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England

Protecting and improving the nation's health

Childhood Cancer Mortality in the UK and Internationally, 2005-2010

Report on behalf of the Children, Teenagers and Young Adults Clinical
Reference Group

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Contents

About Public Health England	2
Executive summary	4
Introduction	5
Data and methods	5
Results	7
Discussion	20
References	22
Acknowledgements	23

Executive summary

Despite continuing advances in treatment and consequent improvements in survival rates, cancer remains the most frequent medical cause of death for children in industrialised countries including the UK. This report presents mortality data for cancer among children under 15 years of age in the UK and 53 other countries up to 2010. The data are derived from the cancer mortality database created and maintained by the Section of Cancer Surveillance at IARC and last updated in April 2014.

In the UK from 2008-2010, age-standardised childhood mortality rates were 22.4 per million for all cancers combined, 5.3 per million for leukaemia and 7.8 per million for central nervous system tumours. The UK was among high-income countries (as defined by the World Bank) and European countries with lower childhood mortality rates from all cancers combined and from leukaemia. The UK was also among European countries with lower childhood mortality rates from central nervous system (CNS) cancers, though it was nearer the middle of the range for high-income countries across all continents.

In the UK between 2005-2007 and 2008-2010, there was a statistically significant decrease of 14% in childhood mortality for all cancers combined. Between the same two periods in the UK, childhood mortality decreased by 16% for leukaemia and by 13% for CNS cancers. These results reflect continuing success in outcomes for childhood cancer. Despite suggestions that survival from childhood cancer in the UK compares poorly with some other countries, the UK had relatively low mortality rates among European countries and among high-income countries worldwide. It is unclear how much the UK's favourable position can be attributed to relatively high survival, and how much to relatively low incidence.

Introduction

Despite continuing advances in treatment and consequent improvements in survival rates, cancer remains the most frequent medical cause of death for children in industrialised countries including the UK. The most recent published analyses of international mortality patterns for childhood cancer cover the period to 2007 (Bosetti *et al.*, 2010; Chatenoud *et al.*, 2010). This report presents mortality data for cancer among children less than 15 years of age in the UK and 53 other countries up to 2010.

Data and methods

The data is derived from the cancer mortality database created and maintained by the Section of Cancer Surveillance at IARC and last updated in April 2014 (IARC, 2014). In this database, numbers of cancer deaths are extracted from the WHO Mortality Database (WHO, 2014) and demographic information (population) is derived from World Population Prospects, the 2012 revision (United Nations, 2012).

All countries were included that satisfied the following criteria:

- data available for at least the period 2006-2009
- civil registration coverage of cause of death was >90%, a standard criterion of high quality for mortality data (Mathers *et al.*, 2005)
- total national population (all ages) at least 1 million

The analyses includes data from 54 countries and territories in total, as described in Table 1. They comprise 31 countries in Europe (including the UK), three in Africa, seven in Asia, three in North America, eight in Central and South America and the Caribbean and two in Oceania. Thirty-four countries (24 in Europe) were classified as high-income by the World Bank, 16 (five in Europe) as upper middle-income and four (two in Europe) as lower middle-income. No low-income countries satisfied the inclusion criteria. Coverage of cause of death by civil registration ranged from 90% to 100%, and the proportion of registered deaths with ill-defined cause ranged from 2% to 36%.

Table 1. Countries included in analyses of childhood cancer mortality. Years covered, percentage coverage of cause of death by civil registration, percentage of deaths with ill-defined cause (all ages), World Bank classification.

Country	Years	% deaths registered with cause	% registered deaths with ill-defined cause	World Bank classification
Austria	2005-2010	100	10	HI
Belgium	2005-2010	99.6	13	HI
Bulgaria	2005-2010	100	28	UMI
Croatia	2005-2010	100	8	HI
Czech Republic	2005-2010	100	11	HI

Country	Years	% deaths registered with cause	% registered deaths with ill-defined cause	World Bank classification
Denmark	2005-2010	98.5	13	HI
Estonia	2005-2010	100	6	HI
Finland	2005-2010	100	2	HI
France	2005-2010	100	15	HI
Germany	2005-2010	99.6	12	HI
Greece	2005-2010	100	26	HI
Hungary	2005-2010	100	5	UMI
Ireland	2005-2010	100	5	HI
Italy	2006-2010	100	8	HI
Latvia	2005-2010	99.9	11	HI
Lithuania	2005-2010	100	5	HI
Macedonia	2005-2010	100	14	UMI
Moldova	2005-2010	91.4	2	LMI
Netherlands	2005-2010	99.8	13	HI
Norway	2005-2010	100	11	HI
Poland	2005-2010	100	27	HI
Romania	2005-2010	99.6	7	UMI
Russia	2005-2010	99.3	5	HI
Serbia	2005-2010	90.2	13	UMI
Slovakia	2005-2010	100	8	HI
Slovenia	2005-2010	100	10	HI
Spain	2005-2010	100	10	HI
Sweden	2005-2010	100	11	HI
Switzerland	2005-2010	100	10	HI
Ukraine	2005-2010	98.6	3	LMI
United Kingdom	2005-2010	100	6	HI
Egypt	2005-2010	94.6	36	LMI
Mauritius	2005-2010	100	8	UMI
South Africa	2005-2009	92.3	21	UMI
China – Hong Kong	2005-2010	?	?	HI
Israel	2005-2010	100	8	HI
Japan	2005-2010	100	12	HI
Kazakhstan	2005-2010	91.6	9	UMI
Kuwait	2005-2010	95.9	10	HI
Kyrgyzstan	2005-2010	97.6	3	LMI
South Korea	2005-2010	99	15	HI
Canada	2005-2009	100	6	HI
Mexico	2005-2010	93.9	5	UMI
United States	2005-2010	98.3	7	HI
Argentina	2005-2010	99.2	22	UMI
Brazil	2005-2010	93	12	UMI
Chile	2005-2009	97.7	6	HI

Country	Years	% deaths registered with cause	% registered deaths with ill-defined cause	World Bank classification
Colombia	2005-2009	98.5	6	UMI
Costa Rica	2005-2010	90.4	5	UMI
Cuba	2005-2010	99.8	6	UMI
Panama	2005-2009	90.3	9	UMI
Venezuela	2005-2009	94.6	8	UMI
Australia	2006-2010	100	6	HI
New Zealand	2005-2009	100	3	HI

Because childhood cancer is rare and survival is high, population mortality rates are low. Of the 12 main diagnostic groups in the International Classification of Childhood Cancer (ICCC-3) (Steliarova-Foucher *et al.*, 2005), by far the largest contributions to childhood cancer mortality are from leukaemia and central nervous system (CNS) tumours. The next largest contributions are from neuroblastoma and soft-tissue sarcomas. Official mortality data are presented by ICD code, however, and so data were not available for these groups. Therefore, data are presented only for all cancers combined (ICD-10 C00-C97), leukaemia (ICD-10 C91-C95), and CNS tumours (ICD-10 C70-72). The category of CNS tumours includes all those classified as malignant in ICD-10. Pilocytic astrocytoma, the most frequent of all childhood CNS tumours, is included since it is classified as malignant in ICD-10 and ICD-O-2 and was only downgraded to non-malignant in ICD-O-3. Other, rarer non-malignant CNS tumours, such as choroid plexus papilloma, myxopapillary ependymoma and subependymal giant-cell astrocytoma are excluded, as are ganglioglioma, meningioma and tumours of unspecified morphology unless specified as malignant. Pineal and pituitary tumours are also excluded.

