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Recent trends in cancer survival across Europe between 2000 and 2004: A model-based period analysis from 12 cancer registries

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ABSTRACT

Background: Monitoring population-based cancer survival is an essential component in the evaluation of cancer control, but subject to an inherent delay in the reporting of the most recent survival estimates with traditional techniques of analysis.
Methods: We examined survival trends between the years 2000 and 2004 for 20 common cancers based on follow-up data from 12 cancer registries from diverse areas of Europe using model-based period analysis techniques.
Results: Between 2000 and 2004, marked rises were seen in 5-year relative survival amongst patients with prostate, breast and colorectal cancer, which were statistically significant in 10, 8 and 7 of the 12 participating cancer registries, respectively. For cancer sites amenable to effective early detection and treatment, major geographical differences in patient prognosis still persisted, with a lower survival generally observed in Eastern European countries.
Conclusion: Model-based period analysis enables the timely monitoring of recent trends in population-based cancer survival. For colorectal and breast cancers, the identified rises in survival are probably (at least partly) explained by the improvements in clinical care and the management of the disease. Nevertheless, persisting geographic differences do point to the potential for a further reduction in the burden of cancer throughout Europe, towards which improvements in diverse areas of care, including secondary prevention, access to

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advances in treatment as well as subspecialisation and regionalisation of oncologic care may all contribute.

1. Introduction

Traditional methods for calculating population-based cancer survival estimates, such as cohort and complete analyses, are less suitable for monitoring recent changes in survival, given that these estimates largely reflect the survival experience of patients diagnosed many years ago. The introduction and the application of the period analysis methodology,[1–4] and particularly the introduction of model based period analysis,[5] have provided new opportunities for monitoring recent progress in population-based cancer survival. Model-based period analysis allows the calculation of precise period survival estimates for the most recent calendar year for which data are available, and, additionally, significant testing of survival trends within a recent calendar period up to that year.[5] It is therefore useful in assessing the impact of recent clinical progress on patient prognosis at the population level, as well as in assessing artefacts such as the advancement of diagnosis via screening activities. In this study, we apply this novel method to obtain up-to-date survival estimates and trends of population-based cancer survival in 11 European countries, using data from longstanding cancer registries taking part in the EUNICE (European Network for Indicators on Cancer) Survival Cooperation.

2. Data sources

For the EUNICE Survival Cooperation, population-based cancer registries representing major geographical regions of Europe (Eastern Europe: Cracow (Poland), Lithuania, Estonia; Southern Europe: Tuscany, Torino (both Italy), Slovenia; West: Scotland, Eindhoven (Netherlands); Northern Europe: Finland, Norway; Central Europe: Saarland (Germany) and Geneva (Switzerland)) were invited to submit cancer-specific incidence and follow-up, as well as background mortality data corresponding to their source populations. The span of available incidence, follow-up and background mortality data are summarised in Table 1.

In order to create a uniform project database, the cancer classification systems of the participating registries were first harmonised via a conversion to ICD-10 using the DEPedits Conversion Tool (Version 1.0).[6,7] Subsequently, non-melanoma skin cancers, non-malignant cancers and childhood cancers (patients diagnosed at age <15 years) were excluded. For the remaining records, missing or implausible data values with respect to the time of diagnosis or follow-up (year and month), age, sex and vital status were excluded, as were autopsy and death certificate only (DCO) registrations. An overview of the conversion and data preparation steps is presented in Table 2.

The topography and morphology codes used by Finnish and Norwegian cancer registries could not be converted automatically using the DEPedits Conversion Tool, and a conversion algorithm was applied. Utilizing first the exclusion criteria mentioned above, registry-specific morphology codes were then used to classify Hodgkin and non-Hodgkin lymphomas, multiple myeloma and leukaemias, irrespective of the topography codes assigned. After classifying the above sites, all the other cancers were coded according to topography. This classification system was validated with data from automatically-converted registry datasets and showed a very good agreement between ICD-10 and the above algorithm, with a 1% difference or less, irrespective of the cancer site.

Table 3 presents the site- and registry-specific number of patients with one of the 20 most common cancers between 2000 and 2004, which is the main period of interest of this analysis. The total number of cases varied between 9589 for Geneva and 116,153 for Scotland.

3. Statistical methods

3.1. *Lifetables*

Previous survival studies found large differences not only in the life expectancy of the general population between European countries, but also found a considerable within-country variation.[8] We, therefore, aimed at using or constructing lifetables for the source populations of the participating cancer registries. These consisted of sex and age-specific conditional survival probabilities for each year of age between 15 and 95, for five 5-year periods (1980–1984, 1985–1989, 1990–1994, 1995–1999, 2000–2004), covering the entire data range utilised by the project. This scheme was marginally modified in certain populations to account for differences in data availability by year and age (Table 1). The lifetables utilised in this analysis, pertaining to the calendar years 2000–2004 are shown in Table 1.

3.2. *Survival analysis*

Five-year relative survival estimates, which may be interpreted as cancer-related excess mortality within a cancer patient population, were calculated for the 20 most frequently occurring cancers during the period 2000–2004. The estimates were derived as a ratio of the observed survival of the cancer patients and the expected survival of the underlying general population.[9] The latter estimate was calculated according to the Ederer II method,[10] using the above described lifetables. All the derived relative survival estimates were period estimates, which are exclusively based on the survival experience of patients during the specific calendar period for which they are derived.[4] These have been shown to closely predict survival later observed for patients diagnosed in that period.[2,11,12]

Table 1 – Participating cancer registries, underlying populations, national coverage percentage, available years of diagnosis, date of last follow-up and background mortality data

Registry	Registry underlying population (millions)	National coverage (%)	Years of diagnosis		Date of last follow-up	Lifetables	
			First year	Last year		Age intervals (years)	Periods available in the project data base (periods utilised in this analysis)
Cracow[a]	0.8	1.9	1980	2004	31/12/2004	1	1980–1981, 1985–1986, 1990–1991, 1995–2004[b] (2000–2004)
Estonia	1.4	100	1980	2003	31/12/2004	1	1980–2004[b] (2000–2004)
Lithuania	3.4	100	1990	2004	31/12/2004	1	1990–2003[b] (2000–2003)
Slovenia	1.9	100	1980	2003	31/12/2004	1	1980–1982,[c] 1982–2004[b] (2000–2004)
Torino	1	1.8	1985	2004	31/12/2004	1	1980–2004[b] (2000–2004)
Tuscany	1.2	2.1	1985	2003	31/12/2004	1	1985–2003[b] (2000–2003)
Eindhoven	1	6.6	1980	2004	31/12/2004	1	1980–2004[b](2000–2004)
Scotland	5.1	100	1980	2004	31/12/2004	1	1980–1982,[d]1983–1985, 1986–1988, 1989–1991, 1992–1994 1995–1997, 1998–2000, 2001–2003 (1998–2003)
Finland	5.2	100	1980	2004	31/12/2004	1	1981–1985, 1986–1990, 1991–1995, 1996–2004 (1996–2000, 2001–2004)
Norway	4.5	100	1980	2004	31/12/2004	1	1980–2004[b] (2000–2004)
Geneva	0.4	5.3	1980	2004	31/12/2004	1	1980–2004[b] (2000–2004)
Saarland	1	1.3	1980	2004	31/12/2004	5[e]	1980–1984, 1985–1989, 1990–1994, 1995–1999, 2000–2004 (2000–2004)

a Lifetable data for Poland from the Human Life-Table Database (HLD, www.lifetable.de) were used; for calendar years with no corresponding lifetable data, the lifetables of the preceding or following periods were used.
b Indicates that data for single years were available.
c Data for 1980–1982 were obtained from the HLD.
d All data for Scotland were based on data available from the HLD.
e Mortality data.

