

Trends in cancer mortality at age 15 to 24 years in Europe

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Abstract

Trends in death certification rates from all cancers and seven selected cancer sites (bone sarcoma, soft-tissue sarcoma, ovary, testis, non-Hodgkin's lymphomas, Hodgkin's disease, leukaemias) were analysed for the population aged 15–24 years in Europe and, for comparative purposes, in the United States of America (USA) and Japan over the period of 1965–1998. Overall, there was a decrease in total cancer mortality of approximately 40% for both sexes. The declined mortality is largely attributable to better treatments and inclusion in multicentre clinical trials. The degree of improvement was similar in Japan and the USA, but was less in Eastern European countries, reflecting delays in the application of effective treatments, and limited involvement in large, well-designed clinical trials for these curable cancers in Eastern Europe.

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1. Introduction

Over the last four decades, substantial declines in childhood cancer (≤ 14 years) mortality have been observed. Rates in developed countries in the late 1990s were less than one-third of those observed in the early 1960s [1,2]. Much less information is available for older children, adolescents and young adults aged 15–24 years. Some of the cancers that are relatively common in this age group, including acute leukaemias [2,3], Hodgkin's disease [4,5], testicular cancer and other germ cell neoplasms [6,7], are among those for which substantially improved survival has been observed. However, comprehensive analyses of trends in cancer incidence and mortality in teenagers in Denmark [8] and in Vaud, Switzerland [9] showed no systematic pattern until the late 1980s or early 1990s. Mixed trends in various countries and between the two genders were also observed in the age group of 25–44 years [10].

To provide a comprehensive picture of trends in European cancer mortality at age 15 to 24 years, we analysed death certification data for seven cancer types in 23 countries over the period of 1965–1998. Trends in the United States of America (USA) and Japan were included for comparative purposes only.

2. Patients and methods

Cancer death certification data and estimates of the resident population for each country at ages 15–19 years and 20–24 years for the period of 1965–1998 were derived from the World Health Organization (WHO) database. Seven cancers or groups of cancers were considered, i.e. bone sarcoma, soft-tissue sarcoma, ovary, testis, Hodgkin's disease, leukaemias, non-Hodgkin's lymphoma (i.e. International Classification of Diseases (ICD)-9 200 and 202 which, for mortality data includes 'other and not specified' lymphomas). Total cancer mortality was also studied.

Between 1968 and 1998, three successive Revisions (8th to 10th) of the ICD were used. There were no

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major changes in the classification or coding of the cancers or groups of cancers considered. However, it was impossible to obtain meaningful death certification data for neoplasms of the kidney and of the nervous system, because of difficulties in histopathological classification. For some countries, data were not available for the entire study period for certain sites, but no extrapolation was used.

Age-standardised mortality rates at age 15–24 years were computed by direct standardisation (world standard) for all European countries whose data were available. These include 16 separate Western European countries, except a few small countries such as Iceland, Liechtenstein, Luxembourg and Malta, and for six Eastern European countries—Bulgaria, the Czech Republic, Hungary, Poland, Romania and Slovakia—that provided data to the WHO during the calendar period considered. ‘Germany’ includes the Federal Republic and, since 1970, the former German Democratic Republic. Rates were also computed for the 15 member countries of the European Union (EU) as a whole (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, The Netherlands, Portugal, Spain, Sweden and the United Kingdom (UK)), the six combined Eastern European countries considered, the USA and Japan. Age-standardised mortality rates were computed for six successive 5-year calendar periods, i.e. 1965–1969, 1970–1974, 1975–1979, 1980–1984, 1985–1989 and 1990–1994 and also for the 4-year period of 1995–1998.

3. Results

In the late 1960s, total cancer mortality at age 15–24 years for males in the EU was 107 per million, and this figure declined to 61 (–43%) during the late 1990s (Table 1). Similar declines were recorded during the same calendar period in the USA and Japan. Reduction of mortality was over 80% for Hodgkin’s disease, with a death rate of only around $2/10^6$ in the late 1990s, around 70% for testicular cancer (to $2/10^6$), around 40% for leukaemias (to $16/10^6$), and around 20% for bone neoplasms (to $7/10^6$). An apparent upward trend was observed for soft-tissue sarcomas, although—in absolute terms—the death rates remained low ($3/10^6$). The fall in mortality was comparable across the major Western European countries, and some apparent variation in rates and trends between less populous countries can readily be explained in terms of the random variation of small numbers. Reduction in overall cancer mortality in this age group was substantially smaller in the few Eastern European countries, for which data covering this calendar period were available (–25% in Bulgaria, –33% in Hungary, –15% in Poland and only –9% in Romania).

Table 2 gives the corresponding figures for females. In the late 1960s, total cancer mortality at age 15–24 years was between 70 and 80 per million girls in the EU, the USA and Japan. Most of the apparent between-country differences are likely to be due to random variation alone. In the late 1990s, mortality from all cancers between ages 15 and 24 years was around 40 per million females, corresponding to declines of between 40 and 50% in the EU (as well as in the USA and Japan). The declines were between 35 and 50% for leukaemias, with a mortality of around $10/10^6$ girls in the late 1990s and around 70% for Hodgkin’s disease, with rates in the late 1990s of $2\text{--}3/10^6$ in Europe and the USA, and only 0.2 in Japan. Similarly, the decline in mortality was 60% for ovarian cancer ($2/10^6$), around 30% for bone neoplasms (rates $3\text{--}5/10^6$) and around 30% for non-Hodgkin’s lymphomas (rates around $3/10^6$, both in the late 1990s). Apparent upward trends were registered for soft-tissue sarcomas, although as in males, the absolute rate was only 2–3 per million girls in the late 1990s.

Fig. 1 provides data on trends in mortality at ages 15–24 years over the period of 1965–1998 in the EU, in selected Eastern European countries, and in the USA and Japan for all seven cancers investigated.

