

Cancer mortality in Europe, 2005–2009, and an overview of trends since 1980

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Background: After a peak in the late 1980s, cancer mortality in Europe has declined by ~10% in both sexes up to the early 2000s. We provide an up-to-date picture of patterns and trends in mortality from major cancers in Europe.

Methods: We analyzed cancer mortality data from the World Health Organization for 25 cancer sites and 34 European countries (plus the European Union, EU) in 2005–2009. We computed age-standardized rates (per 100 000 person-years) using the world standard population and provided an overview of trends since 1980 for major European countries, using joinpoint regression.

Results: Cancer mortality in the EU steadily declined since the late 1980s, with reductions by 1.6% per year in 2002–2009 in men and 1% per year in 1993–2009 in women. In western Europe, rates steadily declined over the last two decades for stomach and colorectal cancer, Hodgkin lymphoma, and leukemias in both sexes, breast and (cervix) uterine cancer in women, and testicular cancer in men. In central/eastern Europe, mortality from major cancer sites has been increasing up to the late 1990s/early 2000s. In most Europe, rates have been increasing for lung cancer in women and for pancreatic cancer and soft tissue sarcomas in both sexes, while they have started to decline over recent years for multiple myeloma. In 2005–2009, there was still an over twofold difference between the highest male cancer mortality in Hungary (235.2/100 000) and the lowest one in Sweden (112.9/100 000), and a 1.7-fold one in women (from 124.4 in Denmark to 71.0/100 000 in Spain).

Conclusions: With the major exceptions of female lung cancer and pancreatic cancer in both sexes, in the last quinquennium, cancer mortality has moderately but steadily declined across Europe. However, substantial differences across countries persist, requiring targeted interventions on risk factor control, early diagnosis, and improved management and pharmacological treatment for selected cancer sites.

Key words: Europe, joinpoint analysis, mortality, neoplasms, trends

Introduction

After a peak in the late 1980s, cancer mortality in Europe has declined by ~10% up to the early 2000s [1, 2]. The major components of these favorable trends in men were the fall in lung and other tobacco-related neoplasms, together with the persistent decline in gastric and a more recent decline in colorectal cancer mortality rates. In women, the major contributors were the persistent decline in cervical cancer and the favorable trends in breast and colorectal cancer mortality, particularly in northern and western Europe. Favorable trends were also observed for leukemias, Hodgkin lymphoma, testicular cancer, and a few other neoplasms amenable to treatment. We have predicted that most of these trends will be maintained up to the most recent years [3].

There were, however, persistent marked differences in cancer mortality rates and trends within Europe, with generally less

favorable trends in Russia, Romania, and other central and eastern European countries, compared with western Europe [1, 4]. These unfavorable trends were in part due to a greater smoking prevalence and other unfavorable lifestyle habits in this area of the continent, but also to some delays in effective disease management, including diagnosis and therapy [5].

Monitoring of mortality patterns and trends is important for planning and evaluating programs for cancer control. Mortality is a synthetic and valid indicator which allows to assess the impact of preventive and therapeutic strategies against cancer. Moreover, it has long been available, reliable, and comparable across Europe. Thus, in order to provide an up-to-date picture of patterns and trends in mortality from major cancers in Europe, here we consider data for the quinquennium 2005–2009, together with an overview of trends since 1980.

materials and methods

We extracted official death certification numbers for 25 cancer sites in 34 European countries for the period 1980–2009 from the World Health

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Organization (WHO) database as available on electronic support [6]. The European Union (EU) was defined as the 27 member states as in January 2007, with the exclusion of Cyprus, for which data were available only for a limited number of years. Data for testicular and kidney cancer in Switzerland for the years 1995–2007 were provided by the Swiss National Institute for Cancer Epidemiology and Prevention [7].

During the calendar period considered, three different revisions of the International Classification of Diseases (ICD) were used [8–10]. Classification of cancer deaths was re-coded, for all calendar periods and countries, according to the 10th revision of the ICD. Because the change from the 8th to the 10th revision of the ICD in 1995 in Switzerland caused discontinuities in trends, Swiss data for a few neoplasms (i.e. prostate, testis, bladder, and kidney) between 1980 and 1995 were corrected using age-specific factors [11]. To improve validity and comparability of data throughout different countries, we pooled together all intestinal sites (mainly colon and rectum), all uterine cancers (cervix and corpus), all skin neoplasms (including melanoma), all non-Hodgkin lymphoma, and all connective and soft tissue sarcomas. We did not consider long-term trends in pleural mesothelioma mortality, since pleural mesothelioma was not available separately from other pleural neoplasms in the 9th revision of the ICD, and the combination of the 10th ICD codes C45.0 (mesothelioma) and C38.4 (other malignant neoplasms of the pleura) is influenced by misclassification with lung cancer, thus introducing spurious trends in several countries. Neoplasms of the brain or nerves were also not considered, since for several countries it was not possible to consistently pool together subsequent revisions of the ICD. Data for liver cancer—presented only in the tables—should be taken with due caution, due to the difficulty in distinguishing primary from unspecified liver cancers in several countries [12].

In a few countries, mortality data were missing for one or more calendar years. No interpolation was made for missing data except for the definition of the EU rates, where, when data were not available for one or more years within a country, the nearest available data (i.e. generally that of the previous or subsequent year) were replicated.

We obtained estimates of the resident population, based on official censuses, from the same WHO database [6]. Population data for France in 2009 and for Portugal and the UK in 2010 were obtained from the EUROSTAT database, since these data were not available in the WHO database [13]. From the matrices of certified deaths and resident populations, we computed age-specific rates for each 5-year age group (from 0–4 to 80–84, and ≥ 85 years) and calendar period. We then computed age-standardized rates per 100 000 person-years (at all ages and truncated 35–64 years) using the direct method and based on the world standard population [14].

To identify significant changes in trends for the EU as a whole and 24 selected countries (excluding countries with less than 2 000 000 inhabitants and a few other entities such as Belarus, Belgium, Bulgaria, Croatia, Slovakia, because of difficulties in evaluating long-term trends), we carried out joinpoint regression analysis, which allows to identify the best-fitting points (the 'joinpoints') where a significant change in the linear slope (in a log scale) of the trend is detected [15, 16]. For each of the identified trends, we also computed the estimated annual percent change (APC) by fitting a regression line to the natural logarithm of the rates using calendar year as a regression variable.

results

Table 1 gives the average annual number of deaths and the overall age-adjusted (world population) mortality rates from selected cancers per 100 000 men in 34 European countries plus the EU as a whole in 2005–2009. Male total cancer mortality rates in the EU were 153.6/100 000. The highest rates were in central and eastern European countries, including in particular

Hungary (235.2/100 000), Croatia, Poland, and Baltic countries (around 200/100 000). In Russia, total cancer mortality in men was 184.0/100 000. The highest rates in western Europe were in France, Scotland, and Denmark (around 160/100 000); other major western European countries (Spain, Italy, the UK, and Germany) had rates between 138 and 152/100 000. The lowest rates (113 to 127/100 000) were in most Nordic countries and Switzerland. With reference to major cancer sites, male mortality rates across Europe ranged from 4.3 in Sweden to 24.6/100 000 in Russia for stomach cancer, from 11.2 in Greece to 33.0/100 000 in Hungary for intestinal cancer, from 6.0 in Portugal to 11.0/100 000 in Hungary for pancreatic cancer, from 19.3 in Sweden to 72.6/100 000 in Hungary for lung cancer, and from 8.9 in Italy to 20.8/100 000 in Estonia for prostate cancer.

Table 2 gives corresponding figures in women. Total cancer mortality rate in EU women in 2005–2009 was 90.8/100 000. The range of variation was between 71.0/100 000 in Spain and 124.4 in Denmark, but there was no clear east–west gradient. Besides Denmark, female cancer mortality rates were over 100/100 000 in Hungary, Poland, Ireland, the Czech Republic, the Netherlands, and the UK. The lowest rates (below 85/100 000) were in Mediterranean countries, Finland, and Belarus. Rates ranged from 1.9 in France to 10.1/100 000 in Russia for stomach cancer, from 7.1 in Switzerland to 16.6/100 000 in Hungary for intestinal cancer, from 3.5 in Belarus to 30.1/100 000 in Scotland for lung cancer, from 12.7 in Spain to 21.3/100 000 in Denmark for breast cancer, and from 3.1 in Belarus to 7.2/100 000 in the Czech Republic for pancreatic cancer.