3.3. *Calculation of up-to-date and precise trends in survival between 2000 and 2004*

Model-based period analysis, which was recently introduced by Brenner and Hakulinen,[5] was used to derive 5-year relative survival estimates for the most recent calendar year for which data were available (2004) as well as for testing for trend in survival within the period under investigation (2000–2004). The modelling approach was extended to allow for age-adjusted analyses. Briefly, after calculating age group specific numbers of patients at risk and of deaths by the year of follow-up for each calendar year of the period in question (i.e. each single year between 2000 and 2004), a Poisson regression model for relative survival was used, in which the logarithm of the excess number of deaths was modelled as a function of the year of follow-up, age (categorical variable) and calendar year (numerical variable), using the logarithm of the person-time at risk as the offset. Model-based estimates of 5-year relative survival for the first (2000) and last year (2004) of the period in question and a *p*-value for the trend in relative survival between those years were derived. Fig. 1 illustrates the database used in the above analysis for all registries which had provided data on incident cases up to 2004. For the registries with data on incident cases until 2003, but follow-up until 2004, the analysis was slightly modified (illustrated in Fig. 2),[13] according to the principles of the hybrid analysis,[14] a computation strategy designed to enable the estimation of up-to-date survival for situations where mortality data are more up-to-date than incidence. Standard errors of the modelled 5-year relative survival estimates were calculated using the delta method. $\alpha = 0.05$ was used as the level of significance for statistical tests.

3.4. *Age adjustment*

To ensure comparability, all survival estimates were age-adjusted, using five age groups (15–44, 45–54, 55–64, 65–74, 75+ years), with the exception of prostate cancer, for which the first age group was 15–54 years, and thyroid cancer, for which only two age groups were used (15–44, 45+). Adjustment was made by deriving weighted averages of modelled age-specific 5-year relative survival estimates, with weights from the International Cancer Survival Standards (ICSS), as proposed by Corazziari et al.[15] All calculations were done using the SAS statistical software package.[16]

4. Results

Tables 4.1–4.5 present, in a uniform layout, model-based age-adjusted 5-year relative survival estimates for the years 2000 and 2004 for oral and gastrointestinal, breast and female genital, urological, haematological and other common cancers, respectively. Corresponding standard errors for the survival estimates and *p*-values for the survival trends are also provided.

Table 2 – Coding systems, conversions and data included in the survival analyses, entire project data base, by registry

Registry	Topography/morphology codes		Applicable records	Conversion	Formal exclusions				Formally accepted records	Analysis related exclusions		Included in survival analyses	
					Conversion related exclusion	Non-melanoma skin cancer	Non-malignant/ uncertain tumours	Childhood cases (age < 15)		Incomplete data[a]	DCO/ autopsy	N	%
Cracow	ICD-10		61,843	n.a.	N/A	3,740	1338	372	56,393	837	4670	50,886	90.2
Estonia	ICD-O-3	ICD-O-3	123,123	ICD-10	0	12,289	0	913	109,921	0	6035	103,886	94.5
Lithuania		ICD-10	196,381	n.a.	N/A	20,652	0	1445	174,284	6	6390	167,888	96.3
Slovenia		ICD-O-1-2-3, ICD-10	185,136	n.a.	N/A	18,289	13,833	1146	151,868	474	4666	146,728	96.6
Torino		ICD-O-2/ICD-10	102,624	n.a.	N/A	12	3171	353	99,088	768	2991	95,329	96.2
Tuscany	ICD-O-3	ICD-O-3	156,712	ICD-10	138	15,140	15,816	449	125,169	29	3098	122,042	97.5
Eindhoven		ICD-O-1-2-3	150,496	ICD-10	674	5797	13,229	749	130,047	123	901	129,023	99.2
Scotland		ICD-9/ICD-10	837,924	ICD-10	N/A	120,269	114,493	3058	600,104	216	1243	598,645	99.8
Finland	ICD-7	National	611,052	protocol	N/A	117,065	31,629	3604	458,754	686	17,215	440,853	96.1
Norway	ICD-7	Motnac, ICD-O-2	749,726	Protocol	N/A	72,948	211,333	2913	462,532	223	8835	453,474	98.0
Geneva	ICD-O-3	ICD-O-3	56,846	ICD-10	6	3693	8931	207	44,009	0	1442	42,567	96.7
Saarland		ICD-9	149,182	ICD-10	0	18,844	10,708	541	119,089	7	9475	109,607	92.0
Total									2,531,258	3369	66,961	2,460,928	97.2

a Records with incomplete data for variables needed for survival analysis.

4.1. *Oral and gastrointestinal tumours*

Amongst patients with cancer of the oral cavity, statistically significant survival trends occurred in only two registries during the period 2000–2004: survival rose from 37% to 46% in Slovenia and decreased from 55% to 45% in Saarland. In 2004, 5-year relative survival was highest in Finland (65%), followed closely by Eindhoven and Norway. Estimates ranged from 55% to 45% (in decreasing order) in Tuscany, Scotland, Torino, Geneva, Slovenia and Saarland. Survival was slightly under 40% in Lithuania and Estonia, and lowest in Cracow, at 24%.

Recent trends in the survival of patients with oesophageal cancer were not significant in any registry, indicating no major change in prognosis in this period. Five-year relative survival remained well below 20% in all registries except Saarland, where survival remained at 22%.

Stomach cancer survival trends were significant in Slovenia only, where 5-year relative survival rose from 23% to 27% between 2000 and 2004, whilst considerable, although not significant rises were found in Geneva and Saarland (absolute rises of 9% and 7% units, respectively). Survival was highest in Saarland, the only registry with values consistently above 30% in both 2000 and 2004. In contrast, survival was low (steady at between 18% and 21%) in Scotland, Cracow and Eindhoven, and ranged from 24% to 32% in the remaining registries.