Fig. 2 provides histograms of mortality from all neoplasms and selected cancer sites in 23 European countries (plus the entire EU, the USA and Japan) over the most recent calendar period (1995–1998, unless otherwise specified in Table 1). Overall death rates were systematically higher in Eastern Europe, and to a lesser degree in Southern Europe for most ‘curable’ neoplasms. These differences apart, geographical variation was remarkably small for cancer mortality in adolescents and young adults.

4. Discussion

The major finding established by this analysis of cancer mortality from ages 15 to 24 years in Europe over the last 30 years is over 40% fall in both genders. This decline is attributable to an improved treatment of Hodgkin’s diseases, leukaemias, testicular and germ cell ovarian cancers, and most other neoplasms in adolescents and young, and is comparable to the falls documented in two other major developed countries, Japan and the USA. Increased participation in multicentre trials may have accounted for some of the decline. However, mortality was still comparatively greater in Eastern Europe, probably reflecting the delays in the adoption of effective integrated treatments for potentially curable cancers and a low participation in well-designed multicentre clinical trials [1,5,6].

However, the declines in mortality from leukaemias and other neoplasms were smaller between the ages of

Table 1

Trends in age-standardised (world standard) death certification rates per million in young males (aged 15–24 years) from selected major cancers plus total cancer mortality in various countries between 1965–1969 and 1995–1998 (unless otherwise mentioned in parentheses)

Country	Average annual population (in millions)	Bone				Soft-tissue sarcomas				Testis				Non-Hodgkin's lymphomas				Hodgkin's disease				Leukaemias				Total, all sites			
		Rate 1965–1969	Rate 1995–1998	No ^a deaths	% change	Rate 1965–1969	Rate 1995–1998	No ^a deaths	% change	Rate 1965–1969	Rate 1995–1998	No ^a deaths	% change	Rate 1965–1969	Rate 1995–1998	No ^a deaths	% change	Rate 1965–1969	Rate 1995–1998	No ^a deaths	% change	Rate 1965–1969	Rate 1995–1998	No ^a deaths	% change	Rate 1965–1969	Rate 1995–1998	No ^a deaths	% change
European Union	24.842	8.90	7.10	175	−20.2	1.20	3.50	88	191.7	7.60	2.50	65	−67.1	8.80	6.00	150	−31.8	11.60	2.20	56	−81.0	26.70	16.10	398	−39.7	106.70	61.20	1534	−42.6
Austria	0.500	10.00	6.30	3	−37.0	2.40	3.20	1	33.3	13.60	3.40	1	−75.0	6.70	2.00	1	−70.1	15.40	1.10	0	−92.9	22.90	16.00	8	−30.1	119.70	55.30	28	−53.8
Belgium (1995)	0.657	11.60	4.70	3	−59.5	1.70	1.40	1	−17.6	3.50	1.70	1	−51.4	7.90	1.40	1	−82.3	13.90	1.40	1	−89.9	23.60	13.90	9	−41.1	104.70	39.90	27	−61.9
Denmark	0.342	10.80	4.00	1	−63.0	2.00	2.70	1	35.0	19.00	1.90	0	−90.0	11.00	7.20	2	−34.5	16.00	1.50	0	−90.6	22.20	12.90	4	−41.9	115.50	57.90	20	−49.9
