Cancer in Ireland 1994-2011: Annual report of the National Cancer Registry 2014

National Cancer Registry Ireland

ABBREVIATIONS

Acronyms	
95% CI	95% Confidence Interval
APC	Annual Percentage Change
ASR	Age Standardised Rate (European standard population)
CIN	Cervical Intraepithelial Neoplasia
CSO	Central Statistics Office
ECO	European Cancer Observatory
ICD	International Statistical Classification of Diseases and Related Health Problems
NCR	National Cancer Registry
NHL	Non-Hodgkin's Lymphoma
NMSC	Non Melanoma Skin Cancer
RS	Relative Survival

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SUMMARY

Incidence:

- An average of approximately 19,200 invasive (excluding non-melanoma skin) cancers was diagnosed per year between 2009 and 2011, equivalent to an incidence rate of 425 cases per 100,000 per year.
- Incidence rate was 28% higher in men than in women and cumulative lifetime risk of diagnosis was 1 in 3 for males and 1 in 4 for females.
- Excluding non-melanoma skin cancers, prostate (3,267 cases per year) and female breast cancer (2,781 cases per year) were the most frequently diagnosed cancers in men and women respectively. Colorectal (2,436 cases per year) and lung (2,165 cases per year) cancers were the 2nd and 3rd most common cancers in both sexes.

Mortality:

- A total of 8,871 deaths from cancer occurred in 2011, equivalent to a mortality rate of 179 deaths per 100,000 per year. Cancer was the second leading cause of death in Ireland after diseases of the circulatory system.
- Cancer mortality rate was 38% higher in men than in women and cumulative lifetime risk of death from cancer was 1 in 9 overall.
- Lung cancer (1,848 total deaths in 2011) was the leading cause of cancer death in both sexes representing 18% of female and 23% of male cancer deaths. Female breast, colorectal and prostate cancers represented the next most common cancer deaths and together with lung cancer made up almost half (47%) of all cancer deaths in 2011.

Current incidence and mortality in young people:

- Only 12% of all cancers registered between 2009 and 2011 were diagnosed in people aged under 40 and an average of 163 children, aged under 15, were diagnosed per year. Leukaemia and cancers of the brain and central nervous system made up the bulk of cancers in this youngest age group.
- 70% of all registered cancers in teenage girls and young women (15-24 year olds) were non-invasive, mostly in situ (CIN III) cervical cancer. Excluding non-invasive cancers, incidence rates between the sexes in this age group were similar.
- Hodgkin's lymphoma (27% in females, 17% in males) and testicular cancer (25% in males) were the most common invasive cancers in 15-24 year old patients. Melanoma of skin comprised 15% of all invasive cancers in females.
- In women aged between 25 and 39, *in situ* (CIN III) cervical cancers still represented the bulk of all cancers registered. Incidence rates of invasive cancers only were still 70% higher in women than in men in this age group; cancers of the breast, cervix and ovary combined representing over half of all female cancers.
- Cancer accounted for just 14% of all deaths in young people, aged under 40, in 2011. The most common cancers causing death in young people were brain cancer, leukaemia and lymphomas, particularly in children and young adults aged under 25. In 25 to 39 year old women, breast and cervical cancer together accounted for 39 of all 81 cancer deaths; 14 of the 60 cancer deaths in males in this age group were from brain cancer. A total of 11 deaths in 25 to 39 year olds were from melanoma.

Trends in incidence and mortality in young people:

- There was little change over time in cancer incidence or mortality in children aged under 15 years.
- Incidence rates for all registered cancers, in patients aged between 15 and 39, showed just a small increase over time in males, but in females increased substantially, largely due to increases in *in situ* (CIN III) cervical cancer incidence, likely influenced by screening activity since the late 1990's.
- Invasive cervix, breast and testicular cancer all increased in incidence over time in patients aged between 25 and 39 years, although rates fluctuated somewhat between years, particularly for invasive cervical and testicular cancer.
- Melanoma incidence increased annually by 2.8% overall in both sexes aged between 25 and 39 with females having higher incidence than males each year.
- Cancer mortality rates in people under 25 have fluctuated between years but remain low in comparison to those in people aged 25 to 39. Mortality rates in this older age group have declined by approximately 30% in both sexes since 1994.

Trends in incidence in Ireland and the UK for 5 common cancers:

- Estimates of lung cancer incidence in Ireland and the UK overall for 2012 were fairly similar, but male rates in Ireland and the UK were substantially lower, and female rates higher, than the EU average. Over time, male rates have been declining and female rates increasing in both Ireland and the UK.
- Incidence rates for melanoma in 2012 were also fairly similar in Ireland and the UK and were higher than the EU average. Since 1994, incidence rates in Irish females have been higher than in the UK, but similar and significant increasing trends were observed over time in both sexes in all countries.
- In 2012, incidence of female breast cancer in Ireland was 5% lower than in the UK but 13% higher than the EU average. Breast screening in both Ireland and UK has resulted in increasing incidence over time.
- Cervical cancer incidence trends also reflect the impact of national screening programmes in Ireland and the UK. Rates in England, Scotland and Wales have declined significantly since the 1990's while in Ireland incidence rates in recent years have been increasing. Incidence rates in Ireland in 2012 were estimated to be 33% higher than the EU average.
- Widespread PSA testing in Ireland has influenced prostate cancer incidence here and in 2012 incidence rates in Ireland were estimated to be 1.5 times higher than in the UK or EU overall. Incidence has been increasing significantly in all countries, particularly in Ireland where an annual percentage increase of over 6% was observed.

Survival in Ireland and how it compares to other European countries:

- 5 year relative survival has improved in Ireland and in Europe generally between 1995-1999 and 2000-2007 for 10 common cancers examined by the EUROCARE-5 study. Irish estimates for melanoma, prostate and non-Hodgkin's lymphoma, diagnosed between 2000 and 2007, were higher than the European average and for these cancers, Ireland ranked amongst the top 10 countries included in the study.
- Survival rates for stomach, ovary and kidney cancers remain poor however and survival rates across Europe for these cancers were very variable. Irish rates for these cancer sites varied from between 81% to 85% of the European average in 2000-2007.
- Although lung cancer survival is still quite poor compared to other cancers, survival rates in Ireland have improved substantially since 1995-1999 and are currently 91% the rate observed for Europe overall.
- For most cancers, 5 year survival rates in Ireland were fairly similar to those observed in the UK.
- Five year survival for children in Ireland during the period 2000-2007 was 79%, very close to the European average.

Publications by the National Cancer Registry, 2013:

- In addition to the routine analysis presented in this report, 11 of the 37 peer reviewed papers authored by National Cancer Registry staff in 2013 were based on more detailed analysis of registration data. Short summaries of these 11 papers are included.

METHODS

The National Cancer Registry (NCR), founded in 1994, records demographic, clinical and treatment information for all cancers diagnosed in Ireland in accordance with internationally accepted registration and coding conventions. Completeness of case ascertainment at five years after diagnosis is estimated to be at least 98% [1].

Mortality data was provided by the Central Statistics Office (CSO) [2]. National anonymised datasets for all cancer deaths are provided to the Registry annually by the CSO.

The age standardised (ASR) rate is the proportion of cases (or deaths) in a given population (and year) weighted by the age structure of the population. Age standardised rates (ASR) for incidence and mortality were weighted by the European standard population [3, 4]. Annual percentage change (APC) of incidence over time was estimated from the annual rates with the Joinpoint regression program [5, 6]. Data was downloaded from the European Cancer Observatory (ECO) database to examine incidence trends in Ireland and other European countries for 5 common cancer sites [7]. Survival data from the EUROCARE-5 [8, 9] publications was extracted to compare survival rates in Ireland against other European countries.

1. INCIDENCE

An average of approximately 34,300 cancers was registered per year between 2009 and 2011 inclusive, representing an incidence rate overall of 746 cases per 100,000 per year (Table 1.1). Approximately 19% of these were non-invasive cancers (in-situ tumours, cancers of uncertain behaviour and benign brain and CNS tumours) and 25% were non-melanoma skin cancers (NMSC, 8,575 cases per year). Looking at figures for all invasive cancers only, and excluding NMSC, just over 19,200 cases were registered annually, representing 56% of all registered cases and equivalent to an incidence rate of 425 cases per 100,000 per year. This indicates an annual increase of 645 cases or 0.5% increase in incidence rate compared to previously published figures (2008-2010 averages). Incidence rates for all invasive cancers, excluding NMSC, were 28% higher for men than for women (similar to previously published figures), and cumulative lifetime risk remains approximately 1 in 3 for men and 1 in 4 for women.

More detailed incidence data for 2009-2011 for individual cancers by ICD10 code is listed in Appendix I.

Table 1.1 Annual average incidence for the main cancers, 2009-2011

	cases			rate/100,000			risk (%) to age 75 years			% of all invasive‡		
	females	males	total	females	males	total	females	males	total	females	males	total
mouth & pharynx	126	241	367	5.4	11.5	8.4	0.4	1.0	0.7	1.4	2.3	1.9
oesophagus	131	252	384	5.0	11.9	8.3	0.4	1.0	0.7	1.5	2.5	2.0
stomach	194	332	526	7.4	15.6	11.2	0.5	1.2	0.8	2.2	3.2	2.7
colorectal	1,031	1,405	2,436	41.1	66.0	52.7	3.1	5.1	4.1	11.5	13.7	12.7
pancreas	225	253	478	8.7	12.0	10.3	0.6	0.9	0.8	2.5	2.5	2.5
lung	904	1,261	2,165	37.0	59.4	47.1	2.9	4.6	3.8	10.1	12.3	11.3
melanoma of skin	485	367	852	20.4	17.1	18.6	1.6	1.3	1.5	5.4	3.6	4.4
breast	2,781	23	2,805	123.7	1.1	63.8	9.7	0.1	5.0	31.0	0.2	14.6
cervix	328	-	328	14.1	-	-	1.1	-	-	3.7	-	1.7
corpus uteri	400	-	400	18.0	-	-	1.6	-	-	4.5	-	2.1
ovary	344	-	344	14.7	-	-	1.2	-	-	3.8	-	1.8
other gynaecological cancers*	100	-	100	4.1	-	-	0.3	-	-	1.1	-	0.5
prostate	-	3,267	3,267	-	156.4	-	-	13.5	-	-	31.9	17.0
testis	-	172	172	-	7.1	-	-	0.5	-	-	1.7	0.9
kidney	181	329	509	7.6	15.5	11.4	0.6	1.3	1.0	2.0	3.2	2.7
bladder	131	318	450	5.0	15.0	9.5	0.4	1.0	0.7	1.5	3.1	2.3
brain & CNS	154	191	345	6.6	8.8	7.7	0.5	0.7	0.6	1.7	1.9	1.8
all lymphomas	383	449	832	16.2	20.8	18.4	1.3	1.6	1.5	4.3	4.4	4.3
Hodgkin's lymphoma	*67*	*74*	*140*	*2.9*	*3.3*	*3.1*	*0.2*	*0.3*	*0.2*	*0.7*	*0.7*	*0.7*
non-Hodgkin's lymphoma	*317*	*375*	*692*	*13.3*	*17.5*	*15.3*	*1.1*	*1.4*	*1.2*	*3.5*	*3.7*	*3.6*
multiple myeloma	101	140	241	3.9	6.6	5.2	0.3	0.5	0.4	1.1	1.4	1.3
leukaemia	191	288	479	7.9	13.4	10.5	0.6	1.0	0.8	2.1	2.8	2.5
non-melanoma skin (NMSC)	3,810	4,764	8,575	152.8	224.1	185.0	11.1	15.8	13.4	-	-	-
other invasive cancers, not listed	777	961	1,735	30.6	44.9	37.3	2.2	3.3	2.8	8.6	9.4	9.0
all invasive cancers (excluding NMSC)	**8,967**	**10,248**	**19,215**	**377.6**	**483.1**	**424.9**	**26.0**	**33.0**	**29.5**	**100**	**100**	**100**
non-invasive cancers	**5,020**	**1,497**	**6,516**	**201.3**	**70.1**	**136.0**	**14.1**	**5.3**	**9.9**	**-**	**-**	**-**
all registered cancers	**17,797**	**16,509**	**34,306**	**731.7**	**777.3**	**745.9**	**43.5**	**46.6**	**45.0**	**-**	**-**	**-**

rate: number of cases per 100,000 population per year (European standard population)
risk: cumulative lifetime risk of cancer diagnosis to age 75 years, expressed as a percentage
‡ all invasive cancers excluding non-melanoma skin cancers (NMSC)
*cancers of the vulva, vagina, uterus (NOS), other female genital and placenta
Note: figures are rounded to the nearest whole number

