

Childhood cancer survival in Europe

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Background: EUROCORE-3 collected data from 45 population-based cancer registries in 20 countries on 24 620 European children aged from 0 to 14 years diagnosed with malignancy in the period 1990–1994.

Methods: Five-year survival between countries was compared for all malignancies and for the major diagnostic categories, adjusting for age, and estimated average European survival weighting for differences in childhood populations.

Results: For all cancers combined, survival variation was large (45% in Estonia to 90% in Iceland), and was generally low (60–70%) in eastern Europe and high ($\geq 75\%$) in Switzerland, Germany and the Nordic countries (except Denmark). The Nordic countries had the highest survival for four of the seven major tumour types: nephroblastoma (92%), acute lymphoid leukaemia (85%), CNS tumours (73%) and acute non-lymphocytic leukaemia (62%). The eastern countries had lowest survival: 89% for Hodgkin's disease, 71% for nephroblastoma, 68% for acute lymphoid leukaemia, 61% for non-Hodgkin's lymphoma, 57% for central nervous system (CNS) tumours and 29% for acute non-lymphocytic leukaemia.

Conclusions: The Nordic countries represent a survival gold standard to which other countries can aspire. Since most childhood cancers respond well to treatment, survival differences are attributable to differences in access (including referral and timely diagnosis) and use of modern treatments; however, the obstacles to access and application of standard treatments probably vary markedly with country.

Key words: childhood tumours, Europe, population-based study, survival variation

Introduction

Population-based studies of survival for childhood cancers provide indications as to whether these malignancies are being treated successfully at the population level and in particular can reveal whether new treatment guidelines are being implemented on a large scale [1]. The EUROCORE database presents a unique opportunity to compare survival for these rare cancers across different European populations. The database contains information on approximately 50 000 cases of childhood cancer diagnosed between 1978 and 1994 [2], archived according to a uniform data collection policy, with data checking and analytical procedures agreed in advance by all the European registries involved in EUROCORE-3 [2].

EUROCORE-1 produced survival data for eight major childhood cancer sites [3] as defined by International Classification of Diseases (ICD)-9 [4] for the period 1978–1985. Following this study, an updated survival analysis (diagnosis period 1985–1989) was published [5] with a more detailed description of survival for these tumours according to the diagnostic groups defined by the International Classification of Childhood Cancers (ICCC) [6].

These publications revealed large differences in childhood cancer survival between different European populations. The present EUROCORE-3 study analyses survival for childhood cancers diagnosed from 1990 to 1994 and incorporates data from more European countries and cancer registries than those that participated in the earlier EUROCORE studies. The aim of the study is to compare survival between European populations by diagnostic group and for all malignancies combined, to determine whether the earlier survival differences persisted in the 1990s, and to analyse and interpret survival differences.

Materials and methods

We analysed survival in 24 620 European children diagnosed with cancer at age <15 years during the period 1990–1994. All children with a malignant neoplasm, as defined by ICD for Oncology (ICD-O) behaviour code 3 or higher were included [7]. The cases were contributed by 45 population-based cancer registries in 20 countries involved in EUROCORE-3 [2]. These countries were Denmark, Finland, Iceland, Norway, Sweden (the Nordic countries); the Czech Republic, Estonia, Poland, Slovakia, Slovenia (eastern Europe); Austria, France, Germany, Italy, Malta, The Netherlands, Spain, Switzerland, England & Wales and Scotland (western Europe). The database includes data from 10 specialised (childhood) cancer registries (England & Wales; Germany; Piedmont and Marche in Italy; Valencia and the Spanish Childhood Cancer Registry; Rhone-Alps, Bretagne and Lorraine in France; and the nationwide Dutch Leukaemia Registry). Cancers were classified according to the 12 diagnostic groups in the ICCC [6].