Figure 1 shows the joinpoint analysis of trends in mortality rates (at all ages and truncated 35 to 64 years) from 23 cancer sites plus all neoplasms in EU men and women between 1980 and 2009. Total cancer mortality in EU men reached a peak in the late 1980s and declined thereafter, with an APC of -0.1% between 1987 and 1993, of -1.2% between 1993 and 2002, and of -1.6% between 2002 and 2009 overall, and of -1.7% per year between 1993 and 2009 in middle age. In EU women, overall cancer mortality declined over most of the period considered, with an APC of about -1% between 1993 and 2009, both at all ages and in middle age. Steady declines in mortality were observed over the period 1980–2009 for stomach cancer, Hodgkin lymphoma, and leukemias in both sexes, uterine cancer in women, and testicular cancer in men. For the latter neoplasm, however, the rates tended to level off in the last decade, particularly in middle-aged men. Favorable trends were observed since the early 1990s for most other cancers considered, with an APC of -1.3% per year between 2002 and 2009 in men and of -1.7% between 1993 and 2009 in women for intestinal cancer, of -1.8% between 1993 and 2009 for lung cancer in men, of -1.7% between 1998 and 2009 for female breast cancer, and of -2.5% between 2003 and 2009 for prostate cancer. However, mortality in the EU has still been increasing for lung cancer in women (APC = 2.2% between 2001 and 2009 at all ages, and 0.7% between 2007 and 2009 at ages 35–64), for pancreatic cancer (APC = 0.6% between 2001 and 2009 in men, and 1.2% between 2003 and 2009 in women), and for connective and soft tissue sarcomas (APC = 1.8% between 2004 and 2009 in men, and 0.8% between 2000 and 2009 in women), while mortality has started to decline over the last years only for

Table 1. Overall age-adjusted (world population) mortality rates (first row) and average annual number of deaths (second row) from selected cancers per 100 000 men in 35 European countries plus the European Union in 2005–2009 (unless otherwise specified)

	Oral cavity/ pharynx	Esophagus	Stomach	Intestines	Liver	Gall- bladder	Pancreas	Larynx	Lung	Bone	Connective/ soft tissue sarcomas	Skin	Prostate	Testis	Bladder	Kidney	Thyroid	HL	NHL	MM	Leukemias	All neoplasms
ICD X	C00–C14	C15	C16	C17–C21, C26	C22.0–C22.7	C23–C24	C25	C32	C33– C34	C40– C41	C47, C49	C43– C44	C61	C62	C67	C64–C66, C68	C73	C81	C82–C85, C96	C88, C90	C91–C95	C00–D48
Austria	5.29 339	3.88 264	6.64 524	15.87 1247	5.81 428	1.35 107	8.86 658	1.76 120	32.35 2338	0.39 20	0.96 62	2.94 212	12.37 1111	0.35 19	3.77 322	4.04 315	0.41 29	0.36 22	3.53 271	1.91 151	4.96 375	138.33 10 480
Belarus (2007–2009)	10.71 630	5.59 330	23.62 1439	16.92 1038	3.62 ^a 214 ^a	– –	7.22 433	6.03 358	47.79 2863	– –	– –	1.71 99	12.27 783	– –	5.03 320	– –	– –	– –	2.47 146	1.36 82	5.89 349	178.04 10 714
Belgium	4.82 401	5.12 462	5.00 506	16.47 1742	3.18 305	0.60 67	7.01 703	2.35 209	50.80 5021	0.60 47	0.87 72	2.16 197	12.41 1474	0.17 16	5.50 608	3.82 387	0.27 26	0.43 39	3.33 331	2.01 209	4.83 466	153.70 15 425
Bulgaria	5.69 341	2.43 154	12.97 907	20.26 1456	8.06 538	0.92 67	8.30 554	6.19 380	43.93 2794	1.38 77	0.24 14	2.43 165	10.13 821	0.91 44	5.34 394	3.81 245	0.34 22	0.85 46	2.38 142	0.65 43	3.99 233	156.71 10 383
Croatia	9.48 328	5.02 180	14.05 544	26.97 1056	8.27 ^a 313 ^a	2.25 91	8.88 331	5.61 205	57.06 2143	1.45 46	0.60 18	3.53 123	15.62 643	0.62 16	6.30 258	5.80 212	0.29 11	0.39 13	3.65 130	1.70 66	5.21 188	202.01 7611
Czech Republic	6.77 530	4.48 365	8.46 720	28.67 2485	2.80 233	3.00 261	10.75 907	2.92 233	48.10 4036	0.70 49	0.73 52	3.24 272	14.39 1323	0.55 35	5.75 518	8.75 738	0.32 27	0.43 33	3.24 272	1.83 161	5.39 441	184.01 15 545
Denmark (2005–2006)	4.73 212	5.89 284	4.73 230	20.21 1060	2.65 123	0.65 34	8.45 413	1.84 88	40.10 2014	0.53 17	0.83 34	3.25 155	19.51 1444	0.38 12	6.59 369	4.50 223	0.27 14	0.26 11	4.11 197	2.38 126	4.91 248	159.26 8112
Estonia	8.04 72	5.22 48	17.93 172	20.32 207	4.29 42	1.16 11	10.68 103	3.78 36	54.21 533	1.14 10	0.92 7	3.44 32	20.77 224	0.51 4	6.54 70	7.90 75	0.45 5	0.51 5	2.86 29	2.17 22	6.80 66	198.12 1944
Finland	2.16 95	2.92 138	5.80 285	11.81 599	4.19 206	1.28 65	8.93 437	0.64 32	28.24 1431	0.26 10	1.08 43	2.79 134	14.08 792	0.18 5	3.35 180	3.81 188	0.26 14	0.28 10	4.38 219	2.35 122	3.91 181	115.72 5801
France	6.75 3248	5.97 3147	5.10 2997	15.84 9880	7.51 4126	0.79 507	7.97 4442	2.36 1211	41.88 22 124	0.72 321	0.87 412	2.15 1191	12.14 8996	0.26 99	5.54 3582	4.31 2551	0.27 151	0.37 168	3.81 2265	2.17 1390	5.06 3006	161.47 92 425
Germany	5.28 3713	4.80 3692	6.95 5951	16.35 14 371	4.11 3448	1.38 1222	8.36 6983	1.68 1294	34.99 29 137	0.39 221	0.80 548	2.07 1648	11.96 11 716	0.30 163	3.79 3596	5.07 4393	0.33 270	0.24 181	3.36 2873	2.09 1878	4.56 3774	138.02 116 787
Greece	1.91 194	1.38 155	6.86 821	11.17 1455	8.02 ^a 994 ^a	1.16 142	6.88 782	2.79 323	46.45 5202	1.41 142	0.38 38	1.66 179	10.10 1571	0.32 23	6.19 863	2.95 355	0.24 29	1.23 126	1.34 144	1.37 175	5.92 741	136.96 16 327
Hungary	18.77 1308	7.08 514	12.60 1022	33.02 2685	6.50 ^a 502 ^a	2.63 221	10.98 852	6.77 494	72.57 5520	0.48 29	0.90 61	3.44 269	12.70 1159	0.85 50	6.83 575	5.74 450	0.45 34	0.33 21	3.64 278	1.42 116	6.16 463	235.22 18 247
Iceland	1.42 3	5.28 12	5.05 12	12.60 31	1.58 4	1.29 3	6.83 15	0.51 2	28.17 66	1.01 2	1.24 3	2.24 5	17.23 51	0.75 1	4.53 13	6.03 14	0.80 2	0.76 2	3.05 8	2.10 6	4.30 10	118.34 293
Ireland	3.37 95	7.36 218	6.78 207	20.35 633	3.11 93	0.48 15	7.37 217	2.00 59	32.95 994	0.57 15	0.73 20	3.42 104	15.58 530	0.25 6	3.69 121	4.27 127	0.29 8	0.35 10	4.36 132	2.68 84	4.96 151	142.41 4355
Italy (2006–2009)	3.56 1963	2.22 1331	8.89 6043	16.53 11 454	4.93 3129	1.92 1352	7.61 4789	2.46 1564	38.39 25 402	0.61 270	0.82 415	2.10 1254	8.88 7473	0.23 87	5.56 4303	3.71 2430	0.34 212	0.48 237	3.87 2426	2.19 1541	5.24 3240	145.64 97 528
Latvia	7.89 119	5.79 89	19.10 313	19.33 331	4.97 ^a 79 ^a	1.07 17	10.36 168	5.41 84	53.44 868	1.24 17	0.82 12	3.16 49	20.24 362	0.77 10	7.72 131	7.56 121	0.48 8	0.55 8	3.59 54	1.77 29	5.77 88	198.92 3238
Lithuania	9.88 207	6.85 148	19.04 445	19.87 485	1.70 40	0.90 23	10.14 233	6.15 132	51.51 1183	0.95 19	0.86 18	2.90 64	20.36 527	0.46 9	6.88 172	8.33 191	0.36 8	0.58 12	3.02 69	1.86 44	5.89 133	199.58 4635
Luxembourg	3.62 13	5.21 19	5.28 21	15.81 62	2.02 7	0.66 3	7.56 29	1.85 6	38.10 146	0.35 1	0.99 3	2.13 8	12.21 52	0.32 1	4.28 18	2.19 9	0.32 2	1.17 4	3.20 13	1.51 6	5.57 22	137.85 535
Macedonia (2006–2009)	3.06 41	1.65 23	15.99 231	15.96 229	8.05 116	1.05 15	7.22 101	6.00 84	45.88 636	1.57 20	0.43 6	4.22 56	9.18 137	0.59 8	5.33 79	2.34 32	0.23 3	0.54 8	1.75 22	0.54 8	4.41 57	151.89 2125
Malta	3.93 13	3.24 11	7.48 27	15.93 57	2.16 7	1.07 4	8.47 30	1.94 7	32.54 116	0.86 2	1.00 3	1.58 5	8.94 34	0.59 2	5.62 22	4.19 15	0.71 2	0.51 2	4.34 15	1.72 6	4.94 16	127.99 451
Netherlands	2.79 371	7.71 1090	5.95 881	19.58 2931	1.82 256	0.88 130	7.62 1097	1.22 172	43.03 6363	0.50 51	0.90 111	3.28 430	14.82 2420	0.27 26	5.14 808	5.45 798	0.23 33	0.36 45	4.08 580	2.34 350	4.54 626	151.07 22 210
Norway	2.29 85	3.23 131	4.55 205	17.51 796	1.69 69	0.67 29	7.28 310	0.77 33	28.66 1212	0.33 10	0.57 21	4.72 190	19.35 1063	0.31 10	4.60 237	4.02 175	0.33 14	0.16 6	3.82 167	2.91 134	3.85 164	126.82 5723