Figure 1.1 Relative frequency of the main invasive cancers diagnosed, 2009-2011

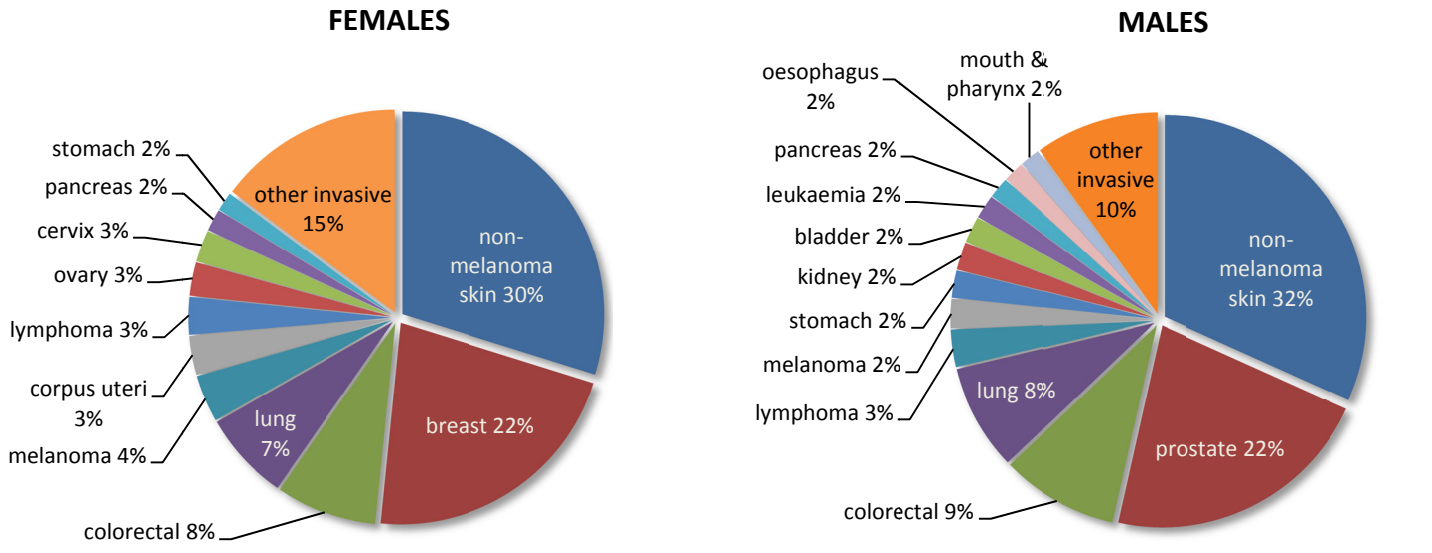

Table 1.2 Ranking of the most commonly diagnosed invasive cancers (excluding NMSC), 2009-2011

	females		males	
	%	rank	%	rank
prostate	-	-	31.9	1
breast	31.0	1	-	-
colorectal	11.5	2	13.7	2
lung	10.1	3	12.3	3
melanoma of skin	5.4	4	3.6	5
corpus uteri	4.5	5	-	-
lymphoma	4.3	6	4.4	4
ovary	3.8	7	-	-
cervix	3.7	8	-	-
stomach	2.2	10	3.2	6
kidney	2.0	12	3.2	7
bladder	1.5	15	3.1	8
leukaemia	2.1	11	2.8	9
pancreas	2.5	9	2.5	10
brain & CNS	1.7	13	1.9	13
oesophageal	1.5	14	2.5	11
mouth & pharynx	1.4	16	2.3	12
multiple myeloma	1.1	17	1.4	15
testis	-	-	1.7	14
other invasive cancers, not listed	9.8		9.6	

Of all invasive cancers registered, NMSC represented the most common cancer, representing 30% and 32% of all cases in women and men respectively (Figure 1.1). If NMSC is excluded, female breast and prostate cancer remain the most commonly diagnosed cancers overall, and each comprised almost one-third of all cancers in women and men respectively (Table 1.2). Colorectal and lung cancer remain the 2nd and 3rd most common cancers in both sexes respectively, and for these 2 sites combined, their relative proportion of all invasive cancers is still less than that for breast and prostate alone. Little change was observed in the relative frequency of individual cancer types from previously reported (2008-2010 average) figures, although in males, prostate cancer increased from 30.7% to 31.9% of all invasive cancers (excluding NMSC) together with a slight decrease in colorectal cancer (14.2% to 13.7%). Following from the 4 most common cancers, the remaining cancer types in both sexes form a much smaller proportion of the total and ranking of all the main cancers in both sexes remains unchanged.

2. MORTALITY

Cancer remains the second most common cause of death, after diseases of the circulatory system, and a total of 8,871 deaths from cancer occurred in 2011. This represented approximately 30% of all deaths for 2011 and a mortality rate of approximately 179 deaths per 100,000 persons per year (Table 2.1). Almost all cancer deaths were from invasive cancers (98%). All-cancer mortality rates in 2011 were approximately 38% higher in men than in women – rates in females remained similar to those reported in 2010 while there was a 2.8% increase in males. This was largely due to a 9% increase in colorectal and 6% increase in lung cancer mortality rates for males in 2011 compared with 2010. The lifetime risk of dying from cancer in 2011 was 1 in 9 overall. Lung cancer was the single most common cause of cancer death in 2011, with a total of 1,848 deaths, just over one-fifth of all cancer deaths.

More detailed mortality data for cancer deaths by ICD10 code is listed in Appendix II.

Table 2.1 Number of deaths and mortality from the main cancers, 2011

	deaths			rate/100,000			risk (%) to age 75 years			% of all cancer deaths		
	females	males	total	females	males	total	females	males	total	females	males	total
mouth & pharynx	47	116	163	1.8	5.3	3.4	0.1	0.4	0.3	1.1	2.5	1.8
oesophageal	127	232	359	4.4	10.6	7.3	0.3	0.8	0.5	3.0	4.9	4.0
stomach	118	209	327	4.1	9.5	6.6	0.2	0.6	0.4	2.8	4.4	3.7
colorectal	430	610	1,040	15.0	27.6	20.7	0.9	1.8	1.4	10.3	13.0	11.7
pancreas	222	256	478	8.0	11.5	9.8	0.5	0.8	0.7	5.3	5.4	5.4
lung	760	1,088	1,848	29.0	49.0	38.0	2.2	3.6	2.9	18.2	23.1	20.8
melanoma of skin	73	83	156	2.8	3.8	3.2	0.2	0.3	0.2	1.8	1.8	1.8
breast	690	7	697	26.5	0.3	14.3	2.0	-	1.0	16.6	0.1	7.9
cervix	98	-	98	4.1	-	2.1	0.3	-	0.2	2.4	-	1.1
corpus uteri	83	-	83	3.2	-	1.7	0.3	-	0.1	2.0	-	0.9
ovary	278	-	278	11.1	-	5.8	0.9	-	0.4	6.7	-	3.1
other gynaecological cancers*	55	-	55	2.0	-	1.1	0.1	-	0.1	1.3	-	0.6
prostate	-	563	563	-	25.5	10.4	-	1.1	0.5	-	12.0	6.3
testis	-	4	4	-	0.2	0.1	-	0.0	0.0	-	0.1	0.0
kidney	53	150	203	2.0	6.8	4.2	0.2	0.5	0.3	1.3	3.2	2.3
bladder	91	129	220	2.9	5.8	4.1	0.1	0.3	0.2	2.2	2.7	2.5
brain & CNS	108	154	262	4.4	6.8	5.6	0.4	0.6	0.5	2.6	3.3	3.0
all lymphomas	145	151	296	5.2	6.8	5.9	0.3	0.4	0.4	3.5	3.2	3.3
Hodgkin's disease	*13*	*11*	*24*	*0.5*	*0.5*	*0.5*	*0.0*	*0.0*	*0.0*	*0.3*	*0.2*	*0.3*
non-Hodgkin's lymphoma	*132*	*140*	*272*	*4.7*	*6.3*	*5.4*	*0.3*	*0.4*	*0.3*	*3.2*	*3.0*	*3.1*
multiple myeloma	72	88	160	2.4	3.9	3.1	0.1	0.3	0.2	1.7	1.9	1.8
leukaemia	86	142	228	2.9	6.4	4.4	0.2	0.3	0.3	2.1	3.0	2.6
non-melanoma skin (NMSC)	25	46	71	0.8	2.2	1.4	0.0	0.1	0.1	0.6	1.0	0.8
other invasive cancers, not listed	513	564	1,077	18.4	25.5	21.6	1.2	1.7	1.5	12.3	12.0	12.1
all invasive cancer listed	3,561	4,028	7,589	132.4	182.0	153.2	9.0	11.4	10.2	85.5	85.6	85.5
all invasive cancer deaths	**4,074**	**4,592**	**8,666**	**150.9**	**207.5**	**174.9**	**10.1**	**12.9**	**11.5**	**97.8**	**97.6**	**97.7**
non-invasive cancer deaths	**91**	**114**	**205**	**2.9**	**5.1**	**3.8**	**0.1**	**0.2**	**0.2**	**2.2**	**2.4**	**2.3**
all cancer deaths	**4,165**	**4,706**	**8,871**	**153.7**	**212.6**	**178.7**	**10.3**	**13.1**	**11.7**	**100**	**100**	**100**

rate: number of deaths per 100,000 population per year (European standard population)
risk: cumulative lifetime risk of cancer death to age 75 years, expressed as a percentage
***Cancers of the vulva, vagina, uterus (NOS), other female genital and placenta
Mortality data provided by the Central Statistics Office **[2].**

Figure 2.1 Relative frequency of the main cancer deaths, 2011

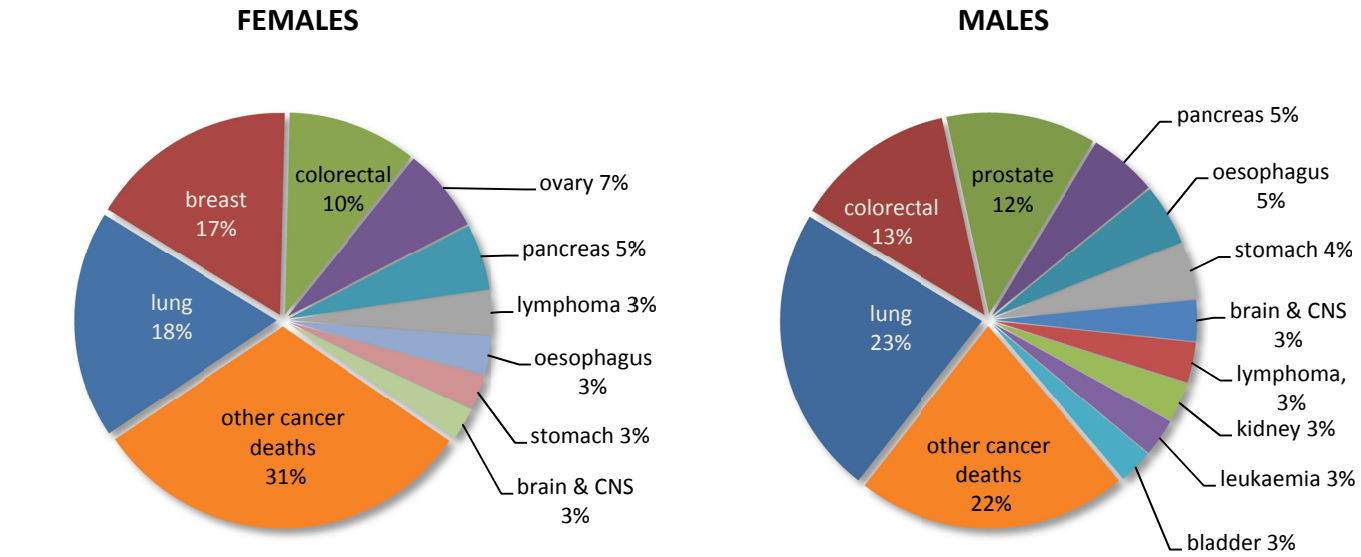

Table 2.2 Ranking of the most common cancer deaths, 2011

	females		males	
	%	rank	%	rank
lung	18.2	1	23.1	1
breast	16.6	2	-	-
colorectal	10.3	3	13.0	2
prostate	-	-	12.0	3
ovary	6.7	4	-	-
pancreas	5.3	5	5.4	4
all lymphomas	3.5	6	3.2	8
oesophageal	3.0	7	4.9	5
stomach	2.8	8	4.4	6
brain & CNS	2.6	9	3.3	7
cervix	2.4	10	-	-
bladder	2.2	11	2.7	11
leukaemia	2.1	12	3.0	10
corpus uteri	2.0	13	-	-
melanoma of skin	1.8	14	1.8	14
multiple myeloma	1.7	15	1.9	13
kidney	1.3	16	3.2	9
mouth & pharynx	1.1	17	2.5	12
other cancer deaths	16.4	-	15.6	-

The relative proportions of the main causes of death from cancer in 2011 were very similar to those described for 2010, with lung cancer representing the leading cause of cancer death in both sexes (Figure 2.1).

Deaths from lung, colorectal, breast (in females) and prostate cancer (in males) combined, made up almost half of all deaths from cancer in 2011. Deaths from cancers of the ovary and pancreas in females and from cancers of the pancreas, oesophagus and stomach in males together made up 12% and 14% respectively of all cancer deaths. These sites respectively ranked as the 4th and 5th most common cancer deaths in women and between the 4th and 6th most common cancer deaths in men (Table 2.2).

The comparatively low ranking in terms of cancer incidence for pancreas and oesophagus in particular (Table 1.2) provides a clear indicator of their relatively high mortality/ poor survival rates.

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3.1 Incidence

Cancer is largely a disease of older people and is comparatively rare in those under 40. Of all cancers registered between 2009 and 2011, 12% were in patients aged under 40 when diagnosed. Only 2% of all cancer patients were under age 25 and just 163 cases, or 0.5% of all cancers, were diagnosed per year in children – patients aged under 15. In children aged under 15 years, leukaemia and cancers of the brain and central nervous system (CNS) together made up over half of all invasive cancers, with boys and girls having broadly similar profiles in terms of cancer types and relative proportions (Table 3.1, Figure 3.1).

