)	309	11 (8–15)	6 132	9 (9–10)	7 873	11 (10–11)
1999–2003	10 137	8 (7–9)	7 369	8 (8–9)	312	11 (9–15)	6 559	10 (9–10)	7 992	11 (10–12)
<b>Women</b>										
1964–1968	1 265	6 (5–8)	653	5 (4–7)	42	7 (4–13)	502	8 (6–11)	1 468	10 (8–11)
1969–1973	1 955	6 (5–8)	774	10 (7–13)	61	7 (4–13)	758	11 (9–13)	1 902	9 (7–10)
1974–1978	2 644	6 (5–7)	1 100	9 (7–11)	93	7 (4–14)	917	11 (9–13)	2 060	10 (8–11)
1979–1983	3 656	6 (5–7)	1 335	10 (8–12)	158	12 (7–18)	1 264	9 (8–11)	2 646	10 (9–12)
1984–1988	4 757	6 (5–6)	1 669	11 (10–13)	201	13 (8–19)	1 772	8 (7–10)	3 348	11 (10–12)
1989–1993	5 463	7 (6–7)	1 909	11 (10–13)	232	12 (8–17)	2 410	11 (10–12)	4 072	11 (10–12)
1994–1998	6 665	7 (7–8)	2 278	12 (11–14)	277	13 (10–18)	3 041	12 (11–13)	4 930	15 (14–16)
1999–2003	7 851	9 (8–9)	2 654	13 (12–14)	318	15 (12–19)	3 958	13 (12–14)	6 108	15 (15–16)

Numbers in *italics* indicate that two or more cells had to be combined to get sufficient number of patients to calculate survival.

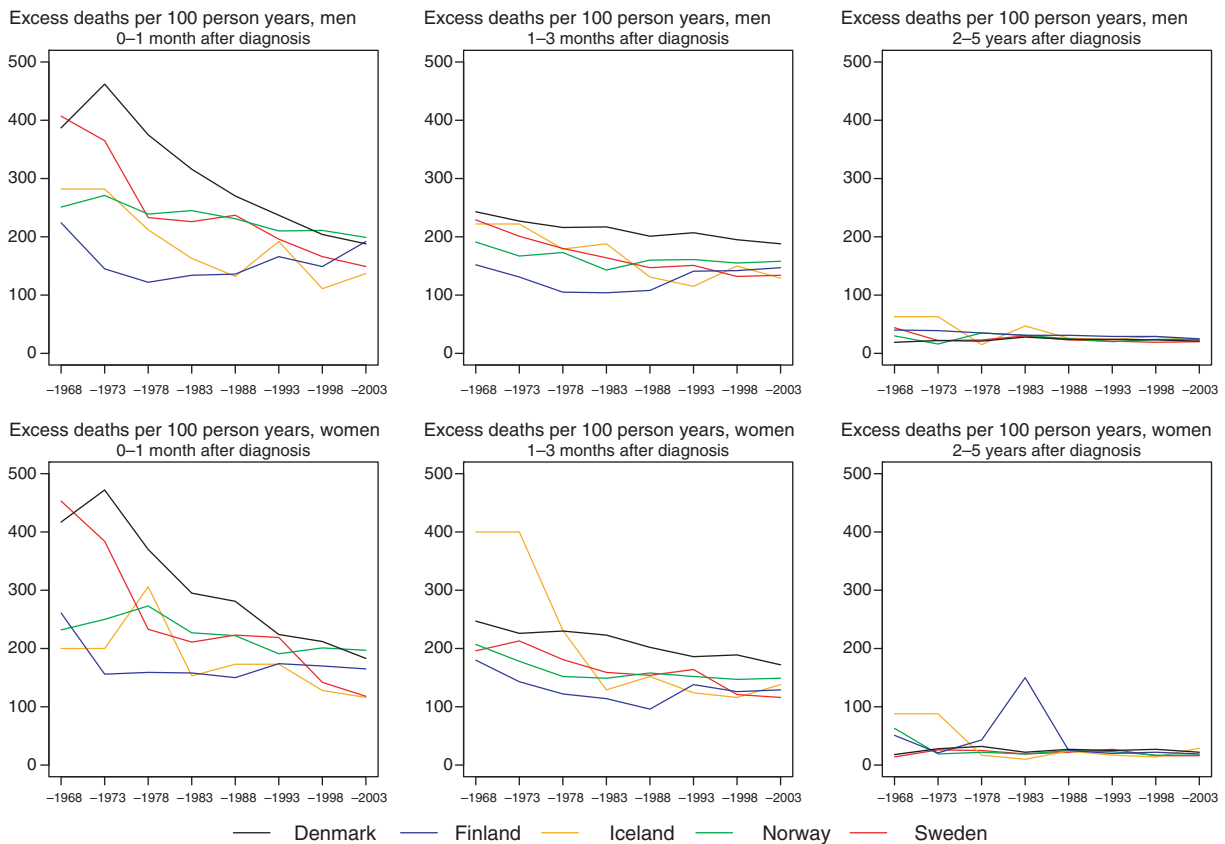


Figure 2. Trends in age-standardised (ICSS) excess death rates per 100 person years for lung cancer by sex, country, and time since diagnosis. Nordic cancer survival study 1964–2003.

Table II. Trends in 5-year age-specific relative survival in percent after lung cancer by sex and country. Nordic cancer survival study 1964–2003.

Age	Men						Women					
	0–49	50–59	60–69	70–79	80–89	90+	0–49	50–59	60–69	70–79	80–89	90+
<b>Denmark</b>												
1964–1968	11	11	8	3	3	0	10	12	6	4	2	0
1969–1973	13	10	7	3	1	0	13	11	6	4	1	0
1974–1978	14	11	8	3	3	0	12	11	7	3	1	0
1979–1983	13	9	7	3	1	0	11	10	7	3	3	0
1984–1988	11	8	7	3	2	0	8	9	6	4	2	0
1989–1993	10	9	8	5	1	0	14	9	8	4	1	0
1994–1998	11	8	8	5	1	0	12	11	9	4	1	22
1999–2003	15	10	9	6	3	3	15	12	10	7	2	1
<b>Finland</b>												
1964–1968	15	9	6	2	0	0	12	11	7	1	0	*
1969–1973	14	12	7	3	1	0	20	13	9	3	10	0
1974–1978	16	14	8	4	2	0	16	16	11	5	0	0
1979–1983	14	15	10	5	3	0	17	16	10	8	0	0
1984–1988	16	13	13	7	1	0	22	14	14	7	4	0
1989–1993	9	13	10	5	2	0	18	15	13	8	3	0
1994–1998	15	10	9	7	3	0	16	18	13	10	6	0
1999–2003	13	11	10	6	3	0	21	19	15	9	5	2
<b>Iceland</b>												
1964–1968	<i>15</i>	<i>8</i>	<i>11</i>	*	*	*	<i>28</i>	<i>14</i>	<i>4</i>	*	*	*
1969–1973	<i>15</i>	<i>8</i>	<i>11</i>	*	*	*	<i>28</i>	<i>14</i>	<i>4</i>	*	*	*
1974–1978	17	8	7	4	*	*	20	13	9	*	*	*
1979–1983	19	15	13	6	*	*	15	18	17	7	*	*
1984–1988	29	13	10	11	10	*	29	20	11	7	7	*
1989–1993	27	13	13	9	6	*	19	15	10	12	6	*
1994–1998	22	16	8	11	0	*	22	20	19	8	*	*
1999–2003	23	14	11	11	1	*	41	16	20	8	*	*
<b>Norway</b>												
1964–1968	11	10	7	5	0	*	21	14	11	2	0	*
1969–1973	14	11	10	5	9	0	25	12	12	7	3	*
1974–1978	17	11	9	2	0	0	25	13	12	6	2	*
1979–1983	13	12	9	5	1	0	12	12	10	8	5	0
1984–1988	10	11	10	6	1	0	15	12	10	5	3	0
1989–1993	15	11	10	6	3	0	28	14	10	8	4	0
1994–1998	21	12	10	6	2	0	17	14	14	10	4	0
1999–2003	19	14	10	7	2	0	24	18	14	9	4	0
<b>Sweden</b>												
1964–1968	14	11	7	3	0	0	21	15	10	4	3	0
1969–1973	17	12	7	3	1	0	19	16	10	3	1	0
1974–1978	10	13	10	4	2	0	19	12	12	6	1	0
1979–1983	15	12	10	6	0	0	17	15	12	8	3	0
1984–1988	13	10	10	6	1	0	19	15	13	8	1	0
1989–1993	17	12	9	7	2	0	17	17	13	10	0	0
1994–1998	22	13	10	8	4	0	20	18	17	15	4	0
1999–2003	19	13	11	9	6	0	28	17	17	13	6	0