Table 1 presents a general description of the data analysed, including sample size, demographic characteristics of the cases and main quality indicators

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Table 1. European cases of childhood tumours by country, diagnosed in 1990–1994, with indicators of data quality

Registries	Cases included in the analysis		Boys, %	0–4 Years of age, %	MV, %	Lost to follow-up, %	Alive with follow-up <4 years, %	DCO/autopsy, %	Unspecified cases, % ^a
	n	(%)							
Northern Europe									
DENMARK ^b	630	2.6	54	50	96	–	1.1	0.3	5.6
FINLAND	799	3.2	54	49	99	0.5	1.4	0.5	3.5
ICELAND	39	0.2	64	54	100	–	–	–	0
NORWAY	539	2.2	53	52	97	0.9	2.0	0.2	10.2
SWEDEN	1215	4.9	54	52	96	0.4	2.8	0.4	14.9
Eastern Europe									
Czech republic									
West Bohemia	119	0.5	60	42	94	–	–	0.8	7.6
ESTONIA	199	0.8	49	47	99	0.5	–	3.4	8.6
Poland	287	1.2	56	36	79	6.4	1.9	0.4	11.5
Krakow	76	0.3	52	33	80	5.6	–	–	8.5
Warsaw	211	0.9	57	41	78	6.6	–	0.5	13.3
SLOVAKIA	711	2.9	55	46	97	–	1.6	5.9	5.6
SLOVENIA	228	0.9	56	47	98	0.4	0.7	0.9	2.6
Western Europe									
Austria									
Tyrol	73	0.3	49	45	100	–	–	–	1.4
France	1419	5.8	57	43	51	0.4	22.2	0.1	2.6
Lorraine	295	1.2	54	43	91	–	19.3	–	2.7
Rhône Alpes	622	2.5	56	45	NA	–	30.7	–	2.3
Bretagne	276	1.1	58	39	83	–	14.1	0.2	1.5
Bas-Rhin	149	0.6	59	49	97	3.4	10.3	–	4.1
Calvados	53	0.2	57	43	96	–	14.3	–	9.4
Côte d'Or ^c	24	0.1	71	38	100	–	–	–	0
GERMANY	7473	30.4	57	46	100	2.0	13.0	–	0.5
THE NETHERLANDS ^d									
Amsterdam	822	3.1	57	47	99	0.2	3.3	–	1.9
Eindhoven	228	0.9	57	46	96	–	4.5	–	3.3
DCOG	83	0.3	63	44	93	–	1.9	–	6.2
	511	2.1	55	51	100	0.4	3.2	–	0

according to country and registry. The registries of Finland, Denmark, England & Wales, Estonia, Germany, Iceland, Malta, Norway, Scotland, Slovakia, Slovenia and Sweden cover the entire populations of those countries. Other countries are represented by one or more local or regional registries. Table 1 also shows the proportions of boys (56%), children aged <5 years (45%), microscopically verified cases (93%, between country range 51–100%), and the proportion of cases lost to follow-up (1.1%). At least 4 years of follow-up were required; however, a number of cases were censored as alive before the completion of the follow-up period. For all the countries, except France and Germany, the proportions withdrawn were <4%.

Both histologically verified and non-verified cases were included, but cases known to registries by death certificate only (DCO) or by autopsy report only were excluded (137 cases, 0.6%). More detailed information on the EURO-CARE database is available elsewhere [2, 8]. The number of cases classified in *unspecified* categories within each major diagnostic group was also low: overall <800 cases (3.4%).

Observed survival was calculated by the actuarial method. Relative survival was also calculated [9], but is not presented here as it corresponds very closely to observed survival in young people since deaths due to competing risks are rare.

Because survival is usually dependent on patient age, and because the age distribution of children with cancer differs between countries, survival rates by cancer site for children of each country were adjusted to the age distribution of all the European children with that cancer, to ensure comparability. For age standardisation, we used three age classes (<1, 1–4, 5–14 years) for neuroblastoma, and 0–4, 5–9 and 10–14 years for all other tumour types. For four rare tumours survival is presented for a single age class: <5 years for retinoblastoma and testicular germ-cell tumours, 10–14 years for osteosarcoma and ovarian germ-cell tumours.