Table 3.1 Annual average number of cases and ranking of the most common cancers diagnosed in young people (aged under 40), 2009-2011

	AGE 0-14 years			AGE 15-24 years			AGE 25-39 years		
FEMALES	**cases**	**%**	**rank**	**cases**	**%**	**rank**	**cases**	**%**	**rank**
leukaemia	24	40.1%	1	7	9.5%	4	12	2.0%	10
brain & CNS	10	17.0%	2	4	5.9%	6	17	2.9%	7
kidney	5	8.2%	3	<1	0.9%	12	9	1.5%	11
Hodgkin's lymphoma	3	4.4%	5	20	26.7%	1	21	3.5%	6
non-Hodgkin's lymphoma	2	2.7%	7	5	6.8%	5	16	2.8%	8
melanoma of skin	0	-	-	11	15.4%	2	79	13.5%	3
breast	0	-	-	2	2.7%	8	172	29.3%	1
ovary	0	-	-	4	5.4%	7	14	2.4%	9
cervix	<1	0.5%	10	2	2.7%	8	116	19.7%	2
thyroid	1	1.6%	9	8	11.3%	3	48	8.2%	4
colorectal	<1	0.5%	10	2	2.3%	9	26	4.4%	5
eye	3	5.5%	4	0	-	-	2	0.3%	20
connective tissues	3	4.4%	5	1	1.4%	11	4	0.6%	16
peripheral nerves	2	3.3%	6	0	-	-	<1	0.1%	24
adrenal	2	2.7%	7	<1	0.5%	13	1	0.2%	22
bones	1	2.2%	8	1	1.8%	10	2	0.4%	18
mouth & pharynx	1	2.2%	8	1	1.4%	11	8	1.4%	12
lung	0	-	-	1	1.8%	10	7	1.2%	13
other invasive	3	4.4%		3	3.6%		34	5.7%	
non-melanoma skin, NMSC	<1	0.4%		7	2.5%		155	5.1%	
all invasive cancers*	**61**	***78.8%***		**74**	***26.3%***		**588**	***19.4%***	
non-invasive in situ melanoma	0	-		3	*1.2%*		27	*0.9%*	
non-invasive in situ breast	0	-		0	-		18	*0.6%*	
non-invasive in situ cervix	0	-		172	*61.5%*		2175	*71.6%*	
non-invasive benign meninges & brain	2	*2.2%*		2	*0.8%*		13	*0.4%*	
non-invasive uncertain meninges, brain & CNS	8	*10.0%*		2	*0.8%*		4	*0.1%*	
non-invasive others	7	*8.7%*		19	*6.8%*		58	*1.9%*	
total registered cancers	**77**			**280**			**3037**		
(incidence rate of all invasive cancers/100,000/yr)*	**(12.9)**			**(25.8)**			**(103.6)**		
MALES									
leukaemia	23	32.5%	1	7	8.4%	4	15	4.4%	7
brain & CNS	13	18.4%	2	7	8.8%	3	22	6.6%	4
kidney	3	4.7%	6	<1	0.8%	13	11	3.2%	9
Hodgkin's lymphoma	4	5.7%	5	14	17.1%	2	22	6.5%	5
non-Hodgkin's lymphoma	3	4.7%	6	7	8.0%	5	24	7.2%	3
testis	1	1.9%	10	21	24.7%	1	105	31.2%	1
melanoma of skin	0	-	-	5	5.6%	6	35	10.5%	2
bones	3	3.8%	7	5	5.6%	6	3	1.0%	15
adrenal	6	8.0%	3	0	-	-	1	0.3%	19
mouth & pharynx	1	1.4%	11	2	2.8%	9	10	3.1%	10
colorectal	0	-	-	2	2.4%	10	20	6.0%	6
lung	<1	0.5%	12	3	3.2%	8	12	3.7%	8
peripheral nerves	1	1.4%	11	0	-	-	<1	0.1%	21
connective tissues	5	7.1%	4	4	4.4%	7	8	2.4%	12
eye	2	2.8%	8	0	-	-	<1	0.2%	20
thyroid	0	-	-	2	2.4%	10	10	2.9%	11
other invasive	5	7.1%		5	6.0%		36	10.8%	
non-melanoma skin, NMSC	1	1.2%		6	5.6%		125	24.2%	
all invasive cancers*	**71**	***82.5%***		**84**	***78.2%***		**336**	***65.2%***	
non-invasive in situ melanoma	*0*	-	-	*2*	*1.9%*		*10*	*1.9%*	
non-invasive benign meninges & brain	*1*	*1.2%*		*2*	*2.2%*		*7*	*1.4%*	
non-invasive uncertain meninges, brain & CNS	*7*	*8.2%*		*5*	*4.4%*		*4*	*0.8%*	
non-invasive others	*6*	*7.0%*		*8*	*7.8%*		*34*	*6.5%*	
total registered	**86**			**107**			**516**		
(incidence rate of all invasive cancers/100,000/yr)*	**(14.3)**			**(29.4)**			**(60.3)**		

* figures for all invasive cancers excludes NMSC

percentages refer to % of all invasive cancers* except for those in italics which refer to % of all registered cancers

Non-invasive cancers, most of which were non-invasive tumours of the brain or CNS, represented 22% of all registered cancers in girls and 16% in boys aged less than 15 years. Total incidence rates for invasive cancers in this age group were 13 per 100,000 per year in girls and 14 per 100,000 per year in boys.

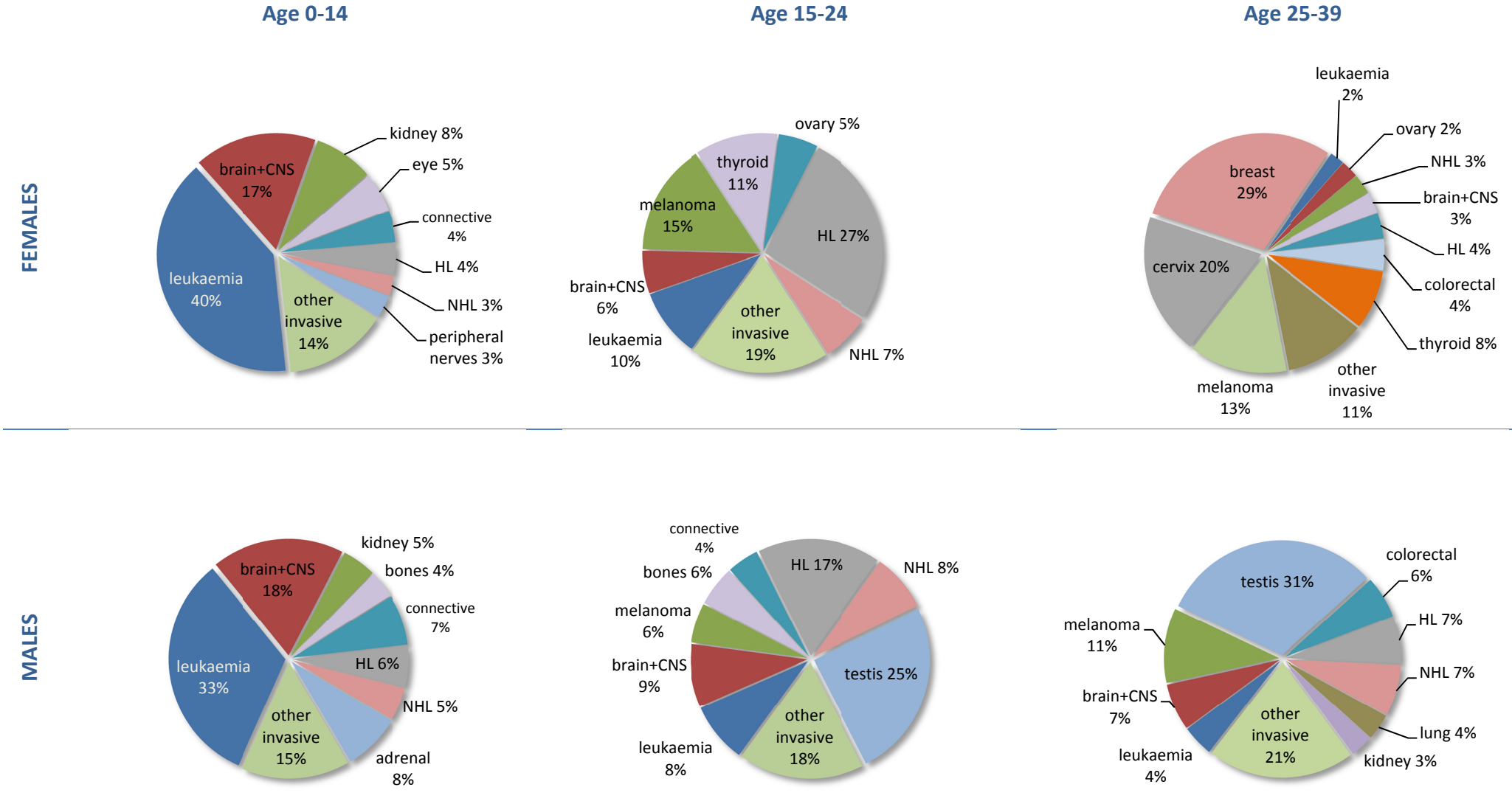
In teenagers and young adults aged between 15 and 24, the distribution of cancers was quite different to those in children and there was also a divergence between males and females. Non-invasive tumours represented 71% of all registered cancers in teenage girls and young women, largely due to the relatively high numbers of *in situ* (CIN III) cervical cancers (Table 3.1). In teenage boys and young men, by contrast, only 16% of all registered cancers were non-invasive (Table 3.1). In total, over twice as many cancers were registered in females compared to males in this age group but if non-invasive cancers are excluded, case numbers and incidence rates were fairly similar (74 cases per year or 26/100,000 in females; 84 cases per year, or 29/100,000 in males). Looking at the distribution of invasive cancers in this age group, leukaemia and brain & CNS, which formed such a large proportion of invasive cancers in children, together represented just 16% of the total in these older patients (Figure 3.1).

In females aged 15-24, Hodgkin's lymphoma (20 cases per year) was ranked as the most common invasive cancer and represented almost 27% of all invasive cancers. In males, 14 cases of Hodgkin's lymphoma were diagnosed per year, making it the 2nd most common invasive cancer after testicular cancer. Cancer of the testis comprised one quarter of all invasive cancers in males of this age group, with an annual average of 21 cases per year. Another notable difference between males and females in this age group was the greater relative proportion of melanoma and thyroid cancers diagnosed in females compared with males.

In the oldest age group – patients aged between 25 and 39 – the difference between the sexes was greater and some cancer types more commonly found in older patients, such as breast, lung and colorectal cancers, became more common. Taking all registered cancers into account, an annual average of 3,037 cancers was diagnosed in young women compared with just 516 in young men (Table 3.1). However, the vast bulk of the female cancers were comprised of *in situ* (CIN III) cervix, which represented over 70% of all registered cancers in females of this age group. Although the large difference in case numbers between the sexes is reduced when only invasive cancers are considered, incidence rates for all invasive cancers in females (103 per 100,000/year) were still over 70% higher than for males (60 per 100,000/year). In females, invasive cervix, breast and ovarian cancers combined made up over half of all cancers diagnosed and in males, testicular cancers represented almost one-third of all cancers (Figure 3.1).

In addition, some cancers common to both sexes, particularly melanoma, and to a lesser extent thyroid cancer, had a much higher incidence rate in women compared with men (melanoma: 14.0 compared to 6.3 cases per 100,000/year in women and men respectively; thyroid: 8.5 compared with 1.7 cases/100,000 per year). Lung and colorectal cancers, which are common in older patients, together represented 6% of all invasive cancers in women and 10% in men of this age group. Finally leukaemia, lymphomas and cancers of the brain & CNS which combined, represented approximately two-thirds of all invasive cancers in children and almost half of all invasive cancers in teenagers and young adults here represented just 11% of all cancers in women and 25% in men (Table 3.1).

Figure 3.1 Proportions of the most commonly diagnosed invasive cancers in young people, 2009-2011



NHL=non-Hodgkin's lymphoma, HL= Hodgkin's lymphoma, connective=connective tissue

3.2 Mortality

A total of 1,411 children and young people aged less than 40 years died in Ireland in 2011. Of these deaths, cancer accounted for 195 or just under 14%. Table 3.2 lists the principal causes of death in children (0-14 years), teenagers and young adults (15-24 years) and people between ages 25 and 44 (data extracted from the 2011 vital statistics report published by the Central Statistics Office [10]).

Table 3.2 Main causes of death in children and young people, 2011

	Females			Males			Total		
	0-14 years	15-24 years	25-44* years	0-14 years	15-24 years	25-44* years	0-14 years	15-24 years	25-44* years
congenital malformations/chromosomal abnormalities	62	2	4	64	3	11	126	5	15
conditions arising in the perinatal period	40	0	0	62	0	0	102	0	0
cancer	6	14	170	16	18	107	22	32	277
external injury/poisoning	7	34	118	15	156	470	22	190	588
diseases of respiratory/circulatory/digestive & musculo-skeletal systems	3	5	77	7	8	162	10	13	239
disease of the blood and endocrine system /metabolic disorders	7	10	8	3	8	18	10	18	26
infectious and parasitic disease	1	2	8	5	0	9	6	2	17
diseases of the nervous system	5	6	18	9	9	25	14	15	43
other	13	1	13	15	4	19	28	5	32
total deaths	**144**	**74**	**416**	**196**	**206**	**821**	**340**	**280**	**1237**

*note older age group (25-44) here is wider than shown in other tables/figures

Source: Central Statistics Office, Ireland [10]

In children aged under 15, there were 22 deaths from cancer in 2011 making it the third most common cause of death together with external injury and poisoning. However in older teenagers and young adults, cancer was the second most common cause of death overall after external injury and poisoning and was the most common illness causing death.