Continued

Table 1. Continued

	Oral cavity/ pharynx	Esophagus	Stomach	Intestines	Liver	Gall- bladder	Pancreas	Larynx	Lung	Bone	Connective/ soft tissue sarcomas	Skin	Prostate	Testis	Bladder	Kidney	Thyroid	HL	NHL	MM	Leukemias	All neoplasms
Poland	6.15 1591	4.40 1150	12.94 3537	20.73 5757	3.70 ^a 1000 ^a	1.71 479	8.16 2189	5.73 1505	61.95 16 615	0.95 228	0.71 160	2.98 791	13.02 3828	0.58 131	8.20 2321	5.98 1600	0.30 82	0.60 150	3.23 850	2.01 554	5.53 1435	196.74 53 259
Portugal	6.78 534	5.35 454	14.72 1455	21.14 2261	4.60 435	1.44 151	5.99 585	4.26 366	28.55 2678	0.69 54	0.91 72	1.97 192	13.45 1697	0.26 18	4.82 543	2.32 236	0.32 30	0.42 34	3.82 363	1.85 200	4.28 413	144.35 14 149
Romania	11.39 1645	3.57 540	14.68 2449	16.73 2853	9.85 ^a 1601 ^a	1.23 211	8.81 1436	6.27 951	47.93 7425	2.10 308	0.77 114	2.47 399	9.02 1713	0.53 73	5.84 1024	3.07 483	0.30 47	0.53 74	2.73 400	0.94 155	4.64 686	170.13 27 091
Russia	8.24 6901	6.07 5091	24.60 21 047	19.53 16 746	5.50 ^a 4637 ^a	– –	8.72 7359	5.36 4518	51.21 43 385	– –	– –	1.69 1428	10.50 9009	– –	6.52 5585	– –	– –	– –	2.35 1912	0.91 764	4.74 3755	184.02 155 298
Slovakia	15.62 542	6.48 226	11.70 422	30.77 1100	6.19 ^a 214 ^a	2.63 95	10.03 353	5.05 174	46.69 1633	0.78 26	0.91 29	3.11 110	13.72 510	0.66 22	5.15 191	6.54 230	0.31 11	0.55 18	3.18 110	1.73 63	5.43 184	194.59 6860
Slovenia	8.12 128	4.40 72	12.78 218	24.26 419	6.74 ^a 111 ^a	2.62 45	8.83 147	2.93 49	46.93 795	0.57 8	0.63 9	3.78 62	18.98 339	0.51 7	6.50 115	5.26 89	0.31 5	0.34 6	4.10 69	2.24 39	5.18 86	182.14 3076
Spain	4.94 1708	4.13 1519	8.16 3515	18.44 8329	6.15 2518	1.04 479	6.60 2630	3.85 1460	42.89 17 039	0.57 160	0.77 259	1.76 741	10.05 5499	0.15 45	7.88 3770	3.22 1364	0.23 95	0.37 130	3.18 1285	1.82 841	4.31 1746	151.60 63 888
Sweden	2.13 186	3.08 283	4.29 438	14.17 1459	3.85 ^a 368 ^a	1.70 172	7.43 716	0.49 48	19.27 1870	0.38 25	0.91 75	3.47 313	19.26 2461	0.16 9	3.96 459	3.97 394	0.29 29	0.21 17	3.53 359	2.49 262	4.08 398	112.94 11 725
Switzerland (2005– 2007)	4.47 281	4.71 313	4.35 308	12.36 911	6.01 ^a 408 ^a	– –	6.49 455	0.99 69	29.53 2009	– –	– –	2.62 169	14.25 1269	0.24 13	3.78 305	3.44 251	– –	– –	3.45 255	2.23 162	4.18 289	123.76 8909
Ukraine (2005–2006/ 2008–2009)	10.04 2965	4.45 1337	19.38 6061	18.66 5983	3.33 1007	– –	7.80 2385	5.42 1644	40.93 12 698	– –	– –	1.76 524	9.49 3198	– –	6.28 2059	– –	– –	– –	2.21 627	0.72 218	4.98 1388	163.28 50 201
UK	2.78 1382	8.71 4934	5.26 3287	16.85 10 225	3.06 1722	0.36 222	6.48 3710	1.15 639	33.12 19 696	0.45 178	0.80 384	2.57 1398	14.05 10 179	0.19 71	4.77 3243	4.06 2299	0.23 130	0.37 173	4.18 2402	2.32 1433	4.40 2494	138.20 82 907
England and Wales	2.65 1167	8.54 4322	5.14 2879	16.48 8939	2.95 1478	0.35 193	6.47 3302	1.09 541	31.95 16 989	0.45 155	0.80 341	2.56 1235	14.10 9174	0.18 61	4.76 2897	4.00 2017	0.23 116	0.37 155	4.19 2153	2.31 1272	4.41 2232	136.05 72 989
Northern Ireland	3.02 39	8.28 113	5.66 87	20.12 293	3.08 42	0.46 7	7.55 105	1.32 19	36.36 525	0.66 7	0.67 8	2.39 34	13.21 222	0.14 2	4.13 67	3.76 53	0.24 3	0.28 3	3.45 49	2.93 44	3.62 51	142.33 2066
Scotland	4.11 176	10.63 499	6.33 321	19.83 994	4.21 202	0.41 21	6.32 304	1.73 78	44.29 2181	0.47 16	0.89 36	2.79 129	13.78 784	0.28 8	5.04 279	4.74 229	0.22 11	0.40 14	4.25 201	2.30 118	4.49 211	159.54 7852
EU	5.42 20 944	4.99 21 295	8.01 37 427	17.74 85 508	5.01 22 493	1.25 6096	7.84 35 161	2.79 11 641	40.97 183 021	0.67 2313	0.80 3025	2.37 10 359	12.20 67 944	0.32 982	5.47 28 282	4.42 20 263	0.29 1316	0.42 1576	3.55 16 124	2.04 10 016	4.85 21 666	153.59 707 159

^aIncluding unspecified liver cancers (ICD 10th C22.9 and C78.7).