The age structure of the population at risk varies markedly between countries in the study, and to a lesser extent between calendar periods. Therefore, all mortality rates are age-standardised to avoid bias in comparisons between countries and periods. The rates were standardised according to the world standard population, which assigns weights of 12, 10 and 9 to the age groups 0-4, 5-9 and 10-14 years respectively.

Results

All cancers

Table 2 shows mortality rates for all cancers combined during 2005-2007 and 2008-2010 (for some countries, as noted in the table, one or two years are missing). Age-standardised mortality in the UK was 26.1 per million in 2005-2007 and 22.4 per million in 2008-2010. In 2005-2007 the UK had the 12th lowest mortality rate among the 34 high-income countries (HIC) in the analysis and the 10th lowest among the 31 European

countries (Figure 1a). In 2008-2010 the UK ranked 10th among the 34 HIC and 7th among the 31 European countries (Figure 1b). Mortality was significantly lower in 2008-2010 than in 2005-2007 in the UK and seven other countries, namely Germany, Russia, Switzerland, South Korea, Mexico, USA and Argentina.

Table 2. International childhood mortality from all malignant neoplasms (ICD-10 C00-C97), 2005-2010. Numbers of deaths (N) and age-standardised rates (ASR) per million children aged 0-14 years with standard errors (SE).

Country	Period 1	N	ASR	SE	Period 2	N	ASR	SE
Austria	2005-2007	83	20.8	2.3	2008-2010	66	17.2	2.1
Belgium	2005-2007	144	26.8	2.3	2008-2010	119	21.7	2.0
Bulgaria	2005-2007	142	47.2	4.0	2008-2010	114	38.3	3.6
Croatia	2005-2007	66	32.5	4.1	2008-2010	64	33.0	4.2
Czech Republic	2005-2007	116	26.8	2.5	2008-2010	118	26.3	2.4
Denmark	2005-2007	62	21.0	2.7	2008-2010	55	18.3	2.5
Estonia	2005-2007	21	34.7	7.7	2008-2010	17	28.7	7.0
Finland	2005-2007	81	29.9	3.4	2008-2010	84	31.5	3.5
France	2005-2007	754	21.9	0.8	2008-2010	751	21.6	0.8
Germany	2005-2007	845	24.1	0.8	2008-2010	740	21.8	0.8
Greece	2005-2007	150	31.4	2.6	2008-2010	159	33.0	2.6
Hungary	2005-2007	137	30.3	2.6	2008-2010	160	36.4	2.9
Ireland	2005-2007	63	23.8	3.0	2008-2010	66	25.3	2.9
Italy	2006-2007	513	30.5	1.4	2008-2010	731	28.6	1.1
Latvia	2005-2007	40	43.6	7.0	2008-2010	33	39.8	6.4
Lithuania	2005-2007	51	33.2	4.8	2008-2010	56	39.2	5.3
Macedonia	2005-2007	32	26.0	4.7	2008-2010	37	34.1	5.7
Moldova	2005-2007	106	52.2	5.3	2008-2010	105	58.6	5.8
Netherlands	2005-2007	271	30.4	1.9	2008-2010	230	26.5	1.8
Norway	2005-2007	51	18.3	2.6	2008-2010	64	23.3	2.9
Poland	2005-2007	571	31.4	1.4	2008-2010	487	28.4	1.3
Romania	2005-2007	516	52.0	2.3	2008-2010	458	47.2	2.2
Russia	2005-2007	2988	47.4	0.9	2008-2010	2750	43.5	0.8
Serbia	2005-2007	111	22.0	2.1	2008-2010	122	25.8	2.4
Slovakia	2005-2007	81	31.3	3.6	2008-2010	82	32.9	3.7
Slovenia	2005-2007	19	22.2	5.2	2008-2010	22	26.3	5.6
Spain	2005-2007	597	30.7	1.3	2008-2010	562	27.4	1.2
Sweden	2005-2007	126	27.6	2.5	2008-2010	108	23.6	2.3
Switzerland	2005-2007	105	30.8	3.1	2008-2010	77	21.6	2.5
Ukraine	2005-2007	1125	58.2	1.8	2008-2010	1021	53.8	1.7
United Kingdom	2005-2007	851	26.1	0.9	2008-2010	729	22.4	0.8
Egypt	2005-2007	3624	52.1	0.9	2008-2010	3903	54.3	0.9
Mauritius	2005-2007	35	39.1	6.7	2008-2010	31	39.4	7.3
South Africa	2005-2007	916	20.6	0.7	2008-2009	661	21.8	0.9
China – Hong Kong	2005-2007	87	29.6	3.5	2008-2010	58	22.5	3.1
Israel	2005-2007	161	28.3	2.2	2008-2010	158	26.5	2.1
Japan	2005-2007	1018	19.5	0.6	2008-2010	965	19.0	0.6
Kazakhstan	2005-2007	554	49.7	2.1	2008-2010	559	47.8	2.0

Country	Period 1	N	ASR	SE	Period 2	N	ASR	SE
Kuwait	2005-2007	55	29.8	4.0	2008-2010	57	26.2	3.5
Kyrgyzstan	2005-2007	102	21.1	2.1	2008-2010	108	22.7	2.2
South Korea	2005-2007	907	35.8	1.1	2008-2010	636	26.3	1.1
Canada	2005-2007	382	23.4	1.2	2008-2009	252	22.8	1.5
Mexico	2005-2007	4860	45.4	0.7	2008-2010	4597	43.2	0.6
United States	2005-2007	4210	22.8	0.4	2008-2010	4003	21.6	0.3
Argentina	2005-2007	1211	39.8	1.2	2008-2010	1108	36.6	1.1
Brazil	2005-2007	6151	40.3	0.5	2008-2010	5882	39.4	0.5
Chile	2005-2007	336	28.7	1.6	2008-2009	236	30.2	2.0
Colombia	2005-2007	1668	41.6	1.0	2008-2009	1115	41.5	1.2
Costa Rica	2005-2007	127	34.7	3.1	2008-2010	120	33.8	3.1
Cuba	2005-2007	284	39.5	2.6	2008-2010	295	40.7	3.0
Panama	2005-2007	127	40.3	3.6	2008-2009	68	32.0	3.9
Venezuela	2005-2007	1030	40.7	1.3	2008-2009	722	42.5	1.6
Australia	2006-2007	173	21.6	1.7	2008-2010	272	21.6	1.3
New Zealand	2005-2007	78	29.8	3.4	2008-2009	51	28.5	4.0

Figure 1a. Age-standardised mortality rates per million children aged 0-14 years from all malignant neoplasms (ICD-10 C00-C97) in 31 European countries, 2005-2007.