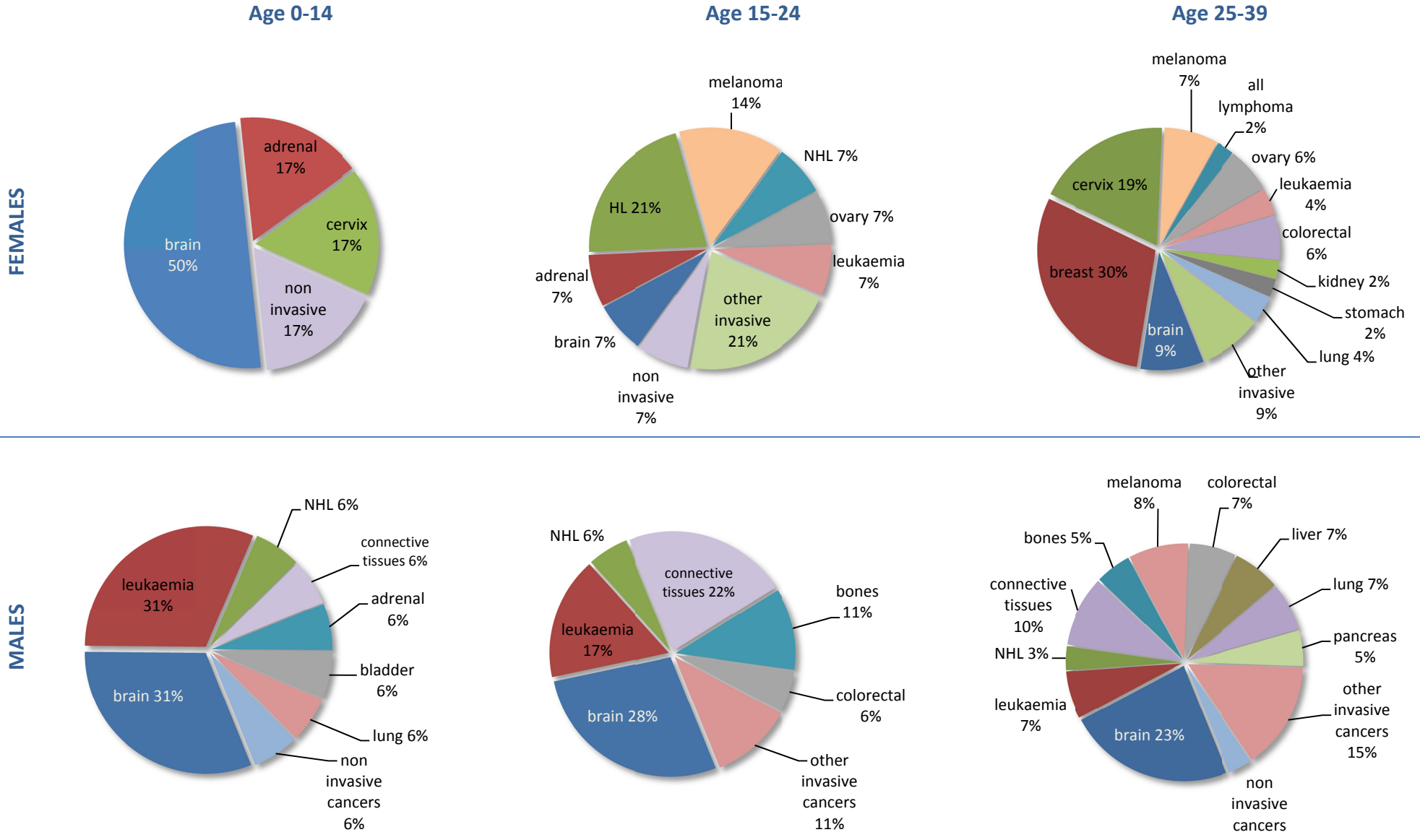
Of the 22 cancer deaths in children, 6 were girls and 16 were boys. Brain tumours accounted for 8 deaths in total (3 girls and 5 boys) with a further 5 boys having died from leukaemia (Table 3.3, Figure 3.2). In older teenagers and young adults, there were 14 female deaths and 18 male deaths from cancer. Cancers of the brain, blood and lymphatic systems accounted for 15 deaths in total, while melanoma and cancer of bones and soft tissue comprised the bulk of the remaining cancer deaths.

In the older age group (25 to 39 years) for both men and women, mortality rates were higher (14 deaths per 100,000 in women and 11 deaths per 100,000 in men) and there was a wider distribution of cancers responsible for death. Breast cancer (N=24) represented almost one-third of all female deaths and cervical cancer accounted for a further 15 deaths in this age group. Brain tumours represented the single most common cause of cancer death in males, with 14 deaths registered. Of the 141 cancer deaths in this age group, 11 were from melanoma making it the 3rd most common cancer death in men and 4th most common cancer death in women.

Table 3.3 Number and ranking of the most common cancer deaths in young people (aged under 40), 2011

	0-14 years			15-24 years			25-39 years		
	No.	% of all cancer deaths	rank	No.	% of all cancer deaths	rank	No.	% of all cancer deaths	rank
FEMALES									
brain	3	50.0%	1	1	7.1%	3	7	8.6%	3
adrenal	1	16.7%	2	1	7.1%	3	0	-	-
cervix	1	16.7%	2	0	-	-	15	18.5%	2
Hodgkin's lymphoma	0	-	-	3	21.4%	1	1	1.2%	8
melanoma of skin	0	-	-	2	14.3%	2	6	7.4%	4
non-Hodgkin's lymphoma (NHL)	0	-	-	1	7.1%	3	1	1.2%	8
leukaemia	0	-	-	1	7.1%	3	3	3.7%	6
ovary	0	-	-	1	7.1%	3	5	6.2%	5
breast	0	-	-	0	-	-	24	29.6%	1
colorectal	0	-	-	0	-	-	5	6.2%	5
kidney	0	-	-	0	-	-	2	2.5%	7
stomach	0	-	-	0	-	-	2	2.5%	7
lung	0	-	-	0	-	-	3	3.7%	6
other invasive cancers	0	-		3	21.4%		7	8.6%	
non-invasive cancers	1	16.7%		1	7.1%		0	-	
all cancer deaths	6			14			81		
all deaths	144			74			247		
(cancer as % of all deaths)	(4%)			19%			33%		
(mortality rate; deaths/100,000/year)	**(1.2)**			**(4.9)**			**(14.3)**		
MALES									
brain	5	31.3%	1	5	27.8%	1	14	23.3%	1
leukaemia	5	31.3%	1	3	16.7%	3	4	6.7%	4
non-Hodgkin's lymphoma (NHL)	1	6.3%	2	1	5.6%	5	2	3.3%	6
connective tissues	1	6.3%	2	4	22.2%	2	6	10.0%	2
adrenal	1	6.3%	2	0	-	-	1	1.7%	7
bladder	1	6.3%	2	0	-	-	0	-	-
lung	1	6.3%	2	0	-	-	4	6.7%	4
bones	0	-	-	2	11.1%	4	3	5.0%	5
colorectal	0	-	-	1	5.6%	5	4	6.7%	4
melanoma of skin	0	-	-	0	-	-	5	8.3%	3
testis	0	-	-	0	-	-	1	1.7%	7
liver	0	-	-	0	-	-	4	6.7%	4
pancreas	0	-	-	0	-	-	3	5.0%	5
other invasive cancers	0			2	11.1%		7	11.7%	
non-invasive cancers	1	6.3%		0	-		2	3.3%	
all cancer deaths	16			18			60		
all deaths	196			206			544		
cancer as % of all deaths	8%			9%			11%		
(mortality rate; deaths/100,000/year)	**(3.1)**			**(6.2)**			**(10.8)**		

Figure 3.2 Proportions of cancer deaths in young people, 2011



NHL=non Hodgkin's lymphoma, HL= Hodgkin's lymphoma

4. TRENDS IN INCIDENCE AND MORTALITY IN YOUNG PEOPLE

This chapter describes the incidence and mortality trends in young people (aged under 40) specifically. Summary information on incidence and mortality trends in people of all ages is provided in a comprehensive set of tables and graphs in appendices III and IV.

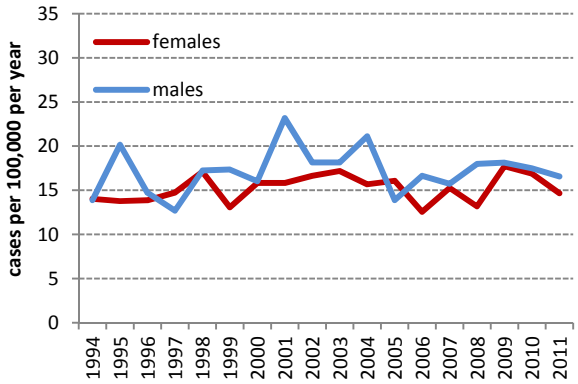
4.1 Incidence

All registered cancers

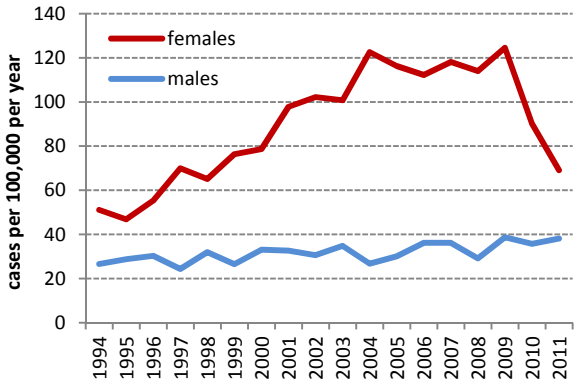
There was little obvious overall change in all-cancer incidence in children aged under 15 years during the 18 year period from 1994 to 2011 inclusive. Incidence rates fluctuated between 13 and 23 cases per 100,000 per year with overall annual percentage change (APC) of less than 1% per year and fairly similar rates in boys and girls overall (Figure 4.1a). Incidence trends in the older age groups

Figure 4.1 Incidence of all registered cancers in people aged under 40 at diagnosis: 1994-2011