Numbers in *italics* indicate that two or more cells had to be combined to get sufficient number of patients to calculate survival.

\*Too few patients to calculate survival, see ref. [11].

most common in Denmark in both sexes. In males, Norway has been catching up with Denmark during the most recent two decades. In Swedish males – and possibly also in Icelandic males – the incidence has not increased in the most recent decade. In females, the higher Danish rates have been decreasing since the mid-1970s and currently they equal the rates observed among Finnish females.

The age-standardised incidence rates for 1999–2003 ranged in males from 0.8 per 100 000 (Iceland) to 1.7 (Denmark), and in females between 0.1 and 0.3 per 100 000.

The mortality rates in recent years convey a very different temporal pattern compared to that of incidence in Denmark, Norway and Sweden. There have been substantial decreases in Denmark and

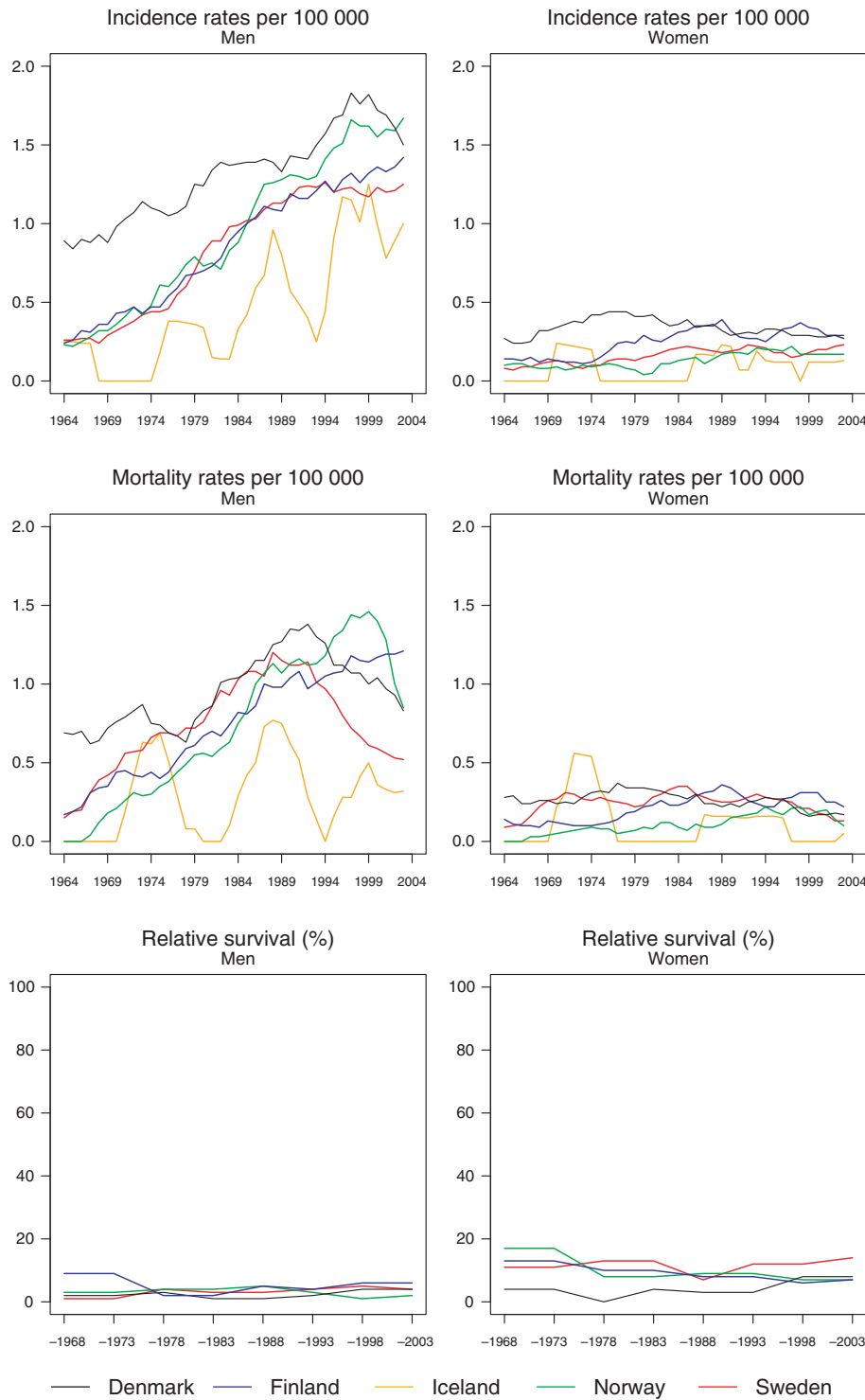


Figure 3. Trends in age-standardised (World) incidence and mortality rates per 100 000 and age-standardised (ICSS) 5-year relative survival for patients of cancer of the pleura by sex and country. Nordic cancer survival study 1964–2003.

Sweden since 1990 and in Norway since 1999. In females, however, the changes are less apparent with time. The decreases in mortality in women in Denmark and Sweden are some five years ahead of the corresponding rates in men, but both exhibit a similar rate of decline.

*Survival.* The declines in mortality in males do not seem to be followed or accompanied by increments in 5-year relative survival in Denmark or Sweden (Figure 3, Table III). The age-standardised 5-year relative survival ratios have in any case remained low, between 2% and 6% in males and

Table III. Trends in survival for cancer of the pleura by sex and country. Number of tumours (N) included and the 5-year age-standardised (ICSS) relative survival in percent with 95% confidence intervals (RS (CI)). Nordic cancer survival study 1964–2003.