The survival of patients with colorectal cancer rose significantly in 7 of the 12 registries between 2000 and 2004. The highest survival estimates, after marked increases, were seen in Geneva and Saarland, where 5-year relative survival reached 66% and 65%, respectively, by 2004 (although the trend was not significant for Geneva). Survival was also high in Tuscany, Norway and Finland, where 5-year relative survival has risen significantly by 6%, 4% and 3% units to reach 63%, 61% and 60%, respectively. A significant rise, but somewhat lower survival was seen for Scotland, where survival reached 55%. In Torino and Eindhoven, no meaningful change in survival occurred, with estimates staying closely around 58% and 56%, respectively. Elsewhere, survival remained below 50% in both Slovenia and Estonia, with a significant rise in the former and no major change in the latter. Finally, survival significantly rose by 5% units to 45% in Lithuania, whilst the lowest survival was found in Cracow, despite a (statistically non-significant) rise of 6.5% units to 42%.

Amongst patients with liver cancer, none of the trends were significant, changes in survival were mostly minor, and the age-adjusted 5-year relative survival of patients remained very low, ranging from 4% to 17%.

Patients with pancreatic cancer had very low survival expectations in all participating registries: 5-year relative survival estimates ranged from 4% to 13%, without any meaningful changes.

4.2. *Breast and female genital cancers*

The survival of patients with breast cancer rose significantly in 8 of 12 registries between 2000 and 2004. By 2004, 5-year relative survival exceeded 86% in Geneva, Torino, Finland and Tuscany (trend in Geneva not significant), and ranged

Table 3 – Number of patients with common cancers, by registry, 2000–2004

Cancer site	ICD-10	Registry											
		Cracow	Estonia[a]	Lithuania	Slovenia[a]	Torino	Tuscany[a]	Eindhoven	Scotland	Finland	Norway	Geneva	Saarland
Oral cavity	0–14	284	593	1977	1208	589	488	934	3340	2268	1916	404	893
Oesophagus	15	129	197	792	370	177	156	785	4028	1,077	890	171	313
Stomach	16	574	1613	4911	1823	979	1925	1375	4414	3561	2918	188	921
Colorectal	18–21	1532	2599	6832	4599	4007	4387	6783	17,674	11,132	17,415	1139	4318
Liver	22	161	201	628	462	818	676	151	1374	1148	1028	252	358
Pancreas	25	405	674	2073	937	740	791	812	3045	3613	3064	290	600
Lung	33–34	1940	2685	7606	4270	3471	3370	6658	22,700	9929	11,235	1086	2989
Skin melanoma	43	300	477	1099	1105	758	805	1702	3879	3530	5377	626	654
Breast	50	1945	2328	6296	4003	3952	4082	8204	18,754	18,650	14,651	1960	3678
Cervix	53	449	610	2479	800	218	232	356	1450	679	1461	60	353
Corpus	54	489	753	2483	1143	647	655	1057	2395	3600	3048	247	673
Ovary	56	419	579	2020	710	467	438	816	3114	2451	2391	178	483
Prostate	61	620	1635	6830	2364	3265	2800	5353	11,738	20,230	15,654	1427	3342
Kidney	64	362	845	2798	758	628	931	1031	2754	3452	3135	189	683
Bladder	67	462	780	2435	886	1206	1240	1568	3919	3918	5641	339	738
Brain and nervous	71–72	269	282	1077	472	418	473	596	1829	1644	1653	142	367
Thyroid	73	243	261	1306	383	422	502	231	722	1642	967	155	239
Non-Hodgkin lymphoma	82–85	301	491	1232	911	1069	947	1397	4212	4400	3574	352	771
Multiple myeloma	90	109	200	682	323	376	373	491	1674	1114	1624	103	229
Leukaemia	91–96	195	546	1804	960	581	601	860	3138	2004	2405	281	436
Total		11,188	18,349	57,360	28,487	24,788	25,872	41,160	116,153	100,042	100,047	9589	23,038

a Number of patients in the years 2000–2003 only.

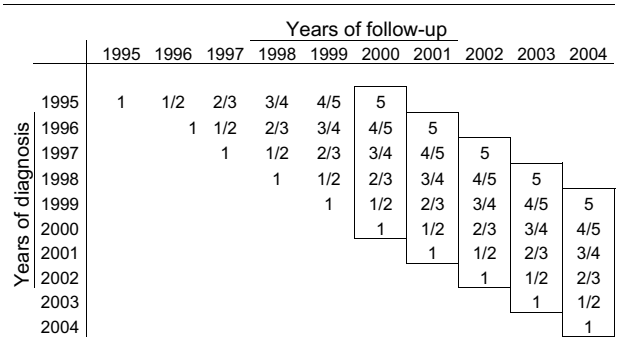

Fig. 1 – Years of diagnosis and years of follow-up included in the calculation of modelled period estimates of 5-year relative survival for the calendar years 2000–2004. The numbers in the cells indicate years following diagnosis.

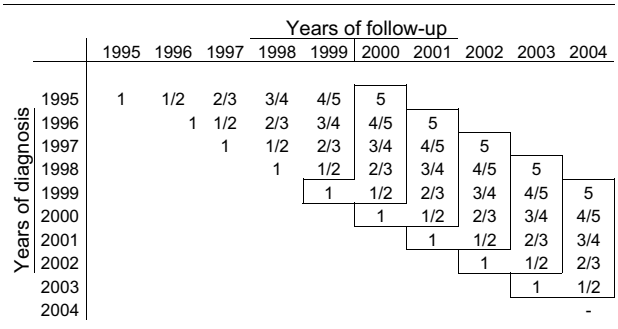

Fig. 2 – Years of diagnosis and years of follow-up included in the calculation of hybrid estimates of 5-year relative survival for the calendar years 2000–2004. The numbers in the cells indicate years following diagnosis.

between 85% and 83% in Norway, Eindhoven and Saarland (upward trends were significant in Norway and Saarland). Five-year relative survival has risen significantly to 79% in Scotland and to 76% in Slovenia. The lowest survival estimates were found in Estonia, Cracow and Lithuania, with 72%, 69% and 63%, respectively. Notably, survival has risen extremely markedly (and significantly), by 14% units within 5 years, in Estonia.

Amongst the female genital cancers, only one statistically significant change occurred (amongst patients with corpus cancer in Estonia). For patients with cervical cancer, survival in 2004 was highest in Eindhoven and Norway (around 70%) and slightly above 65% in Finland, Tuscany and Slovenia. Somewhat lower 5-year relative survival estimates, at around 60%, were seen in Estonia, Torino, Scotland and Geneva, whilst patient survival was lowest (between 55% and 52%) in Saarland, Cracow and Lithuania.

Amongst patients with corpus cancer, survival rose significantly from 67% to 77% in Estonia. Elsewhere, 5-year relative survival exceeded 80% in Geneva, Saarland, Norway, Finland and Eindhoven, and ranged between 71% and 79% in the remaining registries.

The survival of patients with ovarian cancer remained fairly poor: in 2004, 5-year relative survival ranged between 47% in Saarland and 30% in Estonia. Estimates tended to be higher (around 40%) in Finland, Norway, Geneva and Tuscany, and somewhat lower in Eindhoven, Scotland, Slovenia, Torino, Cracow and Lithuania. Changes in survival were minor, and did not reach statistical significance.