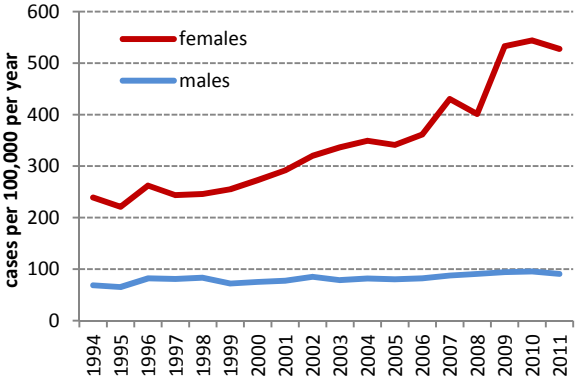
a. 0-14 year olds



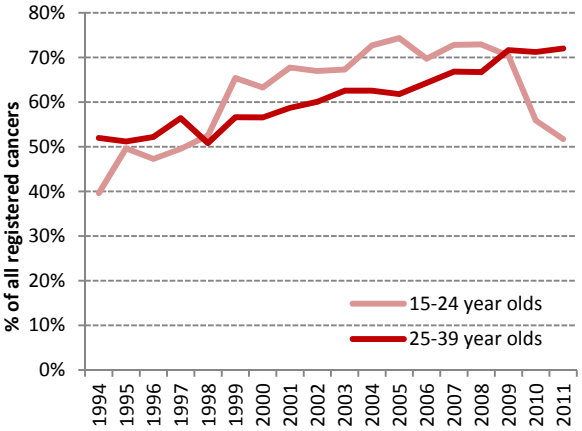
b. 15-24 year olds



c. 25-39 year olds

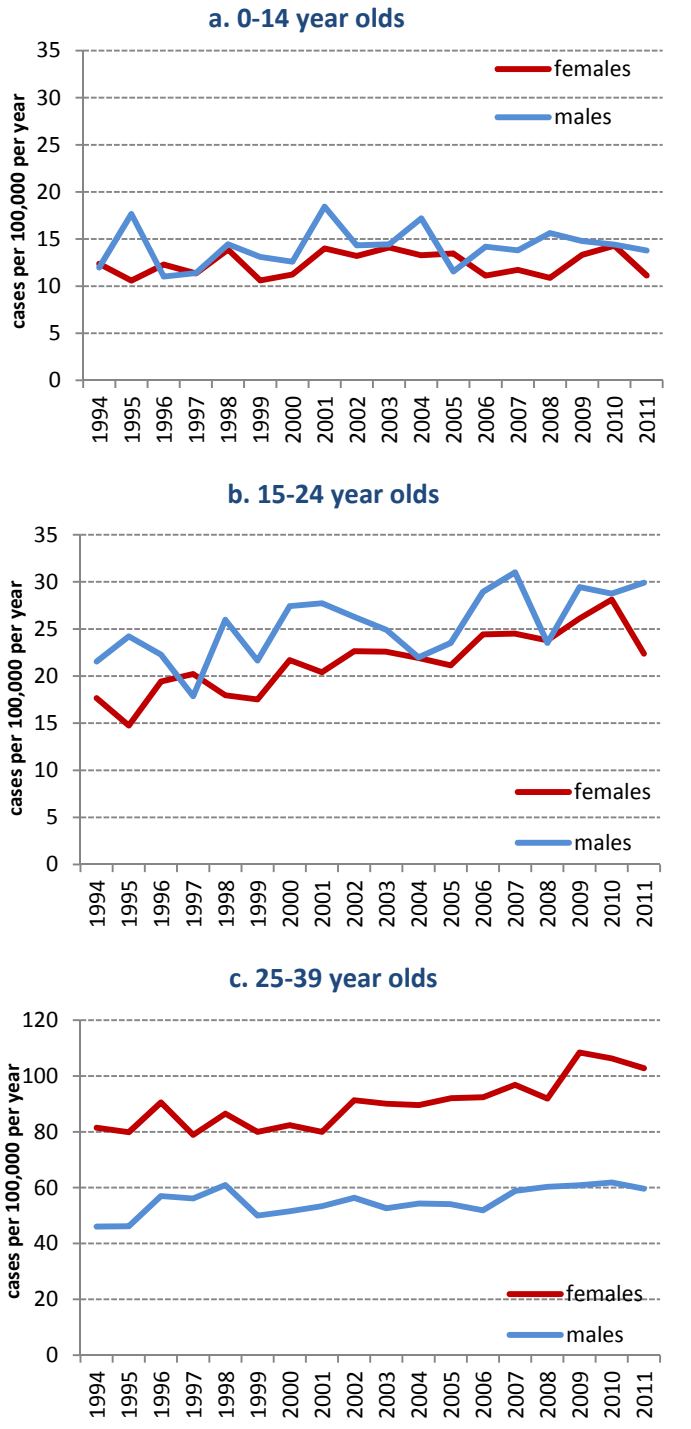


d. in situ (CIN III) cervix as % of all registered cancers in females



were quite different however, particularly for females. Although incidence rates for older boys and young men showed only a small overall increase with time, from between 24 and 38 cases per 100,000/year in 15-24 year olds (APC 1.8%) and between 70 and 95 cases per 100,000/year in 25-39 year olds (APC 1.6%), incidence rates in teenage girls and young women changed considerably over time (Figures 4.1b and 4.1c). In 15-24 year olds incidence rates increased sharply from less than 60 cases per 100,000 per year in the 1990's to over 120 cases per 100,000 per year in the mid/late 2000's, corresponding to an APC of 6.8% between 1994 and 2009.

Figure 4.2 Incidence of all invasive cancers in people aged under 40 at diagnosis: 1994-2011



This increase is clearly related to the large increase of *in situ* (CIN III) cervical cancer incidence during this time (Figure 4.1d). In females in this age group, *in situ* (CIN III) cervical cancers increased from representing less than 40% of all registered cancers in the mid 1990's to 74% in 2005. For women in the older age group (25-39 year olds), there was a steady increase in total cancer incidence rates throughout the 1990's to the mid 2000's (APC 4.2%), followed by a sharper increase in incidence rates during the end of the 2000's (APC 8.7%) (Figure 4.1c).

This sharp increase in all cancer incidence rates in the most recent few years in 25-39 year old women reflects a similar increase in *in situ* (CIN III) and invasive cervical cancer incidence, shown below (Figure 4.3a and b).

The increase in the numbers of *in situ* (CIN III) cervical cancers as a proportion of all registered cancers is likely related to cervical cancer screening activity which became widespread in the late 2000's - organised screening for cervical cancer commenced in Ireland on a limited basis in 2000 and was extended nationwide in 2008, although opportunistic screening by GPs was common throughout the late 1990's and into the 2000's [11]. The very rapid fall in incidence in the younger women in the late 2000's (Figure 4.1b) is consistent with a drop off in screening, presumably due to the fact that it became difficult and costly for women outside the target age groups to have opportunistic screening once the national programme had been introduced.

<u>All invasive cancers, excluding non-melanoma skin cancers</u>

When incidence rates are examined excluding non-invasive and non-melanoma skin cancers, variation between the sexes and between the 2 youngest age groups (<15 year olds and 15-24 year olds) was much less (Figure 4.2a and 4.2b).

As before, little obvious change was seen in incidence rates in children (<15 year olds) over time (APC <0.6%) (Figure 4.2a). Although incidence rates in older teenagers and young adults (aged 15-24 years) did increase from 1994 to 2011, rates between years were very variable, particularly in males (Figure 4.2b). In this group, incidence rates were generally higher in males than in females. This is largely due to the higher proportion of sex-specific cancers (mainly testicular) in males (25% of all invasive cancers, Table 3.1) compared to a much lower proportion of sex-specific invasive cancers in females (breast, ovary and cervix combined, 11%).

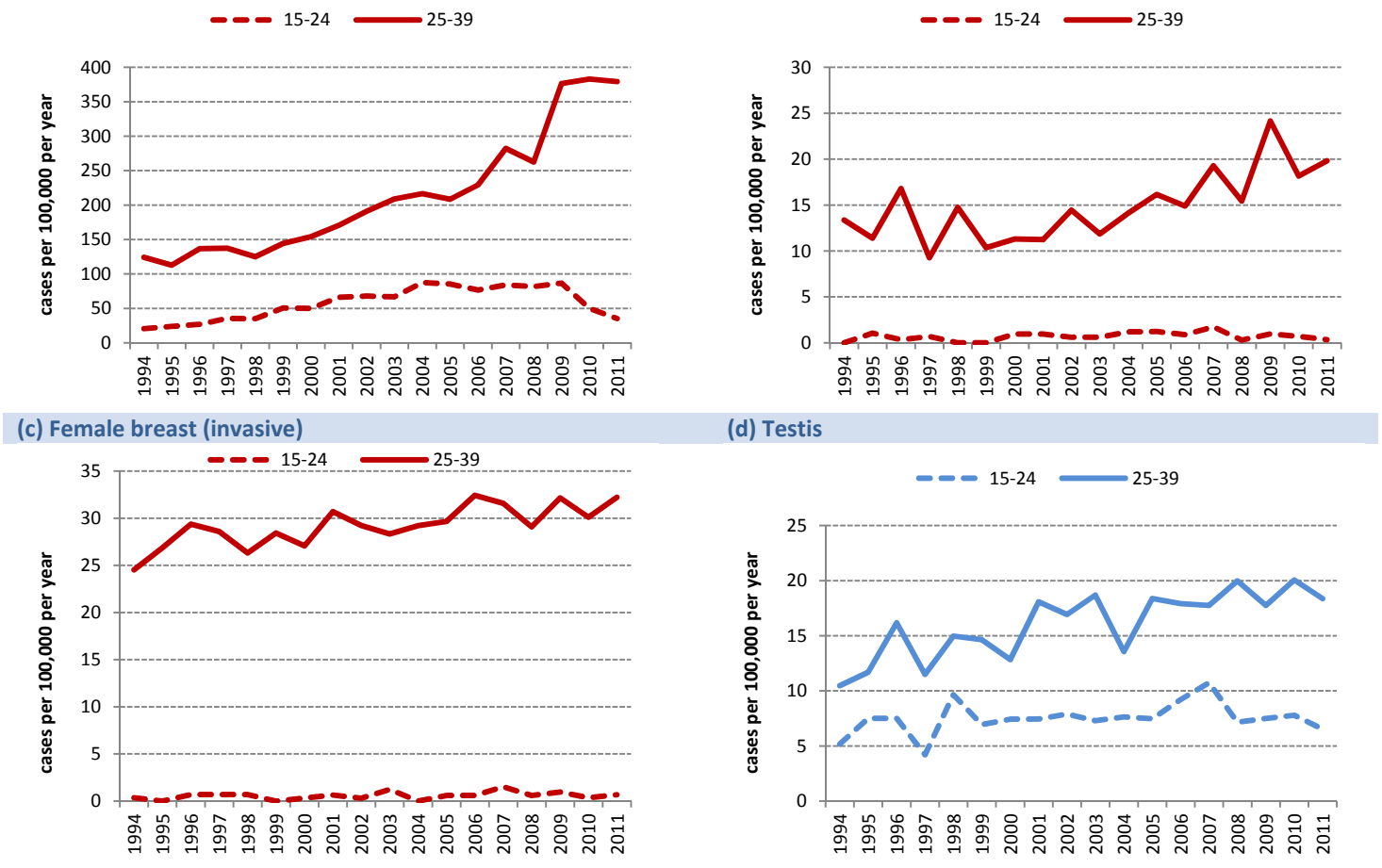
In the oldest age group (25-39 year olds), female incidence rates were considerably higher than those for males (Figure 4.2c) and there was an annual percentage increase of 1.1% in males and 1.6% in females. In this case, the impact of the proportion of sex-

specific cancers is reversed, with female breast, ovary and cervix together representing over 50% of all invasive cancers in women and testicular cancer forming 31% of male invasive cancers (Table 3.1). The greater increase in cancer incidence in females compared to males over time in this age group is likely due to the trend of increasing incidence of these cancers, particularly breast and cervix in women, as shown below (Figure 4.3 a and c).

Sex specific cancers: breast, cervix and testis

Incidence rates of both invasive and *in situ* (CIN III) cervical cancers have increased over time, particularly in the last 5 years or so in women aged between 25 and 39 years (Figure 4.3 a and b). Although incidence rates for *in situ* cancer of cervix in teenagers and young adults (15-24 year olds) also increased over time, as mentioned above, incidence rates in this age group were much lower (Figure 4.3a). Very few teenagers or young women were diagnosed with invasive tumours, usually less than 5 cases of breast or cervical cancer per year, and there was little change over time in this age group.

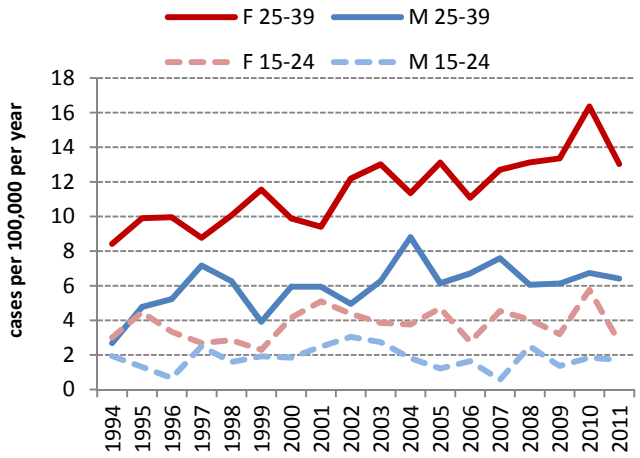
Figure 4.3 Incidence of the most common sex-specific cancers in people aged under 40 at diagnosis: 1994-2011



An average of 134 women aged between 25 and 39 were diagnosed with invasive breast cancer per year between 1994 and 2011 with a slight increase in incidence rates over time (Figure 4.3c). *In situ* breast cancers, in contrast to *in situ* cervix, were very low in number with only 1 case diagnosed in 15-24 year olds during the 18 year period overall. In older women (24-39 year olds) incidence of *in situ* breast cancer increased from less than 5 cases per year during the 1990's to an average of 15 cases per year during the late 2000's (*data not shown*). Testicular cancer showed a variable pattern of incidence over time (Figure 4.3d). Between 1994 and 2011, an annual average of 24 cases was diagnosed per year in teenagers and young men aged under 25 while there were 77 cases

diagnosed on average per year in men aged between 25 and 39. Although incidence rates fluctuated substantially between years, particularly in the older males, an overall annual percentage increase of 3% was observed in this age group.

Figure 4.4 Incidence of melanoma of skin in people aged under 40 at diagnosis: 1994-2011



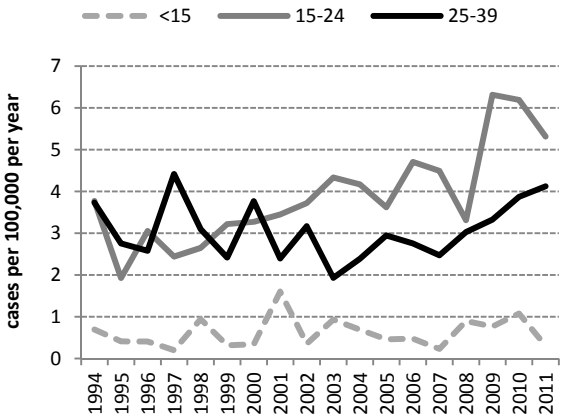
Other common cancers registered in young patients

Between 1994 and 2011, an average of 6 males and 12 females aged between 15 and 24 were diagnosed with melanoma of skin each year, with no obvious change in incidence rate over time (Figure 4.4). Incidence rates in 25-39 year olds were also much higher in women than in men (rates in women ranged between 1.6 and 3.1 times higher than those in men; average of 55 women and 28 men diagnosed per year) and there was an overall annual percentage increase in incidence of 2.8% between 1994 and 2011 for both sexes.