HL, Hodgkin lymphoma; ICD, International Classification of Diseases; NHL, non-Hodgkin lymphoma; MM, multiple myeloma; EU, European Union.

Table 2. Continued

	Oral cavity/ pharynx	Esophagus	Stomach	Intestines	Liver	Gall- bladder	Pancreas	Larynx	Lung	Bone	Connective/soft tissue sarcomas	Skin	Breast	Uterus	Ovary	Bladder	Kidney	Thyroid	HL	NHL	MM	Leukemias	All neoplasms
Poland	1.26	0.75	4.68	11.40	2.20 ^a	3.12	5.17	0.50	15.21	0.48	0.43	1.83	14.61	8.77	7.11	1.33	2.33	0.45	0.38	1.81	1.47	3.20	106.71
	474	295	1971	5017	957 ^a	1355	2154	167	5447	158	127	761	5237	3062	2472	617	972	194	121	713	609	1217	41 498
Portugal	0.92	0.55	6.67	10.90	1.16	0.97	3.42	0.12	5.74	0.45	0.62	1.24	13.71	5.47	3.17	1.05	0.82	0.36	0.26	2.33	1.30	2.66	74.54
	110	87	934	1672	169	155	512	14	703	44	65	180	1543	648	380	197	122	56	25	311	190	338	9735
Romania	1.19	0.46	5.31	9.83	3.88 ^a	1.13	4.54	0.31	8.66	0.94	0.50	1.56	15.78	13.48	5.11	1.06	1.25	0.43	0.34	1.61	0.74	2.96	91.92
	234	99	1247	2305	895 ^a	267	1045	62	1793	173	91	346	3106	2387	968	283	266	96	55	303	156	533	18 832
Russia	1.08	0.84	10.06	12.74	2.35 ^a	–	4.57	0.15	5.55	–	–	1.30	17.12	9.35	5.77	0.77	–	–	–	1.29	0.75	3.07	93.09
	1561	1450	15 906	20 601	3617 ^a	–	7186	218	8495	–	–	1710	22 851	12 310	7608	1401	–	–	–	1693	1051	3759	13 3816
Slovakia	1.39	0.59	5.05	14.20	2.62 ^a	3.60	6.18	0.23	8.43	0.47	0.61	1.91	15.17	9.41	6.36	1.13	2.81	0.41	0.33	1.90	1.46	3.37	98.33
	67	29	284	811	141 ^a	203	339	11	418	20	24	97	739	443	300	68	147	25	13	100	79	160	5046
Slovenia	1.02	0.59	5.12	12.63	2.15 ^a	2.56	6.09	0.26	12.76	0.41	0.42	2.82	17.43	5.97	6.56	1.56	2.13	0.27	0.17	2.49	1.62	3.03	98.54
	22	16	140	354	58 ^a	77	160	6	284	6	8	67	411	137	144	48	54	9	3	67	47	68	2460
Spain	0.87	0.48	3.50	9.48	1.89	1.16	3.99	0.16	6.31	0.35	0.59	1.04	12.68	3.91	3.92	1.07	1.18	0.31	0.23	1.95	1.30	2.50	70.97
	446	252	2179	6088	1225	773	2350	72	2817	119	239	600	5969	1946	1811	822	679	186	105	1132	833	1330	38 993
Sweden	0.98	0.89	2.17	10.72	1.84 ^a	2.67	6.60	0.08	15.59	0.23	0.81	2.03	14.17	4.16	6.11	1.23	2.17	0.31	0.13	2.22	1.66	2.69	90.82
	110	109	279	1452	244 ^a	331	830	8	1624	18	73	221	1483	479	630	194	283	46	15	308	230	323	10 906
Switzerland (2005–2007)	1.23	1.19	2.16	7.06	1.97 ^a	–	5.21	0.12	12.21	–	–	1.41	15.77	3.24	5.01	1.20	1.58	–	–	2.26	1.37	2.38	79.44
	101	104	228	752	179 ^a	–	522	10	943	–	–	117	1295	294	421	148	159	–	–	244	146	227	7272
Ukraine (2005–2006/2008– 2009)	0.91	0.31	7.65	10.84	1.39	–	3.51	0.12	4.66	–	–	1.38	17.79	10.07	5.77	0.59	–	–	–	1.17	0.60	3.05	85.35
	438	176	3915	5851	678	–	1858	55	2365	–	–	581	7948	4354	2472	369	–	–	–	483	270	1181	39 752
UK	1.08	3.04	2.29	10.69	1.52	0.54	5.02	0.23	20.53	0.29	0.65	1.63	18.39	4.11	6.63	1.69	1.96	0.26	0.26	2.68	1.52	2.53	102.95
	727	2546	1997	9006	1155	432	3926	156	14 843	131	354	1112	12 109	2663	4304	1661	1454	211	142	2085	1276	1881	76 233
England and Wales	1.04	2.96	2.19	10.46	1.49	0.52	5.02	0.22	19.58	0.29	0.66	1.63	18.37	4.09	6.59	1.66	1.91	0.26	0.26	2.67	1.53	2.56	101.43
	623	2204	1716	7860	1007	374	3488	132	12 593	116	313	979	10 731	2350	3788	1459	1256	190	124	1840	1126	1686	66 710
Northern Ireland	1.16	2.69	2.97	12.23	1.60	0.56	4.95	0.23	19.55	0.31	0.55	1.76	18.36	3.60	7.53	1.36	2.14	0.33	0.27	2.62	1.51	2.29	102.75
	19	56	63	253	31	13	98	4	349	4	9	33	306	62	123	32	38	6	5	52	32	43	1905
Scotland	1.41	3.97	3.02	12.49	1.81	0.67	5.07	0.33	30.13	0.28	0.66	1.56	18.63	4.49	6.76	2.08	2.39	0.22	0.27	2.82	1.51	2.39	118.18
	85	286	217	893	116	45	339	20	1901	11	32	99	1072	250	393	170	160	16	14	192	118	152	7618
EU	1.15	1.09	3.65	10.51	1.79	1.51	5.23	0.24	12.63	0.39	0.60	1.43	16.43	5.15	5.39	1.23	1.80	0.34	0.26	2.16	1.39	2.91	90.78
	6162	7004	24 791	75 193	11 809	10 581	35 000	1254	69 510	1688	2823	8459	89 319	27 411	29 406	10 009	11 868	2342	1237	14 385	9804	17 793	55 5168

^aIncluding unspecified liver cancers (ICD 10th C22.9 and C78.7).

HL, Hodgkin lymphoma; ICD, International Classification of Diseases; NHL, non-Hodgkin lymphoma; MM, multiple myeloma; EU, European Union

