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Running title: Cancer mortality by education and gender in Europe

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Abstract

The aim is to compare socioeconomic inequalities in total cancer mortality between women and men in different European populations, and to investigate which cancer sites explain the differences between gender and populations. We used longitudinal mortality datasets. Data were collected during the 1990s among women and men aged 30-74 at baseline in 12 European populations (Madrid, Basque region, Barcelona, Slovenia, Turin, Switzerland, France, Belgium, Denmark, Norway, Sweden, Finland). Socioeconomic status was measured using educational level. We conducted Poisson regression analyses and computed relative indices of inequality (RII). We observed large variations within Europe for educational differences in total cancer mortality among men and women. Three types of situations were observed: Denmark, Norway and Sweden (significant RII around 1.3-1.4 among both men and women); France, Switzerland, Belgium and Finland (significant RII around 1.7-1.8 among men and around 1.2 among women); Spanish populations, Slovenia and Turin (significant RII from 1.29 to 1.88 among men; no differences among women except in the Basque region where the RII is significantly lower than 1). Lung, upper aerodigestive tract and breast cancers explained most of the variations found between gender and populations in the magnitude of inequalities in total cancer mortality. Given time trends in cancer mortality, the gap in the magnitude of socioeconomic inequalities in cancer mortality between gender and between European populations will probably decrease in the future.

Key words

Cancer mortality, men, women, Europe, education, cancer site

Introduction

Studies consistently reported socioeconomic inequalities for total mortality and for many causes of death (Borrell et al., 1999; Bucher & Ragland, 1995; Harding, 1995; Steenland et al., 2004). For cancer mortality, several studies consistently observed higher mortality rates among men with lower socioeconomic position (Borrell et al., 2003; Davey Smith et al., 1991; Doornbos & Kromhout, 1990; Faggiano et al., 1995; Faggiano et al., 1997; Mackenbach et al., 1999; Menvielle et al., 2005). On the contrary among women, many studies did not find important variations by socioeconomic status (Borrell et al., 2003; Faggiano et al., 1997; Menvielle et al., 2005; Michelozzi et al., 1999), while other studies observed higher total cancer mortality rates among women with higher or lower socioeconomic position, depending on the country (Faggiano et al., 1995; Mackenbach et al., 1999). This raises the questions to what extent socioeconomic inequalities in total cancer mortality among women really vary between countries, and which cancer sites are mostly responsible for the facts that inequalities in total cancer mortality rates among women are often small or even inverse. An international comparison of educational disparities in cancer mortality could provide some answers to these questions. Previous European comparisons focused on specific cancer sites (Mackenbach et al., 2004; Menvielle et al., 2007; Strand et al., 2007). However, no study included all cancer sites or tried to assess the role of different cancer sites in explaining the sometimes small inequalities among women. Such an international comparison would be informative on cancer etiology and may help to understand the ways in which cancer inequalities are related to national factors such as alcohol consumption patterns, the smoking epidemic or past social and sanitary developments.

A new large longitudinal dataset including many European populations spread all over Western Europe was recently collected. The aim of this study is to compare educational differences in total cancer mortality between women and men, and to investigate which cancer sites explain the differences between gender and populations.

Material and methods

Longitudinal data from 12 European populations was used (Madrid, the Basque region, Barcelona, Slovenia, Turin, Switzerland, France, Belgium, Denmark, Norway, Sweden and Finland). Most datasets covered the entire national population except France (a representative sample of 1% of the population), the entire regional population (Madrid, the Basque region), or the population from specific urban areas (Barcelona, Turin). Subjects were selected from census and followed up during the 1990s (Table 1). Subpopulations were excluded in three datasets: foreigners in Switzerland, subjects deceased outside Catalonia in Barcelona and foreigners and subjects born in overseas areas in France.

Analyses were performed among subjects aged 30-74 at the time of the census. The follow-up period was shorter for Belgium, Denmark, the Basque region and Madrid. In order to get results on comparable ages in terms of observed age at death, analyses were conducted on slightly older age groups at baseline for these populations (35-79 for Madrid and 30-79 for Belgium and the Basque region). The age range for the Danish data could not be changed, as no information on socioeconomic position was available for subjects aged over 75.

The linkage between census data and mortality registries was achieved for more than 96% of all deceased persons in almost all populations except Madrid (70%), the Basque region (93%) and Barcelona (94.5%). In these populations however, no variation in this percentage was found according to age, sex or socioeconomic position (in the Basque region unfortunately, this check could not be conducted for the socioeconomic position). In order to avoid an underestimation of absolute mortality rates in these three populations, observed absolute mortality was increased using correction factors (1/0.70, 1/0.93 and 1/0.945 respectively).

The socioeconomic status was measured with education declared at the census at the beginning of the follow-up period. This variable was categorized into three classes, which correspond to the ISCED (International Standard Classification of Education) classification: 0-2 (lower secondary education or less), 3-4 (upper secondary education), 5-6 (post-secondary education). The percentage of missing values for education was low: 6% for Belgium and less than 3% for the other populations. These subjects were excluded from the analysis.