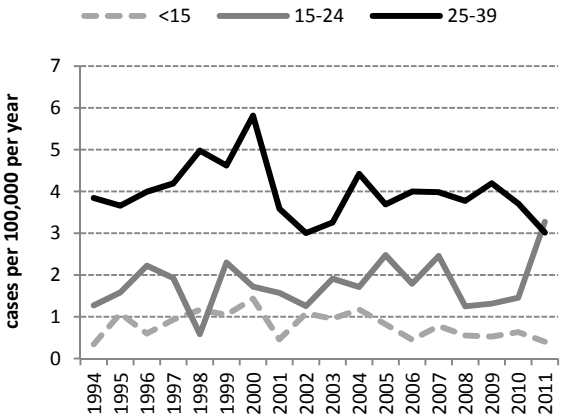
Unlike melanoma, there was no major difference in incidence rates between the sexes for cancers of the blood and lymphatic system and results here are shown for males and females combined (Figure 4.5). Incidence rates of Hodgkin's lymphoma have

Figure 4.5 Incidence of haematopoietic malignancies in people aged under 40 at diagnosis: 1994-2011

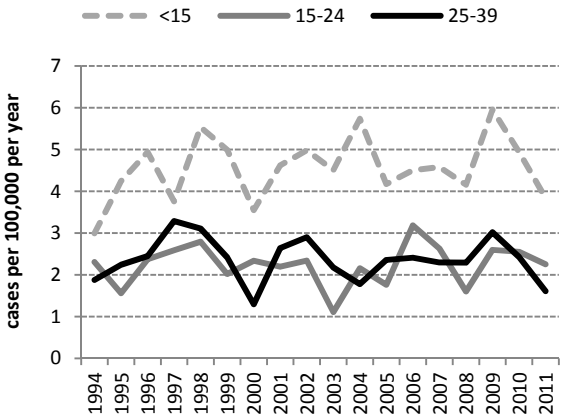
(a) Hodgkin's lymphoma



(b) non-Hodgkin's lymphoma



(c) Leukaemia

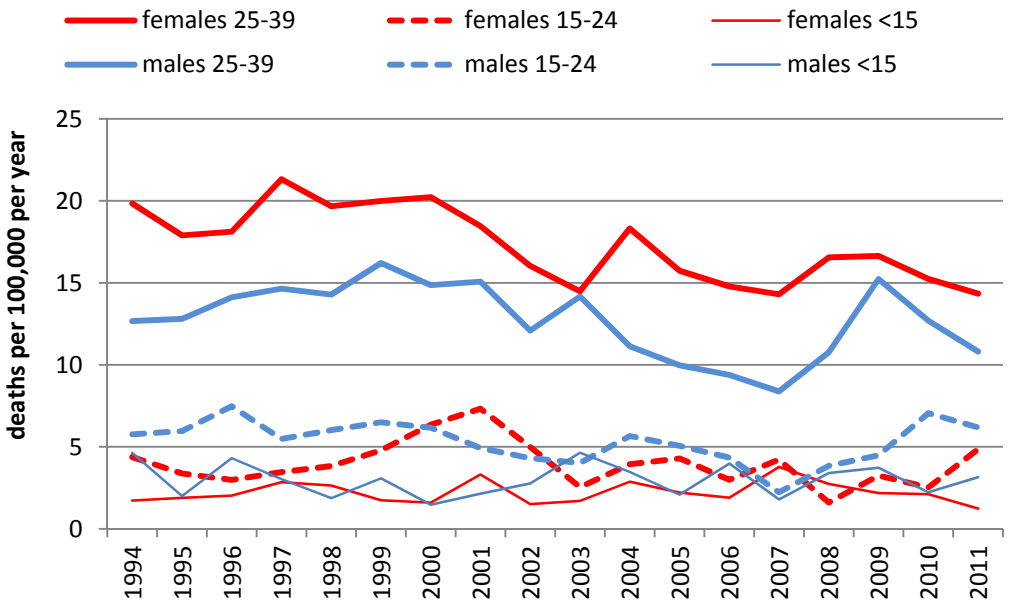


shown an increase in recent years for patients in the two older age bands, particularly in 15 to 24 year olds, where Hodgkin's lymphoma represented a substantial proportion of all cancers. Incidence rates of non-Hodgkin's lymphoma in the oldest age group (25 to 39 years) have declined, from a maximum incidence of almost 6 cases per 100,000 per year in 2000 to most recent rates of 3 cases per 100,000 per year. Incidence rates of leukaemia, highest in children (aged under 15), have fluctuated somewhat over time but no clear trend in incidence is evident.

4.2 Mortality

In 2011, of all cancer deaths in young people aged between 25 and 39, 44 (over 30%) were from sex-specific female cancers (Table 3.3). This is reflected in the higher cancer mortality rates found in women compared to men in this age group (Table 3.3, Figure 4.6). In both sexes, despite some annual variation in mortality rates, there has been an overall decline in all cancer mortality over time with female rates declining from over 20 deaths per 100,000 per year in the late 1990's to 14 deaths per 100,000 per year in 2011; an annual percentage change (APC) of -1.9%. Current all cancer mortality rates for males in this age group are 11 deaths per 100,000 per year, down from a maximum of 16 deaths per 100,000 per year in 1999 (APC=-1.7%). Mortality rates in the younger age groups were lower and more variable from year to year.

Figure 4.6
All cancer mortality rates, 1994 to 2011 in young people



5. TRENDS IN INCIDENCE IN IRELAND AND THE UK FOR SOME COMMON CANCERS

The European Cancer Observatory [12] produces latest estimates of cancer incidence by country (EUCAN, data for 2012) and annual incidence data for a range of cancers for individual cancer registries (EUREG) across Europe. In this chapter, trends in incidence rates in Ireland and how they compare with those in our nearest neighbours, the UK, are described, using the EUREG data for 5 common cancers. Ireland, Northern Ireland, Scotland and Wales are represented by national cancer registries covering the entire population, while England, at the time the EUREG data was collected, was represented by eight separate regional cancer registries covering the entire country. The five cancers described here are both common in incidence and the subject of public health initiatives in terms of risk awareness or early detection through cancer screening programmes. Years for which data are available in the EUREG database vary somewhat between registries and countries. EUREG data for England and Wales is available from 1991 to 2007, for Scotland from 1975 to 2007, for Northern Ireland from 1993 to 2007 and for Ireland from 1994 to 2009. Here data for the twenty year period from 1990 to 2009 was examined and results are shown in Figures 5.1 to 5.5, with trends for the period 1994-2007, the years common to all, for which data was available. EUCAN estimated incidence data for 2012 is shown for Ireland, the UK overall and the 27 countries of the EU overall in Table 5.1.

Table 5.1
Estimated incidence rates* for 2012 (EUCAN European age standardised) for Ireland, the UK overall and the European Union average for 5 common cancers

	MALES			FEMALES		
	Ireland	UK	EU average	Ireland	UK	EU average
lung	54.9	53.3	66.3	40.4	38.5	26.1
melanoma of skin	17.7	18.6	13.2	18.6	19.6	11.0
female breast	-	-	-	122.4	129.2	108.8
cervix	-	-	-	15.1	7.9	11.3
prostate	168.7	111.1	110.8	-	-	-

*Rates expressed as cases per 100,000

5.1 Lung cancer

Tobacco smoking is well recognized as the main risk factor for lung cancer. Historically, smoking prevalence has been higher in males than in females and this is reflected in their generally higher lung cancer incidence. According to 2012 estimates, incidence rates in Ireland and the UK were broadly similar, with male rates approximately 1.4 times higher than those in women (Table 5.1). However incidence rates for the EU overall were higher for males and lower for females, resulting in male rates in Europe generally being 2.5 times higher than females. Trends of lung cancer incidence have been changing however, with male incidence rates declining and female rates increasing in recent years, a trend observed across many European countries. This is related to shifts in smoking prevalence, notably a rise in female smoking since the 1940's-50's, which has resulted in increases in female lung cancer incidence in more recent years. This trend has been observed in both Ireland and the UK (Figure 5.1).

Lung cancer in males

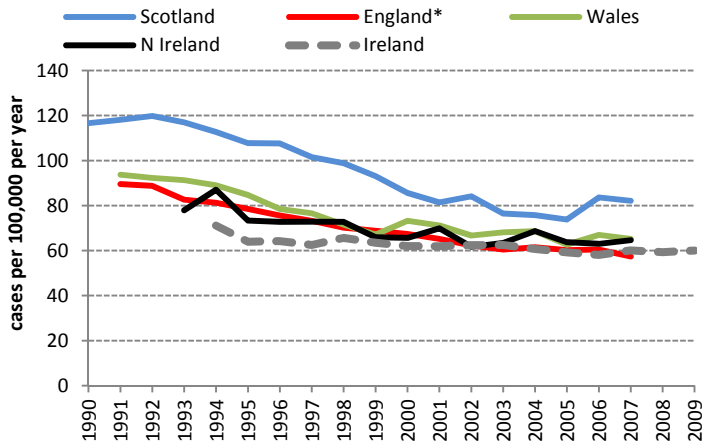
Rates in Ireland have been consistently lower than those in the UK, although each country, like Ireland, has shown a decline in incidence over time (Figure 5.1a). This was particularly noticeable in Scotland where rates in the mid 1990's were up to 70% higher than in Ireland. Since the mid 2000's rates in Ireland have been fairly close to those recorded in England, Northern Ireland and Wales. Despite a significant annual percentage decline in incidence rates of 3.0% in Scotland, in 2007 rates here were still around 30% higher than in Ireland. Recently published figures indicate that current smoking prevalence in Scotland (22% males and females combined) remains the highest in the UK [13].

Lung cancer in females

Irish women have one of the highest prevalences of smoking in Europe, with 29% of the adult population described as current smokers and 17% former smokers [14]. Similar to the pattern observed in men, lung cancer rates in women in Scotland have been higher than other UK countries and Ireland since the early 1990's. In 2007, incidence rates in Scotland were 60% higher than in Ireland (Figure 5.1b). Incidence rates in women across the UK have been increasing, as in Ireland, although at a slower pace. Between 1994 and 2007, an annual percentage change (APC) of 2.4% was found in Ireland compared to 1.1% in Wales and less than 1% for the remainder of the UK. Although incidence in Ireland was up to 20% less than Northern Ireland, England or Wales in the mid 1990's, by 2007 rates were almost equal as a result of the faster rate of increase in Ireland.

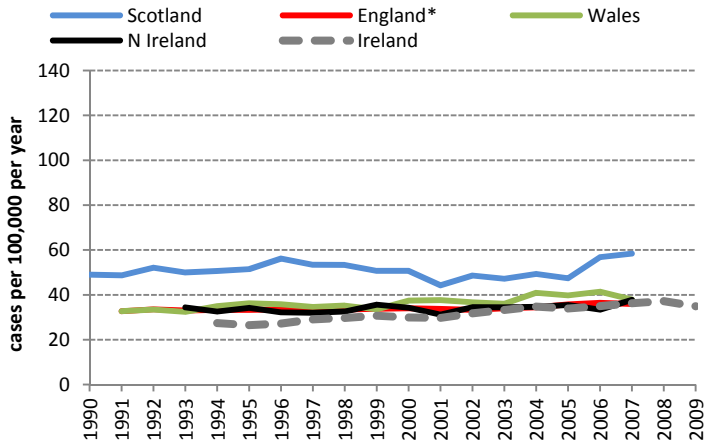
Figure 5.1
Lung cancer incidence and trends: UK and Ireland 1990-2009

(a) males



TREND 1994-2007	APC	95%CI	trend
1 IRELAND	-1.0	[-1.4,-0.6]	↓
2 ENGLAND	-2.6	[-2.9,-2.3]	↓
3 SCOTLAND	-3.0	[-3.9,-2.1]	↓
4 WALES	-2.2	[-2.8,-1.5]	↓
5 NORTHERN IRELAND	-1.8	[-2.6,-0.9]	↓

(b) females



TREND 1994-2007	APC	95%CI	trend
1 IRELAND	2.4	[2.0,2.8]	↑
2 ENGLAND	0.7	[0.4,0.9]	↑
3 SCOTLAND	0.1	[-1.0,1.3]	↔
4 WALES	1.1	[0.5,1.8]	↑
5 NORTHERN IRELAND	0.7	[0.1,1.4]	↑

Source: ECO EUREG [7]. APC: annual percentage change
trend : ↔ no change; ↓ significant decrease; ↑ significant increase, at the 95% level
* England represented by 8 individual registries combined, all other countries represented by national cancer registries

5.2 Melanoma of skin

Excess sun exposure is the single most important risk factor for skin melanoma [15] and Ireland and the UK, despite having a climate with less sunshine than many other European countries, had higher estimated incidences of melanoma in 2012, for both sexes, than the average for the European Union overall (Table 5.1). Estimates for 2012 show Irish rates were 34% higher than the EU average for males and 69% higher for females.

Males

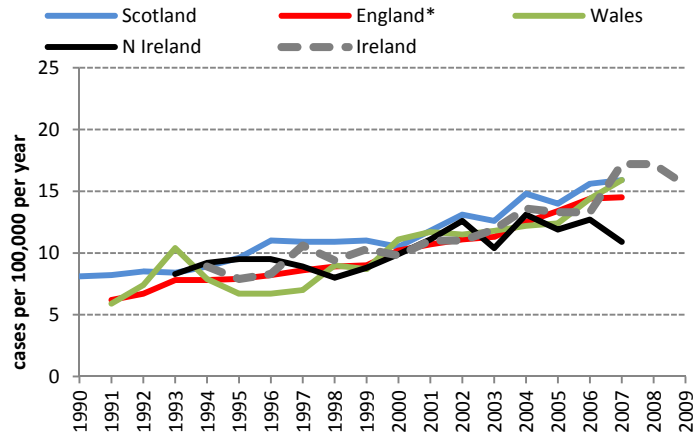
Incidence of male melanoma in Ireland and the UK has been very similar since the early 1990's and there has been a fairly comparable trend of significant increasing incidence across all countries over time (Figure 5.2a). The greatest annual percentage change of 6.5% was observed in Wales.

Females

There was somewhat greater variation in female incidence rates between countries in the UK compared to the pattern seen in males, but here again all countries showed a significant increasing trend over time (Figure 5.2b). Ireland had higher incidence rates compared to the UK during most years, with rates closest to those observed in Scotland. As observed for males, Wales had the greatest annual percentage increase over 1994-2007.