Survival estimates for each diagnostic group were compared between the populations. Differences in survival for childhood cancers are difficult to evaluate because they are fortunately rare. Since survival differences between countries in eastern and western Europe were large for most childhood cancers, we calculated the survival rates for all childhood malignancies combined, as well as for the major diagnostic groups, to provide an overall comparison between different European areas and countries. For the purposes of the analyses we defined seven European areas as follows: three geographically related groups of registries with broadly similar survival rates: Finland, Iceland, Norway and Sweden (Nordic countries); England & Wales and Scotland (the UK); the Czech Republic, Estonia, Poland, Slovakia and Slovenia (eastern Europe). Denmark was kept separate because its survival rates differed from those of the other Nordic countries (as for adult cancers [10]). The national registry of Germany was also kept separate. For the remaining central and southern European registries, only France, Italy and Spain had sufficient numbers of cases (>1000) to warrant separate analyses. Data from the remaining countries (Austria, Malta, Switzerland and The Netherlands) were combined as 'other western European countries'.

Since the largest contribution of cases came from the nationwide registries of the UK and Germany, overall European survival figures were estimated as the weighted average of the survival of each country. Weightings were proportional to the childhood population (0–14 years) in each country [2, 8] and assumed that the survival of patients in the registries of countries not completely covered by cancer registration was representative of national survival.

To improve the power of comparison between countries for the category of all malignancies combined, we estimated the relative risk of dying (RR) using the Cox model [11], adjusting by sex, age and diagnostic group; for the latter we considered the 10 most frequent diagnostic groups separately (85% of all malignancies) and the remaining cancer types (15% of cases) together.

Results

Five-year survival for all cancers combined by country is shown in Table 2 with relative risks of dying of each country versus England & Wales. Survival variation was large: from 45% in Estonia to 90% in Iceland. Five-year survival was 60–70% in the eastern countries (the Czech Republic, Poland, Slovenia, Slovakia). Germany, Switzerland and the Nordic countries, with the exception of Denmark, had high survival figures ($\geq 75\%$).

Five-year survival for the entire European pool (with 95% confidence intervals) for the major diagnostic groups and for 10 very rare tumours are shown in Table 3. For most haemopoietic tumours survival was high [79% for acute lymphoid leukaemia (ALL), 79% for non-Hodgkin's lymphoma and 94% for Hodgkin's disease]. The exception was acute non-lymphocytic leukaemia (ANLL) with 5-year survival at 48%.

Survival for central nervous system (CNS) tumours varied according to histology, but overall was modest. For ependymoma, and primitive neuroectodermal tumours (PNET), 5-year survival was <60%; survival for astrocytoma was high (79%).

With regard to other solid tumours, survival for retinoblastoma was good, with 91% alive 5 years after diagnosis, and favourable also for Wilms' tumour (84%). For neuroblastoma 5-year survival was 62%; for osteosarcoma, rhabdomyosarcoma and Ewing's sarcoma outcomes were at 66%, 67% and 69%, respectively.

The between-country range in survival is illustrated in Table 3. The greatest differences were for PNET, osteosarcoma, neuroblastoma, rhabdomyosarcoma and lymphoid leukaemia. Estonia had the lowest survival for lymphoid leukaemia, non-Hodgkin's lymphoma and PNET, and Slovakia had lowest survival for ependymoma, astrocytoma, osteosarcoma and rhabdomyosarcoma. Sweden and Norway had the highest survival for ANLL, astrocytoma, Wilms' tumour, osteosarcoma and Ewing's sarcoma; Iceland and Malta had highest survival for ALL; and the Czech Republic for PNET (based on seven cases, all microscopically verified). For the tumours with small survival differences, Estonia and Slovakia still had the poorest outcomes, with survival particularly low for lymphomas, CNS tumours and retinoblastoma (data not shown).