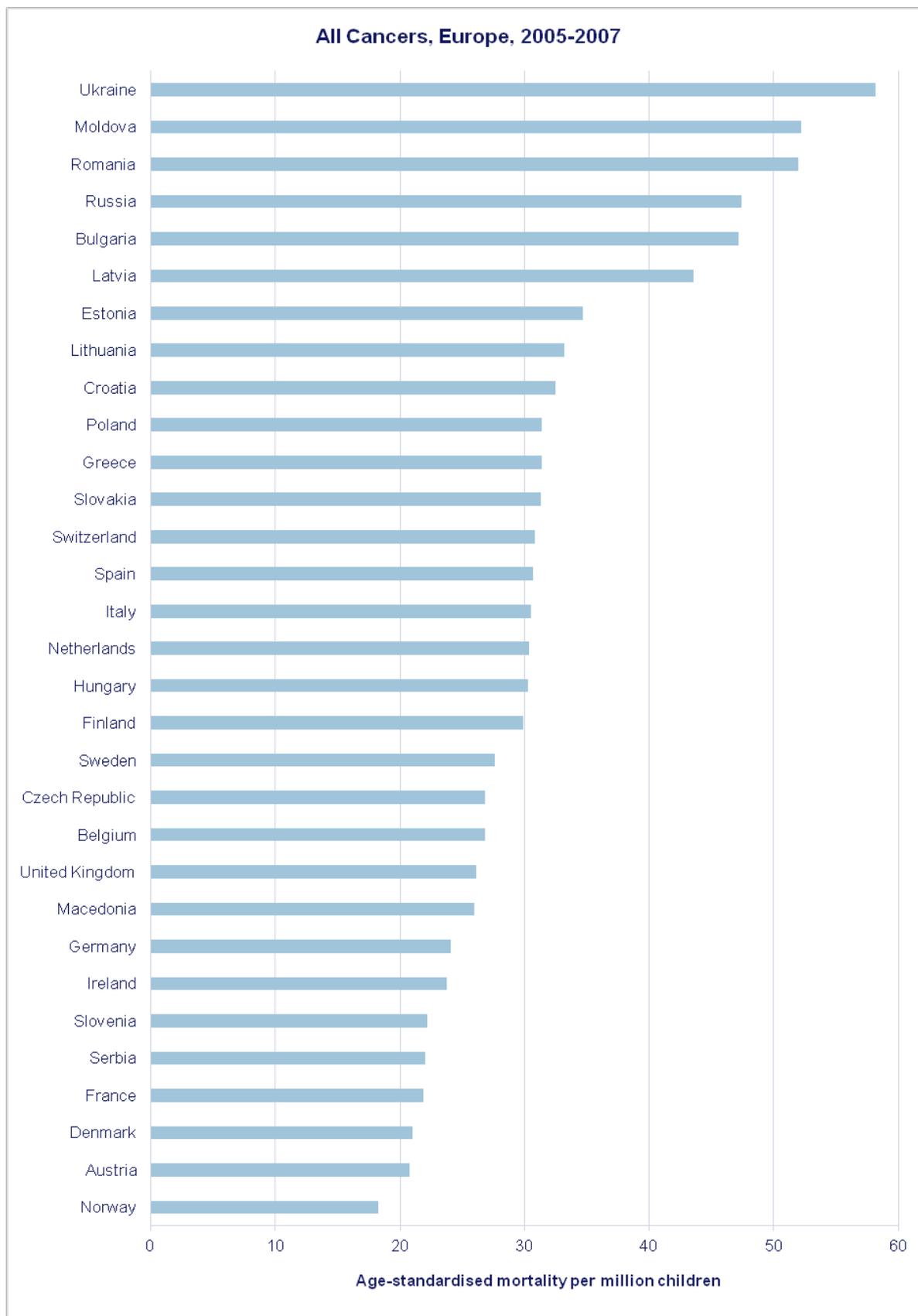
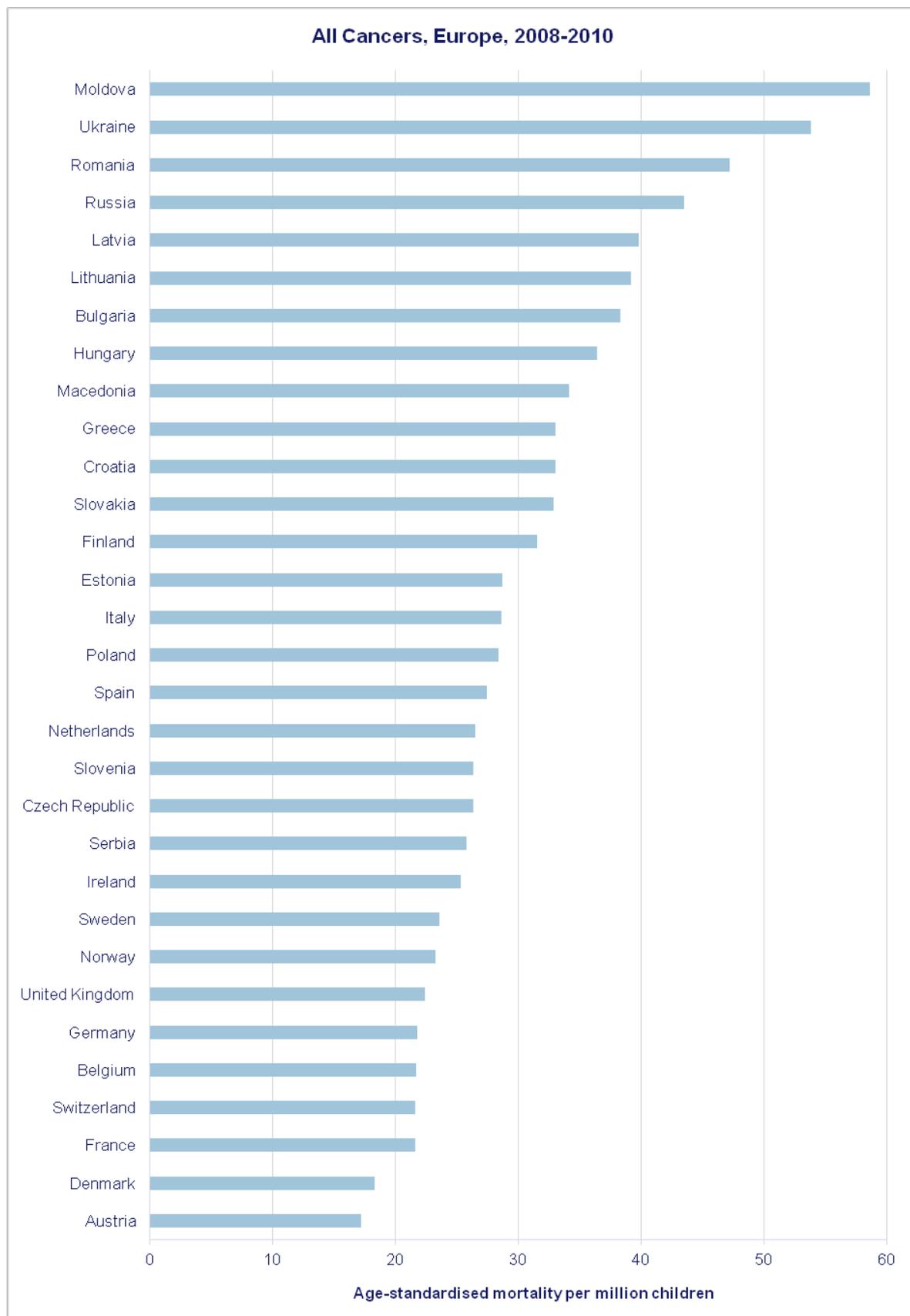