Finland	0.329	9.60	5.40	1	−43.8	3.60	3.60	1	0.0	3.70	4.90	1	32.4	4.50	3.60	1	−20.0	12.40	1.80	0	−85.5	23.30	14.10	4	−39.5	91.70	46.90	15	−48.9
France	4.020	7.80	8.30	33	6.4	0.60	3.30	13	450.0	5.50	2.80	11	−49.1	9.30	5.20	21	−44.1	9.50	1.80	7	−81.1	29.30	14.70	59	−49.8	106.20	58.50	236	−44.9
Germany	4.670	9.20	5.40	25	−41.3	1.40	3.10	14	121.4	12.90	2.60	12	−79.8	9.10	4.10	19	−54.9	12.50	2.50	12	−80.0	21.90	14.10	66	−35.6	111.10	55.00	260	−50.5
Greece	0.787	6.10	8.10	6	32.8	0.70	1.40	1	100.0	1.70	1.80	1	5.9	7.50	5.10	4	−32.0	8.90	3.40	2	−61.8	27.60	14.70	11	−46.7	95.60	57.70	45	−39.6
Ireland	0.326	11.60	5.40	1	−53.4	0.80	3.10	1	287.5	7.60	3.10	1	−59.2	7.00	7.70	2	10.0	12.00	3.90	1	−67.5	19.30	13.10	4	−32.1	100.90	61.50	20	−39.0
Italy	3.889	9.20	7.20	27	−21.7	0.70	4.00	16	471.4	5.50	2.00	8	−63.6	9.60	9.50	36	−1.0	12.10	3.00	12	−75.2	31.80	19.80	75	−37.7	110.20	72.70	284	−34.0
Netherlands	0.991	13.60	8.70	8	−36.0	2.00	2.40	2	20.0	9.40	3.80	4	−59.6	7.10	7.00	7	−1.4	9.90	1.70	1	−82.8	25.90	16.00	16	−38.2	100.50	64.30	64	−36.0
Portugal	0.760	11.90	7.00	5	−41.2	3.50	2.10	1	−40.0	1.90	4.30	0	126.3	5.90	8.10	6	37.3	3.10	1.90	1	−38.7	41.20	22.10	17	−46.4	109.50	78.80	62	−28.0
Spain	3.204	5.40	9.30	29	72.2	0.10	5.30	17	5200.0	1.40	2.00	6	42.9	5.60	7.10	22	26.8	6.70	1.70	5	−74.6	28.30	17.50	55	−38.2	98.20	69.70	223	−29.0
Sweden	0.546	10.50	3.60	2	−65.7	1.40	3.80	2	171.4	7.40	2.80	1	−62.2	11.80	2.60	1	−78.0	10.90	0.90	0	−91.7	25.40	12.20	6	−52.0	99.40	47.90	26	−51.8
United Kingdom	1.892	9.80	7.70	29	−21.4	2.30	3.70	14	60.9	10.60	2.20	8	−79.2	11.20	5.60	21	−50.0	15.80	2.20	8	−86.1	22.90	16.00	59	−30.1	108.50	57.70	217	−46.8
Norway	0.291	8.40	8.50	2	1.2	5.20	1.90	0	−63.5	7.70	3.00	1	−61.0	9.80	10.60	3	8.2	17.40	3.00	1	−82.8	22.10	14.60	3	−33.9	103.50	63.60	18	−38.6
Switzerland (1990–1994)	0.427	14.00	7.20	3	−48.6	3.00	1.80	1	−40.0	16.90	4.20	2	−75.1	7.10	8.50	4	19.7	11.00	3.70	2	−66.4	28.80	19.30	14	−33.0	110.50	62.30	23	−43.6
Bulgaria	0.624	10.40	6.10	3	−41.3	0.40	0.90	0	125.0	5.90	9.10	6	54.2	12.30	4.10	2	−66.7	10.20	6.20	4	−39.2	28.10	20.40	12	−27.4	117.60	88.60	56	−24.7
Hungary	0.815	6.00	7.10	5	18.3	5.30	3.10	2	−41.5	14.80	5.40	4	−63.5	12.60	8.10	6	−35.7	4.90	3.00	2	−38.8	26.10	21.40	17	−18.0	112.80	75.10	62	−33.4
Poland	1.907	8.50	9.30	9	9.4	1.10	1.50	1	36.4	3.10	5.60	10	80.6	3.60	6.70	4	86.1	8.30	6.10	11	−26.5	24.40	16.80	32	−31.1	91.20	77.90	148	−14.6
Romania	1.922	9.20	12.40	23	34.8		5.80	2		3.70	3.70	7	0.0		9.70	3		8.20	4.10	8	−50.0	25.70	18.80	35	−26.8	104.70	94.90	183	−9.4
USA	18.703	10.10	6.10	113	−39.6	3.10	3.90	72	25.8	9.30	2.00	37	−78.5	7.90	5.50	103	−30.4	13.40	2.80	53	−79.1	25.20	14.20	265	−43.7	106.30	56.30	1056	−47.0
Japan	8.884	7.50	5.10	25	−32.0	0.90	2.40	21	166.7	2.20	1.40	13	−36.4	7.40	5.20	46	−29.7	1.70	0.20	2	−88.2	28.80	17.60	155	−38.9	92.60	55.70	497	−39.8