Prognoses for very rare tumours are also shown in Table 3. Five-year survival was relatively poor for adrenocortical carcinoma (46%) and chronic myeloid leukaemia (47%), more encouraging for hepatoblastoma (67%), chondrosarcoma (77%), fibrosarcoma (77%) and nasopharyngeal carcinoma (72%); and excellent for thyroid carcinoma (98%) and gonadal germ-cell tumours (99% for boys and 92% for girls). Survival for Burkitt's lymphoma and malignant melanoma was also quite good and >80% 5 years after diagnosis.

Five-year survival rates for the major malignancies according to the country groupings are shown in Table 4. For the seven types of tumour considered, the Nordic countries had the highest survival for four of these: 92% for neuroblastoma, 85% for ALL, 73% for CNS tumours, and 62% for ANLL. The eastern countries had the lowest survival: 68% for ALL, 29% for ANLL, 61% for non-Hodgkin's lymphomas; 89% for Hodgkin's disease; 57% for CNS tumours and 71% for neuroblastoma.

Table 2. Five-year survival and relative risks of dying for all malignant childhood cancer in Europe, period 1990–1994 (23 120 children)

Registries	No. of cases	5-year survival ^a	95% CI	Relative risk ^b
ESTONIA ^c	199	44.9	38.1–51.9	2.51
SLOVAKIA	711	63.1	59.5–66.6	1.44
Poland	287	63.2	57.4–68.8	1.30
Czech Republic	119	65.3	55.7–73.8	1.19
SLOVENIA	228	65.7	59.2–71.7	1.19
The Netherlands	439	70.7	66.2–74.8	1.00
Spain	1185	70.8	68.1–73.4	0.99
SCOTLAND	636	71.0	67.3–74.4	1.02
ENGLAND & WALES	5835	71.1	70.0–72.3	1
DENMARK	630	71.6	67.9–75.0	0.99
EUROPE	23 120	71.8	70.7–72.8	–
Italy	1228	72.3	69.7–74.8	0.97
France	1419	72.8	70.3–75.2	0.89
MALTA	23	73.3	51.3–87.8	1.09
Austria	73	74.2	63.0–82.9	0.84
NORWAY	539	74.8	70.9–78.3	0.81
GERMANY	7473	76.4	75.4–77.4	0.81
SWEDEN	1215	79.4	77.0–81.6	0.68
Switzerland	43	81.0	63.4–91.3	0.59
FINLAND	799	81.2	78.3–83.8	0.64
ICELAND	39	90.1	60.0–98.2	0.47

^aSurvival figures are age standardised, for Europe survival is also weighted.

^cCountries with national coverage in upper case.

^bRelative risk of death versus England & Wales, adjusted for sex, age and type of tumour; bold indicates a value of $P < 0.05$.

Source of data: EURO CARE-3.

CI, confidence interval.

Discussion

This paper presents survival comparisons between young patients diagnosed in 20 European countries during the period 1990–1994. Before seeking to draw conclusions from these comparisons, it is important to consider some possible sources of bias. One possible source of bias is differences in the age distribution of cancer patients between different European populations. This was accounted for by age standardisation. Furthermore, when all malignancies were considered together (Table 2), we compared relative risks of dying adjusted by type of cancer in addition to age and sex. Other biases may arise due to differences in the quality and comparability of the cancer registry data.

The main indicators of data quality are the proportion of DCO cases, the proportion of microscopically verified cases and the proportion of cases lost to follow-up. In the EURO CARE children's database, DCO cases were rare (0.6% overall) except for data from Slovakia (5.9%) and Estonia (3.4%). Furthermore, a high proportion of cases were confirmed microscopically (93% overall) and for all countries, except Poland and France (Table 1),

the figure was >90%. Microscopic confirmation is a particularly important indicator of data quality in childhood cancers because the primary classification is by histological type. The proportion of microscopically verified cases varied according to ICCC category, and was lowest for CNS malignancies (85%) and highest for lymphomas and leukaemias (96%).

It is noteworthy that few cases (1.1%) were lost to follow-up. All countries except Germany and France followed their cases for ≥ 4 years; in these two countries legislation makes the collection of life status data difficult [2, 8].