Figure 1b. Age-standardised mortality rates per million children aged 0-14 years from all malignant neoplasms (ICD-10 C00-C97) in 31 European countries, 2008-2010.



Leukaemia

Table 3 shows mortality rates for leukaemia. In the UK, leukaemia accounted for 24.1% of childhood cancer deaths in 2005-2007 and 23.3% in 2008-2010. The corresponding proportions in the HIC of Europe, North America and Oceania were 28.8% in 2005-2007 and 28.3% in 2008-2010. Leukaemia accounted for a similar proportion in European middle-income countries (MIC), 28.4% in 2008-2010. Elsewhere in the world, leukaemia accounted for a higher proportion of all childhood cancer deaths: in 2008-2010 the percentages were 36.4% in Africa, 34.6% in Asia and 43.4% in the Americas outside the United States and Canada. Age-standardised mortality in the UK was 6.3 per million in 2005-2007 and 5.3 per million in 2008-2010. In 2005-2007 the UK ranked 9th equal among the 34 HIC and 8th equal among the 31 European countries (Figure 2a). In 2008-2010 the UK ranked 8th among the 34 HIC and 7th among the 31 European countries (Figure 2b). Childhood mortality from leukaemia did not change significantly between 2005-2007 and 2008-2010 in the UK. Mortality was significantly lower in 2008-2010 than in 2005-2007 in five countries, namely the Netherlands, Russia, Spain, Switzerland and South Korea.

Table 3. International childhood mortality from leukaemia (ICD-10 C91-C95), 2005-2010. Numbers of deaths (N) and age-standardised rates (ASR) per million children aged 0-14 years with standard errors (SE).

Country	Period 1	N	ASR	SE	Period 2	N	ASR	SE
Austria	2005-2007	15	3.8	1.0	2008-2010	17	4.2	1.0
Belgium	2005-2007	47	8.9	1.3	2008-2010	34	6.3	1.1
Bulgaria	2005-2007	43	13.9	2.2	2008-2010	35	11.4	1.9
Croatia	2005-2007	19	8.9	2.1	2008-2010	14	7.0	1.9
Czech Republic	2005-2007	22	5.1	1.1	2008-2010	30	6.7	1.2
Denmark	2005-2007	18	6.3	1.5	2008-2010	17	5.8	1.4
Estonia	2005-2007	3	4.2	2.5	2008-2010	9	15.4	5.1
Finland	2005-2007	27	10.1	2.0	2008-2010	27	10.1	2.0
France	2005-2007	214	6.3	0.4	2008-2010	192	5.6	0.4
Germany	2005-2007	203	5.8	0.4	2008-2010	168	4.9	0.4
Greece	2005-2007	28	5.8	1.1	2008-2010	39	7.9	1.3
Hungary	2005-2007	41	8.7	1.4	2008-2010	45	10.0	1.5
Ireland	2005-2007	15	3.2	1.5	2008-2010	20	3.9	1.6
Italy	2006-2007	148	8.7	0.7	2008-2010	234	9.2	0.6
Latvia	2005-2007	11	11.5	3.5	2008-2010	8	8.8	3.1
Lithuania	2005-2007	18	11.4	2.8	2008-2010	22	15.7	3.4
Macedonia	2005-2007	8	7.0	2.5	2008-2010	12	10.8	3.2
Moldova	2005-2007	25	12.0	2.5	2008-2010	25	13.4	2.7
Netherlands	2005-2007	84	9.5	1.0	2008-2010	54	6.3	0.9
Norway	2005-2007	19	6.7	1.6	2008-2010	10	3.6	1.1
Poland	2005-2007	168	9.3	0.7	2008-2010	152	8.8	0.7
Romania	2005-2007	153	15.3	1.3	2008-2010	129	13.5	1.2
Russia	2005-2007	899	14.2	0.5	2008-2010	811	12.8	0.5

Country	Period 1	N	ASR	SE	Period 2	N	ASR	SE
Serbia	2005-2007	22	4.5	1.0	2008-2010	31	6.5	1.2
Slovakia	2005-2007	22	8.4	1.9	2008-2010	24	9.6	2.0
Slovenia	2005-2007	8	8.8	3.2	2008-2010	4	5.1	2.6
Spain	2005-2007	225	11.6	0.8	2008-2010	174	8.5	0.7
Sweden	2005-2007	41	8.8	1.4	2008-2010	36	8.0	1.4
Switzerland	2005-2007	23	6.7	1.4	2008-2010	11	3.1	0.9
Ukraine	2005-2007	314	16.5	0.9	2008-2010	295	15.5	0.9
United Kingdom	2005-2007	205	6.3	0.5	2008-2010	172	5.3	0.4
Egypt	2005-2007	1361	19.5	0.5	2008-2010	1466	20.3	0.5
Mauritius	2005-2007	13	14.5	4.1	2008-2010	13	16.5	4.7
South Africa	2005-2007	275	6.1	0.4	2008-2009	194	6.3	0.4
China – Hong Kong	2005-2007	25	10.1	2.2	2008-2010	20	8.1	1.9
Israel	2005-2007	41	7.3	1.1	2008-2010	35	5.9	1.0
Japan	2005-2007	371	7.1	0.4	2008-2010	329	6.5	0.4
Kazakhstan	2005-2007	179	16.3	1.2	2008-2010	169	14.5	1.1
Kuwait	2005-2007	26	13.9	2.7	2008-2010	25	11.4	2.3
Kyrgyzstan	2005-2007	45	9.4	1.4	2008-2010	47	9.7	1.4
South Korea	2005-2007	371	14.6	0.8	2008-2010	253	10.4	0.7
Canada	2005-2007	96	5.6	0.6	2008-2009	72	6.5	0.8
Mexico	2005-2007	2543	23.6	0.5	2008-2010	2425	22.6	0.5
United States	2005-2007	1269	6.9	0.2	2008-2010	1181	6.4	0.2
Argentina	2005-2007	486	16.0	0.7	2008-2010	445	14.7	0.7
Brazil	2005-2007	2072	13.5	0.3	2008-2010	2105	13.9	0.3
Chile	2005-2007	151	12.9	1.1	2008-2009	114	14.3	1.4
Colombia	2005-2007	811	20.1	0.7	2008-2009	521	19.4	0.9
Costa Rica	2005-2007	51	14.2	2.0	2008-2010	47	13.3	2.0
Cuba	2005-2007	98	15.2	1.6	2008-2010	107	18.1	1.8
Panama	2005-2007	44	12.2	2.1	2008-2009	23	11.0	2.3
Venezuela	2005-2007	479	18.9	0.9	2008-2009	349	20.4	1.1
Australia	2006-2007	38	4.6	0.8	2008-2010	62	4.9	0.6
New Zealand	2005-2007	23	9.0	1.9	2008-2009	10	5.4	1.7