	Denmark		Finland		Iceland		Norway		Sweden	
	N	RS (CI)	N	RS (CI)	N	RS (CI)	N	RS (CI)	N	RS (CI)
<b>Men</b>										
1964–1968	137	2 (1–6)	34	9 (2–41)	1	*	31	3 (1–10)	79	1 (0–7)
1969–1973	173	2 (1–8)	41	9 (2–41)	0	*	54	3 (1–10)	106	1 (0–6)
1974–1978	183	3 (1–9)	64	2 (0–7)	1	*	87	4 (1–11)	128	4 (1–10)
1979–1983	237	1 (0–4)	86	2 (0–7)	4	*	123	4 (1–11)	247	3 (1–6)
1984–1988	244	1 (0–4)	150	5 (2–10)	3	*	174	5 (3–11)	320	3 (1–5)
1989–1993	277	2 (1–7)	182	4 (2–9)	3	*	211	3 (1–8)	408	4 (3–7)
1994–1998	326	4 (2–6)	225	6 (3–13)	8	*	266	1 (0–4)	446	5 (3–8)
1999–2003	363	4 (2–6)	251	6 (4–9)	7	*	296	2 (1–4)	465	4 (3–6)
<b>Women</b>										
1964–1968	42	4 (1–9)	18	13 (7–26)	0	*	15	17 (7–45)	29	11 (5–23)
1969–1973	72	4 (1–9)	19	13 (7–26)	1	*	10	17 (7–45)	40	11 (5–23)
1974–1978	91	0 (–)	28	10 (5–20)	0	*	18	8 (2–30)	32	13 (7–23)
1979–1983	95	4 (1–13)	46	10 (5–20)	0	*	9	8 (2–30)	59	13 (7–23)
1984–1988	84	3 (1–8)	76	8 (3–18)	1	*	30	9 (4–20)	73	7 (3–16)
1989–1993	67	3 (1–8)	71	8 (3–21)	1	*	36	9 (4–20)	81	12 (6–23)
1994–1998	78	8 (5–14)	79	6 (3–16)	1	*	40	7 (3–17)	78	13 (7–23)
1999–2003	79	8 (5–14)	80	7 (3–15)	1	*	40	7 (3–17)	95	14 (9–24)

Numbers in *italics* indicate that two or more cells had to be combined to get sufficient number of patients to calculate survival.

\*Too few patients to calculate survival, see ref. [11].

0(–) No patients survived 5 years.

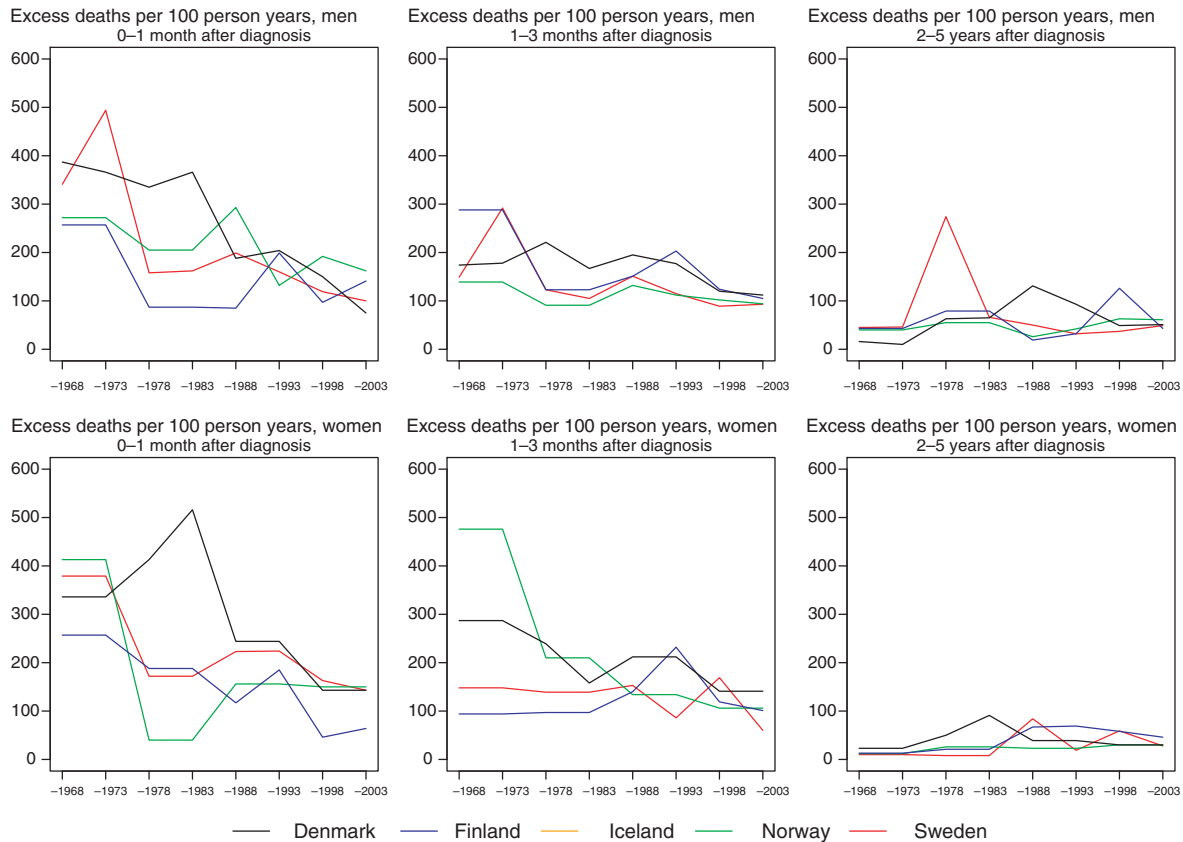


Figure 4. Trends in age-standardised (ICSS) excess death rates per 100 person years for cancer of the pleura by sex, country, and time since diagnosis. Nordic cancer survival study 1964–2003. No Icelandic curves. Too few patients to calculate survival for Iceland.

Table IV. Trends in 5-year age-specific relative survival in percent after cancer of the pleura by sex and country. Nordic cancer survival study 1964–2003.

Age	Men						Women					
	0–49	50–59	60–69	70–79	80–89	90+	0–49	50–59	60–69	70–79	80–89	90+
<b>Denmark</b>												
1964–1968	5	4	3	0	0	*	<i>18</i>	<i>0</i>	5	0	0	*
1969–1973	6	0	2	4	0	*	<i>18</i>	<i>0</i>	5	0	0	*
1974–1978	20	0	0	3	0	*	0	0	.	0	0	*
1979–1983	4	2	2	0	0	*	13	0	0	4	10	*
1984–1988	0	0	0	4	0	*	<i>17</i>	<i>0</i>	3	0	0	*
1989–1993	20	0	0	0	0	*	<i>17</i>	<i>0</i>	3	0	0	*
1994–1998	0	7	8	1	0	*	23	11	6	5	2	*
1999–2003	3	7	5	3	1	*	23	11	6	5	2	*
<b>Finland</b>												
1964–1968	0	6	0	0	51	*	37	37	9	0	*	*
1969–1973	0	6	0	0	51	*	37	37	9	0	*	*
1974–1978	0	0	3	4	0	*	12	12	17	7	0	*
1979–1983	0	0	3	4	0	*	12	12	17	7	0	*
1984–1988	0	5	3	10	0	*	12	12	9	5	0	*
1989–1993	12	5	4	3	0	*	11	11	0	16	0	*
1994–1998	0	12	4	2	15	*	17	17	6	0	0	*
1999–2003	12	12	5	3	0	*	9	9	15	2	0	*
<b>Norway</b>												
1964–1968	0	6	8	0	0	*	18	18	18	26	*	*
1969–1973	0	6	8	0	0	*	18	18	18	26	*	*
1974–1978	17	6	3	0	0	*	7	7	7	14	*	*
1979–1983	17	6	3	0	0	*	7	7	7	14	*	*
1984–1988	16	9	2	5	0	*	13	13	13	5	0	*
1989–1993	11	3	2	2	0	*	13	13	13	5	0	*
1994–1998	0	3	2	0	0	*	12	12	12	2	0	*
1999–2003	0	4	2	1	3	0	12	12	12	2	0	*
<b>Sweden</b>												
1964–1968	0	6	0	0	0	*	16	16	18	6	0	*
1969–1973	0	5	0	0	0	*	16	16	18	6	0	*
1974–1978	7	12	3	0	0	*	23	23	9	4	16	*
1979–1983	0	10	4	0	0	*	23	23	9	4	16	*
1984–1988	6	6	1	2	0	*	14	14	11	0	0	*
1989–1993	9	5	6	3	0	*	29	29	5	8	0	*
1994–1998	6	7	8	4	0	*	8	8	37	0	0	*
1999–2003	4	9	4	2	1	0	19	19	21	4	13	*

Numbers in *italics* indicate that two or more cells had to be combined to get sufficient number of patients to calculate survival.