The cause of death was obtained by linkage with death registries. Analyses were conducted for total cancer mortality (ICD 9: 140-249), and for the following cancer sites: lung (ICD 9: 162-3, 165), upper aerodigestive tract (UADT which group oral cavity, pharynx, esophagus and larynx) (ICD 9: 140-50, 161), colorectal (ICD 9: 153-4), stomach (ICD 9: 151), leukaemia and Hodgkin's disease (ICD 9: 201, 204-8), kidney and bladder (ICD 9: 188-9), liver (ICD 9: 155), pancreas (ICD 9: 157), breast (ICD 9: 174-5), cervix (ICD 9: 180), prostate (ICD 9: 185), other neoplasms (ICD 9: rest 140-249).

The magnitude of socioeconomic inequalities in mortality was estimated in both absolute and relative terms. To estimate relative inequalities, we computed relative indices of inequality (RII) using Poisson regression. The calculation of the RII is based on a ranked variable, which specifies for each educational group the mean proportion of the population with a higher level of education. For instance, the rank of the lowest educational group is calculated as the proportion of the population with middle or high education, plus half of the proportion of the population with a lowest educational level. The RII is then computed by regressing the mortality on this ranked variable. Thus, the RII expresses inequality within the whole socioeconomic continuum and can be interpreted as the ratio of mortality rates between the two extremes of the educational hierarchy. As it takes into account the size and relative position of each educational group, it is well adapted to compare populations with different educational distributions (Mackenbach & Kunst, 1997; Pamuk, 1985). Analyses were conducted separately for each population separately. In order to assess whether the estimates significantly differed between populations, we tested the interaction between country and education in a model that included all populations.

To estimate absolute socioeconomic inequalities we computed absolute mortality rate differences between the lowest and the highest educational level, both for all cancer mortality as for specific cancer types. Age-standardized mortality rates were computed, using the population of EU-15 plus Norway of 1995 as the standard population.

Results

Large differences were observed in the educational distribution between countries and among men and women (Table 1). The percentage of subjects with post-secondary education was lower among women in all populations except Sweden. This percentage was below 10% among women in Turin, France and Slovenia.

Graph 1 presents total cancer mortality rates by educational level. Mortality rates were dramatically lower among women. The mortality rate among women with the lowest education was lower than that found among men with the highest education in all populations except Denmark. Total cancer mortality rates were generally higher among men with lower educational levels. Among women however, the gradient was much narrower and was not observed in the Spanish regions, Slovenia and Finland. The lowest total cancer mortality rates were observed in the Spanish regions and in France for women, in the Nordic countries, especially in Sweden, for men (Tables 2&3). Breast, lung and colorectal cancers accounted for 39-46% of all cancer cases among women except in Denmark (52%). Among men, prostate, lung and colorectal cancers accounted for 47-52% of all cancer cases, except in France (42%), the Basque region (44%) and Belgium (57%).

RII for total cancer mortality by population are presented in tables 2 (for women) and 3 (for men). We can distinguish three main patterns: in Denmark, Norway and Sweden, we observed higher rates among low educated men and women with statistically significant RIIs around 1.3-1.4; in France, Switzerland, Belgium and Finland, RIIs were significantly higher than 1 among men and women, but they were larger among men (RII around 1.7-1.8) than among women (RII around 1.2); in Madrid, Barcelona, Slovenia and Turin, RIIs were significant among men (RII from 1.29 to 1.88) but not among women (borderline in Turin). The RII among women was even significantly lower than 1 in the Basque region.

RIIs among women by population and cancer site are presented in table 2. For some cancer sites, inequalities did not significantly differ between populations. No educational differences were found for leukaemia and Hodgkin's disease. Small socioeconomic inequalities favouring high educated people were found for colorectal cancer, they were larger for liver cancer, and especially for cervical and stomach cancer. However, the analyses for cervix cancer were based on small number of deaths. For breast cancer, RIIs were significantly lower than 1 in all populations except in Turin, France and Switzerland.

A clear North-South gradient was found for lung cancer: we found an RII significantly lower than 1 in the three Spanish regions and Slovenia; and an RII significantly larger than 1 in Switzerland, Belgium, and the Nordic countries. No significant association between education and lung cancer mortality was observed in France and Turin. Statistically significantly higher UADT cancers mortality rates were found among lower educated women in Switzerland, France and the Nordic countries, even though mortality rates were low. Contrasting situations were found for pancreatic and kidney and bladder cancer. RIIs lower than 1 were found in the Spanish populations and in Slovenia whereas the highest RIIs were observed in the Nordic countries. For the category "other cancers", the inequalities were remarkably similar: the RII ranged from 1.17 to 1.30 in 10 out of 12 countries.

RIIs among men by population and cancer site are presented in table 3. No statistically significant interaction between education and populations was observed for leukaemia and Hodgkin's disease, prostate and pancreatic cancer. Mortality rates did not differ by educational level for leukaemia and Hodgkin's disease and prostate, and we found slightly higher pancreatic cancer mortality rate among lower educated people.

Large variations between populations were found for lung, UADT and stomach cancers even though higher mortality rates among lower educated men were found in all populations. Larger RIIs were found in Northern countries and Switzerland for lung cancer; in Slovenia, Switzerland and France for UADT cancers; in the Southern populations for stomach cancer. A contrasting picture was found for liver cancer mortality with no educational differences in mortality in some populations (Belgium, Norway, Slovenia, Basque region) and higher mortality rates among lower educated people in others. Higher rates for low educated men were found for cancer of colorectum, they were slightly higher for cancer of bladder and kidney (RIIs around 1.5).