European Union

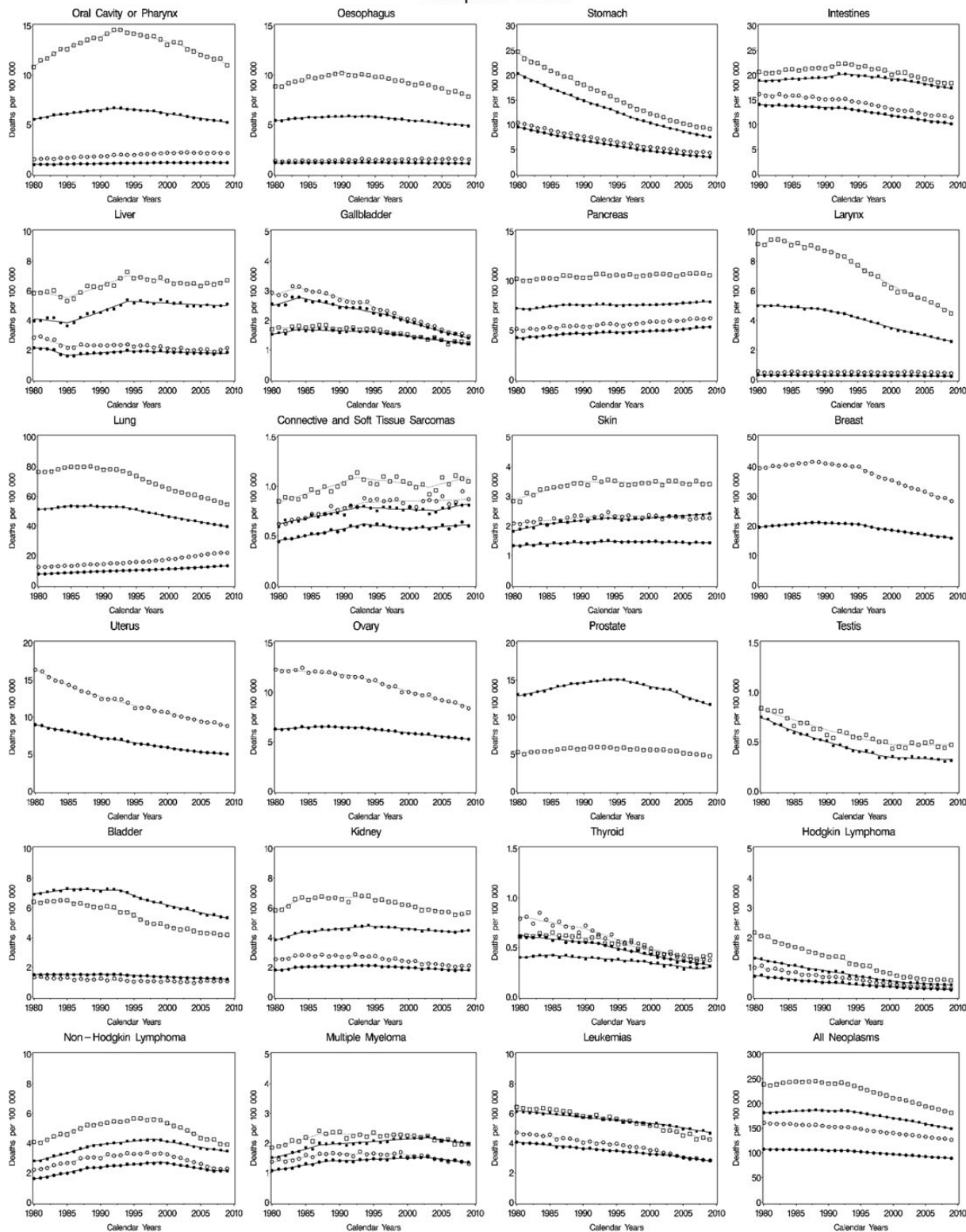


Figure 1. Joinpoint analysis of trends in age-standardized (world population) mortality rates from 23 cancer sites plus all neoplasms (malignant and benign) in the European Union, 1980–2009. Filled boxes represent men, all ages; open boxes represent men, 35–64 years; filled circles represent women, all ages; open circles represent women, 35–64 years.

All Neoplasms

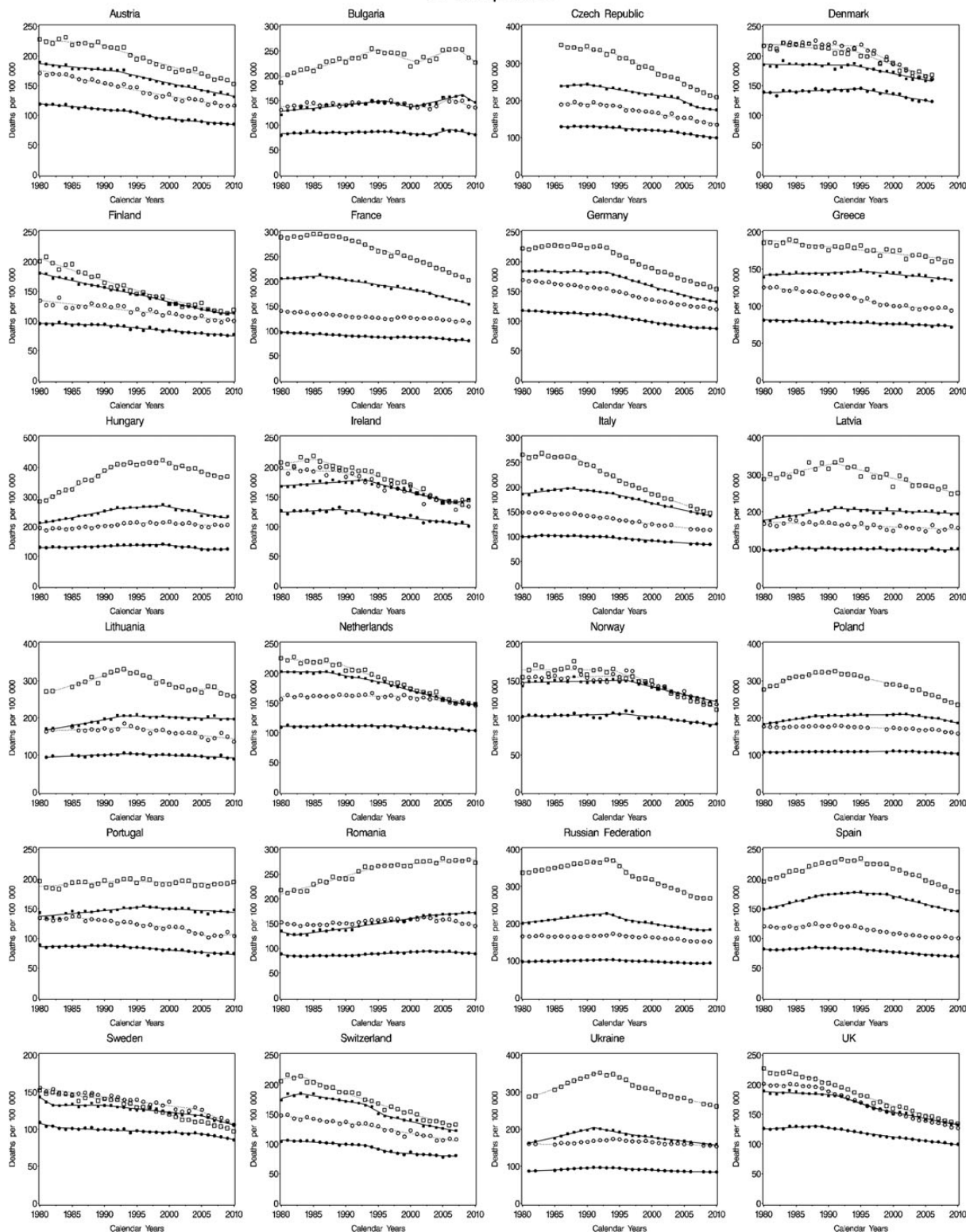


Figure 2. Joinpoint analysis of trends in age-standardized (world population) mortality rates from all neoplasms (malignant and benign) and major cancer sites (i.e. intestines, lung, breast, and prostate) in 24 selected European countries, 1980–2009. Filled boxes represent men, all ages; open boxes represent men, 35–64 years; filled circles represent women, all ages; open circles represent women, 35–64 years.