The proportion of cases allocated to 'unspecified' categories within each major diagnostic group is another important indicator of the quality of diagnostic data. The number of 'unspecified' cases in the EURO CARE children's database was low at 3.4% (Table 1). These considerations on data quality indicate that the cancer survival differences between the European populations we analysed are unlikely to be due to registration artefacts.

The major finding of this study is the large variation in survival for childhood cancers across Europe. Nordic countries, with the exception of Denmark, had the highest survival figures at between

Table 3. Weighted 5-year survival (%) for European children (0–14 years) diagnosed with cancer during the period 1990–1994, by type of tumour

Diagnostic group	ICCC group	No. of cases	EUROPE (EUROCARE) 5-year survival ^a	95% CI	Between-country 5-year survival range ^b	
Haemopoietic tumours						
Lymphoid leukaemia	Ia	6650	79	77–81	47–100	EST, ICE, MLT ^c
ANLL	Ib	1169	48	41–49	17–70	CZ, N
Hodgkin's disease	IIa	1039	94	88–97	73–100	SLO, SCO
Non-Hodgkin's lymphoma	IIb	1292	79	73–84	42–92	EST, SLO
CNS tumours						
Ependymoma	IIIa	453	55	49–62	36–73	SK, A
Astrocytoma	IIIb	2241	79	74–83	63–89	SK, S
PNET	IIIc	1156	50	46–55	11–100	EST, CZ ^c
Other solid tumours						
Neuroblastoma	IVa	1731	62	57–66	41–68	DK, FIN
Retinoblastoma ^e	V	603	91	81–96	60–100	PL, many countries ^{c,d}
Wilms' tumour	VIa	1440	84	80–87	70–100	SCO, N ^c
Osteosarcoma ^e	VIIIa	359	66	57–64	13–82	SK, S ^c
Ewing's sarcoma	VIIIc	406	69	62–75	31–86	NL, S ^c
Rhabdomyosarcoma	IXa	885	67	62–72	39–100	SK, SLO ^c
Rare tumours^f						
Chronic myeloid leukaemia	Ic	157	47	39–56		
Burkitt's lymphoma	IIc	283	83	78–87		
Hepatoblastoma	VIIa	205	67	60–74		
Chondrosarcoma	VIIIb	22	77	57–90		
Fibrosarcoma	IXb	154	77	69–83		
Germ-cell: testis ^e	Xc	136	99	96–100		
Germ-cell: ovary ^e	Xc	108	92	85–95		
Adrenocortical carcinoma	XIa	36	46	31–62		
Thyroid carcinoma	XIb	117	98	94–100		
Nasopharyngeal carcinoma	XIc	47	72	58–83		
Malignant melanoma	XId	138	85	78–90		

^aSurvival figures are age-standardised, except for rare tumours.

^bRange only includes countries with at least five cases.

^cExtreme survival figure CIs do not overlap.

^dMany countries with highest 5-year survival for retinoblastoma: Denmark, Finland, Norway, Scotland, Spain, Sweden.

^eRetinoblastoma and testicular germ-cell tumours, children aged 0–4 years only; osteosarcoma and ovarian germ-cell tumours, children aged 10–14 years only.

^fRare tumours: <350 cases, with survival figures not weighted.

A, Austria; CZ, Czech Republic; DK, Denmark; EST, Estonia; F, France; FIN, Finland; ICE, Iceland; MLT, Malta; N, Norway; NL, The Netherlands; PL, Poland; S, Sweden; SCO, Scotland; SK, Slovakia; SLO, Slovenia.

ANLL, acute non-lymphocytic leukaemia; CI, confidence interval; PNET, primitive neuroectodermal tumours.

Source of data: EUROCARE-3.