4.3. *Urological cancers*

Survival of patients diagnosed with prostate cancer rose significantly in 10 of the 12 cancer registries under study between 2000 and 2004. Survival estimates were highest in Saarland (93%) and Torino (92%), whilst substantially lower – despite significant survival increases – in Scotland, Lithuania and Estonia (around 75% in 2004), and lowest in Slovenia and Cracow, at 67% and 58%, respectively. Trends between 2000 and 2004 indicated rapid increases in survival in Lithuania (+27% units), Tuscany and Estonia (+15% units both). Increases in survival were between 7% and 10% units elsewhere, except in Cracow and Geneva, where survival remained essentially unchanged.

Significant survival rises were found in 4 of the 12 registries amongst patients diagnosed with kidney cancer. Marked increases (around +10% units) were seen in Estonia, Norway, Tuscany and Lithuania. By 2004, estimates were highest in Tuscany (75%), Saarland and Torino (70% both). Elsewhere, survival exceeded or came very close to 60% in Estonia, Lithuania, Norway, Geneva and Finland. Substantially lower survival (and no significant trends) were seen in Eindhoven (52%), Slovenia (50%), Cracow (46%) and Scotland (44%).

The survival of bladder cancer patients was characterised by large differences and diverging trends. Survival was highest (with estimates consistently above 70% in both 2000 and 2004) in Norway and Finland, with a significant upward trend in Norway. Survival was also high in Estonia (69%) and Saarland (67%), as well as in Tuscany and Lithuania (63% both), with a significant rise of 10% units in the latter. A non-significant downward trend was found for Torino, where survival decreased to 62%, whilst survival was slightly above 55% in Geneva, and slightly above 50% in Eindhoven and Scotland in 2004. Finally, survival was lowest in Slovenia and Cracow, at 47% and 42%, respectively.

4.4. *Haematological cancers*

With the exception of Eindhoven, Slovenia, Estonia and Torino, absolute increases in 5-year survival of patients with non-Hodgkin's lymphoma (NHL) were between 5% and 15% units. Increases were statistically significant in Cracow, Lithuania, Tuscany, Scotland, Finland and Norway. In 2004, 5-year relative survival exceeded 60% in Geneva, Tuscany, Saarland, Torino and Norway, but remained as low as 37% in Estonia.

Amongst patients with multiple myeloma, no significant trend occurred during the period examined. Consistently high survival was found in Tuscany and Norway, where estimates were above 40% in both 2000 and 2004. Elsewhere, 5-year relative survival slightly exceeded or came close to 40% in Torino, Geneva and Saarland, whilst estimates around 30% were found for Scotland, Finland, Estonia and Eindhoven. The lowest survival estimates were found for Slovenia (26%), Lithuania (22%) and Cracow (18%).

Amongst patients with leukaemia, no significant trends occurred between 2000 and 2004. By 2004, 5-year relative

Table 4.1 – Model-based age-adjusted 5-year relative survival estimates (with standard error (SE) in 2000 and 2004 for patients with common oral and gastrointestinal cancers, and test for survival trend in 2000–2004, by registry

	2000		2004		Change 2000–2004[b]	p		2000		2004		Change 2000–2004[b]	p
	PE[a]	SE[a]	PE[a]	SE[a]				PE[a]	SE[a]	PE[a]	SE[a]		
Oral cavity							*Colorectal*						
Cracow	34.2	4.9	23.8	4.4	−10.4	0.16	Cracow	35.4	2.5	41.9	2.5	6.5	0.09
Estonia	36.7	3.2	36.6	3.2	0.0	1.00	Estonia	47.2	1.7	49.4	1.6	2.3	0.36
Lithuania	34.3	2.1	38.3	2.1	4.0	0.17	Lithuania	40.1	1.2	44.8	1.2	4.7	0.01
Slovenia	37.2	2.6	45.8	2.5	8.6	0.01	Slovenia	44.1	1.2	48.2	1.2	4.1	0.02
Torino	48.1	3.9	47.4	4.0	−0.7	0.91	Torino	58.9	1.5	57.7	1.5	−1.2	0.62
Tuscany	56.0	3.6	54.7	3.6	−1.3	0.81	Tuscany	56.4	1.3	62.6	1.2	6.2	0.00
Eindhoven	52.7	3.4	58.1	3.2	5.4	0.28	Eindhoven	56.2	1.2	56.1	1.2	0.0	0.98
Scotland	49.0	1.8	52.0	1.7	2.9	0.27	Scotland	52.0	0.8	55.0	0.8	3.0	0.01
Finland	62.3	2.1	65.1	2.0	2.7	0.41	Finland	55.8	1.0	59.9	0.9	4.1	0.01
Norway	53.9	2.3	57.1	2.2	3.2	0.36	Norway	57.5	0.8	60.9	0.7	3.4	0.00
Geneva	46.3	4.7	46.6	4.7	0.3	0.97	Geneva	60.7	2.9	66.2	2.7	5.5	0.21
Saarland	54.6	3.3	45.0	3.6	−9.6	0.05	Saarland	59.1	1.6	64.7	1.5	5.6	0.02
Oesophagus							*Liver*						
Cracow	6.8	4.1	10.6	5.1	3.8	0.48	Cracow	21.7	5.1	12.0	3.9	−9.7	0.19
Estonia	13.2	3.5	7.9	2.6	−5.3	0.18	Estonia	11.2	3.3	9.8	3.0	−1.5	0.68
Lithuania	9.7	1.8	7.2	1.5	−2.5	0.26	Lithuania	12.5	2.4	15.8	2.6	3.3	0.34
Slovenia	8.1	2.0	10.2	2.3	2.1	0.43	Slovenia	3.8	1.3	3.5	1.2	−0.4	0.78
Torino	12.3	4.3	14.6	4.7	2.3	0.70	Torino	17.9	2.3	13.7	2.0	−4.2	0.19
Tuscany	12.2	3.9	11.2	3.8	−1.0	0.83	Tuscany	11.3	1.8	12.9	1.9	1.7	0.47
Eindhoven	9.6	1.8	11.9	2.0	2.3	0.40	Eindhoven	15.6	4.9	12.3	4.4	−3.3	0.60
Scotland	12.0	0.9	12.9	0.9	0.9	0.49	Scotland	8.3	1.3	8.6	1.3	0.2	0.90
Finland	12.5	1.8	15.4	2.0	2.9	0.27	Finland	8.6	1.4	7.3	1.3	−1.4	0.43
Norway	10.8	1.9	11.2	1.9	0.4	0.87	Norway	12.8	1.8	14.6	1.9	1.9	0.47
Geneva	18.9	5.0	18.1	5.0	−0.8	0.91	Geneva	13.9	3.7	16.8	4.1	2.9	0.62
Saarland	22.5	4.3	22.4	4.3	−0.1	0.99	Saarland	15.6	3.2	12.2	2.9	−3.4	0.44
Stomach							*Pancreas*						
Cracow	15.8	2.7	20.1	3.0	4.3	0.29	Cracow	11.2	2.6	13.5	2.9	2.3	0.53
Estonia	24.6	1.6	24.1	1.6	−0.5	0.82	Estonia	9.6	1.6	6.6	1.3	−3.0	0.09
Lithuania	23.7	1.1	25.3	1.1	1.6	0.33	Lithuania	10.9	1.2	10.2	1.2	−0.7	0.65
Slovenia	22.6	1.4	27.0	1.5	4.4	0.03	Slovenia	8.2	1.4	7.5	1.3	−0.7	0.63
Torino	33.2	2.6	28.1	2.5	−5.1	0.20	Torino	10.9	2.0	10.0	1.9	−0.9	0.71
Tuscany	33.2	1.6	32.0	1.6	−1.2	0.58	Tuscany	9.2	1.5	8.3	1.4	−0.9	0.59
Eindhoven	20.7	1.9	21.2	1.9	0.5	0.86	Eindhoven	5.0	1.2	3.6	1.0	−1.4	0.32
Scotland	17.3	1.0	18.1	1.1	0.8	0.58	Scotland	4.8	0.7	5.4	0.7	0.6	0.46
Finland	29.3	1.3	26.2	1.3	−3.2	0.12	Finland	4.8	0.6	3.8	0.5	−1.0	0.10
Norway	24.8	1.5	25.9	1.5	1.0	0.63	Norway	5.8	0.8	7.2	0.9	1.4	0.13
Geneva	22.3	5.4	31.0	5.9	8.7	0.28	Geneva	13.1	3.7	12.8	3.6	−0.3	0.92
Saarland	33.2	3.0	40.6	3.0	7.4	0.10	Saarland	9.4	2.0	9.4	2.0	0.0	0.99