Absolute mortality rate differences by cancer site are presented in table 4. Few cancer sites (lung, UADT and breast) explain most of the European and gender discrepancies. Colorectal and prostate cancers are also frequent but do not explain much of the differences observed in absolute socioeconomic inequalities. Among women, populations with larger excess deaths among lower educated women due to lung cancer are also those where breast cancer mortality is more common among high educated women (Norway, Sweden and Denmark). These populations contrast to the populations where excess deaths among higher educated women are due to both breast and lung cancer (Spanish populations and Slovenia).

Discussion

Educational differences in total cancer mortality were about equally large among women and men in Norway, Sweden and Denmark. In the other countries, inequalities in cancer mortality among women were smaller as compared to men, non-existent in Madrid, Barcelona, Turin and Slovenia, and even reverse in the Basque region. Variations in socioeconomic inequalities in mortality from lung, UADT and breast cancers explained most of the differences between men and women and between European populations.

Evaluation of the data

In France and Switzerland, foreigners were excluded. Migrants have lower cancer mortality rates for most cancer sites, except some sites specific of their native country (nasopharynx, gallbladder or liver (because of exposure to hepatitis B virus)) (Bouchardy et al., 1994; Bouchardy et al., 1996; Bouchardy et al., 1995). As foreigners have generally lower educational levels, their exclusion may have led to some overestimation of socioeconomic inequalities in cancer mortality in France and Switzerland.

Potential influences of national practices in the coding of causes of death should be considered. All data came from populations with reliable cause-of-death registries. Our results would be biased only if diagnosing practices differed by socioeconomic position of the deceased. Even though there is no supporting evidence, such a bias cannot be entirely excluded.

Large variations between populations were observed in the educational distribution. Part of these differences may be due to real differences. Nevertheless, despite the use of a common educational classification for all populations, there may also be differences in the way in which national educational classifications are being squeezed into this common classification.

We evaluated the sensitivity of the results to alternative educational classifications. We used a classification into 4 educational levels by distinguishing between subjects who completed lower secondary education from those with primary education only. In addition, we applied another classification in which population distributions were as similar as possible between populations. The results were quite robust to these alternative classifications. The RIIs only slightly changed and the relative order of populations did not change. We infer that, even though we could not avoid some misclassification, this is unlikely to have biased the main results.

Comparison to previous studies

Other studies also observed that high-educated men have lower rates of total cancer mortality (Borrell et al., 2003; Davey Smith et al., 1991; Doornbos & Kromhout, 1990; Faggiano et al., 1995; Faggiano et al., 1997; Mackenbach et al., 1999; Menvielle et al., 2005; Michelozzi et al., 1999). The available literature among women was fragmentary, and mainly for Southern Europe countries, and did not consistently report socioeconomic inequalities in total cancer mortality. We found a North-South gradient among women with no inequalities in the South and large inequalities in the Nordic countries.

Our results agree with previous reports on higher cervix cancer mortality rates among women with lower education, and no association between education and mortality for leukaemia and Hodgkin’s disease. No clear association is documented in the literature for pancreatic, kidney and bladder cancer (Davey Smith et al., 1991; Faggiano et al., 1995; Faggiano et al., 1997; Fernandez & Borrell, 1999; Michelozzi et al., 1999; van Loon et al., 1995). However, from our international overview, kidney and bladder cancer have consistently higher mortality rates among lower educated men. Previous studies found contradictory results for colon and rectal cancer (Davey Smith et al., 1991; Faggiano et al., 1995; Faggiano et al., 1997; Fernandez &

Borrell, 1999). However, two American studies observed higher mortality from colorectal cancer among lower socioeconomic groups since the 1980s (Singh et al., 2002; Steenland et al., 2002). We consistently found a similar gradient in European populations in the 1990s, both among men and women.

Interpretation of key findings

We observed large disparities between populations in the difference between men and women in the magnitude of socioeconomic inequalities in total cancer mortality. For instance, this difference is much smaller in Sweden, Norway and Denmark. Compared to other countries, these countries have larger inequalities among women, and smaller inequalities among men. Looking at the situation by cancer sites will give some clues to understand these differences.

Patterns of educational differences in lung cancer mortality strongly differ according to population and gender. This result, already found in previous work (Mackenbach et al., 2004), is confirmed in the present study across a broader set of populations, including France, Slovenia, and the Basque region. The heterogeneity found between populations reflects differences in the diffusion of the smoking epidemic (Lopez et al., 1994). During this diffusion, higher smoking rates are first observed among subjects with higher socioeconomic position but later among subjects with lower socioeconomic position. The smoking epidemic was less advanced in Spain and Slovenia. There, we observed higher tobacco consumption among women with high education but already reverse patterns among men. On the contrary, this epidemic was already at its final stage in Nordic countries, Belgium and Switzerland, with higher tobacco consumption among women and men with low education. France and Italy showed an intermediate situation with no clear association between education and smoking rates among women (Giskes et al., 2005; Huisman et al., 2005). Male-female differences in smoking consumption by education are less pronounced in Nordic countries or

Belgium than in more southern countries. This is mostly due to the clear north-south contrast observed among women for socioeconomic inequalities in smoking consumption. Thus the gradual diffusion of the smoking epidemic not only underlies international variations in socioeconomic inequalities in lung cancer mortality, but also explains why in southern populations these inequalities are still much larger among men than among women.