USA, United States of America.

^a Average number of deaths per year in the most recent calendar period.

Table 2

Trends in age-standardised (world standard) death certification rates per million in young females (aged 15 to 24 years) from selected major cancers plus total cancer mortality in various countries between 1965–1969 and 1995–1998 (unless otherwise mentioned in parentheses)

Country	Average annual population (in millions)	Bone				Soft-tissue sarcomas				Ovary				Non-Hodgkin's lymphoma				Hodgkin's disease				Leukaemias				Total, all sites			
		Rate	Rate	No ^a	%	Rate	Rate	No ^a	%	Rate	Rate	No ^a	%	Rate	Rate	No ^a	%	Rate	Rate	No ^a	%	Rate	Rate	No ^a	%	Rate	Rate	No ^a	%
		1965 –1969	1995 –1998	deaths	change	1965 –1969	1995 –1998	deaths	change	1965 –1969	1995 –1998	deaths	change	1965 –1969	1995 –1998	deaths	change	1965 –1969	1995 –1998	deaths	change	1965 –1969	1995 –1998	deaths	change	1965 –1969	1995 –1998	deaths	change
European Union	23.799	6.20	4.70	108	–24.2	0.80	2.60	62	225.0	3.70	1.50	35	–59.5	4.00	3.40	82	–15.0	8.60	1.90	47	–77.9	18.70	10.50	248	–43.9	75.60	43.20	1036	–42.9
Austria	0.484	4.60	3.70	4	–19.6	2.00	0.80	13	–60.0	2.00	0.40	0	–80.0	2.80	0.80	0	–71.4	8.40	0.70	0	–91.7	15.80	7.20	3	–54.4	70.50	28.40	14	–59.7
Belgium (1995)	0.834	7.30	3.20	2	–56.2	0.30	1.40	17	366.7	3.90	0.00	0	–100.0	4.20	5.30	3	26.2	9.40	1.40	1	–85.1	19.10	7.80	5	–59.2	81.20	42.00	27	–48.3
Denmark	0.330	7.40	7.40	2	0.0	1.60	0.70	0	–56.3	7.50	0.70	0	–90.7	3.70	6.30	2	70.3	6.90	2.20	0	–68.1	18.30	7.00	2	–61.7	77.20	39.70	13	–48.6
Finland	0.314	7.60	5.00	1	–34.2	0.50	1.90	0	280.0	5.20	1.50	0	–71.2	1.40	3.10	1	121.4	7.30	1.30	0	–82.2	18.60	6.30	2	–66.1	64.20	35.40	11	–44.9
France	3.887	6.50	5.30	20	–18.5	0.50	2.20	8	340.0	3.90	1.40	5	–64.1	3.80	2.20	8	–42.1	7.30	1.00	3	–86.3	19.90	9.80	38	–50.8	74.30	40.40	158	–45.6
Germany	4.438	5.30	3.60	16	–32.1	1.00	2.30	10	130.0	4.30	1.30	6	–69.8	4.10	2.70	12	–34.1	9.40	2.20	10	–76.6	16.50	9.20	40	–44.2	77.20	37.50	167	–51.4
Greece	0.750	3.30	5.90	4	78.8	0.00	0.70	0		2.20	2.60	2	18.2	2.90	3.80	2	31.0	6.40	2.70	2	–57.8	16.70	7.60	5	–54.5	66.60	45.30	34	–32.0
Ireland	0.313	8.20	3.20	1	–61.0	1.70	1.60	0	–5.9	2.90	4.80	1	65.5	2.70	0.80	0	–70.4	9.20	0.00	0	–100.0	16.10	9.60	3	–40.4	66.80	33.60	10	–49.7
Italy	3.736	6.50	4.80	17	–26.2	0.30	3.10	11	933.3	3.80	0.90	3	–76.3	5.40	5.30	21	–1.9	11.10	2.30	9	–79.3	23.10	12.40	45	–46.3	85.00	47.60	179	–44.0
Netherlands	0.956	9.40	6.30	5	–33.0	2.10	3.10	3	47.6	4.50	2.40	2	–46.7	4.50	3.70	3	–17.8	8.20	1.60	1	–80.5	20.50	6.90	6	–66.3	80.50	43.10	42	–46.5
Portugal	0.777	7.20	4.80	3	–33.3	2.50	1.80	1	–28.0		2.10	1		7.10	2.20	1	–69.0	3.10	1.70	1	–45.2	23.20	12.80	10	–44.8	79.00	52.00	41	–34.2
Spain	3.067	4.00	5.20	15	30.0	0.20	4.10	12	1950.0	1.70	1.40	4	–17.6	2.20	3.60	11	63.6	4.50	2.10	6	–53.3	17.10	10.60	31	–38.0	68.20	46.80	143	–31.4
Sweden	0.523	6.70	3.90	2	–41.8	1.60	3.70	2	131.3	4.20	3.10	1	–26.2	3.00	2.50	1	–16.7	8.00	1.80	1	–77.5	16.20	9.90	5	–38.9	63.30	40.40	21	–36.2
United Kingdom	1.799	7.30	4.20	14	–42.5	1.80	2.50	8	38.9	3.80	1.70	5	–55.3	4.40	3.40	12	–22.7	10.50	2.00	7	–81.0	16.40	12.40	43	–24.4	73.00	45.10	161	–38.2
Norway	0.280	4.20	5.60	1	33.3	2.80	0.00	0	–100.0	6.90	0.00	0	–100.0	8.30	4.20	1	–49.4	8.20	3.60	1	–56.1	11.00	12.40	3	12.7	73.00	42.50	12	–41.8
Switzerland (1990–1994)	0.417	4.30	1.80	1	–58.1	2.40	2.10	1	–12.5	7.30	0.90	0	–87.7	6.30	3.50	2	–44.4	6.10	1.70	1	–72.1	12.50	7.30	3	–41.6	62.80	33.30	15	–47.0
Bulgaria	0.596	4.20	3.20	1	–23.8	1.20	0.70	0	–41.7					4.20	1.70	1	–59.5	5.20	5.20	3	0.0	18.50	17.10	10	–7.6	76.70	64.30	38	–16.2
Hungary	0.777	2.40	4.40	3	83.3	3.90	1.90	1	–51.3	3.90	3.00	2	–23.1	8.80	2.40	2	–72.7	2.30	3.40	2	47.8	12.60	12.20	9	–3.2	69.30	46.90	37	–32.3
Poland	1.833	5.10	4.90	9	–3.9	0.80	1.60	1	100.0	6.00	4.40	2	–26.7	3.00	4.60	3	53.3	6.70	3.90	7	–41.8	19.00	9.60	17	–49.5	81.10	50.80	93	–37.4
Romania	0.184	5.80	6.30	11	8.6		2.40	0			4.00	1		4.20	4.00	1	–4.8	2.60	3.30	6	26.9	17.70	13.20	24	–25.4	79.00	67.90	125	–14.1
USA	17.785	5.00	3.50	62	–30.0	2.10	3.30	58	57.1	4.60	1.20	86	–73.9	3.20	3.20	57	0.0	9.00	2.00	35	–77.8	15.20	9.60	171	–36.8	70.10	39.50	706	–43.7
Japan	8.469	4.30	3.20	25	–25.6	0.60	2.30	18	283.3	6.30	2.60	21	–58.7	3.80	2.60	22	–31.6	0.90	0.20	2	–77.8	21.60	11.00	94	–49.1	76.60	37.30	318	–51.3

USA, United States of America.

^a Average number of deaths per year in the most recent calendar period.