a PE: point estimate, SE: standard error.
b Absolute change in the 5-year relative survival, in per cent.

survival was highest in Geneva, reaching 56%. Survival was between 50% and 40% elsewhere, except in Lithuania (34%), and in Cracow, where survival was estimated at 19% for patients diagnosed in 2004.

4.5. *Other common cancers*

4.5.1. *Lung cancer*

Few changes in lung cancer survival occurred, and none reached statistical significance during the 5-year period examined. In 2004, comparatively higher 5-year survival was found in Geneva, where relative survival almost reached 20%, and Saarland, where survival rose to around 18%. Elsewhere, survival ranged from 10% to 16%.

4.5.2. *Melanoma of the skin*

Absolute improvements of 16% and 14% units in the 5-year relative survival were seen in Cracow and Lithuania (although the rise in Cracow did not reach statistical significance due to low numbers of patients). Survival estimates were highest (with around 90% for the year 2004) in Geneva, Scotland, Saarland and Torino. Survival was between 86% and 83% in Eindhoven, Finland, Tuscany and Norway, and somewhat lower, marginally below 80% in Slovenia. Survival remained, despite increases, lowest (around 70%) in the Eastern European registries.

The survival of patients with brain and nervous system cancers tended to be lower than 30% in all registries, without any significant trends.

Amongst patients with thyroid cancer, 5-year relative survival was higher than or very close to 90% in all registries

Table 4.2 – Model-based age-adjusted 5-year relative survival estimates (%) with standard error (SE) in 2000 and 2004 for patients with breast and female genital cancers, and test for survival trend in 2000–2004, by registry

	2000		2004		Change 2000–2004[b]	p		2000		2004		Change 2000–2004[b]	p
	PE[a]	SE[a]	PE[a]	SE[a]				PE[a]	SE[a]	PE[a]	SE[a]		
Breast							*Cervix*						
Cracow	72.5	2.2	68.7	2.4	−3.8	0.31	Cracow	58.8	4.2	52.5	4.5	−6.2	0.37
Estonia	57.8	2.3	72.2	1.8	14.4	0.00	Estonia	59.9	3.3	62.5	3.1	2.5	0.60
Lithuania	58.7	1.4	63.4	1.3	4.7	0.02	Lithuania	51.2	1.8	52.0	1.8	0.8	0.79
Slovenia	70.1	1.5	75.6	1.3	5.5	0.01	Slovenia	61.2	2.8	65.5	2.7	4.4	0.28
Torino	81.6	1.7	87.3	1.2	5.7	0.01	Torino	58.6	6.0	62.0	5.7	3.3	0.71
Tuscany	82.9	1.4	86.2	1.1	3.3	0.08	Tuscany	70.4	4.2	65.5	4.7	−4.8	0.51
Eindhoven	81.7	1.1	84.0	1.0	2.3	0.12	Eindhoven	57.8	5.7	71.3	4.5	13.5	0.07
Scotland	74.6	0.8	78.5	0.7	3.9	0.00	Scotland	58.5	2.4	60.7	2.4	2.1	0.56
Finland	82.0	0.8	86.8	0.6	4.8	0.00	Finland	59.8	3.6	67.3	3.2	7.5	0.15
Norway	81.3	0.9	84.7	0.7	3.4	0.00	Norway	67.1	2.5	70.8	2.3	3.8	0.29
Geneva	85.4	2.2	87.6	1.9	2.2	0.46	Geneva	66.2	7.8	59.6	8.2	−6.6	0.60
Saarland	77.7	1.8	82.7	1.4	5.0	0.03	Saarland	57.5	4.4	55.0	4.6	−2.5	0.72
Corpus							*Ovary*						
Cracow	66.9	5.9	74.6	4.8	7.7	0.32	Cracow	39.2	4.1	32.6	4.0	−6.6	0.31
Estonia	67.4	3.5	76.9	2.8	9.4	0.04	Estonia	28.5	2.5	30.1	2.6	1.6	0.67
Lithuania	70.0	2.1	72.6	2.0	2.6	0.41	Lithuania	29.7	1.7	31.5	1.7	1.7	0.51
Slovenia	73.9	2.7	79.5	2.2	5.6	0.13	Slovenia	40.5	2.5	34.5	2.4	−6.0	0.13
Torino	72.2	3.6	74.7	3.4	2.4	0.67	Torino	32.5	3.2	33.2	3.3	0.7	0.88
Tuscany	77.0	2.9	76.7	2.9	−0.3	0.96	Tuscany	35.0	3.0	37.8	3.1	2.8	0.55
Eindhoven	80.1	2.8	80.3	2.8	0.2	0.97	Eindhoven	37.9	2.7	35.2	2.7	−2.8	0.54
Scotland	72.7	2.0	74.3	1.9	1.6	0.61	Scotland	35.9	1.4	34.6	1.4	−1.3	0.54
Finland	79.7	1.4	80.8	1.4	1.1	0.62	Finland	42.6	1.7	41.4	1.7	−1.1	0.68
Norway	80.8	1.6	81.7	1.5	0.9	0.72	Norway	42.6	1.7	41.3	1.7	−1.3	0.63
Geneva	78.6	9.5	90.2	5.0	11.6	0.20	Geneva	41.0	5.4	38.5	5.4	−2.5	0.77
Saarland	79.3	4.2	86.1	3.0	6.8	0.19	Saarland	37.0	4.1	47.2	4.0	10.3	0.11

a PE: point estimate, SE: standard error.
b Absolute change in the 5-year relative survival, in per cent.

except Scotland and Eindhoven. Survival trends indicated a significant absolute increase in survival of 13% and 5% units in Lithuania and Norway, respectively.