\*Too few patients to calculate survival. Iceland not shown for the same reason, see ref. [11].

between 7% and 14% in females. The ratios in Swedish female patients have had a tendency to be higher than those in female patients in the other Nordic countries. The Icelandic numbers are too small to allow estimation of relative survival ratios.

The excess death rates of the patients during the first three months have tended to decline with calendar time (Figure 4). No systematic differences between countries can be seen, in part related to the inherent random variation associated with these estimations.

The age-specific trends in 5-year survival are hard to interpret because of the few numbers involved (Table IV). In Swedish and Finnish females, the younger patients appear to have a higher relative survival than older patients.

### Cancer of the larynx

*Incidence and mortality.* Among men, the incidence rates varied between countries and over time. Finland started with the highest incidence of about 7 per 100 000, but the rates steadily decreased over the period to around 2 by 2003 (Figure 5). In all the other countries, rates increased initially but then reached a plateau and subsequently fell, although the calendar year at which the decline began to emerge varied considerably by population. To illustrate, rates began to fall in the mid-1970s in Sweden but as late as the mid-1990s in Denmark.

Among women, rates appear rather flat on this scale, although evidently rates are higher and were increasing in women in Denmark in a manner similar



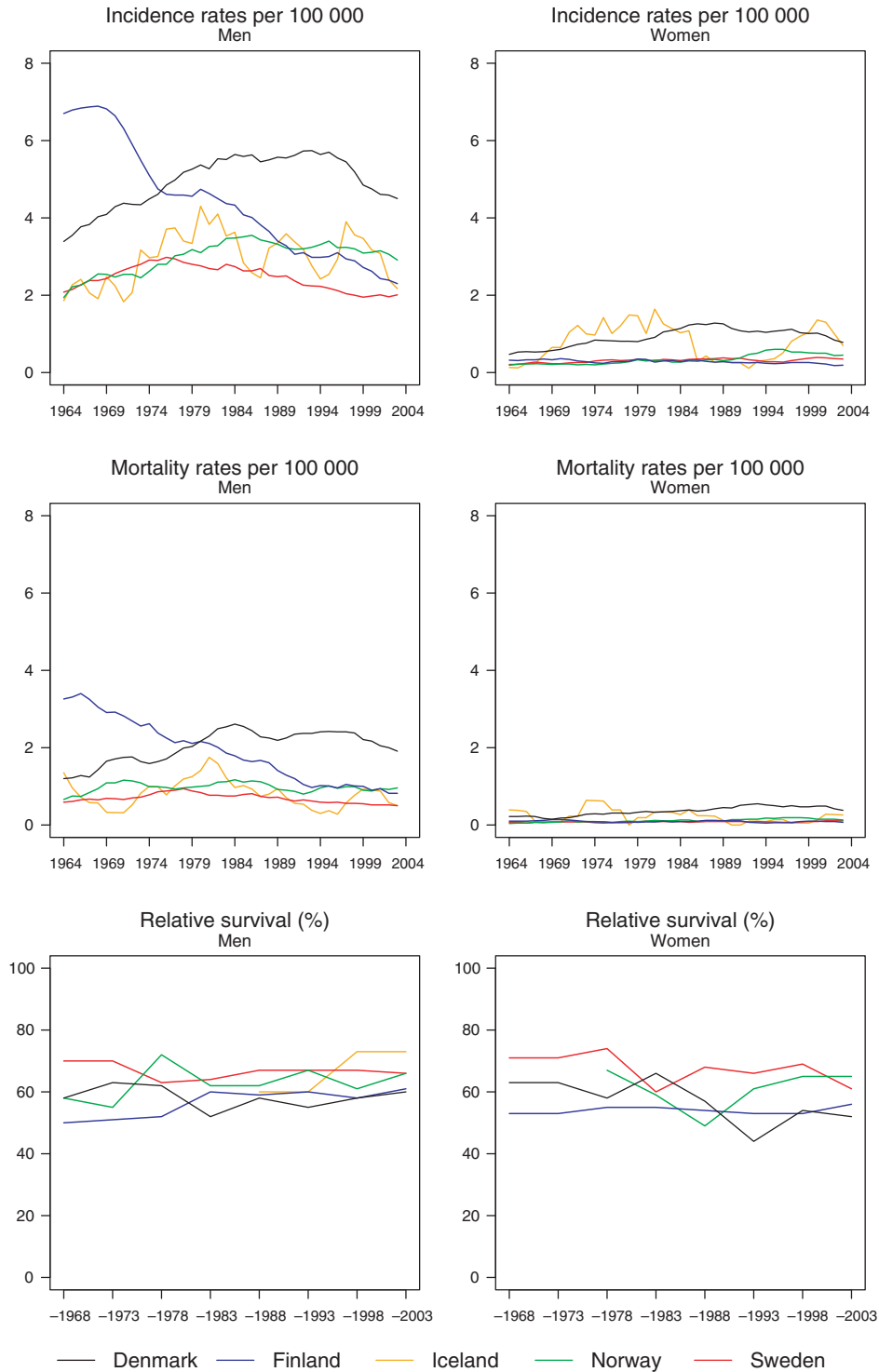


Figure 5. Trends in age-standardised (World) incidence and mortality rates per 100 000 and age-standardised (ICSS) 5-year relative survival for patients of laryngeal cancer by sex and country. Nordic cancer survival study 1964–2003.

to that observed in men. The mortality patterns reflect those of incidence, although the absolute level of rates is diminished by about one-half (Figure 5).

*Survival.* Any increases in 5-year relative survival among men are very slight over the study years, while

the survival patterns among women are quite flat (Figure 5). Sweden appears most consistently as the country with the highest survival in both sexes and over time (Table V).

Among men, the most substantive variation in excess mortality is within the first three months, but

Table V. Trends in survival for laryngeal cancer by sex and country. Number of tumours (N) included and the 5-year age-standardised (ICSS) relative survival in percent with 95% confidence intervals (RS (CI)). Nordic cancer survival study 1964–2003.