Alcohol consumption is likely to be involved in liver and UADT cancers. Socioeconomic inequalities were also observed in most populations among women. However, because of low overall mortality rates, UADT cancers hardly contribute to socioeconomic inequalities in total cancer mortality among women in all populations. We found especially large socioeconomic inequalities favouring high-educated men for these cancers in France and the Spanish populations. The results for men have been described elsewhere (Menvielle et al., 2007). Evidence on socioeconomic inequalities in alcohol consumption is still fragmentary. Nevertheless, data from the literature suggested differences between countries in socioeconomic inequalities in alcohol consumption, especially among men (Cavelaars et al., 1997)(Kunst and Schaap, 2008, personal communication). A north-south contrast was found among men. In Italy and Spain, alcohol consumption was higher among lower educated men whereas in more northern countries, alcohol consumption was higher among high educated men. Among regular drinkers, average alcohol consumption levels were strongly associated with low education among men from southern European countries (Spain, Italy).

Higher breast cancer mortality rates are generally observed among higher educated women. This is mainly due to differences in reproductive behaviour, and especially delayed first birth among women with high education (Braaten et al., 2004; Strand et al., 2005). We found variations between populations in socioeconomic inequalities in breast cancer mortality. The magnitude of relative inequalities did not strongly differ between populations; the magnitude of absolute inequalities nevertheless substantially differed because of variations in national breast cancer mortality rates. These variations had an effect on inequalities in total cancer mortality among women. In Norway, Sweden and Denmark the “moderating” effect of breast cancer on inequalities in total cancer mortality is not as strong in these countries as in Madrid or Slovenia.

Consistent with literature, we found higher stomach cancer mortality rates among lower educated men and women (Davey Smith et al., 1991; Faggiano et al., 1995; Faggiano et al., 1997; Fernandez & Borrell, 1999; Menvielle et al., 2005; Michelozzi et al., 1999). Among cancers with highers rate among low educated people, stomach cancer is the only one for which inequalities tend to be smaller in the Nordic countries. As Helicobacter Pylori infection at young age is a risk factor for stomach cancer and is likely to be associated with factors linked to living conditions during childhood (Boffetta, 1997), the smaller inequalities in Nordic countries might be due to improved social and sanitary conditions in the past. There is however no evidence to directly support this suggestion. We hypothesize that relevant factors include the active housing policies as well as the more egalitarian social and economic policies developed in Nordic countries since the first half of the 20^{th} century.

Differences between countries in health care access probably also explain part of the differences we observed, especially for cancers with high survival rates. Nevertheless, we did not observe socioeconomic inequalities for leukaemia and Hodgkin’s disease or prostate cancer mortality neither in cancer incidence. As these cancers do not present any socioeconomic inequalities in incidence and have a good prognosis, this result suggests that the contribution of medical care to inequalities in cancer mortality in Western Europe is modest.

Future perspectives

The large geographical and gender variations in the magnitude of socioeconomic inequalities in cancer mortality suggest a large potential for change. Recent studies have suggested smaller educational differences in breast cancer mortality among younger generations of women in many European populations (Martikainen & Valkonen, 2000; Menvielle et al., 2006; Strand et al., 2007). On the other hand, countries in Southern Europe will enter into the last stage of the smoking epidemic, which may finally result in higher lung cancer mortality rates among low educated women in these countries as well. Given these recent trends, variations between countries and between genders in socioeconomic inequalities in cancer mortality are likely to become smaller in the future. Future trends will to a large extent be determined by trends in inequalities in lung, UADT and breast cancers. Policies that may affect these trends, including tobacco control, alcohol policies and breast cancer screening, should ensure that they reach lower groups as well as higher socioeconomic groups.