Figure 2a. Age-standardised mortality rates per million children aged 0-14 years from leukaemia (ICD-10 C92-C95) in 31 European countries, 2005-2007.

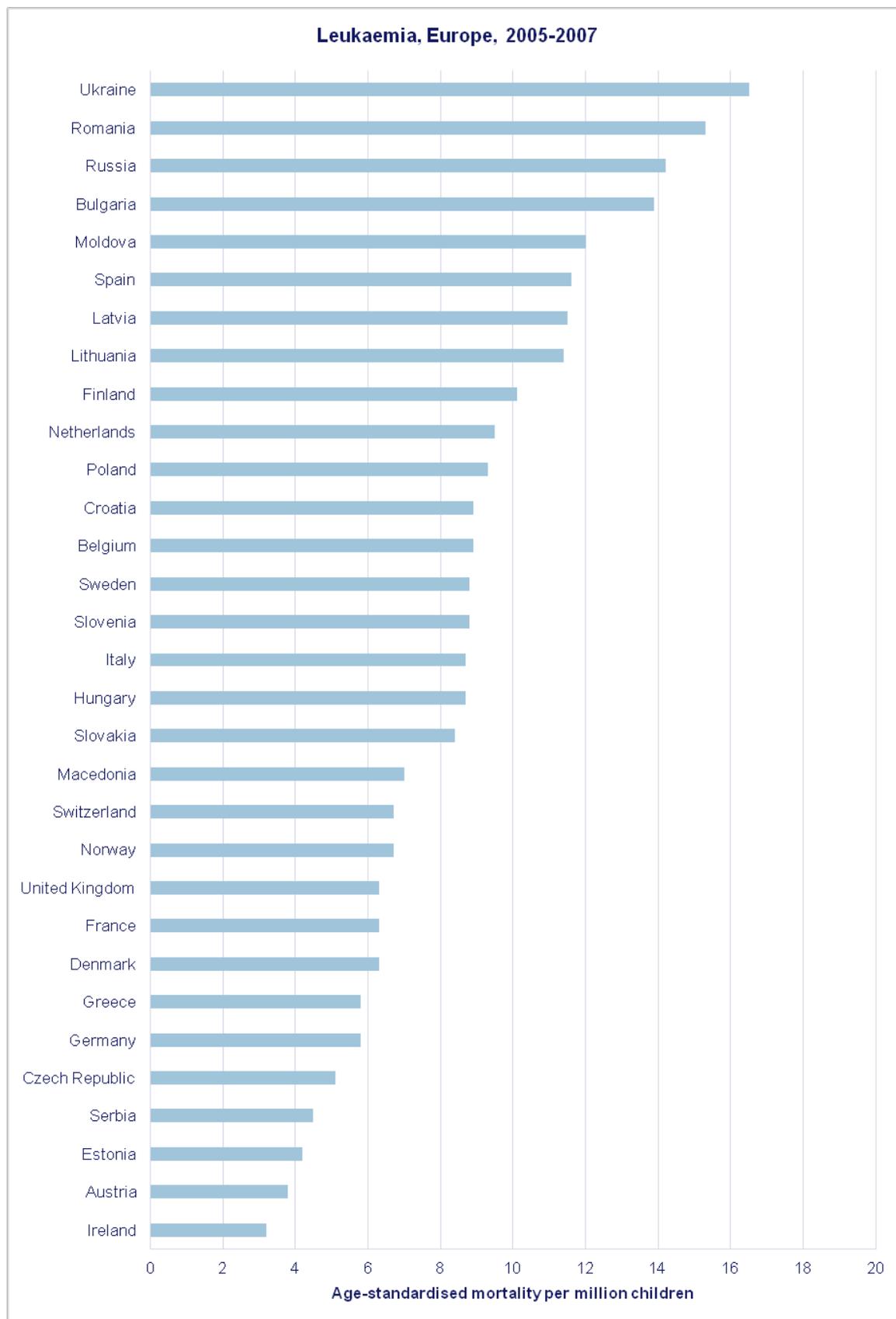
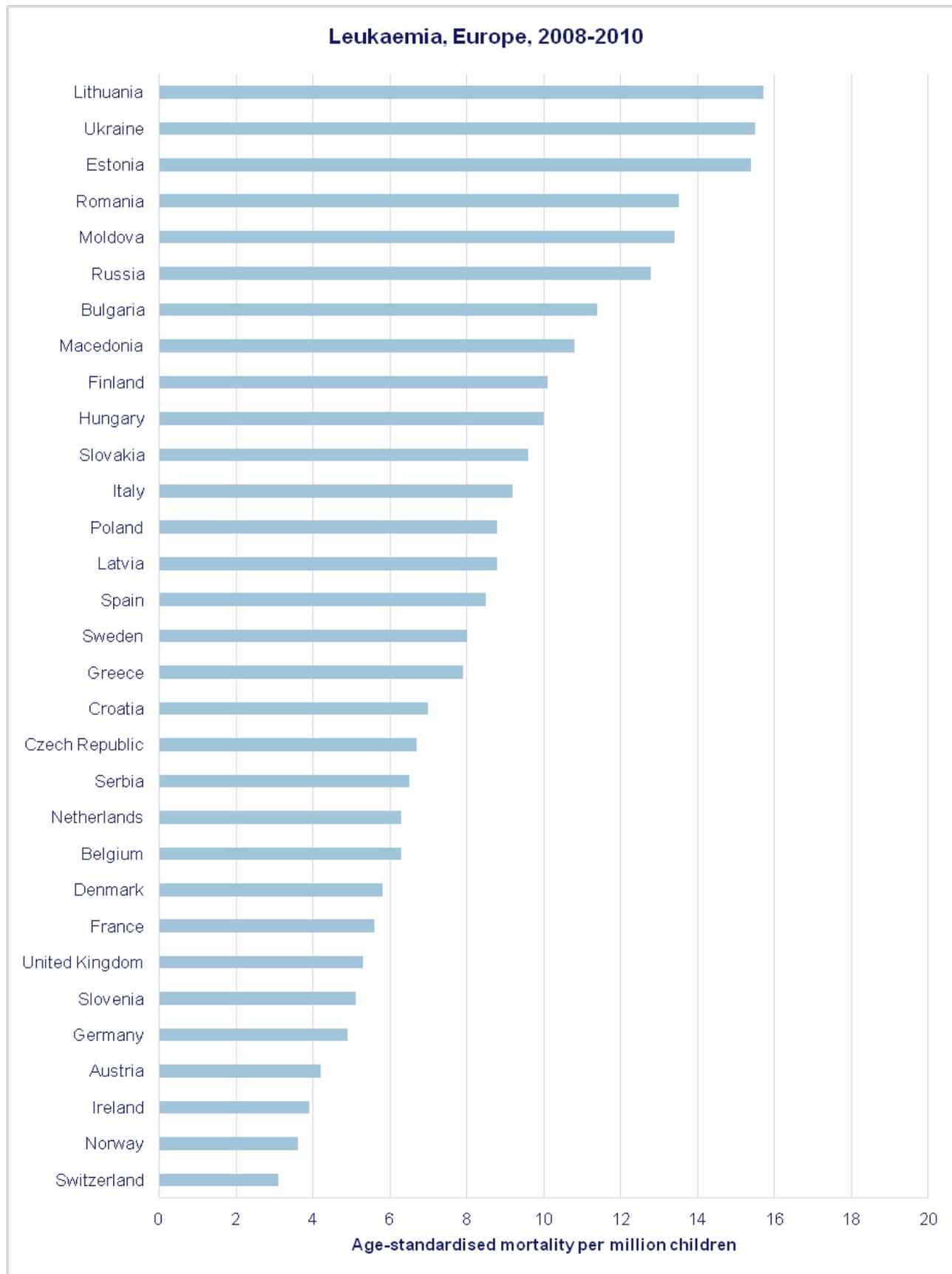