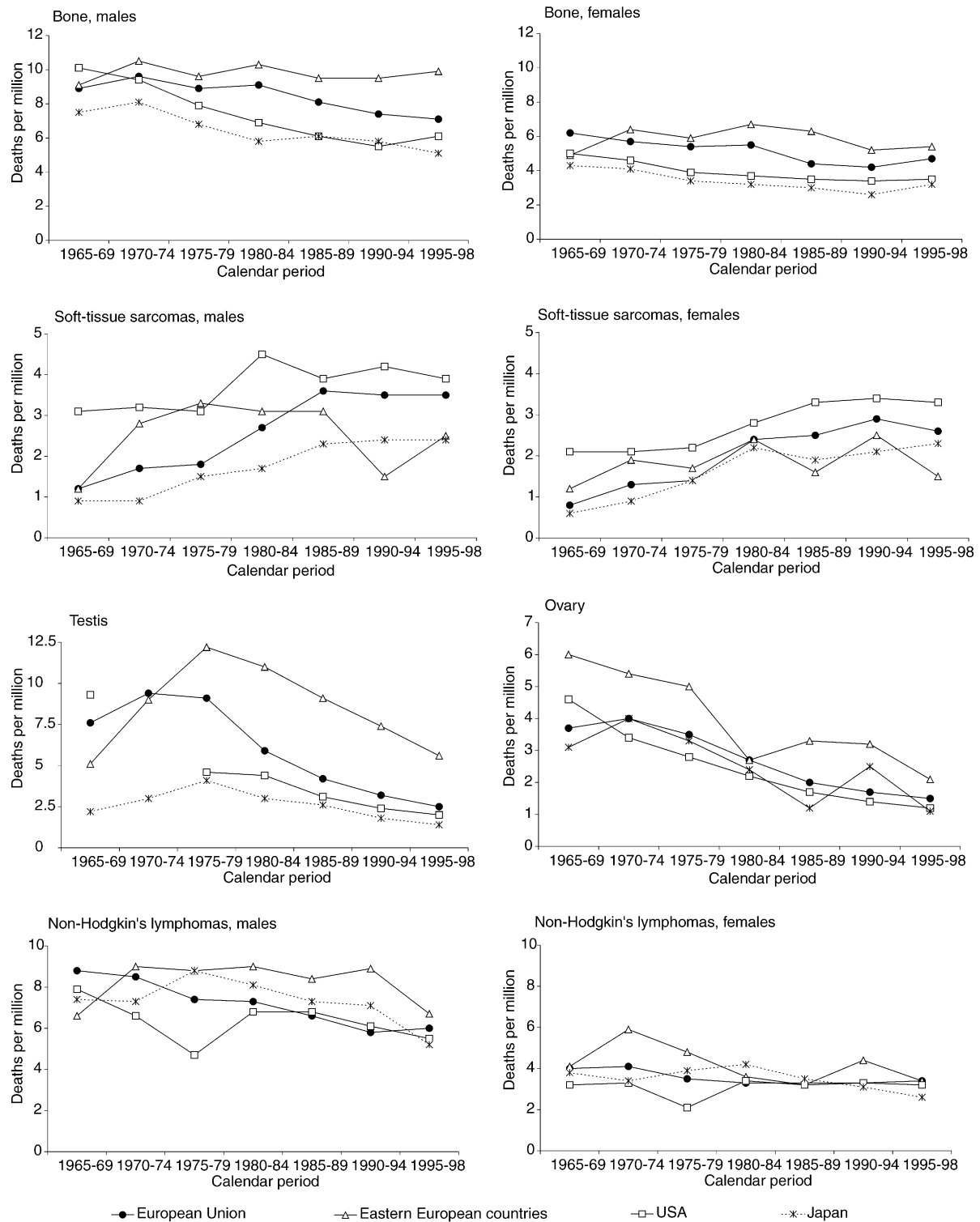


Fig. 1. Trends in 15–24-year-old age-standardised (world) mortality from seven cancers plus total cancer mortality in the European Union (EU; comprising Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, The Netherlands, Portugal, Spain, Sweden and the UK, six combined Eastern European countries (Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovakia), the USA and Japan, 1965–1998.

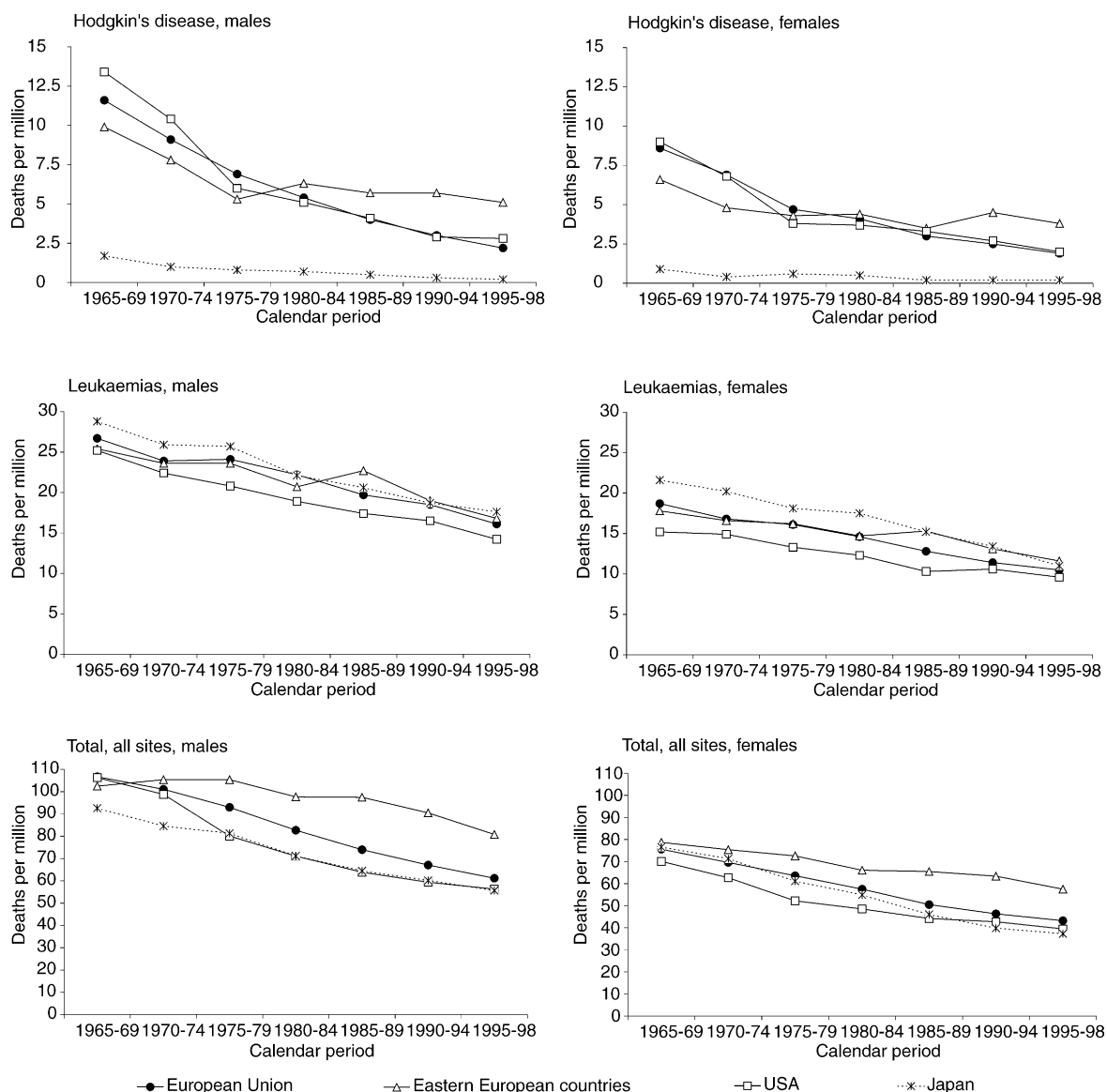


Fig. 1. (continued)