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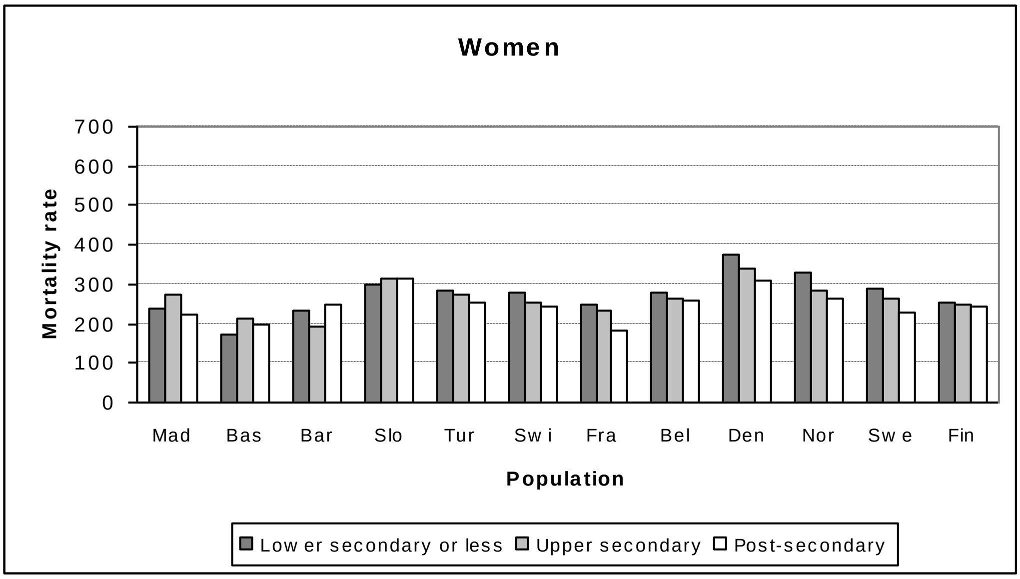
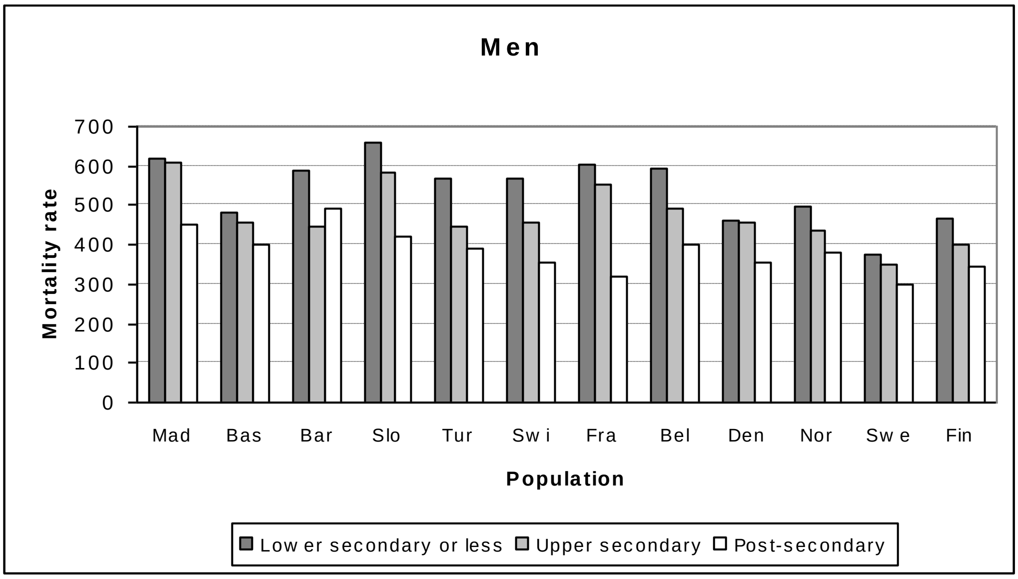
Table 1: Socio-demographic characteristics, by gender and population

Population	Follow-up	Women				Men			
				Education (%)[1]				Education (%)[1]	
		Person years	Cancer deaths	Middle/high	High	Person years	Cancer deaths	Middle/high	High
Madrid	May-1996/Dec-1997	2,030,998	3,331	24.2	11.7	1,756,059	6,133	35.9	18.5
Basque region	May-1996/Jun-2001	3,186,595	5,431	25.4	12.0	2,985,865	11,737	34.4	14.3
Barcelona	Jan-1992/Dec-2001	4,489,610	11,450	23.1	13.8	3,714,380	20,253	34.8	19.5
Slovenia	Apr-1991/Dec-2000	5,158,738	14,316	43.5	9.1	4,614,864	20,105	62.6	12.4
Turin	Nov-1991/Oct-2001	2,611,141	7,837	24.5	6.8	2,611,968	11,294	32.8	10.6
Switzerland	Dec-1990/Dec-2000	15,113,931	39,612	60.3	7.2	12,969,989	53,679	80.4	24.3
France	Mar-1990/Dec-1999	1,270,981	2,883	37.2	10.0	1,135,299	5,375	49.4	12.7
Belgium	Mar-1991/Dec-1995	13,688,568	37,354	32.7	13.9	12,700,788	58,760	38.7	16.8
Denmark	Jan-1996/Dec-2000	7,033,258	24,170	49.9	19.9	6,893,032	25,915	59.9	20.1
Norway	Nov-1990/Nov-2000	10,424,746	69,894	63.8	16.8	10,021,675	38,722	70.1	21.7
Sweden	Jan-1991/Dec-2000	22,116,058	61,446	59.1	19.0	21,421,623	70,339	59.7	16.4
Finland	Dec-1990/Dec-2000	13,478,149	32,880	48.6	19.7	12,396,052	39,734	51.2	21.5

[1] Middle/high: upper secondary education or more, High: post-secondary education

Graph 1: Total cancer mortality rates[1] (per 100000 person years) by education among women and men, by population





1: Age adjusted mortality rates using direct standardization

Table 2: Mortality rates[1] (MR) and relative indices of inequality (RII) related to education by cancer site among women, by population.