	Denmark		Finland		Iceland		Norway		Sweden	
	N	RS (CI)	N	RS (CI)	N	RS (CI)	N	RS (CI)	N	RS (CI)
<b>Men</b>										
1964–1968	579	58 (52–65)	773	50 (41–60)	11	*	291	58 (50–67)	659	70 (64–76)
1969–1973	727	63 (56–69)	766	51 (43–60)	9	*	346	55 (48–63)	830	70 (64–76)
1974–1978	842	62 (56–67)	592	52 (45–59)	20	*	397	72 (64–81)	967	63 (58–67)
1979–1983	931	52 (48–57)	642	60 (53–68)	22	*	484	62 (56–69)	907	64 (60–69)
1984–1988	1010	58 (53–62)	584	59 (53–66)	19	<i>60 (46–78)</i>	542	62 (56–68)	900	67 (63–72)
1989–1993	1037	55 (51–60)	493	60 (54–67)	25	<i>60 (46–78)</i>	502	67 (61–74)	844	67 (63–72)
1994–1998	1060	58 (54–63)	546	58 (52–64)	24	<i>73 (59–91)</i>	506	61 (56–67)	787	67 (63–71)
1999–2003	962	60 (57–64)	488	61 (56–66)	30	<i>73 (59–91)</i>	548	66 (62–71)	794	66 (63–69)
<b>Women</b>										
1964–1968	88	63 (53–76)	51	53 (42–67)	1	*	28	*	69	71 (57–88)
1969–1973	120	63 (53–76)	54	53 (42–67)	5	*	34	*	73	71 (57–88)
1974–1978	153	58 (48–71)	50	55 (45–68)	6	*	38	67 (48–94)	106	74 (62–90)
1979–1983	174	66 (56–78)	50	55 (45–68)	10	*	59	59 (46–75)	101	60 (48–74)
1984–1988	243	57 (49–65)	65	54 (40–71)	3	*	51	49 (37–64)	127	68 (58–80)
1989–1993	222	44 (37–52)	57	53 (41–69)	3	*	67	61 (49–75)	134	66 (57–76)
1994–1998	228	54 (46–64)	63	53 (40–71)	4	*	103	65 (55–78)	112	69 (59–81)
1999–2003	220	52 (46–59)	57	56 (45–70)	9	*	96	65 (56–75)	158	61 (54–68)

Numbers in *italics* indicate that two or more cells had to be combined to get sufficient number of patients to calculate survival.

\*Too few patients to calculate survival, see ref. [11].

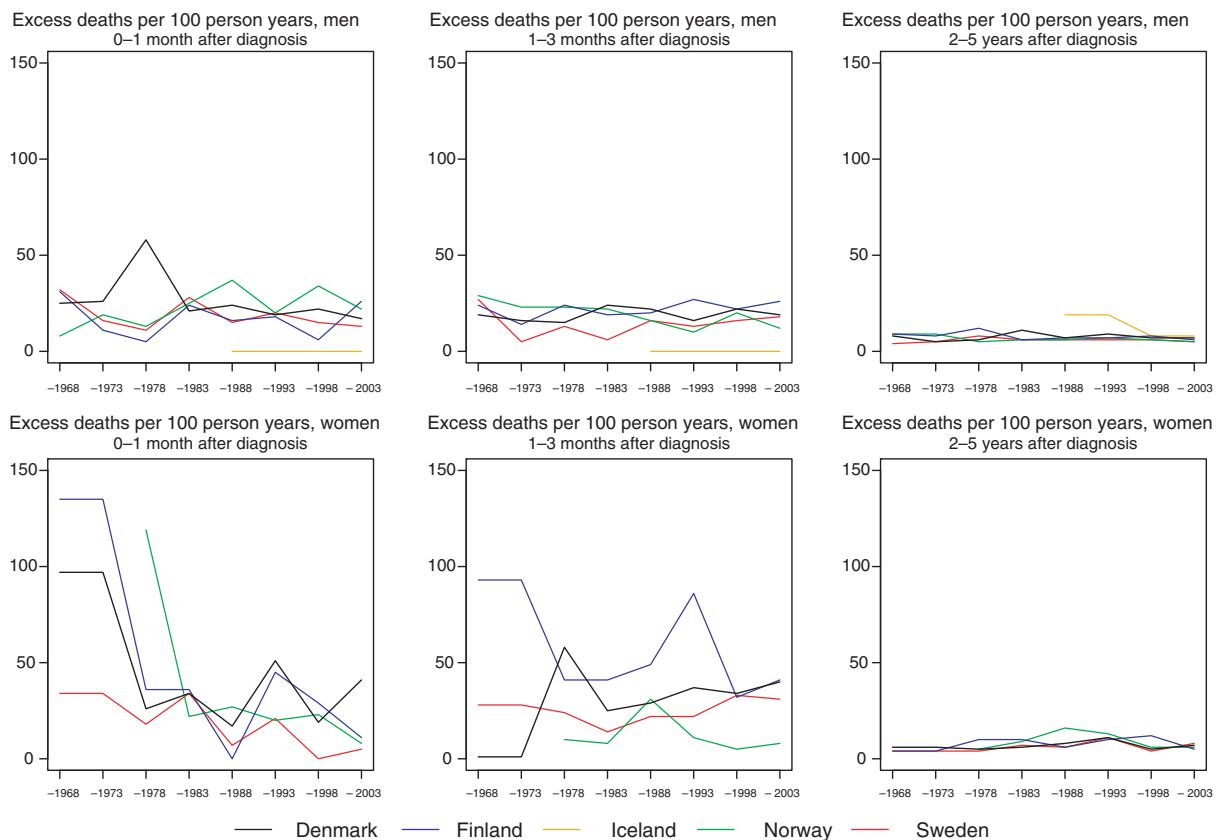


Figure 6. Trends in age-standardised (ICSS) excess death rates per 100 person years for laryngeal cancer by sex, country, and time since diagnosis. Nordic cancer survival study 1964–2003.

Table VI. Trends in 5-year age-specific relative survival in percent after laryngeal cancer by sex and country. Nordic cancer survival study 1964–2003.