5. Discussion

The results presented in this paper provide up-to-date population-based cancer survival estimates and trends for diverse regions of the European continent. Our results suggest that, for most forms of cancers, large differences existed not only in the proportions surviving cancer in different European populations, but also that there are additional divergences in survival trends. Statistically significantly increasing 5-year relative survival was found in 10 of the 12 participating cancer registries for prostate cancer, and for 8 and 7 of 12 registries for breast and colorectal cancer, respectively; rising survival was also frequently found amongst patients with non-Hodgkin lymphoma and kidney cancer. The number of significant improvements amongst 20 major forms of cancers between 2000 and 2004 was highest in Lithuania and Norway, with eight and seven sites, respectively. Elsewhere, significant improvements for five cancer sites were found in Slovenia, for four cancer sites in Estonia, Tuscany, Scotland and Finland, for three sites in Saarland, for two sites in Torino, one site in Cracow and Eindhoven, whilst no statistically significant increase could be found in Geneva. However, these results have to be viewed in the light of the very different population sizes covered by the participating registries.

Previous comparative survival studies, such as those carried out in the consecutive rounds of the EUROCARE study during last two decades, have shown that large between- and within-country differences in survival were present in Europe, that survival was generally lower in Eastern European countries than elsewhere, and that survival in UK populations was, with the exception of a few cancer sites, lower than that in other non-Eastern populations.[17,18] Trends in survival were shown not to occur in a parallel fashion, as the difference in survival between Eastern Europe and elsewhere increased in the early 1990s, and decreased during the late 1990s.[17–19] An analysis of more recent data has indicated a general pattern of lower survival in Eastern Europe (compared to all other regions) and in the UK (compared to other non-Eastern regions), in spite of the observation of a narrowing of survival differences between European populations.[20] Our analysis of more recent trends within the first years of the 21st century suggest that whilst the pattern of survival differences between European regions generally still holds, specific developments in individual countries are emerging.

A markedly lower survival in Eastern Europe, as well as Slovenia, was evident for colorectal cancer, and trends in survival did not suggest stronger rises in these areas than elsewhere. Ongoing improvements in the management of colorectal cancer in recent decades with progress in both

Table 4.3 – Model-based age-adjusted 5-year relative survival estimates (%) with standard error (SE) in 2000 and 2004 for patients with common urological cancers, and test for survival trend in 2000–2004, by registry

	2000		2004		Change 2000–2004[b]	p		2000		2004		Change 2000–2004[b]	p
	PE[a]	SE[a]	PE[a]	SE[a]				PE[a]	SE[a]	PE[a]	SE[a]		
Prostate							*Kidney*						
Cracow	61.3	4.1	57.9	4.3	−3.4	0.60	Cracow	43.2	4.9	45.7	4.9	2.6	0.73
Estonia	57.9	3.3	73.1	2.4	15.2	0.00	Estonia	54.1	3.2	63.4	2.8	9.3	0.03
Lithuania	47.0	2.5	74.1	1.6	27.1	0.00	Lithuania	47.6	2.1	60.0	1.8	12.4	0.00
Slovenia	60.1	2.2	67.1	2.0	7.0	0.02	Slovenia	48.9	2.7	49.8	2.7	0.9	0.83
Torino	83.3	3.3	91.9	1.7	8.6	0.01	Torino	73.3	3.4	69.9	3.7	−3.3	0.56
Tuscany	73.4	3.0	88.8	1.4	15.4	0.00	Tuscany	65.3	2.9	75.2	2.3	9.8	0.01
Eindhoven	77.3	2.1	84.7	1.5	7.4	0.01	Eindhoven	48.6	3.0	51.5	2.9	2.9	0.53
Scotland	68.7	1.3	76.1	1.1	7.3	0.00	Scotland	43.3	1.7	44.0	1.7	0.7	0.79
Finland	80.3	1.1	87.2	0.7	6.8	0.00	Finland	55.5	1.6	58.1	1.6	2.6	0.31
Norway	75.9	1.1	82.9	0.8	7.0	0.00	Norway	51.0	1.8	59.9	1.7	8.9	0.00
Geneva	83.1	2.5	83.4	2.4	0.3	0.94	Geneva	62.9	6.2	59.2	6.5	−3.6	0.73
Saarland	82.6	3.5	92.8	1.5	10.2	0.00	Saarland	67.5	3.8	70.2	3.6	2.6	0.65
Bladder													
Cracow	58.5	3.8	42.0	4.4	−16.5	0.02							
Estonia	63.9	3.3	69.0	3.0	5.1	0.24							
Lithuania	52.9	2.3	63.3	2.0	10.5	0.00							
Slovenia	48.7	2.6	47.2	2.6	−1.5	0.71							
Torino	68.0	2.5	61.9	2.9	−6.1	0.14							
Tuscany	61.0	2.4	63.4	2.3	2.4	0.49							
Eindhoven	52.5	2.5	51.3	2.5	−1.2	0.77							
Scotland	52.4	1.6	51.8	1.6	−0.6	0.80							
Finland	73.2	1.5	71.8	1.5	−1.4	0.56							
Norway	71.0	1.3	75.7	1.2	4.7	0.01							
Geneva	53.6	5.3	56.5	5.1	2.9	0.72							
Saarland	58.3	3.9	66.5	3.4	8.2	0.13							

a PE: point estimate, SE: standard error.
b Absolute change in the 5-year relative survival, in per cent.

adjuvant therapy[21,22] and surgical management[23–25] may explain the rises documented in survival. The implementation of concerted strategies[26] as well as quality control[27] may help to improve outcomes in populations with lower survival.

Amongst the other gastrointestinal cancers, the survival of patients with stomach cancer showed no particular geographical pattern, with the lowest survival found in Scotland, whilst in Slovenia, survival was similar to most of the non-Eastern European populations. For oesophageal, liver and pancreatic cancers, survival estimates remained rather poor in all registries.

The interpretation of trends in cancer patient survival, particularly for cancers that are subject to screening efforts, is best done with simultaneous attention to trends in incidence and mortality, in order to distinguish between survival rises because of true progress against cancer from survival rises due to increased or earlier detection.[28–30] As these trends are addressed in detail in another article in this issue,[31] we consider and summarise them here for some of the major cancer sites only.