	All cancers		Lung		UADT[2]		Leukemia and Hodgkin's disease		Breast		Cervix	
	MR	RII (95% CI)	MR	RII (95% CI)	MR	RII (95% CI)	MR	RII (95% CI)	MR	RII (95% CI)	MR	RII (95% CI)
Madrid	242	0.89 (0.74-1.08)	15	0.34 (0.17-0.65)	5	1.02 (0.27-3.79)	8	0.94 (0.34-2.62)	48	0.51 (0.35-0.74)	5	4.87 (0.92-25.90)
Basque region	178	0.63 (0.54-0.75)	13	0.29 (0.17-0.48)	4	0.76 (0.26-2.25)	5	0.73 (0.28-1.92)	36	0.61 (0.43-0.86)	3	4.31 (0.79-23.49)
Barcelona	246	1.04 (0.94-1.16)	16	0.49 (0.34-0.69)	5	0.79 (0.40-1.56)	8	1.20 (0.66-2.19)	51	0.79 (0.64-0.97)	5	1.43 (0.71-2.91)
Slovenia	302	0.93 (0.87-1.00)	29	0.49 (0.40-0.61)	5	1.56 (0.89-2.74)	8	0.73 (0.48-1.10)	57	0.69 (0.59-0.80)	9	2.10 (1.39-3.17)
Turin	284	1.12 (0.98-1.27)	32	0.74 (0.52-1.06)	6	1.16 (0.49-2.77)	10	0.95 (0.49-1.82)	61	0.93 (0.72-1.20)	3	7.77 (1.48-40.86)
Switzerland	263	1.21 (1.16-1.26)	29	1.35 (1.20-1.52)	7	1.28 (1.00-1.63)	8	1.05 (0.84-1.31)	59	0.96 (0.88-1.04)	5	1.78 (1.33-2.38)
France	239	1.30 (1.08-1.57)	18	0.84 (0.45-1.55)	7	4.41 (1.38-14.08)	8	0.87 (0.31-2.48)	54	1.19 (0.82-1.71)	4	3.05 (0.65-14.45)
Belgium	276	1.17 (1.11-1.23)	26	1.61 (1.35-1.93)	7	0.88 (0.64-1.20)	9	1.10 (0.82-1.47)	66	0.83 (0.75-0.91)	5	2.36 (1.58-3.51)
Denmark	356	1.33 (1.26-1.40)	80	2.31 (2.05-2.60)	11	1.60 (1.17-2.19)	8	1.09 (0.77-1.55)	67	0.83 (0.74-0.93)	9	2.26 (1.61-3.16)
Norway	303	1.38 (1.32-1.44)	43	2.77 (2.45-3.14)	6	1.94 (1.40-2.69)	7	0.89 (0.66-1.19)	51	0.78 (0.70-0.86)	9	3.28 (2.52-4.27)
Sweden	271	1.31 (1.27-1.35)	37	1.79 (1.63-1.96)	5	1.70 (1.33-2.17)	8	0.98 (0.81-1.18)	45	0.88 (0.82-0.95)	5	2.59 (2.02-3.32)
Finland	257	1.20 (1.15-1.26)	24	1.85 (1.56-2.21)	6	2.00 (1.41-2.82)	9	1.10 (0.84-1.44)	46	0.85 (0.76-0.94)	4	3.47 (2.20-5.46)
Interaction[3]		<0.005		<0.005		<0.005		NS		NS		NS

	Stomach		Liver		Kidney and bladder		Pancreas		Colorectum		Other	
	MR	RII (95% CI)	MR	RII (95% CI)	MR	RII (95% CI)	MR	RII (95% CI)	MR	RII (95% CI)	MR	RII (95% CI)
Madrid	17	2.41 (0.97-5.97)	12	0.68 (0.27-1.68)	6	0.64 (0.18-2.26)	12	0.73 (0.31-1.74)	32	1.19 (0.67-2.10)	83	1.29 (0.91-1.83)
Basque region	11	1.80 (0.76-4.24)	7	1.29 (0.43-3.89)	6	0.54 (0.21-1.40)	10	0.38 (0.19-0.75)	20	0.77 (0.44-1.33)	62	0.63 (0.47-0.85)
Barcelona	11	2.02 (1.17-3.50)	12	1.63 (0.97-2.76)	6	1.26 (0.64-2.47)	11	0.67 (0.43-1.05)	32	1.36 (1.00-1.84)	74	1.30 (1.07-1.57)
Slovenia	24	1.51 (1.15-1.99)	7	1.55 (0.93-2.59)	9	0.64 (0.42-0.96)	16	0.86 (0.63-1.18)	38	1.28 (1.03-1.59)	100	1.04 (0.92-1.18)
Turin	13	3.16 (1.48-6.71)	10	2.77 (1.16-6.59)	8	2.52 (0.94-6.75)	15	1.25 (0.69-2.24)	34	0.97 (0.67-1.41)	93	1.17 (0.94-1.47)
Switzerland	9	2.34 (1.86-2.95)	5	1.49 (1.10-2.03)	11	1.89 (1.54-2.32)	16	1.27 (1.08-1.50)	26	1.02 (0.90-1.16)	89	1.23 (1.15-1.32)
France	8	4.95 (1.24-19.68)	6	1.59 (0.45-5.63)	8	0.96 (0.35-2.64)	12	1.86 (0.73-4.70)	27	1.24 (0.70-2.17)	86	1.26 (0.93-1.72)
Belgium	10	2.44 (1.74-3.41)	5	1.38 (0.90-2.11)	11	1.68 (1.24-2.28)	13	1.31 (1.01-1.70)	34	1.24 (1.05-1.45)	90	1.22 (1.11-1.34)
Denmark	7	1.51 (1.01-2.25)	5	1.72 (1.10-2.70)	14	1.80 (1.35-2.40)	17	0.94 (0.74-1.19)	40	1.18 (1.01-1.39)	100	1.23 (1.12-1.36)
Norway	12	1.77 (1.41-2.20)	2	1.32 (0.79-2.18)	12	2.09 (1.66-2.62)	18	1.39 (1.16-1.67)	42	1.25 (1.11-1.41)	100	1.26 (1.17-1.36)
Sweden	9	1.83 (1.53-2.20)	7	1.80 (1.45-2.24)	12	1.71 (1.46-2.01)	19	1.23 (1.09-1.39)	29	1.31 (1.18-1.45)	96	1.29 (1.22-1.37)
Finland	14	1.39 (1.12-1.73)	7	1.81 (1.31-2.50)	10	1.10 (0.85-1.41)	20	1.45 (1.20-1.75)	24	1.03 (0.88-1.21)	93	1.21 (1.12-1.32)
Interaction[3]		NS		NS		<0.005		<0.005		NS		<0.005