Age	Men						Women					
	0–49	50–59	60–69	70–79	80–89	90+	0–49	50–59	60–69	70–79	80–89	90+
Denmark												
1964–1968	76	65	54	66	26	*	<i>71</i>	<i>68</i>	<i>59</i>	<i>33</i>	<i>118</i>	*
1969–1973	60	66	62	59	68	*	<i>71</i>	<i>68</i>	<i>59</i>	<i>33</i>	<i>118</i>	*
1974–1978	67	60	67	54	64	*	<i>72</i>	<i>75</i>	<i>49</i>	<i>38</i>	<i>85</i>	*
1979–1983	64	57	57	45	41	*	<i>83</i>	<i>76</i>	<i>64</i>	<i>60</i>	<i>58</i>	*
1984–1988	66	61	60	59	39	179	<i>74</i>	<i>74</i>	<i>59</i>	<i>53</i>	<i>26</i>	*
1989–1993	62	56	57	55	46	*	<i>63</i>	<i>43</i>	<i>48</i>	<i>48</i>	<i>15</i>	*
1994–1998	63	62	58	54	59	*	<i>75</i>	<i>62</i>	<i>64</i>	<i>39</i>	<i>43</i>	*
1999–2003	71	55	60	61	56	48	<i>77</i>	<i>58</i>	<i>63</i>	<i>43</i>	<i>26</i>	*
Finland												
1964–1968	65	59	56	35	43	*	<i>75</i>	<i>75</i>	<i>67</i>	<i>46</i>	<i>0</i>	*
1969–1973	69	65	50	49	27	*	<i>75</i>	<i>75</i>	<i>67</i>	<i>46</i>	<i>0</i>	*
1974–1978	78	62	54	46	26	*	<i>83</i>	<i>83</i>	<i>58</i>	<i>35</i>	<i>35</i>	*
1979–1983	65	62	57	59	61	*	<i>83</i>	<i>83</i>	<i>58</i>	<i>35</i>	<i>35</i>	*
1984–1988	77	67	56	53	51	*	<i>51</i>	<i>51</i>	<i>66</i>	<i>55</i>	<i>33</i>	*
1989–1993	59	63	64	58	55	*	<i>68</i>	<i>68</i>	<i>68</i>	<i>40</i>	<i>24</i>	*
1994–1998	60	58	60	61	44	*	<i>68</i>	<i>68</i>	<i>49</i>	<i>41</i>	<i>56</i>	*
1999–2003	64	65	63	59	52	*	<i>55</i>	<i>55</i>	<i>47</i>	<i>59</i>	<i>68</i>	*
Iceland												
1964–1968	66	66	16	72	*	*	*	*	*	*	*	*
1969–1973	66	66	16	72	*	*	*	*	*	*	*	*
1974–1978	65	65	65	69	*	*	*	*	*	*	*	*
1979–1983	65	65	65	69	*	*	*	*	*	*	*	*
1984–1988	80	80	88	14	59	*	*	*	*	*	*	*
1989–1993	80	80	88	14	59	*	*	*	*	*	*	*
1994–1998	78	78	81	73	50	*	*	*	*	*	*	*
1999–2003	78	78	81	73	50	*	*	*	*	*	*	*
Norway												
1964–1968	77	75	64	53	21	*	<i>76</i>	<i>76</i>	<i>78</i>	<i>0</i>	<i>99</i>	*
1969–1973	63	68	58	59	23	*	<i>76</i>	<i>76</i>	<i>78</i>	<i>0</i>	<i>99</i>	*
1974–1978	85	71	62	48	127	*	<i>63</i>	<i>63</i>	<i>62</i>	<i>69</i>	<i>79</i>	*
1979–1983	74	65	62	67	39	*	<i>78</i>	<i>78</i>	<i>69</i>	<i>46</i>	<i>26</i>	*
1984–1988	66	73	66	61	38	*	<i>65</i>	<i>65</i>	<i>71</i>	<i>37</i>	<i>0</i>	*
1989–1993	78	68	65	60	73	*	<i>76</i>	<i>76</i>	<i>76</i>	<i>24</i>	<i>75</i>	*
1994–1998	64	69	66	56	51	*	<i>83</i>	<i>83</i>	<i>47</i>	<i>55</i>	<i>85</i>	*
1999–2003	70	74	64	64	61	*	<i>76</i>	<i>76</i>	<i>64</i>	<i>50</i>	<i>73</i>	*
Sweden												
1964–1968	85	75	68	65	66	*	<i>87</i>	<i>85</i>	<i>69</i>	<i>53</i>	<i>81</i>	*
1969–1973	80	80	68	67	57	*	<i>87</i>	<i>85</i>	<i>69</i>	<i>53</i>	<i>81</i>	*
1974–1978	78	75	65	63	32	*	101	79	64	79	57	*
1979–1983	79	64	65	64	53	*	<i>76</i>	<i>85</i>	<i>43</i>	<i>50</i>	<i>67</i>	*
1984–1988	78	69	63	58	84	*	<i>85</i>	<i>67</i>	<i>67</i>	<i>62</i>	<i>69</i>	*
1989–1993	71	70	71	63	62	*	<i>84</i>	<i>74</i>	<i>69</i>	<i>72</i>	<i>25</i>	*
1994–1998	77	70	73	67	46	158	<i>76</i>	<i>79</i>	<i>62</i>	<i>71</i>	<i>61</i>	*
1999–2003	76	72	68	66	46	124	<i>83</i>	<i>81</i>	<i>56</i>	<i>54</i>	<i>42</i>	*

Numbers in *italics* indicate that two or more cells had to be combined to get sufficient number of patients to calculate survival.

\*Too few patients to calculate survival, see ref. [11].

compared to many other sites the excess rates are not very high (Figure 6). The comparison is less meaningful in women given the rarity of the disease and the random variation inherent. The age-specific time trends are based on small numbers of patients (Table VI). The relative survival tends to be lower in older patients.

#### Cancer of the nose and sinuses

*Incidence and mortality.* As an uncommon set of tumours, there is considerable random variation in the trends in the underlying rates (Figure 7). The incidence rates tend to be rather stable or slightly increasing with time in Denmark, at least in men.