15 and 24 years than for children. This might reflect different molecular and cellular characteristics of leukaemias between children and young adults [3] and/or less effective treatments in the young adults. Compared with children, there are few organised structures for the integrated treatment of cancer in older teenagers and young adults.

Reduction in mortality was comparatively modest for bone neoplasms, and one type of cancer—soft-tissue sarcoma—showed an upward trend in mortality over the last few decades [11]. It is difficult to understand how much of this apparently unfavourable trend is due to changed criteria for diagnosis and certification [12], rather than to a possible increase in the incidence of the disease, or to unfavourable consequences of more con-

servative treatment. Similar unfavourable trends were observed in the USA and Japan, although the latter started from exceedingly low rates. Only a limited and inconsistent increase has been observed in 5-year survival from soft-tissue sarcomas between 1978 and 1990 across Europe [13,14]. However, these neoplasms are rare in this age group, and death rates are correspondingly low (around $3/10^6$ young) for both genders in most parts of the world.

Uncertainties in diagnosis and certification have probably influenced the rates and trends of other neoplasms, including neuroblastoma, brain and kidney cancers. However, these difficulties can hardly eclipse the overall picture of cancer mortality in the young, which shows steady, favourable trends over recent

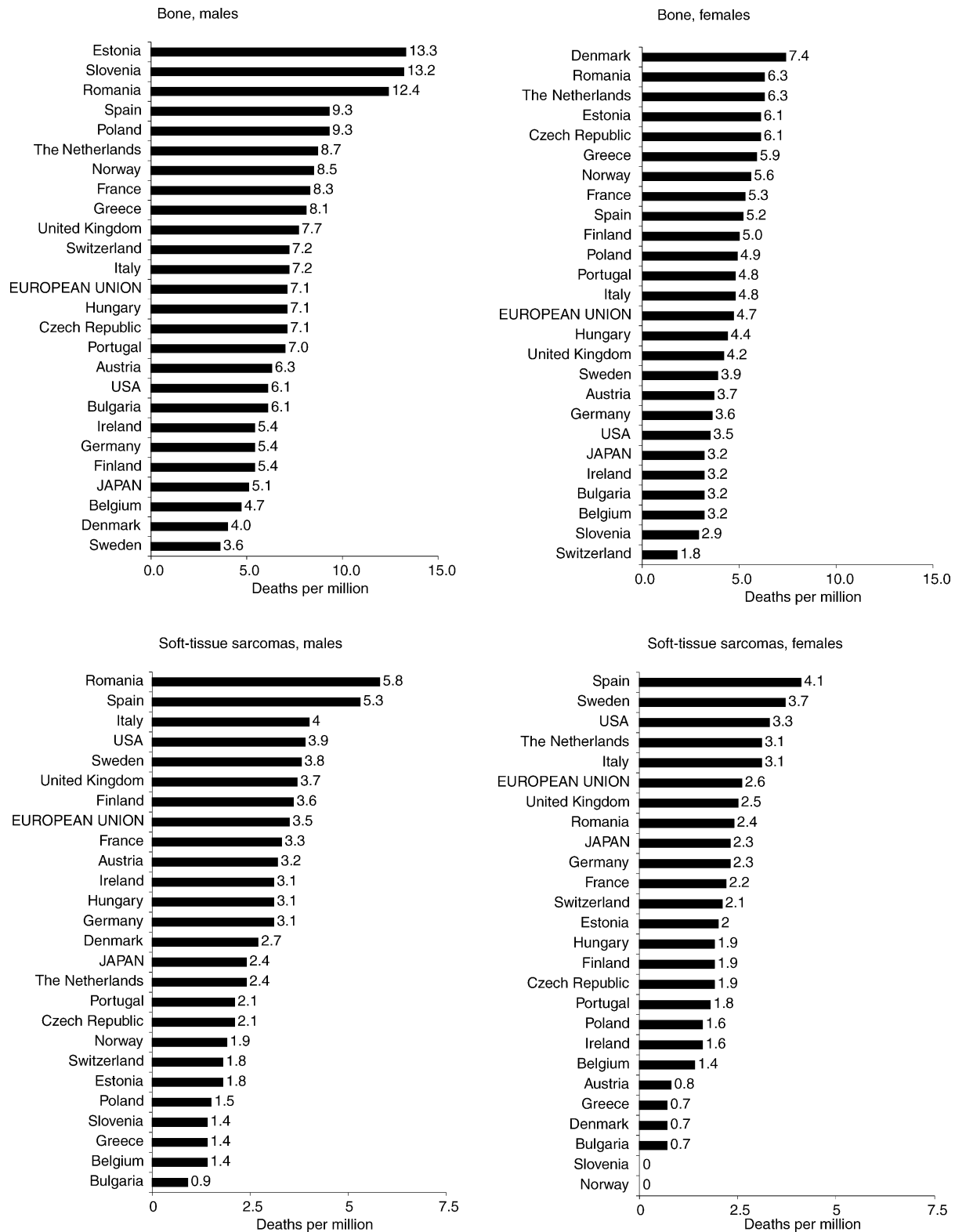


Fig. 2. 15–24-year-old age-standardised (world) mortality from seven cancers plus total cancer mortality in 1995–1998 in 23 separate European countries, the European Union (EU; comprising Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, The Netherlands, Portugal, Spain, Sweden and the UK), the USA and Japan.