The survival of patients with breast cancer remained lower in Eastern Europe than elsewhere, despite improving survival in Estonia and Lithuania. Amongst the other registries, Slovenia, and Scotland remained the areas with considerably lower survival. In general, advances in both treatment and earlier diagnosis through screening, both mass and opportunistic, may account for the increases in survival seen for patients with breast cancer. Ongoing advances in hormonal therapy,[32–34] and better risk assessment of individual patients[35] could have contributed to improved clinical outcomes. With regard to incidence and mortality, between 1995 and 2004, registry specific case numbers have risen between 7% and 40%, indicating that breast cancer incidence was mostly rising in the underlying populations of the participating registries, whilst national level age-adjusted mortality rates remained constant in Lithuania, and declined between 10% and 24% elsewhere.[36] Increasing survival and decreasing mortality has been shown to be explained jointly by the effects of screening by mammography and improvements in therapy,[37,38] but improvements in therapy were suggested to be more important.[39,40] Lesser access to effective treatment as well as smaller effects from mammography screening in Eastern parts of Europe[37,41] is likely to contribute to lower survival seen in that area in 2004.

For cervical cancer, a recent Europe-wide evaluation suggested that differences in survival may be explained by variation in the age- and stage-specific outcomes, as well as variations in screening.[42] The very large excess mortality from cervical cancer in the Eastern parts of the European Union underscores the importance of improving cervical cancer control.[43]

Amongst patients with prostate cancer, large geographic differences in survival continued to exist, whilst survival trends between 2000 and 2004 indicate, with few exceptions,

Table 4.4 – Model-based age-adjusted 5-year relative survival estimates (%) with standard error (SE) in 2000 and 2004 for patients with common haematological cancers, and test for survival trend in 2000–2004, by registry

	2000		2004		Change 2000–2004[b]	p		2000		2004		Change 2000–2004[b]	p
	PE[a]	SE[a]	PE[a]	SE[a]				PE[a]	SE[a]	PE[a]	SE[a]		
Non-Hodgkin lymphoma							*Multiple myeloma*						
Cracow	29.2	5.1	44.4	5.5	15.3	0.05	Cracow	28.1	6.3	18.0	4.7	−10.2	0.24
Estonia	39.5	3.3	37.0	3.3	−2.5	0.63	Estonia	30.3	4.8	30.0	4.8	−0.3	0.97
Lithuania	36.0	2.8	47.2	2.8	11.3	0.01	Lithuania	21.6	2.8	21.6	2.8	0.0	0.99
Slovenia	52.5	2.7	54.1	2.6	1.6	0.70	Slovenia	33.9	3.6	25.7	3.4	−8.1	0.12
Torino	58.3	2.9	61.6	2.8	3.2	0.48	Torino	30.4	4.6	41.5	4.6	11.2	0.10
Tuscany	49.0	2.9	64.2	2.4	15.3	0.00	Tuscany	50.9	3.8	46.5	3.9	−4.4	0.45
Eindhoven	50.2	2.5	51.8	2.5	1.7	0.69	Eindhoven	30.8	3.6	28.5	3.6	−2.3	0.69
Scotland	50.8	1.5	55.5	1.5	4.7	0.04	Scotland	31.8	2.1	34.6	2.2	2.9	0.38
Finland	50.3	1.4	56.9	1.4	6.6	0.00	Finland	33.7	2.1	31.5	2.0	−2.3	0.45
Norway	50.6	1.7	60.5	1.6	10.0	0.00	Norway	43.2	2.2	42.7	2.2	−0.5	0.88
Geneva	59.0	5.4	64.6	4.9	5.6	0.49	Geneva	37.5	8.0	40.8	8.1	3.3	0.79
Saarland	57.7	3.6	63.2	3.3	5.5	0.32	Saarland	25.4	5.0	38.4	5.5	13.0	0.09
Leukaemia													
Cracow	25.0	5.6	19.3	5.1	−5.7	0.49							
Estonia	39.4	3.4	44.8	3.3	5.4	0.28							
Lithuania	31.1	2.0	33.9	2.0	2.8	0.36							
Slovenia	36.1	2.5	41.9	2.5	5.8	0.13							
Torino	44.0	3.6	44.9	3.6	0.8	0.88							
Tuscany	37.5	2.8	39.0	2.8	1.5	0.72							
Eindhoven	46.4	3.0	43.4	3.0	−3.0	0.54							
Scotland	49.5	1.6	46.0	1.7	−3.5	0.18							
Finland	36.7	1.9	42.0	1.9	5.3	0.07							
Norway	46.8	1.9	49.2	1.9	2.5	0.41							
Geneva	53.3	5.6	55.7	5.5	2.4	0.78							
Saarland	44.5	4.2	44.4	4.2	−0.2	0.98							

a PE: point estimate, SE: standard error.
b Absolute change in the 5-year relative survival, in per cent.

strong and partly dramatic increases in patient survival in the participating registries. Whilst no major breakthrough has occurred in the treatment of prostate cancer in and before the examined period, advances in hormonal therapy[44,45] could have contributed to real improvements in patient survival. However, the dramatic increases in survival are very likely mostly due to increased lead time and overdiagnosis[46,47] resulting from rapidly increasing use of the prostate specific antigen (PSA) test in European populations.[48,49] In the data set of this study, the registry specific increase in the number of cases between 1995 and 2003 was lowest with +25% and +39% in Scotland and Norway, respectively, and at least +50% elsewhere (and a maximum of +200% in Lithuania), reflecting rapidly rising numbers of detected cases in recent years. In contrast to incidence and survival, age-adjusted mortality rates of the countries included in this study were heterogeneous: between 1995 and 2004, mortality was rising in Estonia (+65%), Lithuania (+25%), Poland (+20%) and Slovenia (+12%), whilst rates decreased by between 10 (Scotland, Norway, Italy (till 2002) and Finland) to 20–25% (Switzerland, Netherlands and Germany).[36] These observed mortality declines may partially be explained by advances in treatment as well as stage shift,[50] whilst the rising mortality in Eastern European populations and Slovenia may reflect suboptimal care. Prostate cancer treatment may induce serious undesirable side effects,[51] whilst the potential benefit to patients may be very small. Non-adherence to national guidelines on screening,[49] as well as the testing of patients for whom no potential benefit may be achieved is a serious concern.[52,53]

Amongst patients with kidney cancer, survival was found to be lower in Cracow and Slovenia, as well as Scotland and Eindhoven, and higher in the remaining registries. Early diagnosis, mostly through incidental detection as a result of increased use of abdominal imaging, has been suggested as a possible explanation for rises in patient survival.[54,55]

For haematological malignancies, the survival of patients with non-Hodgkin lymphoma remained considerably lower in Eastern Europe than elsewhere even by 2004, despite the marked improvements in Cracow and Lithuania. Amongst patients with multiple myeloma and leukaemia, survival estimates for Cracow and Lithuania appeared to be considerably lower than in either Estonia or Slovenia – these results indicate a possible lack of access to effective treatment for these patients. At the same time, it is important to keep in mind that differences in the incidence of sub-types may explain some variation between the survival estimates for the different registries.