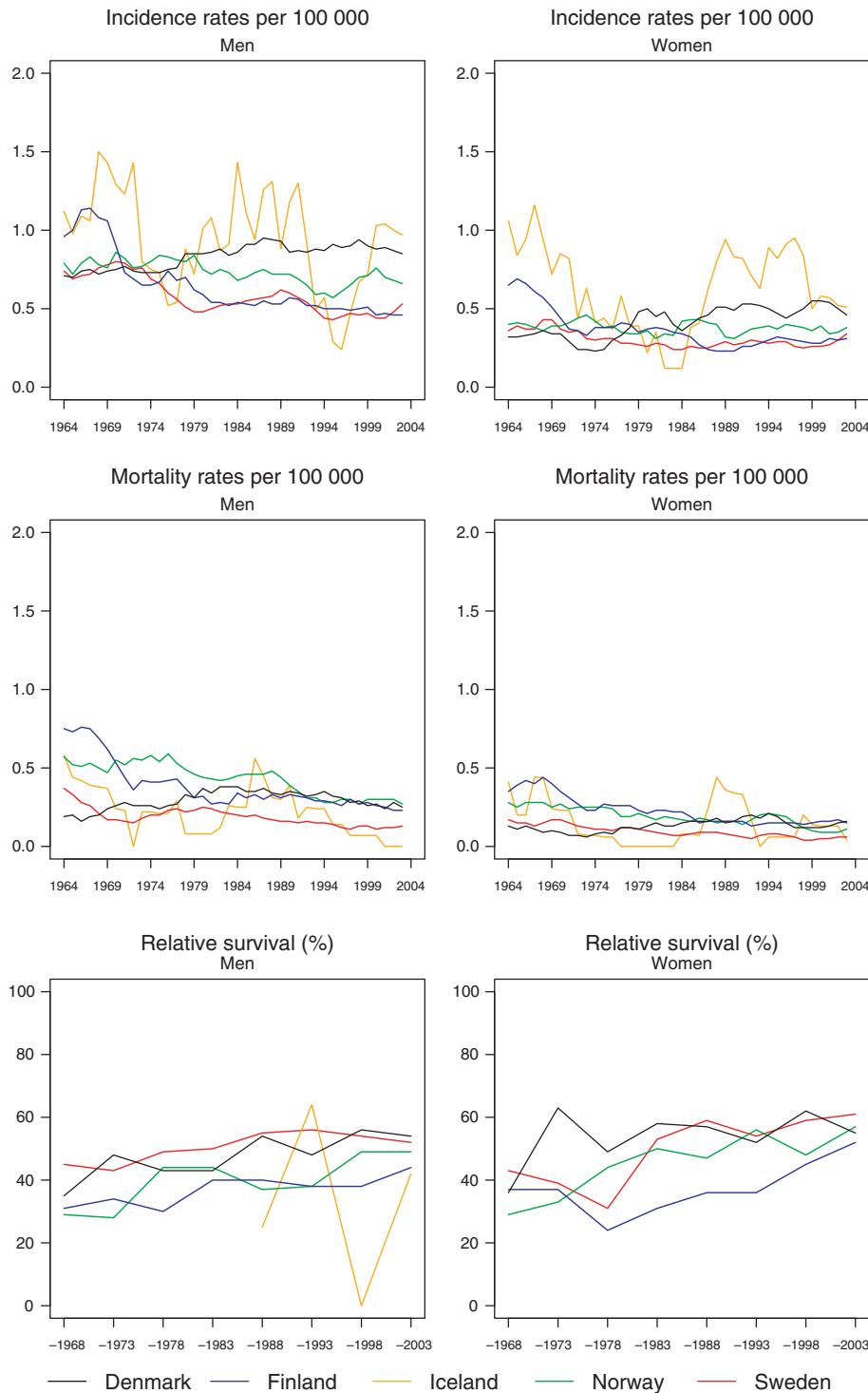


Figure 7. Trends in age-standardised (World) incidence and mortality rates per 100 000 and age-standardised (ICSS) 5-year relative survival for patients of cancer of the nose and sinuses by sex and country. Nordic cancer survival study 1964–2003.

In 2003, the rate in Danish males, 0.9 per 100 000 was almost double of that in Finland. Mortality trends exhibit mainly consistent, minor declines in all countries. Of note is an earlier increase in Denmark, observed for men and women until the early-1980s.

*Survival.* In general, increases in 5-year relative survival ratios are observed over time in the Nordic countries, although there is some heterogeneity in the extent of the increase, ranging from 10 to 20 percentage points (Table VII). Variations in excess mortality are most apparent among males in

Table VII. Trends in survival for cancer of the nose and sinuses by sex and country. Number of tumours (N) included and the 5-year age-standardised (ICSS) relative survival in percent with 95% confidence intervals (RS (CI)). Nordic cancer survival study 1964–2003.

	Denmark		Finland		Iceland		Norway		Sweden	
	N	RS (CI)	N	RS (CI)	N	RS (CI)	N	RS (CI)	N	RS (CI)
<b>Men</b>										
1964–1968	115	35 (27–45)	124	31 (20–47)	6	*	103	29 (21–42)	205	45 (37–55)
1969–1973	128	48 (36–62)	86	34 (25–47)	7	*	114	28 (19–40)	241	43 (36–52)
1974–1978	128	43 (31–58)	93	30 (20–47)	4	*	124	44 (34–57)	192	49 (40–60)
1979–1983	161	43 (35–54)	76	40 (30–53)	8	*	111	44 (34–57)	173	50 (41–61)
1984–1988	166	54 (45–66)	76	40 (30–53)	8	*	113	37 (28–50)	192	55 (47–65)
1989–1993	163	48 (39–59)	92	38 (30–48)	11	*	111	38 (29–48)	206	56 (47–65)
1994–1998	181	56 (48–65)	91	38 (30–48)	2	*	98	49 (39–63)	173	54 (46–63)
1999–2003	186	54 (47–62)	93	44 (36–54)	10	*	116	49 (40–59)	162	52 (45–59)
<b>Women</b>										
1964–1968	57	36 (24–54)	103	37 (28–49)	5	*	64	29 (18–45)	126	43 (35–54)
1969–1973	59	63 (49–80)	64	37 (28–49)	5	*	67	33 (22–51)	126	39 (31–50)
1974–1978	63	49 (36–67)	72	24 (15–36)	2	*	65	44 (34–57)	129	31 (24–41)
1979–1983	99	58 (48–70)	78	31 (22–45)	2	*	61	50 (38–66)	112	53 (44–64)
1984–1988	97	57 (46–71)	64	36 (27–47)	4	*	82	47 (37–59)	114	59 (50–70)
1989–1993	121	52 (42–64)	71	36 (27–47)	5	*	73	56 (43–71)	126	54 (45–64)
1994–1998	116	62 (52–73)	73	45 (33–61)	9	*	82	48 (36–62)	128	59 (50–70)
1999–2003	140	55 (48–63)	89	52 (43–63)	5	*	67	57 (47–69)	133	61 (54–69)

Numbers in *italics* indicate that two or more cells had to be combined to get sufficient number of patients to calculate survival.  
 \*Too few patients to calculate survival, see ref. [11].

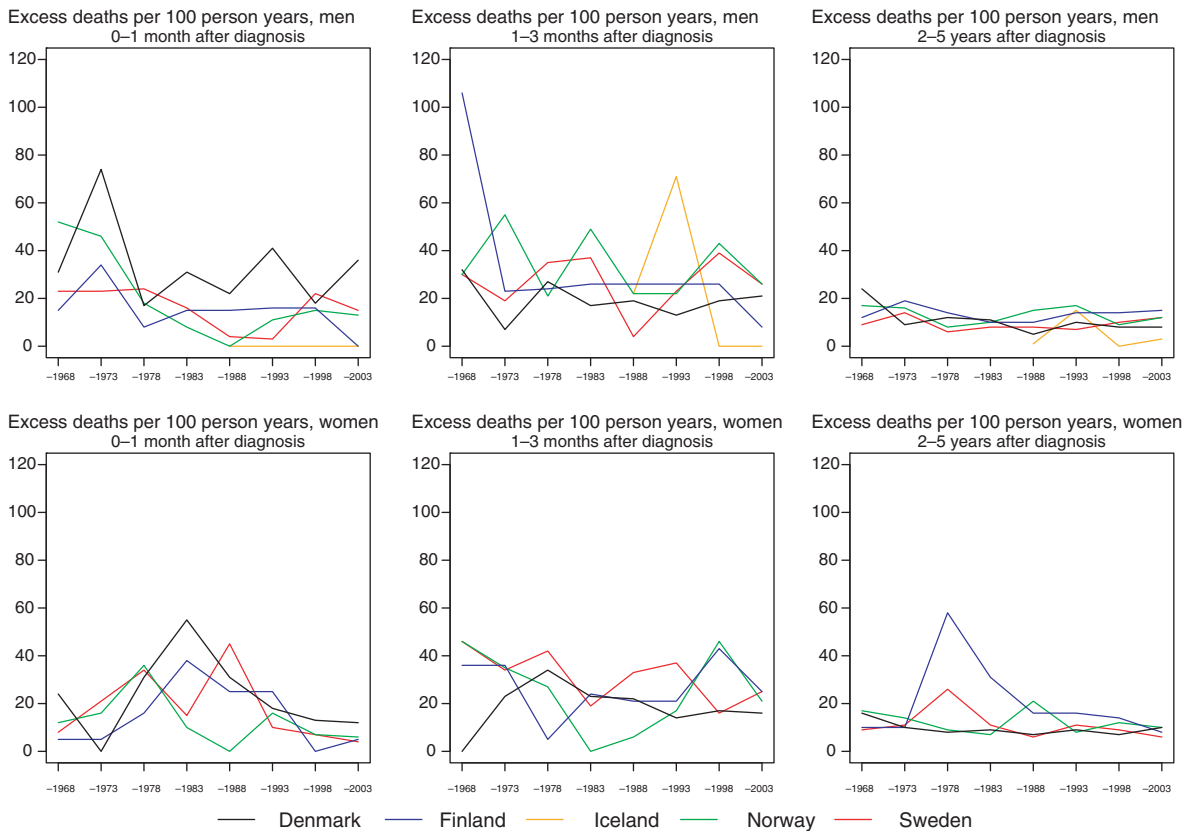


Figure 8. Trends in age-standardised (ICSS) excess death rates per 100 person years for cancer of the nose and sinuses by sex, country, and time since diagnosis. Nordic cancer survival study 1964–2003.