1: Age adjusted mortality rates using direct standardization, per 100,000 person years, 2: Upper aerodigestive tract, 3: p-value for interaction test between education and population

Table 3: Mortality rates[1] (MR) and relative indices of inequality (RII) related to education by cancer site among men, by population.

	All cancers		Lung		UADT[2]		Leukaemia and Hodgkin's disease		Prostate	
	MR	RII (95% CI)	MR	RII (95% CI)	MR	RII (95% CI)	MR	RII (95% CI)	MR	RII (95% CI)
Madrid	593	1.52 (1.34-1.72)	175	1.53 (1.22-1.92)	56	2.58 (1.71-3.89)	16	1.75 (0.84-3.65)	38	1.12 (0.67-1.87)
Basque region	473	1.29 (1.17-1.43)	125	1.31 (1.08-1.59)	59	2.04 (1.53-2.71)	11	0.90 (0.48-1.71)	29	0.94 (0.61-1.45)
Barcelona	586	1.57 (1.47-1.68)	169	1.80 (1.60-2.04)	52	3.12 (2.48-3.91)	15	1.04 (0.71-1.52)	34	1.01 (0.77-1.32)
Slovenia	595	1.72 (1.63-1.82)	181	2.08 (1.89-2.29)	62	5.56 (4.70-6.57)	14	1.22 (0.86-1.72)	44	1.18 (0.95-1.47)
Turin	532	1.88 (1.71-2.06)	179	2.53 (2.13-2.99)	33	3.61 (2.41-5.42)	14	1.07 (0.63-1.80)	31	1.01 (0.69-1.49)
Switzerland	465	1.83 (1.77-1.89)	127	2.91 (2.73-3.10)	37	4.05 (3.60-4.55)	14	1.19 (0.98-1.43)	56	1.13 (1.03-1.25)
France	555	1.89 (1.69-2.13)	147	1.64 (1.32-2.03)	78	4.30 (3.10-5.95)	13	1.36 (0.63-2.91)	37	1.04 (0.65-1.65)
Belgium	555	1.80 (1.73-1.88)	216	3.10 (2.89-3.32)	38	1.74 (1.51-2.00)	16	1.03 (0.83-1.28)	50	1.17 (1.01-1.34)
Denmark	441	1.31 (1.25-1.37)	128	1.76 (1.61-1.93)	36	1.77 (1.51-2.08)	13	1.02 (0.78-1.32)	43	0.94 (0.81-1.10)
Norway	449	1.45 (1.39-1.50)	107	2.45 (2.26-2.65)	21	2.27 (1.90-2.71)	11	0.82 (0.65-1.05)	67	0.94 (0.85-1.03)
Sweden	356	1.32 (1.28-1.35)	70	1.81 (1.69-1.93)	17	2.03 (1.77-2.33)	12	1.12 (0.96-1.32)	59	1.04 (0.97-1.12)
Finland	437	1.72 (1.64-1.80)	138	3.48 (3.18-3.81)	19	2.38 (1.94-2.94)	13	1.18 (0.93-1.51)	52	1.01 (0.88-1.16)
Interaction[3]		<0.005		<0.005		<0.005		NS		NS