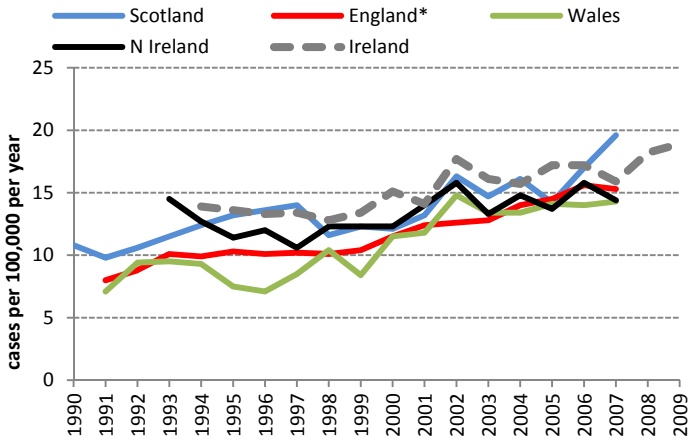
Figure 5.2
Melanoma of skin incidence and trends: UK and Ireland 1990-2009

(a) males



TREND 1994-2007	APC	95%CI	trend
1 IRELAND	5.1	[3.9,6.4]	↑
2 ENGLAND	5.4	[4.9,5.9]	↑
3 SCOTLAND	4.2	[3.4,5.0]	↑
4 WALES	6.5	[5.1,7.9]	↑
5 NORTHERN IRELAND	2.8	[1.3,4.4]	↑

(b) females



TREND 1994-2007	APC	95%CI	trend
1 IRELAND	2.2	[1.1,3.2]	↑
2 ENGLAND	4.0	[3.4,4.7]	↑
3 SCOTLAND	2.9	[1.4,4.4]	↑
4 WALES	5.3	[3.4,7.2]	↑
5 NORTHERN IRELAND	2.2	[1.0,3.4]	↑

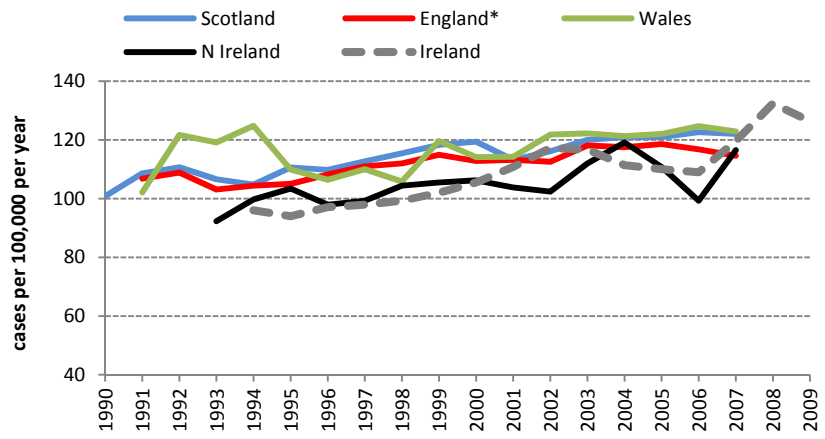
Source: ECO EUREG [7]. APC: annual percentage change. trend : ↔ no change; ↓ significant decrease; ↑ significant increase, at the 95% level
* England represented by 8 individual registries combined, all other countries represented by national cancer registries

5.3 Female breast cancer

In 2012, incidence of female breast cancer in Ireland was 5% lower than in the UK but 13% higher than the European average (Table 5.1).

Regional and national screening programmes for breast cancer have been implemented at various times across Europe [16, 17] which is likely to have an impact on the variations in trends observed between countries. In Ireland, BreastCheck, the national breast cancer screening programme, began on a phased basis in 2000, initially covering the eastern part of the country and extended nationwide from 2007 [18].

Figure 5.3
Female breast cancer incidence and trends: UK and Ireland 1990-2009



TREND 1994-2007	APC	95%CI	trend
1 IRELAND	1.7	[1.1,2.3]	↑
2 ENGLAND	0.8	[0.5,1.1]	↑
3 SCOTLAND	1.0	[0.7,1.3]	↑
4 WALES	0.8	[0.1,1.5]	↑
5 NORTHERN IRELAND	1.0	[0.2,1.7]	↑

Source: ECO EUREG [7]. APC: annual percentage change
trend : ↔ no change; ↓ significant decrease; ↑ significant increase, at the 95% level
* England represented by 8 individual registries combined,
all other countries represented by national cancer registries

Although breast cancer incidence in Ireland has been increasing annually since the mid 1990's, sharper increases in incidence observed between 2000 and 2003 and again between 2006 and 2008 reflect the increasing reach of the national screening programme (Figure 5.3).

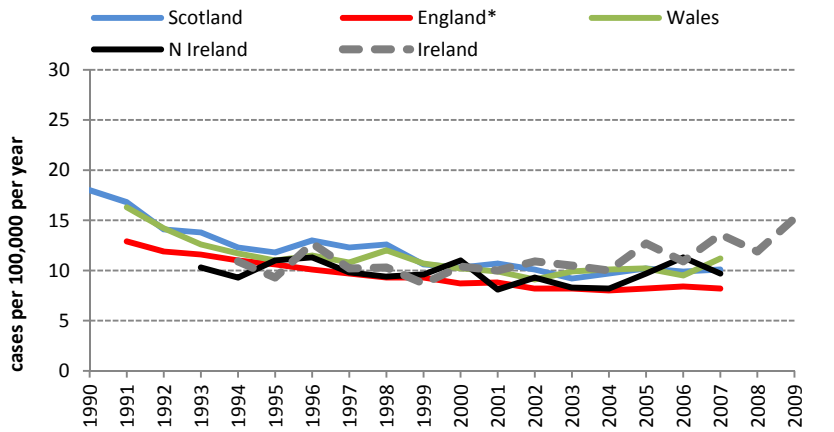
Between 1994 and 2007 overall, breast cancer incidence in Ireland has increased significantly by an annual average of 1.7%.

Breast screening was introduced in the UK in 1988 and incidence rates for female breast cancer there have been increasing since 1990, although at a lower rate than in Ireland. Throughout the 1990's incidence rates in the UK were higher than in Ireland, but by 2001 incidence rates in England, Scotland and Wales were similar to those in Ireland. Incidence rates in Northern Ireland, while also increasing over time, generally have been somewhat lower.

5.4 Invasive cervical cancer

In 2012 the estimated incidence of invasive cervical cancer in Ireland was 33% higher than the EU average and almost twice the rate estimated for the UK (Table 5.1). Screening for cervical cancer has been underway in Ireland and many other countries across Europe on an opportunistic basis for many years. A national screening programme was introduced in Ireland initially in 2000 on a limited basis and was rolled out nationally in 2008 [11].

Figure 5.4
Invasive cervical cancer incidence and trends: UK and Ireland 1990-2009



TREND 1994-2007	APC	95%CI	trend
1 IRELAND	1.3	[-0.4,3.0]	↔
2 ENGLAND	-2.3	[-2.9,-1.8]	↓
3 SCOTLAND	-2.2	[-3.1,-1.3]	↓
4 WALES	-1.1	[-2.1,-0.2]	↓
5 NORTHERN IRELAND	-0.5	[-2.2,1.1]	↔

Source: ECO EUREG [7]. APC: annual percentage change
trend : ↔ no change; ↓ significant decrease; ↑ significant increase, at the 95% level
* England represented by 8 individual registries combined,
all other countries represented by national cancer registries

The UK was one of the first regions in Europe to introduce a national cervical screening programme, initially introduced in the 1960's with good coverage achieved by the early 1980's [11, 17].

Since 1994, there has been a significant decline in incidence rates in England, Scotland and Wales and these have tended to level out during the early to mid-2000's, when rates were similar to those recorded in Ireland (Figure 5.4).

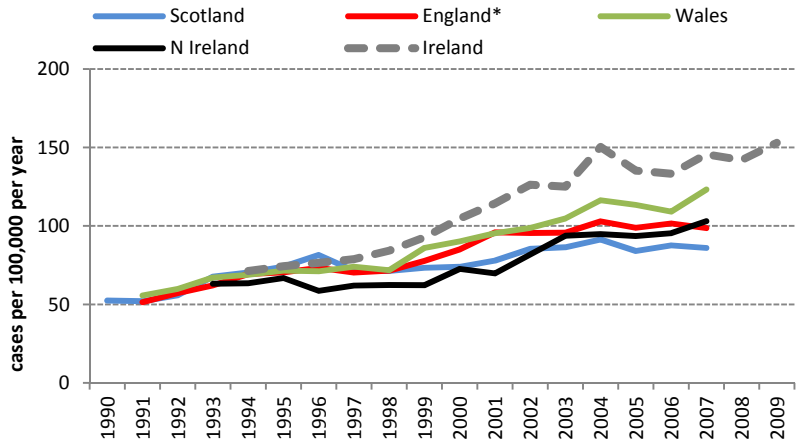
The pattern in Northern Ireland is less clear, although incidence rates there during the mid-2000's were lower than in the mid-1990's. In 2007, the last year for which data is available for all countries, incidence rates in Ireland were 40% higher than in Northern Ireland and 66% higher than in England.

5.5 Prostate cancer

Opportunistic screening for prostate cancer through PSA testing varies considerably between countries in Europe. Unlike breast and cervical cancer screening there is little data available on national practices or on the extent and time frame of screening activity.

Prostate cancer incidence in Ireland is currently one of the highest in Europe and estimated incidence rates in Ireland for 2012 are approximately 1.5 times higher than in the UK or the EU overall (Table 5.1).

Figure 5.5
Prostate cancer incidence and trends: UK and Ireland 1990-2009



TREND 1994-2007	APC	95%CI	trend
1 IRELAND	6.2	[5.0,7.5]	↑
2 ENGLAND	3.5	[2.6,4.5]	↑
3 SCOTLAND	1.8	[0.9,2.6]	↑
4 WALES	4.9	[4.1,5.7]	↑
5 NORTHERN IRELAND	4.6	[3.5,5.8]	↑

Source: ECO EUREG [7]. APC: annual percentage change
trend : ↔ no change; ↓ significant decrease; ↑ significant increase, at the 95% level
* England represented by 8 individual registries combined,
all other countries represented by national cancer registries

In the mid 1990's prostate cancer incidence in Ireland was very similar to that in the UK (Figure 5.5). PSA testing for prostate cancer has been widely adopted in Ireland since the late 1990's [19] and this resulted in a steep increase in incidence here between 1994 and 2004. Although the rate of increase subsequently slowed somewhat, an overall annual percentage increase of 6.2% was found between 1994 and 2007 overall, considerably higher than in the UK countries.

Although all countries in the UK have shown an increase in incidence over time, the steeper rate of increase in Ireland has resulted in Irish rates becoming 18% higher than those in Wales (the country in the UK with the highest rates) by 2007.

6. SURVIVAL: IRELAND AND EUROPE

The EUROCARE project has monitored cancer patients' survival in Europe for over 20 years. The latest EUROCARE-5 study analysed the survival of over 10 million cancer patients diagnosed between 2000 and 2007, and followed up to the end of 2008 [8]. Similar to the EUREG database, the project is based on data from individual population-based cancer registries (109 registries in 29 countries), which cover over 50% of the adult and 77% of the childhood European population. The survival estimates emanating from the EUROCARE-5 study are summarised below and compared to the earlier EUROCARE-4 study which covered the diagnostic period 1995-1999 [20]. Note that only those countries that were included in both EUROCARE-4 and EUROCARE-5 are included here.

Survival at 5 years from diagnosis varied remarkably by tumour type, ranging from over 80% for cancers of testis, thyroid, prostate, breast, skin melanoma and Hodgkin's lymphoma, to less than 15% for cancers of the lung, oesophagus, liver, pleura and pancreas The between-country range of variation for major cancer types, such as colorectal cancers, breast, prostate, skin melanoma and lymphomas, was also high. Survival was usually lowest in countries in Eastern Europe (Bulgaria, Slovakia, Estonia, Latvia, Lithuania and Poland) and highest in Nordic countries (with the exception of Denmark) and some countries in central and southern Europe. Survival in the UK and Ireland was lower than the average for stomach, colon, ovary and kidney cancers and close to the European average for others (rectum, breast, prostate, skin melanoma and lymphomas).

Cancer survival has generally been increasing, with the highest increases recorded for prostate and rectal cancers, and for non-Hodgkin's lymphoma. Although survival has increased in all European regions, international differences have narrowed for only a few cancer sites (e.g. breast and prostate cancers and skin melanoma). The European 5-year survival for children diagnosed in the period 2000-2007 was 78% and between-country variation was considerable [9].

6.1 Cancer of the stomach

Stomach cancer continues to have a poor survival, with an average survival at five years after diagnosis of just 25% reported for Europe overall during 2000-2007 (Figure 6.1). Although survival rates in Ireland have improved somewhat and are higher than our nearest neighbours in the UK, survival in this country is still ranked amongst the lowest in Europe. Iceland, Italy, Portugal and Switzerland had the highest survival rates during 2000-2007. Greatest improvements in survival were observed in those countries with the poorest survival in 1995-1999, particularly the Czech Republic, Slovakia and Slovenia.