Figure 2b. Age-standardised mortality rates per million children aged 0-14 years from leukaemia (ICD-10 C92-C95) in 31 European countries, 2008-2010.



CNS tumours

Table 4 shows mortality rates for CNS tumours. In the UK, CNS tumours accounted for 34.8% of childhood cancer deaths both in 2005-2007 and in 2008-2010. The corresponding proportions in the HIC of Europe, North America and Oceania were 30.4% in 2005-2007 and 31.7% in 2008-2010. Elsewhere, CNS tumours accounted for a lower proportion of all childhood cancer deaths: in 2008-2010 the percentages were 28.1% in European MIC, 28.5% in Africa, 25.2% in Asia and 20.2% in the Americas outside the United States and Canada. Age-standardised mortality in the UK was 9.0 per million in 2005-2007 and 7.8 per million in 2008-2010. In 2005-2007 the UK ranked 14th equal among the 34 HIC and 8th equal among the 31 European countries (Figure 3a). In 2008-2010 the UK ranked 15th equal among the 34 HIC and 7th equal among the 31 European countries (Figure 3b). Childhood mortality rates from CNS tumours did not change significantly between 2005-2007 and 2008-2010 in the UK. Mortality was significantly lower in 2008-2010 than in 2005-2007 in Germany and Argentina, and significantly higher in 2008-2010 than in 2005-2007 in Moldova and Egypt.

Table 4. International childhood mortality from malignant neoplasms of meninges, brain and other parts of central nervous system (ICD-10 C70-C72), 2005-2010. Numbers of deaths (N) and age-standardised rates (ASR) per million children aged 0-14 years with standard errors (SE).

Country	Period 1	N	ASR	SE	Period 2	N	ASR	SE
Austria	2005-2007	35	8.5	1.5	2008-2010	23	5.9	1.2
Belgium	2005-2007	49	9.0	1.3	2008-2010	56	10.2	1.4
Bulgaria	2005-2007	48	16.4	2.4	2008-2010	38	13.0	2.1
Croatia	2005-2007	22	11.0	2.4	2008-2010	27	13.9	2.7
Czech Republic	2005-2007	44	10.1	1.5	2008-2010	55	12.3	1.7
Denmark	2005-2007	17	5.8	1.4	2008-2010	20	6.4	1.4
Estonia	2005-2007	7	11.8	4.5	2008-2010	4	6.5	4.2
Finland	2005-2007	25	9.1	1.8	2008-2010	24	9.0	1.9
France	2005-2007	318	9.4	0.5	2008-2010	318	9.2	0.5
Germany	2005-2007	324	9.1	0.5	2008-2010	266	7.7	0.5
Greece	2005-2007	69	14.3	1.7	2008-2010	71	14.8	1.8
Hungary	2005-2007	37	8.2	1.4	2008-2010	53	12.3	1.7
Ireland	2005-2007	27	10.1	1.9	2008-2010	23	8.3	1.7
Italy	2006-2007	118	6.9	0.6	2008-2010	171	6.7	0.5
Latvia	2005-2007	13	13.7	3.9	2008-2010	15	16.9	4.4
Lithuania	2005-2007	10	6.9	2.2	2008-2010	11	7.8	2.4
Macedonia	2005-2007	12	9.7	2.9	2008-2010	10	9.2	2.9
Moldova	2005-2007	19	10.4	2.1	2008-2010	28	16.2	3.1
Netherlands	2005-2007	95	10.4	1.1	2008-2010	94	10.7	1.1
Norway	2005-2007	25	9.1	1.8	2008-2010	27	10.0	1.9
Poland	2005-2007	193	10.9	0.8	2008-2010	173	10.2	0.8
Romania	2005-2007	147	14.9	1.2	2008-2010	133	13.6	1.2
Russia	2005-2007	721	11.4	0.4	2008-2010	724	11.4	0.4