	Stomach		Liver		Kidney and bladder		Pancreas		Colorectum		Other	
	MR	RII (95% CI)	MR	RII (95% CI)	MR	RII (95% CI)	MR	RII (95% CI)	MR	RII (95% CI)	MR	RII (95% CI)
Madrid	40	2.41 (1.46-3.97)	38	2.76 (1.61-4.74)	41	1.23 (0.77-1.98)	21	0.85 (0.47-1.55)	63	1.08 (0.75-1.56)	105	1.29 (0.97-1.70)
Basque region	36	3.15 (2.03-4.90)	22	1.16 (0.72-1.87)	33	1.62 (1.07-2.45)	18	0.78 (0.49-1.25)	52	0.92 (0.69-1.24)	87	1.02 (0.82-1.28)
Barcelona	29	4.14 (2.95-5.79)	37	1.56 (1.20-2.02)	40	1.31 (1.02-1.67)	26	1.02 (0.75-1.39)	61	1.15 (0.95-1.40)	95	1.22 (1.05-1.43)
Slovenia	59	2.31 (1.93-2.76)	17	1.15 (0.84-1.57)	31	0.95 (0.75-1.20)	24	1.31 (1.00-1.70)	72	0.97 (0.83-1.14)	90	1.10 (0.96-1.26)
Turin	29	4.53 (2.82-7.28)	36	2.49 (1.69-3.68)	39	1.58 (1.11-2.25)	23	0.83 (0.55-1.23)	53	1.46 (1.09-1.95)	95	1.33 (1.08-1.64)
Switzerland	21	2.53 (2.16-2.95)	18	1.68 (1.42-1.98)	30	1.41 (1.24-1.60)	23	1.27 (1.10-1.47)	47	1.27 (1.14-1.40)	93	1.35 (1.26-1.45)
France	22	2.62 (1.39-4.94)	36	2.59 (1.63-4.12)	33	1.33 (0.83-2.14)	24	1.01 (0.60-1.70)	47	1.58 (1.06-2.36)	118	1.73 (1.36-2.20)
Belgium	25	3.19 (2.57-3.96)	12	1.03 (0.79-1.34)	35	1.37 (1.17-1.61)	22	0.97 (0.80-1.17)	52	1.18 (1.04-1.34)	90	1.25 (1.14-1.37)
Denmark	13	2.05 (1.55-2.69)	9	1.39 (1.01-1.93)	34	1.09 (0.92-1.30)	21	1.06 (0.86-1.30)	54	1.03 (0.90-1.18)	90	1.11 (1.00-1.22)
Norway	27	1.89 (1.61-2.21)	4	1.00 (0.68-1.46)	32	1.62 (1.40-1.88)	23	1.35 (1.14-1.60)	61	1.08 (0.97-1.19)	96	1.19 (1.10-1.29)
Sweden	19	1.83 (1.60-2.08)	11	1.68 (1.42-1.98)	26	1.28 (1.15-1.43)	23	1.16 (1.04-1.30)	39	1.11 (1.01-1.21)	81	1.14 (1.07-1.21)
Finland	29	2.36 (1.97-2.83)	13	1.35 (1.05-1.73)	27	1.50 (1.26-1.79)	27	1.16 (0.98-1.37)	36	0.94 (0.81-1.09)	82	1.25 (1.14-1.38)
Interaction[3]		<0.005		<0.005		0.01-0.005		NS		0.025-0.01		<0.005

1: Age adjusted mortality rates using direct standardization, per 100,000 person years, 2: Upper aerodigestive tract, 3: p-value for interaction test between education and population

Table 4: Mortality rate[1] difference between subjects with lower secondary education or less and subjects with post-secondary education for total cancer mortality and by cancer site, per gender and population

Population	Total cancer	Cancer site											
		Lung	UADT	Breast	Cervix	Prostate	Leukemia and Hodgkin's disease	Stomach	Liver	Bladder and kidney	Pancreas	Colorectum	Other
WOMEN													
Madrid	16	-5	1	-23	4	-	3	4	-1	0	-2	9	27
Basque region	-27	-13	-1	-7	2	-	-4	6	1	1	-1	-5	-6
Barcelona	-18	-8	0	-13	1	-	1	1	1	0	-4	3	0
Slovenia	-16	-18	2	-22	6	-	0	8	2	-1	-3	4	7
Turin	34	-7	0	5	3	-	2	6	6	7	-2	6	7
Switzerland	4	2	0	0	0	-	0	0	0	0	0	0	1
France	65	6	5	2	3	-	4	8	1	2	2	-5	39
Belgium	20	7	-1	-9	3	-	-1	4	1	4	2	3	7
Denmark	67	42	4	-9	6	-	0	2	2	6	1	3	10
Norway	68	31	3	-13	8	-	-1	3	0	6	4	7	18
Sweden	58	18	3	-6	4	-	0	4	3	4	3	5	20
Finland	22	7	3	-10	3	-	0	4	3	0	3	0	9
MEN													
Madrid	165	48	32	-	-	5	4	17	25	8	-2	5	22
Basque region	83	26	19	-	-	-2	-5	18	3	13	4	2	4
Barcelona	102	46	26	-	-	-1	-1	17	10	2	-3	0	6
Slovenia	240	107	74	-	-	5	2	36	2	2	1	7	4
Turin	176	84	14	-	-	-1	0	22	15	16	-2	10	17
Switzerland	214	104	38	-	-	5	2	15	7	9	4	8	22
France	281	83	78	-	-	4	-1	12	25	18	13	13	35
Belgium	188	126	11	-	-	7	1	14	0	8	0	9	12
Denmark	105	63	16	-	-	-1	-1	7	2	7	1	4	8
Norway	119	67	13	-	-	-3	-2	11	1	11	6	4	13
Sweden	77	32	8	-	-	1	1	9	5	6	3	4	8
Finland	123	85	10	-	-	-1	1	13	1	5	1	-2	11

1: Age adjusted mortality rates using direct standardization, per 100,000 person years

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