Patients with lung cancer continued to have a very poor prognosis in all participating registries, with little geographical variation. Estimates for patients with melanoma of the skin indicated lower survival in the Eastern registries, despite the survival increases in Lithuania and Cracow, as well as in Slovenia. The prognosis of patients with brain and nervous system cancers appeared to vary little by registry, with a

Table 4.5 – Model-based age-adjusted 5-year relative survival estimates (%) with standard error (SE) in 2000 and 2004 for patients with other common cancers, and test for survival trend in 2000–2004, by registry

	2000		2004		Change 2000–2004[b]	p		2000		2004		Change 2000–2004[b]	p
	PE[a]	SE[a]	PE[a]	SE[a]				PE[a]	SE[a]	PE[a]	SE[a]		
Lung							*Skin melanoma*						
Cracow	13.2	1.3	15.7	1.5	2.4	0.22	Cracow	55.4	7.1	71.2	5.3	15.8	0.08
Estonia	12.2	0.9	12.2	0.9	0.0	0.97	Estonia	68.4	3.7	68.9	3.7	0.5	0.93
Lithuania	12.7	0.7	11.8	0.6	−0.8	0.36	Lithuania	59.4	3.6	73.7	2.6	14.3	0.00
Slovenia	11.5	0.7	12.1	0.7	0.6	0.54	Slovenia	78.9	2.2	78.0	2.3	−0.9	0.81
Torino	12.8	1.0	11.9	1.0	−0.9	0.48	Torino	86.2	2.8	87.9	2.5	1.6	0.70
Tuscany	14.6	0.9	15.9	0.9	1.4	0.26	Tuscany	82.0	2.6	84.6	2.2	2.7	0.47
Eindhoven	14.5	0.7	14.4	0.7	−0.1	0.93	Eindhoven	81.8	2.3	85.7	1.9	3.9	0.23
Scotland	9.2	0.3	10.0	0.4	0.8	0.07	Scotland	88.1	1.3	89.8	1.1	1.7	0.40
Finland	10.7	0.5	9.9	0.5	−0.8	0.24	Finland	82.6	1.5	85.4	1.2	2.8	0.19
Norway	12.6	0.5	13.9	0.6	1.3	0.09	Norway	84.0	1.1	83.9	1.1	−0.1	0.96
Geneva	20.1	2.1	19.3	2.0	−0.8	0.79	Geneva	93.2	2.0	90.3	2.7	−2.8	0.54
Saarland	15.9	1.2	18.6	1.2	2.7	0.13	Saarland	84.9	3.8	89.4	2.8	4.5	0.37
Brain and nervous							*Thyroid*						
Cracow	15.7	3.5	18.8	3.7	3.1	0.51	Cracow	89.6	3.3	93.2	2.3	3.6	0.37
Estonia	21.1	2.8	18.8	2.6	−2.3	0.54	Estonia	88.4	2.7	91.2	2.1	2.9	0.34
Lithuania	22.4	1.6	19.9	1.6	−2.6	0.27	Lithuania	84.3	2.4	93.2	1.3	8.9	0.00
Slovenia	18.3	2.0	23.3	2.2	5.0	0.07	Slovenia	89.6	2.3	92.8	1.7	3.2	0.24
Torino	25.8	3.1	26.8	3.1	1.0	0.78	Torino	93.8	2.5	95.6	1.9	1.8	0.59
Tuscany	24.4	2.5	26.7	2.5	2.3	0.44	Tuscany	90.4	2.0	93.2	1.6	2.8	0.25
Eindhoven	21.3	2.4	21.6	2.4	0.3	0.93	Eindhoven	85.1	3.5	84.0	3.7	−1.1	0.85
Scotland	20.2	1.2	20.4	1.2	0.2	0.92	Scotland	84.5	2.3	87.8	1.9	3.4	0.27
Finland	29.6	1.6	32.4	1.6	2.8	0.24	Finland	92.6	0.9	89.9	1.2	−2.7	0.13
Norway	23.8	1.4	27.5	1.5	3.8	0.06	Norway	89.1	1.9	94.1	1.2	4.9	0.02
Geneva	20.6	5.1	21.2	5.1	0.6	0.93	Geneva	93.5	5.0	98.2	1.5	4.8	0.23
Saarland	24.3	3.1	29.6	3.3	5.3	0.23	Saarland	91.9	3.3	92.2	3.2	0.3	0.94

a PE: point estimate, SE: standard error.
b Absolute change in the 5-year relative survival, in per cent.

somewhat higher survival in the Northern countries and in Saarland. Finally, geographic variation in the survival of patients with thyroid cancer has become much smaller than that reported before.[56]

Geographic differences in survival achieved by 2004 and survival trends between 2000 and 2004 indicate that timely detection and effective treatment for some generally treatable malignancies, such as thyroid cancer, have become increasingly available in all parts of Europe. In contrast, the survival observed for patients in Eastern European populations tended to be consistently lower than elsewhere in Europe, particularly for haematological malignancies, as well as with several common forms of cancer, such as breast and colorectal cancers. Further efforts towards improving outcomes in these populations remains a priority.

The potential of model-based analysis to identify a statistically significant survival trend within a calendar period is determined by the number of cancer cases (which is a function of the registry's underlying population and the incidence), the magnitude of the change, and the level of survival. The application of a uniform modelling strategy for all cancer sites and registries in this project has limited the power to identify significant trends in smaller registries (as Geneva and Cracow), as well as for less common forms of cancer. In registry or site specific analyses, the modelling approach may be easily modified to enhance the power of the analysis.[57]

There has been considerable debate on the validity of international survival comparisons.[58–63] However, previous methodological work clearly suggests that artefacts in cancer registry data are unlikely to explain but a small part of the considerable observed survival differences.[18,58] Nevertheless, data-related factors, such as low case numbers, as for cervical cancer, and the correspondingly high standard errors for many registries made the interpretation of some of the trends difficult. For ovarian cancer, differences in the classification of borderline tumours may also explain some variation in the survival. The heterogeneous trends in bladder cancer survival were probably influenced by differences in registration policies.[64]

In summary, model-based analysis, by enabling the detection of trends, provides an additional comparative indicator beyond the level of survival; the comparison of trends in the international context may become a helpful additional measure in the timely monitoring of cancer patient survival. The persisting geographic differences in survival for a number of common cancers in this study underline the need, particularly for Eastern European populations, for further reductions in the burden of cancer. Improvements in diverse areas of cancer care, including increased secondary prevention efforts,[65] better access to advances in treatment, as well as subspecialisation and regionalisation of oncologic care may all contribute towards this goal.

Conflict of interest statement

None declared.

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