Country	Period 1	N	ASR	SE	Period 2	N	ASR	SE
Serbia	2005-2007	47	9.4	1.4	2008-2010	53	11.2	1.6
Slovakia	2005-2007	25	9.7	2.0	2008-2010	26	10.7	2.1
Slovenia	2005-2007	11	13.3	4.1	2008-2010	12	14.4	4.2
Spain	2005-2007	112	5.8	0.6	2008-2010	141	6.9	0.6
Sweden	2005-2007	39	8.4	1.4	2008-2010	37	8.0	1.3
Switzerland	2005-2007	36	10.5	1.8	2008-2010	30	8.3	1.5
Ukraine	2005-2007	270	14.0	0.9	2008-2010	255	13.5	0.9
United Kingdom	2005-2007	296	9.0	0.5	2008-2010	254	7.8	0.5
Egypt	2005-2007	1096	15.8	0.5	2008-2010	1242	17.3	0.5
Mauritius	2005-2007	5	5.5	2.5	2008-2010	1	1.6	1.6
South Africa	2005-2007	113	2.6	0.2	2008-2009	68	2.2	0.3
China – Hong Kong	2005-2007	30	10.0	2.0	2008-2010	16	5.8	1.5
Israel	2005-2007	62	10.8	1.4	2008-2010	70	11.8	1.4
Japan	2005-2007	210	3.9	0.3	2008-2010	230	4.4	0.3
Kazakhstan	2005-2007	95	8.3	0.9	2008-2010	113	9.7	0.9
Kuwait	2005-2007	14	7.6	2.0	2008-2010	15	6.9	1.8
Kyrgyzstan	2005-2007	14	3.0	0.8	2008-2010	16	3.5	0.7
South Korea	2005-2007	226	8.5	0.6	2008-2010	181	7.3	0.6
Canada	2005-2007	138	8.3	0.7	2008-2009	77	6.9	0.8
Mexico	2005-2007	711	6.6	0.3	2008-2010	695	6.6	0.3
United States	2005-2007	1274	6.9	0.2	2008-2010	1242	6.7	0.2
Argentina	2005-2007	263	10.4	0.5	2008-2010	221	7.3	0.5
Brazil	2005-2007	1578	10.3	0.3	2008-2010	1492	10.0	0.3
Chile	2005-2007	62	5.2	0.7	2008-2009	44	5.8	0.9
Colombia	2005-2007	268	6.7	0.4	2008-2009	195	7.3	0.5
Costa Rica	2005-2007	26	7.1	1.4	2008-2010	26	7.3	1.4
Cuba	2005-2007	62	9.4	1.2	2008-2010	65	10.8	1.4
Panama	2005-2007	24	7.8	1.6	2008-2009	18	8.6	2.0
Venezuela	2005-2007	146	5.8	0.5	2008-2009	95	5.6	0.6
Australia	2006-2007	67	8.4	1.0	2008-2010	98	7.7	0.8
New Zealand	2005-2007	27	9.9	1.9	2008-2009	18	10.0	3.6

Figure 3a. Age-standardised mortality rates per million children aged 0-14 years from malignant neoplasms of meninges, brain and other parts of central nervous system (ICD-10 C70-C72) in 33 European countries in 2005-2007.

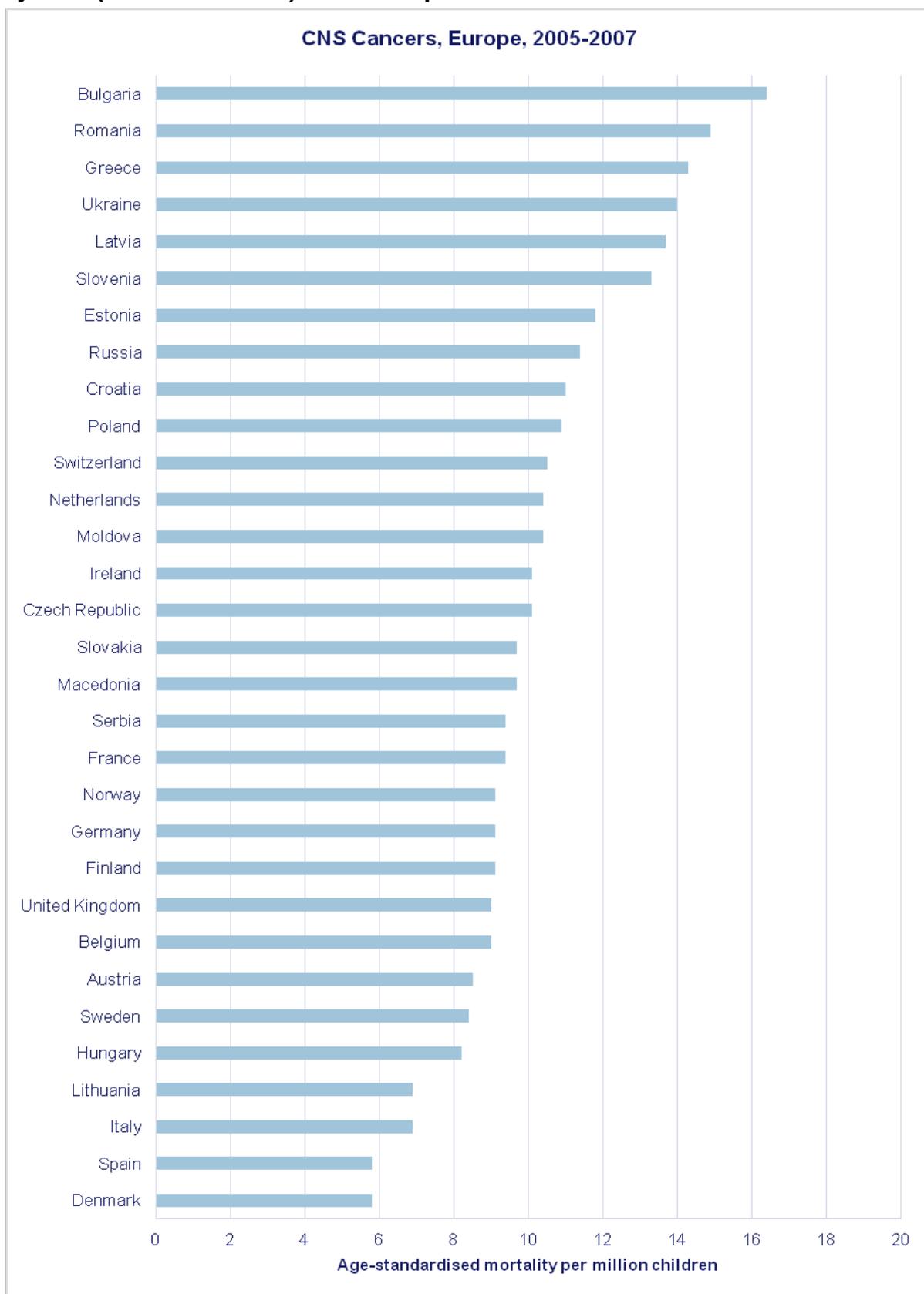
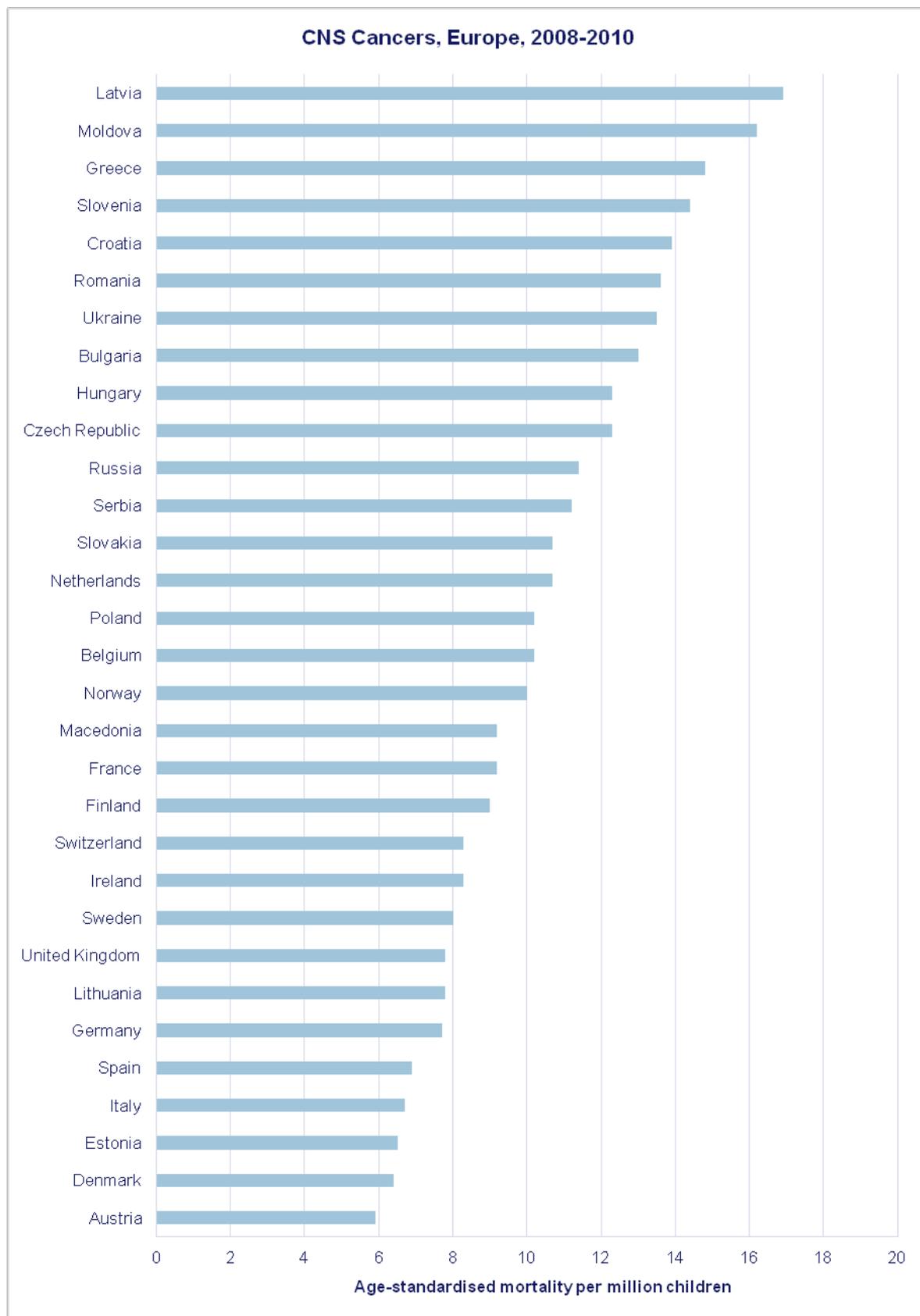