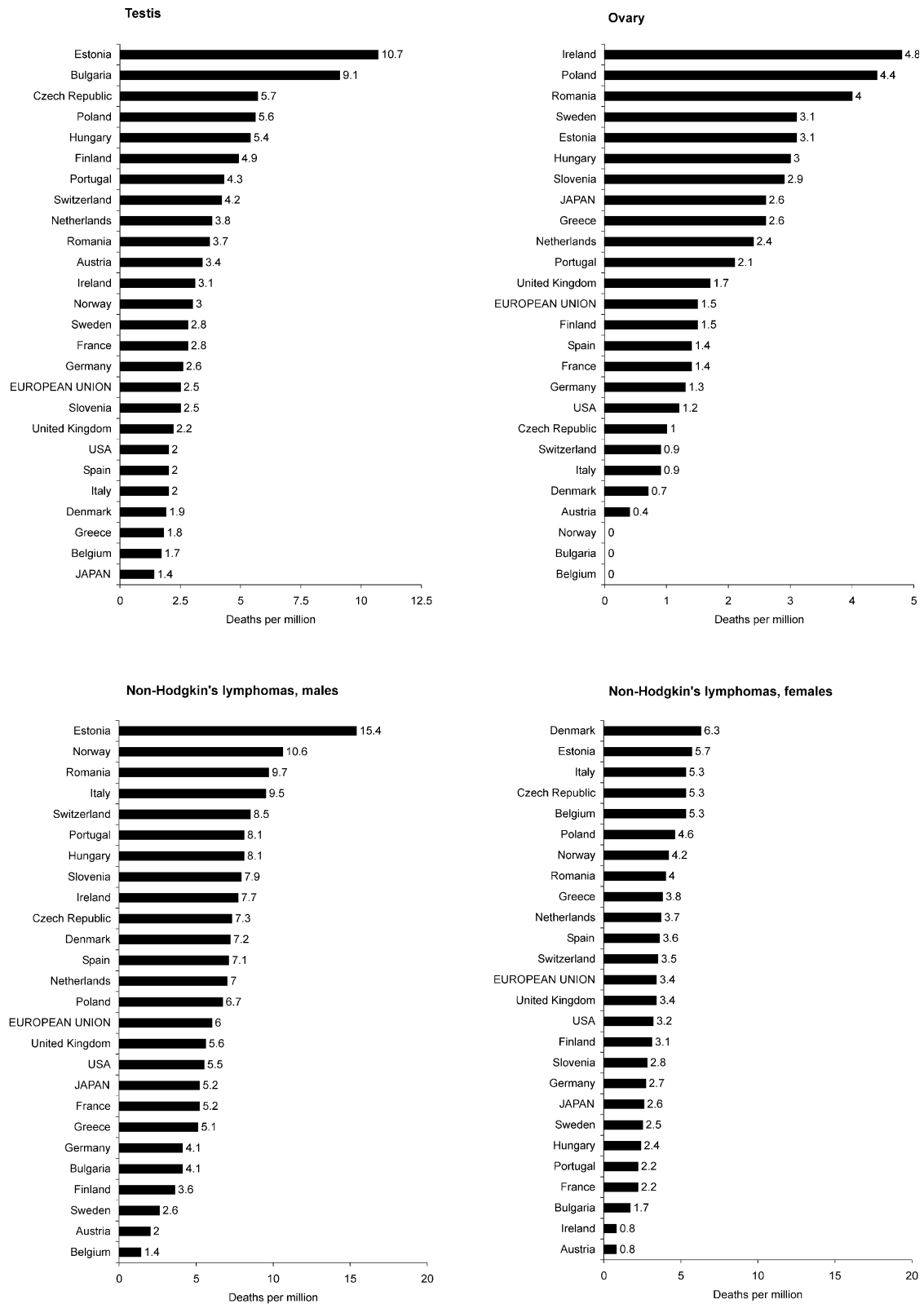


Fig. 2. (continued).