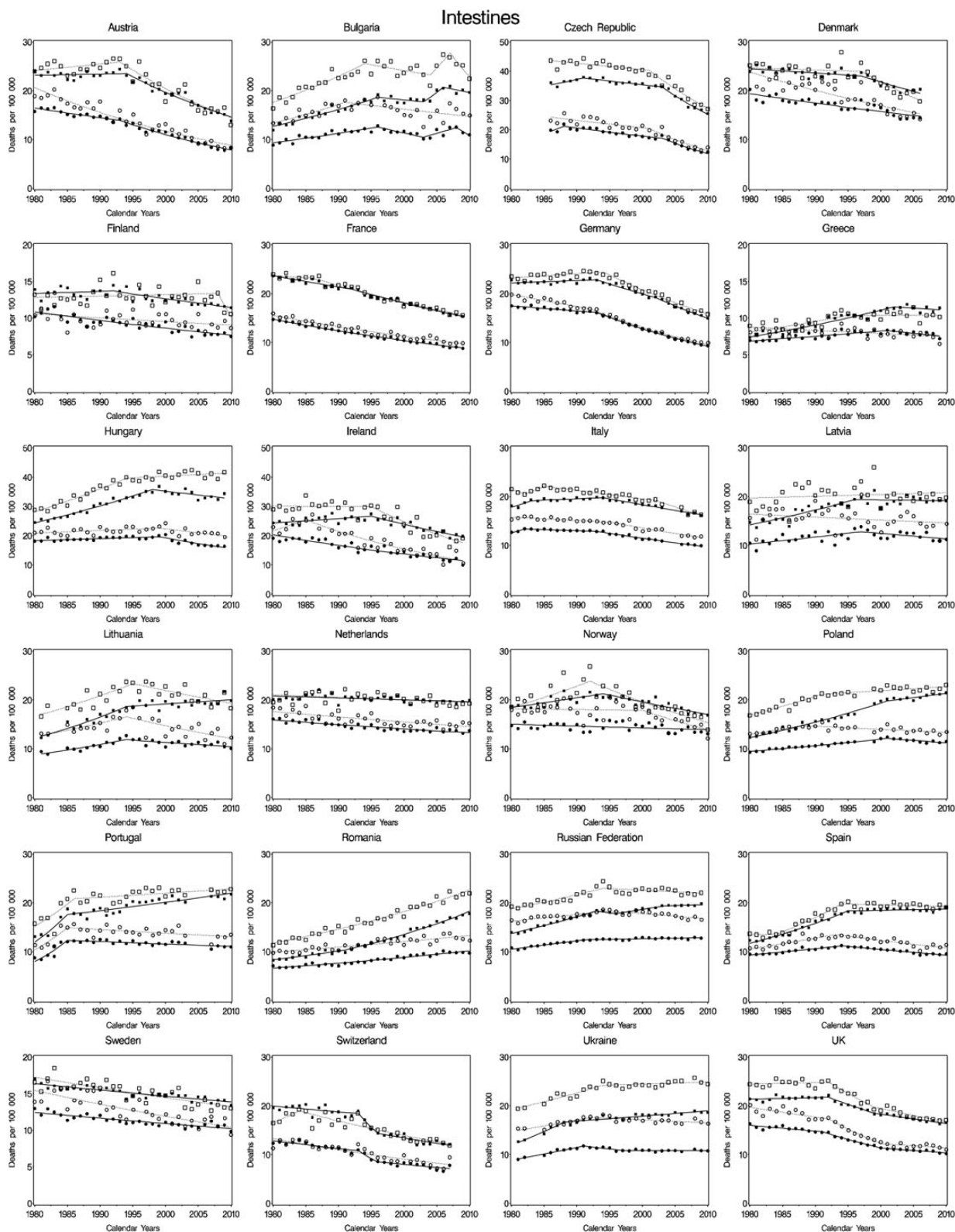


Figure 2. *Continued*

multiple myeloma (APC = -1.6% in men and -2.1% in women between 2003 and 2009).

Figure 2 presents the results of the joinpoint analysis of trends in mortality rates (at all ages and truncated 35 to 64 years) from

all neoplasms (malignant and benign) and major cancer sites, i.e. intestines, lung, breast, and prostate, in 24 selected European countries between 1980 and 2009. Since the late 1980s/early 1990s, mortality from all neoplasms has been declining in most

Lung

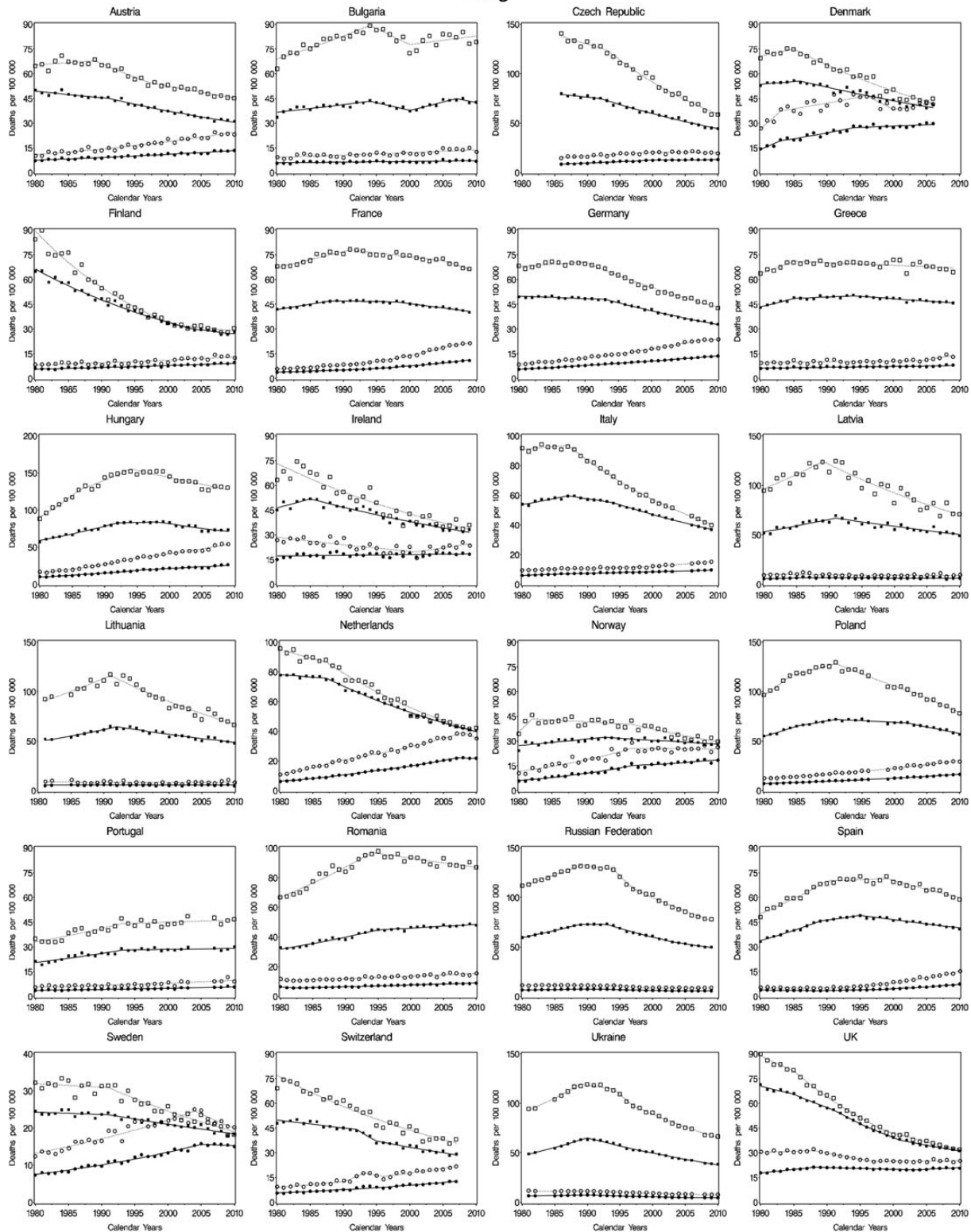


Figure 2. Continued

European countries. The reductions started earlier (since the early 1980s) in some western and northern countries, such as Austria, Denmark, Finland, Germany, Sweden, and the UK, and more recently (since the early 2000s) in Hungary and Poland,

while in Bulgaria and Romania, mortality has been leveling off over the last years only. In most countries, trends in total cancer mortality were more favorable in middle-aged populations. Cancer mortality has been converging in men and women from