75 and 90%. Within western Europe 5-year survival ranged from 81 (Switzerland) to 71% (The Netherlands and Spain). Survival in eastern Europe was low; the outcome for ALL in Estonia had hardly changed since the 1970s. For Denmark, survival rates for many childhood cancers were also low. Denmark is also charac-

terised by low survival for adult cancers [10], for reasons that are not clear. For most diagnoses, the same treatment protocols seem to have been used in all the Nordic countries including Denmark. It has been reported that event-free survival for ALL is similar in all Nordic countries, including Denmark [12]. In the present

Table 4. Age-standardised 5-year survival for European children with cancer diagnosed during the period 1990–1994, by European grouping or country

	No. of children	5-year survival ^a	95% CI		No. of children	5-year survival ^a	95% CI
Lymphatic leukaemia ^b				Other western	21	94.7	84.5–100.0
Nordic countries	654	84.8	82.1–87.7	Denmark	13	93.6	19.2–99.9
Germany	2232	84.8	83.2–86.2	Nordic countries	89	93.3	87.8–99.3
Other western	455	82.2	78.7–85.9	Italy	71	92.5	70.0–98.5
UK	1813	81.1	79.3–83.0	Eastern countries	108	88.5	82.2–95.3
Denmark	169	80.3	73.4–85.8	CNS tumours ^f			
Italy	347	78.6	74.2–82.5	Nordic countries	664	73.0	69.6–76.6
France	345	78.1	73.2–82.3	Other western	138	67.2	59.4–75.9
Spain	271	76.3	70.8–81.1	Germany	1240	66.2	63.4–69.0
Eastern countries	364	67.9	63.1–73.1	Italy	228	65.4	59.0–71.4
Acute non-lymphocytic leukaemia ^c				Denmark	141	63.9	56.0–71.2
Nordic countries	87	61.8	51.9–73.5	Spain	254	60.1	53.8–66.1
UK	321	52.9	47.6–58.8	UK	1384	60.0	57.4–62.7
Spain	50	46.6	32.2–61.6	France	296	58.8	52.6–64.7
Germany	397	46.4	41.4–51.4	Eastern countries	280	56.5	50.8–62.3
France	70	45.8	34.2–58.0	Neuroblastoma ^g			
Other western	87	44.9	35.7–57.1	France	141	66.8	58.3–74.4
Denmark	27	42.5	25.6–61.3	Spain	82	65.3	54.5–75.5
Italy	54	41.0	28.7–54.6	Italy	91	63.5	53.0–72.9
Eastern countries	76	29.1	19.9–42.8	Germany	630	62.1	58.3–65.9
Non-Hodgkin's lymphoma ^d				Nordic countries	139	62.0	54.6–71.2
Germany	526	89.2	86.2–91.7	Other western	37	52.7	37.8–70.6
France	63	85.4	70.0–93.6	Eastern countries	112	52.6	43.7–62.3
Nordic countries	149	79.4	72.8–86.6	UK	456	50.4	45.6–55.2
UK	322	75.6	71.0–80.6	Denmark	43	41.3	27.5–56.5
Italy	53	73.6	57.0–85.4	Wilms' tumour ^h			
Denmark	21	72.6	43.3–90.2	Nordic countries	149	91.9	87.5–96.5
Other western	38	68.8	29.1–69.1	Denmark	34	91.2	75.0–97.3
Spain	47	67.4	52.9–79.2	Germany	527	86.9	83.7–89.5
Eastern countries	73	61.1	50.9–73.4	France	97	84.9	75.9–90.9
Hodgkin's disease ^e				Other western	34	82.4	69.3–95.4
Spain	69	97.5	39.4–100.0	Spain	61	82.4	70.0–90.3
UK	228	96.7	94.3–99.2	Italy	53	82.3	69.8–90.3
Germany	383	95.6	92.9–97.3	UK	391	79.6	75.8–84.0
France	57	95.3	67.4–99.5	Eastern countries	94	71.1	62.5–80.9

^aSurvival rates are age-standardised, except for neuroblastoma in Spain.

Based on the following number of cases: 6650^b; 1169^c; 1292^d; 1039^e; 4625^f; 1731^g; 1440^h.