Table VIII. Trends in 5-year age-specific relative survival in percent after cancer of the nose and sinuses by sex and country. Nordic cancer survival study 1964–2003.

Age	Men						Women					
	0–49	50–59	60–69	70–79	80–89	90+	0–49	50–59	60–69	70–79	80–89	90+
Denmark												
1964–1968	54	59	33	31	0	*	74	35	26	37	20	*
1969–1973	43	51	41	32	89	*	63	74	66	35	98	*
1974–1978	46	44	45	42	33	*	63	47	55	24	78	*
1979–1983	58	44	44	42	30	*	79	86	63	48	18	*
1984–1988	44	49	63	56	50	*	70	57	64	53	45	*
1989–1993	75	38	58	37	41	*	54	60	53	37	66	*
1994–1998	59	65	64	61	18	*	67	80	57	65	40	*
1999–2003	61	70	50	57	34	*	84	65	55	45	38	41
Finland												
1964–1968	33	36	39	16	36	*	60	34	30	35	40	*
1969–1973	47	73	46	13	0	*	60	34	30	35	40	*
1974–1978	40	52	30	15	28	*	58	15	31	20	0	*
1979–1983	56	45	37	32	42	*	25	56	42	25	0	*
1984–1988	56	45	37	32	42	*	30	37	45	29	34	*
1989–1993	58	54	47	21	18	*	30	37	45	29	34	*
1994–1998	58	54	47	21	18	*	64	56	45	28	49	*
1999–2003	64	51	54	40	10	*	58	73	50	40	52	*
Norway												
1964–1968	60	49	22	15	21	*	45	45	27	14	28	*
1969–1973	51	29	30	20	19	*	40	40	48	12	35	*
1974–1978	57	29	60	35	37	*	68	68	64	25	0	*
1979–1983	65	68	43	26	35	*	68	68	53	32	42	*
1984–1988	23	55	37	31	41	*	45	45	66	55	0	*
1989–1993	47	59	53	26	0	*	70	70	58	47	40	0
1994–1998	54	72	56	36	36	*	60	60	53	37	35	*
1999–2003	55	59	50	36	52	*	66	66	66	48	42	*
Sweden												
1964–1968	62	43	53	43	24	*	47	71	35	46	20	*
1969–1973	49	49	39	50	25	*	74	38	39	35	23	*
1974–1978	38	56	49	49	52	*	.	39	59	21	19	*
1979–1983	54	67	58	33	49	*	82	69	66	43	7	*
1984–1988	53	44	75	51	46	*	84	63	84	40	28	*
1989–1993	59	60	46	63	50	*	78	81	63	33	29	*
1994–1998	58	54	68	54	22	*	101	60	62	47	43	57
1999–2003	68	64	57	45	28	*	96	73	62	50	41	12

Numbers in *italics* indicate that two or more cells had to be combined to get sufficient number of patients to calculate survival.

\*Too few patients to calculate survival. Iceland not shown for the same reason, see ref. [11].

the first year after diagnosis between Denmark and the other countries (Figure 8). The age-specific trends are based on small numbers (Table VIII). The relative survival ratios tend to be higher in younger patients, particularly in Finland, Norway and Sweden.

## Discussion

Respiratory cancer survival is relatively poor and particularly low for cancers of the lung and pleura. Male patients, elderly patients, and patients diagnosed in Denmark are the broad groups that tended to have lower survival than others.

The lower relative survival ratios for lung cancer in Denmark have been related to an unfavourable

stage distribution, whereas differences between morphologic types have not been able to explain the survival differences between countries [4]. Patients diagnosed with small cell carcinoma have an unfavourable survival compared to the other patients. As the stage and histological type-specific differences in relative survival between the Nordic countries are much smaller, it is likely that the delays in diagnosis can play an important role. These delays can be related to both the patient and the health services.

Accounting for differences in general (competing-risk) mortality by educational level in Denmark made the relative survival ratios by educational level approximately equal [13]. As smoking is more common in

Denmark than in the other Nordic countries, smoking-related co-morbidity may worsen the Danish patients' survival compared to that of the other Nordic patients. Stopping smoking is thus not only important in lung cancer prevention, but it is also important in patient survival as a factor leading to a decreased co-morbidity of these patients.

The early excess mortality has been decreasing, and the differences between the Nordic countries in this respect have diminished as well. More rapid diagnostics and less postoperative deaths may play an important role in this [14]. Clearly, these improvements are not as yet impacting on 5-year relative survival.

For cancer of the pleura, Danish, Swedish and possibly also Norwegian men appear to have favourable mortality developments without evidence of increasing survival. This could possibly relate to a subset of deaths due to cancer of the pleura being misclassified, for example, as cancers of the lung. The mortality rates are sensitive to these kinds of changes, although relative survival will be unaffected since it is not based on the coding of individual causes of death. In Finland, the official causes of death are reclassified by the Cancer Registry based on multiple information sources (on average, there are five notifications per case) available for each patient so such a phenomenon is not likely to occur [15].

The high survival of female patients in Sweden may in part relate to a lack of death certificate-initiated cases in Sweden. These cases normally have an inferior survival compared to the other registered cases [16].

Incidence and mortality trends of laryngeal cancer are likely to reflect the cohort-driven independent and interactive risks associated with high levels of tobacco and alcohol consumption in each of the Nordic populations. Finnish men started to smoke earlier than Danish men, but effective smoking cessation campaigns started earlier in Finland [17] with marked decreasing trends in lung cancer incidence observed in males. The proportion of smokers in Sweden has been lower than in the other countries [18]. Alcohol consumption increased in Denmark up to mid-1980s with less strict regulations on the purchase of beer, wine and alcohol than in force in the other Nordic countries [19].

That the trends in incidence and mortality are rather similar between countries implies, among other explanations, a general lack of improvement in prognosis, and indeed the survival estimates do not show any marked increases over time, an observation in keeping with those reported by EURO-CARE-4 across Europe [20]. While Denmark and Finland had the lowest survival in both sexes, it is unclear whether there are genuine survival differences in the Nordic

countries, and where they exist, the extent to which competing causes of death operate as a function of the prevalence and distribution of these risk factors. While larynx-preserving techniques are considered one of the most important achievements in head and neck oncology [21], their collective impact on survival as opposed to life quality at the population level over the last decades appears rather minor in the Nordic countries. Given these survival trends and the fact that the vast majority of laryngeal cancer patients are current or ex-smokers, however, the role of primary prevention cannot be understated.

Cancers of the nose, nasal cavities, middle ear and accessory sinuses are rare neoplasms, with occupational exposures and smoking considered as the dominant aetiological factors [10] with prognosis dependent on localisation, stage, and treatment modality [22,23]. The stable incidence, steady declines in mortality and increasing survival across the Nordic countries imply modest improvements in the quality of care, which may include improving treatment modalities [24].

Relatively little improvement has thus far been achieved in improving the prognosis of respiratory cancer patients, in spite of many clinical actions and possibilities [14,24,25]. Early detection through screening interventions has been shown to be ineffective at the population level [26]. Primary prevention strategies therefore that promote smoking avoidance and cessation remain key actions not only in terms of cancer control as a whole, but specifically in enabling improvements in cancer patient survival.

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