Breast

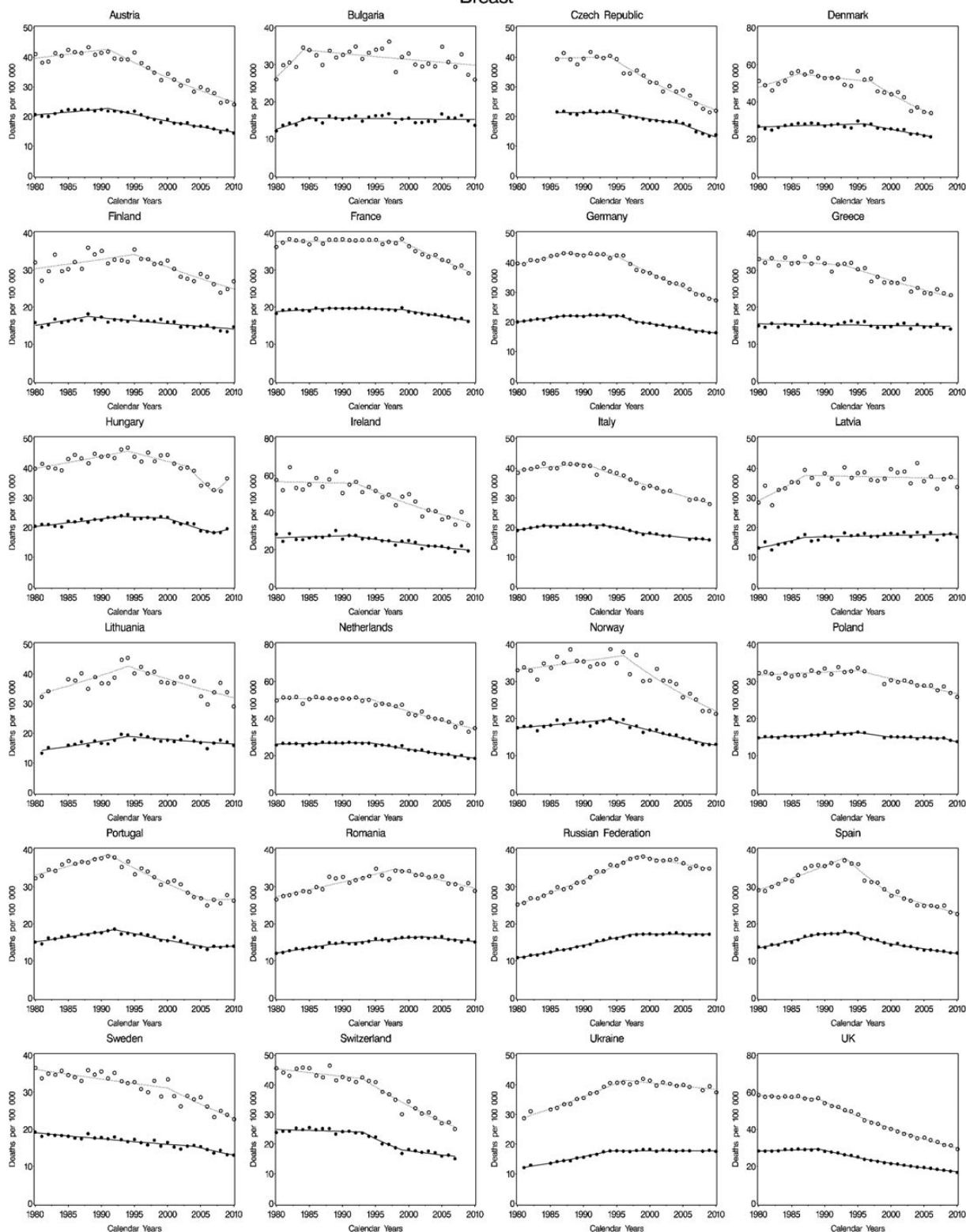


Figure 2. Continued

several countries, and in most recent years truncated rates in the two sexes were very similar in Nordic countries and the UK.

Mortality has been declining for cancer of the intestines (chiefly colon and rectum) since the early 1990s in most

northern and western countries, including France, Germany, Italy, and the UK, as well as in the Czech Republic, which, however, started from exceedingly high rates (Figure 2). Mortality from intestinal cancer has still been increasing or only

Prostate

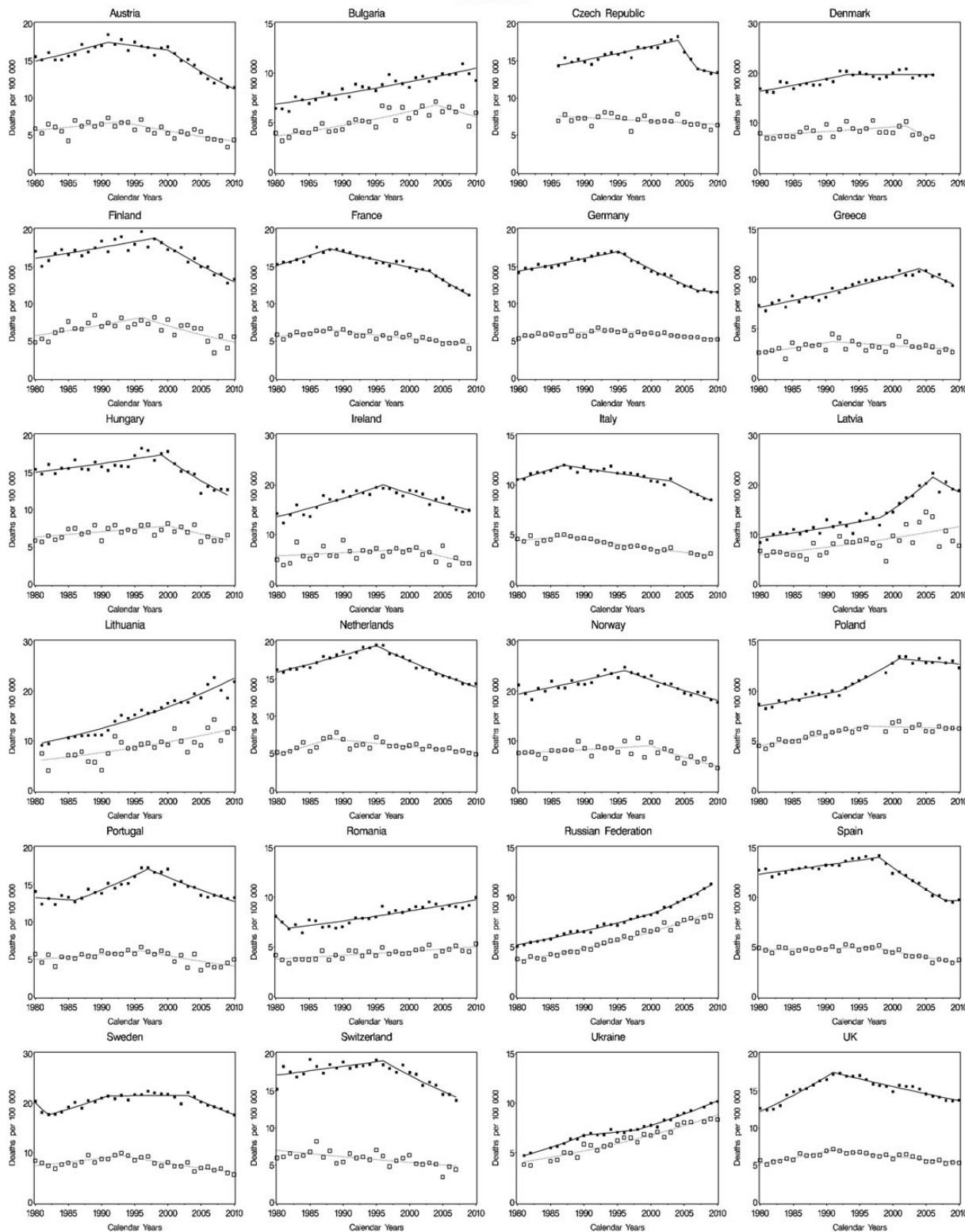


Figure 2. Continued

leveling off over most recent calendar years, particularly in men, in some central and eastern European countries, such as Poland, Romania, and Russia, but also in Greece and Portugal, where rates were relatively low in the past. In most countries, mortality

from intestinal cancer has been more favorable in women, with earlier and larger (proportional) declines.

Mortality from lung cancer in men has long been declining in Austria, Finland, the Netherlands, Switzerland, and the UK

(Figure 2). Long-term declines in male lung cancer were observed in Sweden, too, where lung cancer has always been low. Male mortality rates had a peak in the mid/late 1980s in most other northern and western European countries and in the 1990s in several central and eastern countries, leveling off or declining thereafter. Only in Portugal and Romania, overall male lung cancer mortality was still increasing over recent years. Portuguese rates were, however, comparatively low (28.6/100 000). Overall and middle-age mortality from lung cancer in women increased up to recent calendar years in most European countries, the highest recent rises being in Hungary, France, and Spain. In contrast, in the Netherlands and the UK, which had high rates in the past, but also in Sweden, female lung cancer mortality has leveled off in the last few years, particularly in middle-aged women.