CI, confidence interval.

analysis the differences in ALL survival between Denmark and the Nordic countries were less marked than in a previous study on ALL [13] and are not significant (Table 4). These considerations suggest that differences in the results of first-line treatment between Denmark and other Nordic countries for ALL may be small, but variations in salvage or relapse therapy (in terms of effectiveness and the enthusiasm with which it is applied) may

account for most of the survival difference between Denmark and these other northern European countries.

Survival in Germany shown in the present analysis is not fully comparable with that published in earlier analyses [3, 5] due to the inclusion of former East Germany.

EUROCARE-3 is characterised by the participation of more nationwide cancer registries than previous EUROCARE studies.

This is important because, for various reasons, survival in a particular area is not necessarily representative of the entire country. Past survival comparisons between countries with only partial registration and those with national coverage have been criticised for this reason [1]. Countries totally or partially covered by cancer registries provide the opportunity to assess within-country survival differences. This was possible for Germany (East versus West), the UK (Scotland versus England & Wales), France, Spain, and Italy. We found marked within-country survival variations for Italy, France and Germany for all cancers considered together. This result was based on estimates of the relative excess risk of dying, adjusted by sex, age and cancer type. These outcomes seem to be influenced by the presence or otherwise of a specialised hospital in or close to the registration region. This was the case for the more favourable outcomes in Sassari and Genoa compared with other Italian registries; for Bas-Rhin and Rhône Alpes compared with other French registries, and for former West Germany compared with East Germany (data not shown). When there is inter-country variation in childhood cancer survival, the highest survival is an evident target level to which other regions can reasonably aspire.

For the major childhood cancers, we found a tendency for overall European survival to improve compared with earlier periods [5]. Large improvements ($\geq 10\%$) were seen for neuroblastoma and Ewing's sarcoma, while survival for Hodgkin's disease and retinoblastoma remained stable. Survival for all cancers combined also improved in each country, except Sweden and Slovenia (stable) and Austria. Note, however, that the European pool of children in the present EUROCARE-3 differs from that of the earlier EUROCARE-2: the number of participating registries increased, and Sweden had nationwide coverage in EUROCARE-3 compared with coverage of South Sweden only in EUROCARE-2. For Austria, only a small proportion of the population is covered and the deterioration of survival over time may be just a random fluctuation. Clearly a more rigorous analysis of survival trends with time is necessary and this will be carried out for the period 1978–1994.

Comparisons between survival for childhood cancers in Europe and the United States have been published [14]. Excluding eastern Europe, survival was generally similar between the two continents, except for neuroblastoma and Wilms' tumour, where survival was significantly lower in Europe. The Surveillance, Epidemiology and End Results (SEER) paediatric monograph [15] reported that for neuroblastoma diagnosed during the period 1985–1994, 5-year survival in the SEER cancer registries was 64%, while in Europe 5-year survival ranged between 67% (France) and 41% (Denmark). In the present study, survival for neuroblastoma for all countries combined was 62%. For Wilms' tumour, over the same diagnosis period, 5-year survival was 92% in the USA, and 84% for all European countries combined, although in the Nordic countries survival at 5 years for the more recent diagnosis period (1990–1994) was also 92%.

Since the great majority of childhood cancers are curable or at least respond well to treatment, the main factors influencing survival are access to treatment and application of up-to-date treatment protocols. Cancer survival differences could also be due to

differences in the availability of resources, since these would directly influence access to and the use of more modern treatment protocols. Similarly, hospitals in countries or areas with limited financial resources are less likely to be able to fully participate in clinical trials of new treatments both for organisational and financial reasons. The adequacy of the early diagnosis and referral system may also have an important influence on the likelihood of timely access to treatment, and this requires, among other things, awareness by paediatricians, general practitioners and emergency physicians of paediatric cancer. In this regard Hamre et al. [16] have suggested that primary care physicians should focus on early childhood cancer detection among high-risk groups.

We conclude that survival in the Nordic countries represents a gold standard to which all countries who devote similar resources and have comparable health systems can aspire. For each individual country however it is important to understand the obstacles to achieving better survival for childhood cancer.

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