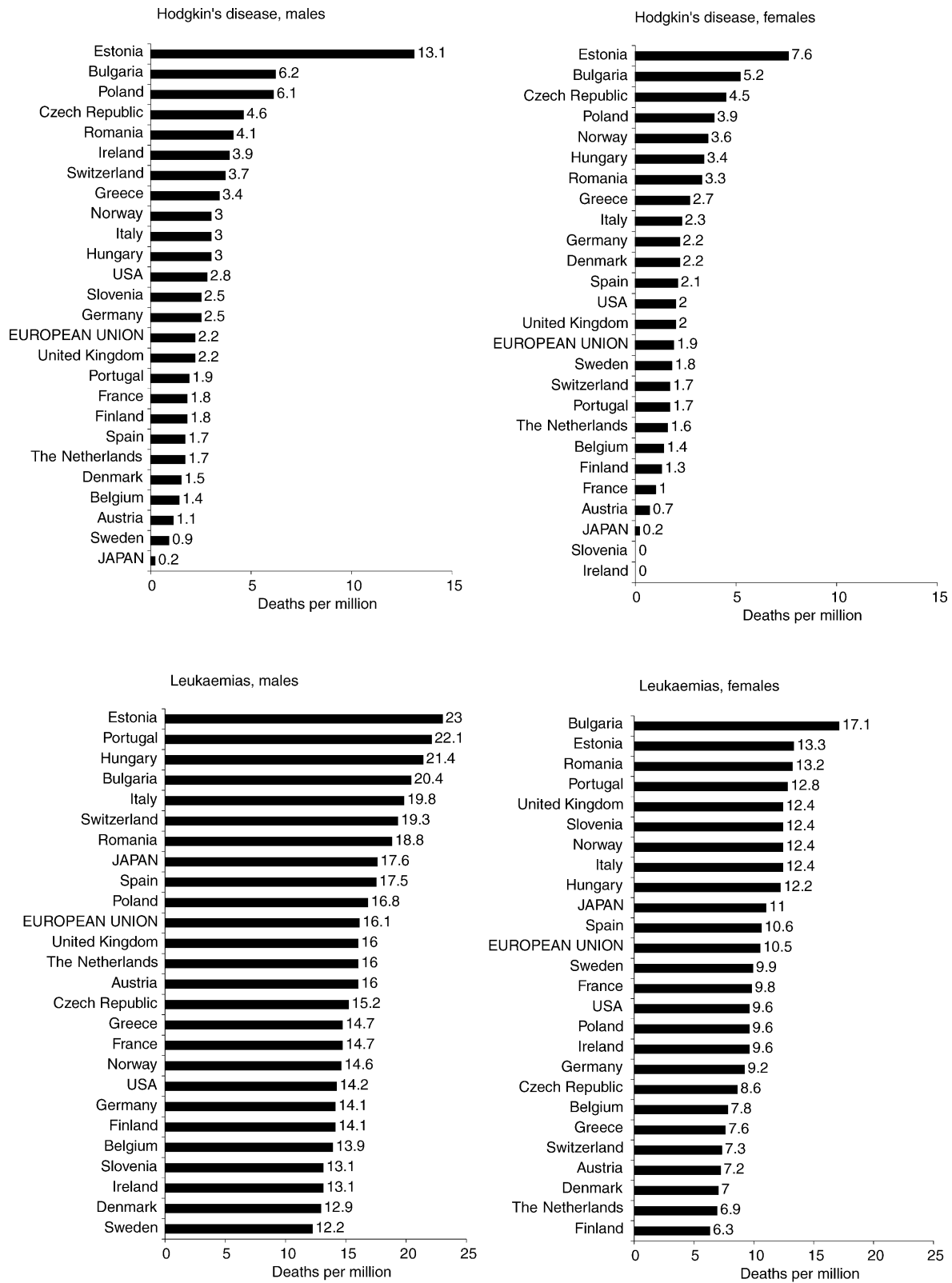


Fig. 2. (continued).

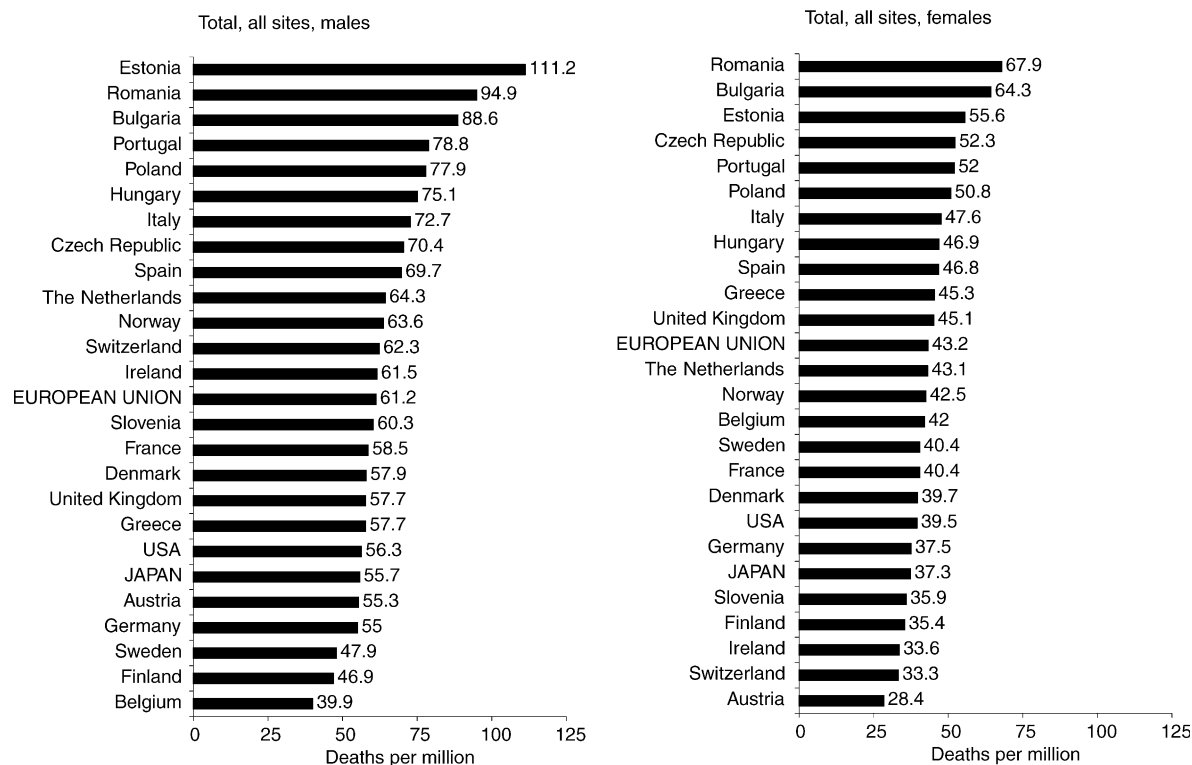


Fig. 2. (continued).

decades in Western Europe and most other developed areas of the world. Random variation due to the low absolute number of deaths can influence trends in small countries, thus partly accounting for the inconsistent trends observed in countries like Bulgaria, but can hardly explain the trends observed in large geographical areas, such as the EU or the aggregate of Eastern Europe.

Another interesting observation is the similarity of cancer mortality in the young, as previously reported for childhood cancer, across most 'developed' areas of the world [3,15]. Eastern Europe, where treatment of several potentially curable cancers remains unsatisfactory [1–7], is a major exception, with persisting higher cancer mortality rates in the young.

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