Mortality from breast cancer started to decline between the late 1980s and the early 1990s in most European countries, including those (Spain, Sweden, and Norway) that already had relatively low rates (below 20/100 000) in the 1990s (Figure 2). The declines were generally more marked in relative terms in middle-aged women. Only in Bulgaria, Latvia, Russia, and Ukraine (which had comparatively low rates in the past) overall breast cancer rates have not declined in the last two decades, although trends were more favorable in the middle-aged. This led to a reduction of the difference in breast cancer mortality across Europe, most national overall rates being between 13 and 19/100 000 over most recent calendar years.

Mortality rates from prostate cancer have been leveling off since the mid-1990s in most countries of western Europe, including Italy, which had comparatively low rates in the past (Figure 2). Declines in mortality rates have been observed more recently in the Czech Republic, Hungary, and Latvia, whereas mortality has still been rising over the most recent calendar years in other central and eastern European countries, including Poland, Romania, Russia, and Ukraine, which, however, maintained comparably low rates.

Supplementary Figure S1, available at *Annals of Oncology* online, gives the corresponding trends for other selected cancer sites, i.e. oral cavity or pharynx, esophagus, stomach, gallbladder, pancreas, larynx, bone, connective and soft tissue sarcomas, skin, uterus, ovary, testis, bladder, kidney, thyroid, Hodgkin lymphoma, non-Hodgkin lymphoma, multiple myeloma, and leukemias.

discussion

In the interpretation of the data presented, problems related to random variation, which are greater in relation to smaller populations and rarer cancers, should be considered. There are also problems of death certification reliability and accuracy (validity) due to the difficulties in ascertaining and certifying the cause of death for selected cancer sites [17, 18]. For some countries, coverage of the population is incomplete, and for that reason we excluded Albania, Macedonia, the Republic of Moldova, and several countries of the former Soviet Union whose national coverage was <90% [6]. Low-quality cause-of-death data have also been reported for some other countries, such as Greece, Bulgaria, and Poland [19]. However, for most countries considered, death certification is sufficiently reliable to

permit meaningful inference on trends particularly for common cancer sites, including stomach, intestines, lung, and breast particularly under age 65 years. For a few cancer sites (including bone, soft tissue sarcomas, prostate, multiple myeloma, and other lymphoid neoplasms), diagnosis and certification may be influenced by the availability of diagnostic techniques and the accuracy of death certification.

This up-to-date analysis confirms the persistence of favorable trends in mortality from cancer in most European countries [3]. Total cancer mortality in EU men reached a peak at 187/100 000 in 1988 to decline by 20% in 2009 (149.2). Over the same calendar period, cancer mortality in women steadily declined by 16%, in the absence, however, of a peak in the late 1980s. Such a fall in cancer mortality in the EU was similar to that observed in the USA for women (−16% from 1991 to 2009), but it was smaller for men (−24%) [20].

The major contributors to the decline in total cancer mortality in men were the steady fall in lung cancer and other tobacco-related neoplasms since the late 1980s, along with the persistent decline in gastric cancer mortality, and the decline since the early 1990s in mortality from cancers of the intestines and prostate. In women, the fall in total cancer mortality has been mainly due to the decline in intestinal and breast cancer mortality since the late 1980s and the long-term reduction in mortality from cancer of the (cervix) uterus. Only mortality from female lung cancer, pancreatic cancer, and soft tissue sarcomas in both sexes was still increasing (or not declining), while mortality from multiple myeloma has started to decline in the most recent calendar years.

Trends in cancer mortality have been less favorable in central and eastern European countries, where mortality (overall and from major sites) has been increasing up to the late 1990s/early 2000s. Consequently, over recent calendar years, there still was a twofold difference between the highest rate in male cancer mortality in Hungary (253.2/100 000) and the lowest one in Sweden (112.9/100 000), and a 1.7-fold one in women (between 124.4 in Denmark and 71.0/100 000 in Spain).

The favorable trends in cancer mortality can be largely attributed to favorable changes in the exposure to specific environmental and lifestyle risk factors [1, 2, 21], mainly the reduction in tobacco consumption in subsequent generations of European men (with a favorable impact on lung and other tobacco-related neoplasms) [22, 23], the reduction in occupational exposure to carcinogens (lung and bladder cancer) [24], a better food conservation, and the control of *Helicobacter pylori* infection (gastric cancer) [25], and a more affluent and varied diet (gastric, but probably colorectal cancer) [26–28]. Alcohol consumption has been steadily declining over the last decades in countries from southern Europe, with a consequent favorable impact on oral, pharyngeal, esophageal, and laryngeal cancers in those countries. Mortality from alcohol-related cancers remains, however, exceedingly high in countries from central and eastern Europe [22, 29].

Early diagnosis through opportunistic and organized screenings has likely had a role on colorectal (through fecal occult blood test, flexible sigmoidoscopy, and colonoscopy) [28, 30], breast (mammography) [31–33], and possibly prostate cancer (prostate-specific antigen test) mortality [34, 35], although the quantification of the role of diagnostic screening

on mortality from those neoplasms (mostly for prostate cancer) is still under debate [32, 36–41]. Screening has been the main responsible factor for the long-term decline in cervical cancer (through the PAP smear test and, more recently, the human papilloma virus test) particularly in countries from western and northern Europe [42], while the less widespread and/or later adoption of cervical cancer screening in central and eastern countries is likely to largely explain the less favorable trends and the persistent exceedingly high rates in those countries [4, 43, 44].

Improvements in disease treatment and management are likely to have appreciably contributed to the favorable trends in breast cancer (through hormonal therapies and chemotherapy, advancement in radiotherapy and surgery) [31, 33, 45], but also colorectal (chemotherapy and radiotherapy) [28, 30] and prostate (androgen blockage, transurethral resection of the prostate, and radiotherapy) [35, 41] cancer. The adoption of newer therapies has also had a marked impact toward the reduction in mortality from a few other neoplasms amenable to treatment, including testicular cancer [35, 46], Hodgkin lymphoma [47], and leukemias [48]. Trends in mortality from those neoplasms have been less favorable in countries from central and eastern Europe, probably due to delays in the adoption of modern integrated therapies in those areas of the continent [5, 47]. With reference to testicular cancer, in several countries of western and northern Europe where treatments for this neoplasm (namely platinum-based therapies) have been available since the 1970s and where mortality from the disease has long been declining, a leveling off in the rates has been observed in most recent calendar years, suggesting that a plateau in mortality has been reached.

The persistent increase in mortality from lung cancer in women from most European countries reflects the different pattern of tobacco smoking in women when compared with men, with a later spread in tobacco consumption [21, 49]. The female lung cancer epidemic is still expanding in countries of western (particularly France, Spain, and Switzerland) and central/eastern Europe, where smoking prevalence in women has only leveled off since the late 1990s, while the epidemic seems to have reached a plateau in the UK and the Netherlands, where smoking prevalence in women has been falling over the last few decades [50]. We predicted a persistent rise in lung cancer mortality in EU women, to reach a rate of 14.0/100 000 in 2015 [49].

The reasons for the unfavorable patterns in pancreatic cancer in Europe (as in the USA and other developed countries of the world) are not clearly understood [51, 52]. Diagnostic improvements may partly or largely account for earlier rises. The reduction in male tobacco smoking prevalence (the major recognized risk factor for pancreatic cancer) [25] should have played a favorable role on mortality from this neoplasm. However, the increasing prevalence of overweight/obesity [53] and consequent type II diabetes—other two major recognized risk factors for pancreatic cancer [25]—over the last decades in many European countries have likely unfavorably influenced mortality from this neoplasm. Improved diagnosis and certification may also have contributed to the rising trends.

With the major exceptions of lung cancer in women and pancreatic cancer in both sexes, in the last quinquennium

cancer mortality has declined moderately but steadily across Europe. There are, however, persisting differences across countries which require specific attention and intervention on risk factor control, early diagnosis, and improved management.

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disclosure

The authors have declared no conflicts of interest.

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