Figure 3b. Age-standardised mortality rates per million children aged 0-14 years from malignant neoplasms of meninges, brain and other parts of central nervous system (ICD-10 C70-C72) in 33 European countries in 2008-2010.



Discussion

There is no shortage of international comparative studies of survival from childhood cancer (Sankila *et al.*, 2006; Gatta *et al.*, 2014), however, childhood mortality from cancer still has its place as an indicator of success against this group of potentially lethal diseases. The most obvious reason for this is that mortality data are available from more countries than incidence and survival data. Almost as important is the fact that population-based mortality data almost invariably cover entire countries, whereas in several large countries (eg Italy, Japan, Poland, Spain) survival data are only available from a patchwork of areas which are covered by cancer registration. Mortality data also tend to be more up to date than survival data, even with the advent of the period method of survival analysis.

The most recent comprehensive analyses of international childhood cancer mortality cover the period to 2007 (Bosetti *et al.*, 2010; Chatenoud *et al.*, 2010). One later study of leukaemia mortality at all ages included childhood data to 2009, but only for a few European countries (Bertuccio *et al.*, 2013). The present study includes mortality data to 2010 from 47 countries and to 2009 from a further seven countries. Countries were included only if civil registration coverage of cause of death was >90%, a standard criterion of high quality for mortality data (Mathers *et al.*, 2005). Following the previous comprehensive analyses (Bosetti *et al.*, 2010; Chatenoud *et al.*, 2010), it was not required that cause of death was ill-defined on <10% of registrations of deaths at all ages, as this would have led to the exclusion of too many countries.

In 2008-2010, age-standardised mortality rates in childhood from all cancers combined ranged from 17 per million to 44 per million in HIC, from 22 per million to 59 per million in MIC, and from 17 per million to 59 per million in Europe. Mortality from leukaemia ranged from 3 per million to 16 per million in HIC, from 6 per million to 23 per million in MIC, and from 3 per million to 16 per million in Europe. Mortality from CNS cancers ranged from 4 per million to 17 per million in HIC, from 2 per million to 17 per million in MIC, and from 6 per million to 17 per million in Europe.

Mortality from all cancers combined decreased significantly between 2005-2007 and 2008-2010 in eight countries. No country in this study showed a significant increase between the two periods. Mortality from leukaemia decreased significantly between 2005-2007 and 2008-2010 in five countries, and no country showed a significant increase in childhood leukaemia mortality between the two periods. Mortality from CNS tumours decreased significantly between 2005-2007 and 2008-2010 in only two countries, despite the fact that mortality from CNS tumours in childhood is now fairly similar to, or even exceeds, that from leukaemia in many relatively affluent countries. This presumably reflects the greater progress made in outcomes for childhood leukaemia in recent years. Two countries, both of them lower middle-income, showed a significant increase in childhood CNS cancer mortality between the two periods. While

this may be due to a worsening in survival, it could equally be attributable to improved diagnosis.

The UK was among high-income countries and European countries with lower childhood mortality rates from all cancers combined and from leukaemia. The UK was also among European countries with lower childhood mortality rates from CNS cancers, though it was nearer the middle of the range for high-income countries across all continents.

In the UK, childhood mortality decreased by 14% between 2005-2007 and 2008-2010 for all cancers combined, and the UK was among the relatively few countries to record a significant decrease. Between the same two periods in the UK, childhood mortality decreased by 16% for leukaemia and by 13% for CNS cancers. Assuming that childhood cancer incidence has not decreased, these results demonstrate continuing success in outcomes for childhood cancer. Despite suggestions that survival from childhood cancer in the UK compares poorly with some other countries, the UK had relatively low mortality rates among European countries and among high-income countries worldwide. It is unclear how much the UK's favourable position can be attributed to relatively high survival, and how much to relatively low incidence. A complete picture of international variations in success against childhood cancer needs to take into account not only mortality data, but also the results of international studies of incidence, such as the forthcoming third volume of International Incidence of Childhood Cancer, and of international studies of survival such as CONCORD-2 (Allemani *et al.*, 2014) (which includes childhood leukaemia) and EURO CARE (Gatta *et al.*, 2014).

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