Figure 6.1
Five year relative survival: cancer of the stomach in Europe, both sexes

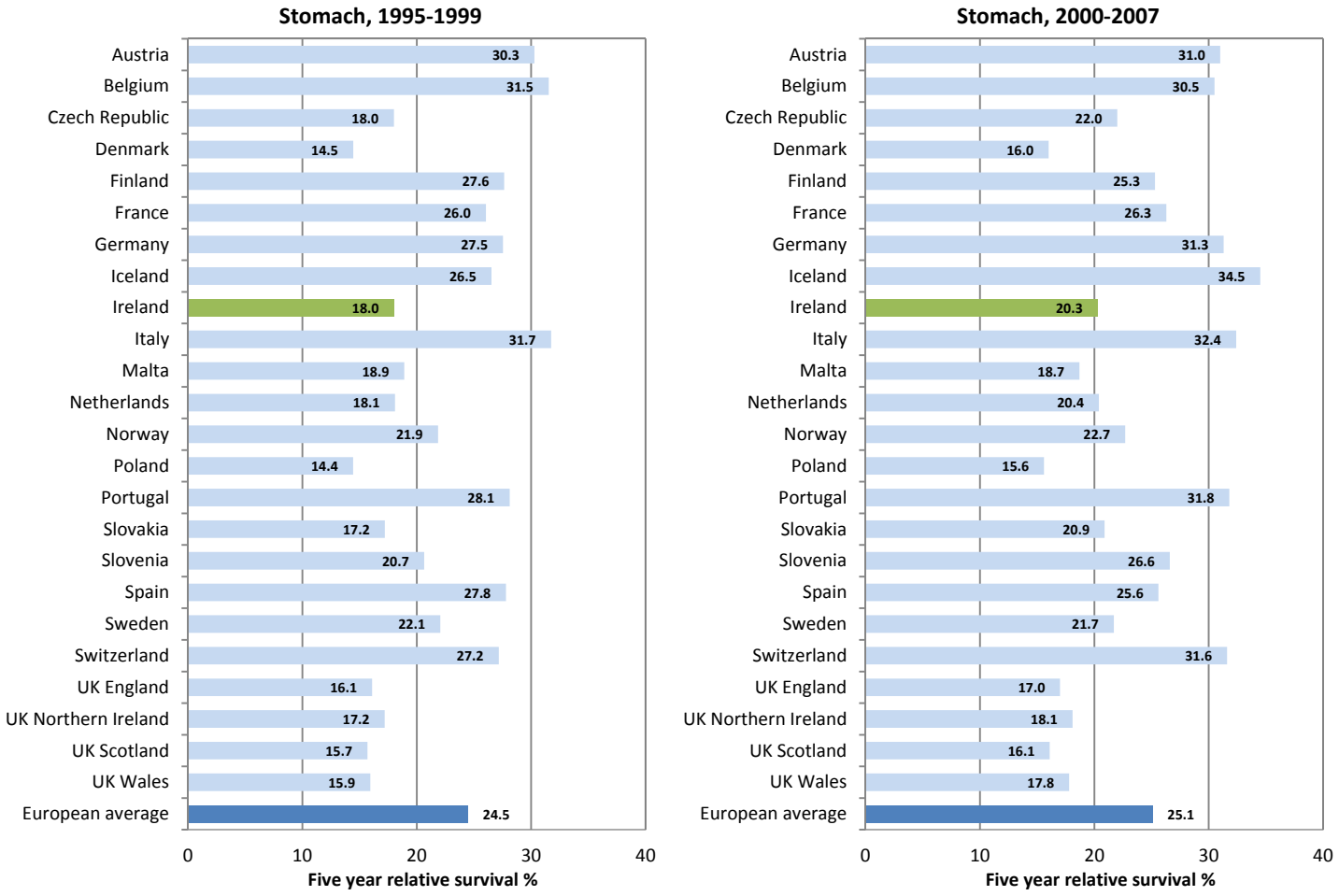


Table 6.1
Rank, % of European average and % change: cancer of the stomach in Ireland 1995-1999 and 2000-2007, both sexes

Years of incidence	rank	% average	% change 1995-99/2000-07	% absolute change 1995-99/2000-07
1995-1999	16	74%		
2000-2007	17	81%	113%	2.3%

6.2 Colon cancer

Survival from colon cancer in Ireland has remained at 96% of the European average overall and is currently ranked 15th of the 24 countries included in the Eurocare study. Survival rates across Europe remain fairly dispersed with poorer survival rates in Eastern Europe and in the UK and highest survival rates in Northern Europe and Scandinavia (Figure 6.2).

Figure 6.2
Five year relative survival: colon cancer in Europe, both sexes

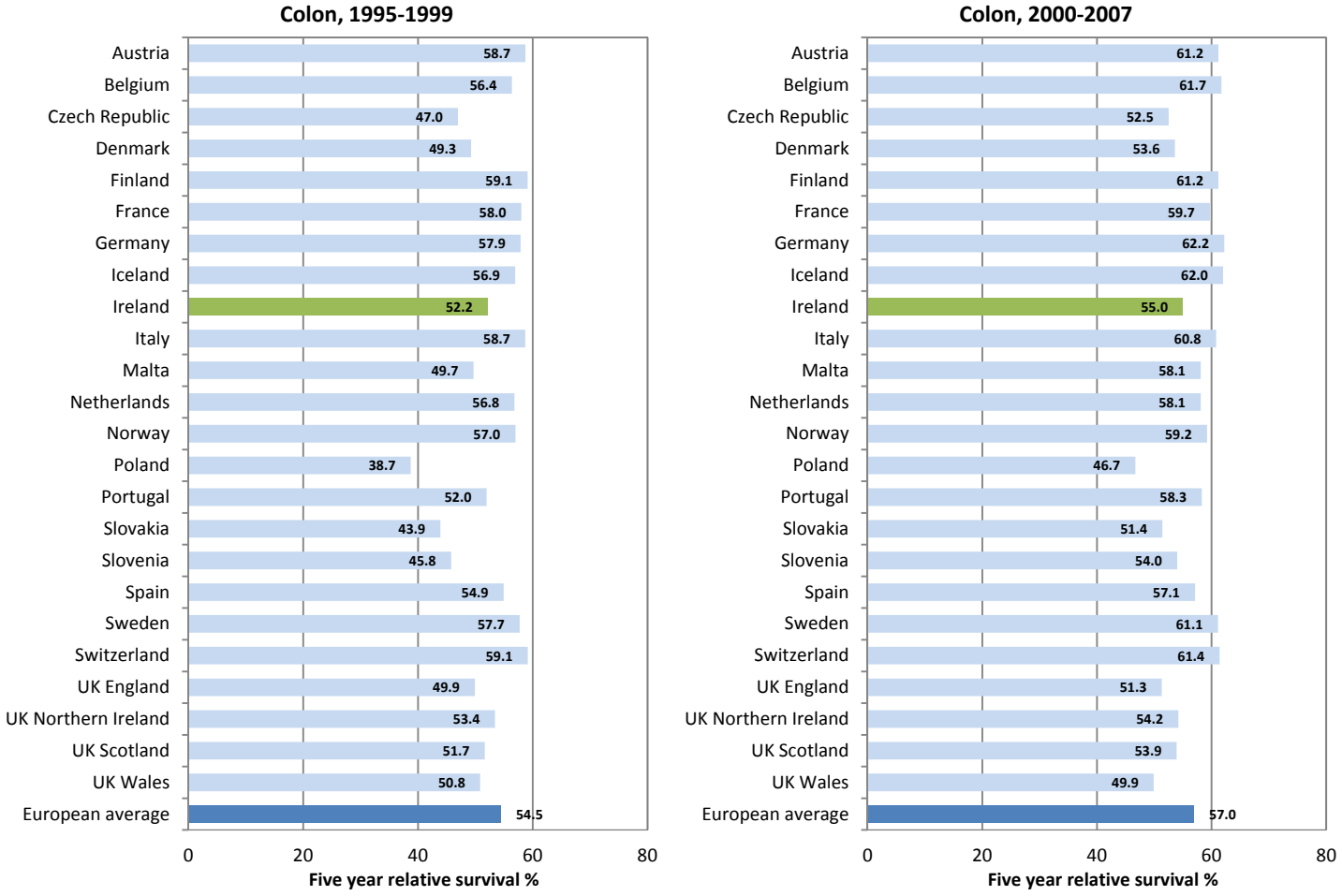


Table 6.2
Rank, % of European average and % change: cancer of the colon in Ireland 1995-1999 and 2000-2007, both sexes

Years of incidence	rank	% average	% change 1995-99/2000-07	% absolute change 1995-99/2000-07
1995-1999	14	96%		
2000-2007	15	96%	105%	2.8%

6.3 Cancer of the rectum

Survival from rectal cancer in Ireland at 53% is currently ranked 18th of the 24 European countries. Although improvements in survival have been observed in all countries except Malta, overall survival from this cancer remains quite poor, at 56% overall (Figure 6.3). Highest survival rates were observed in Iceland, Belgium, Switzerland and Norway. Although survival remains low by comparison in the eastern European countries Poland, Slovakia and the Czech Republic, these countries have shown some of the greatest relative improvements in survival since 1994-1999.

Figure 6.3
Five year relative survival: cancer of the rectum in Europe, both sexes

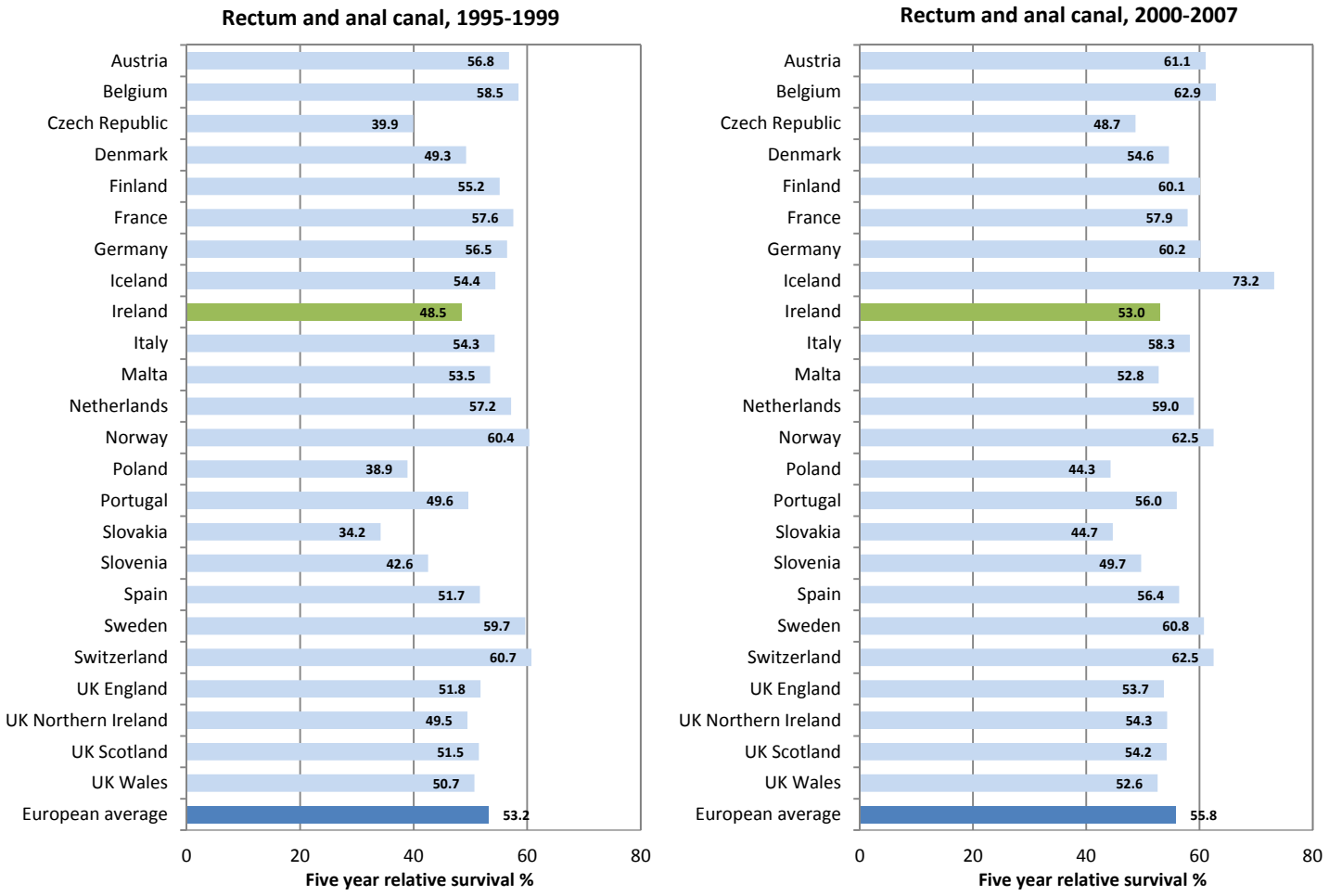


Table 6.3
Rank, % of European average and % change: cancer of the rectum in Ireland 1995-1999 and 2000-2007, both sexes

Years of incidence	rank	% average	% change 1995-99/2000-07	% absolute change 1995-99/2000-07
1995-1999	20	91%		
2000-2007	18	95%	109%	4.6%

6.4 Lung cancer

Survival rates for lung cancer in Ireland rank approximately midway between the highest and lowest in Europe. Although survival from this cancer remains very poor overall, disparities between the countries included in the Eurocare-5 study have narrowed somewhat over time (Figure 6.4), with greatest improvements in survival rates observed in Poland, the Czech Republic and Denmark. Austria and Belgium remain the countries with the best survival overall. Survival rates in Ireland are currently 9% lower than the European average, an improvement from 18% lower in 1995-1999. England, Scotland and Wales continue to have some of the poorest survival rates, while survival in Northern Ireland is closer to that in Ireland.

Figure 6.4
Five year relative survival: lung cancer in Europe, both sexes

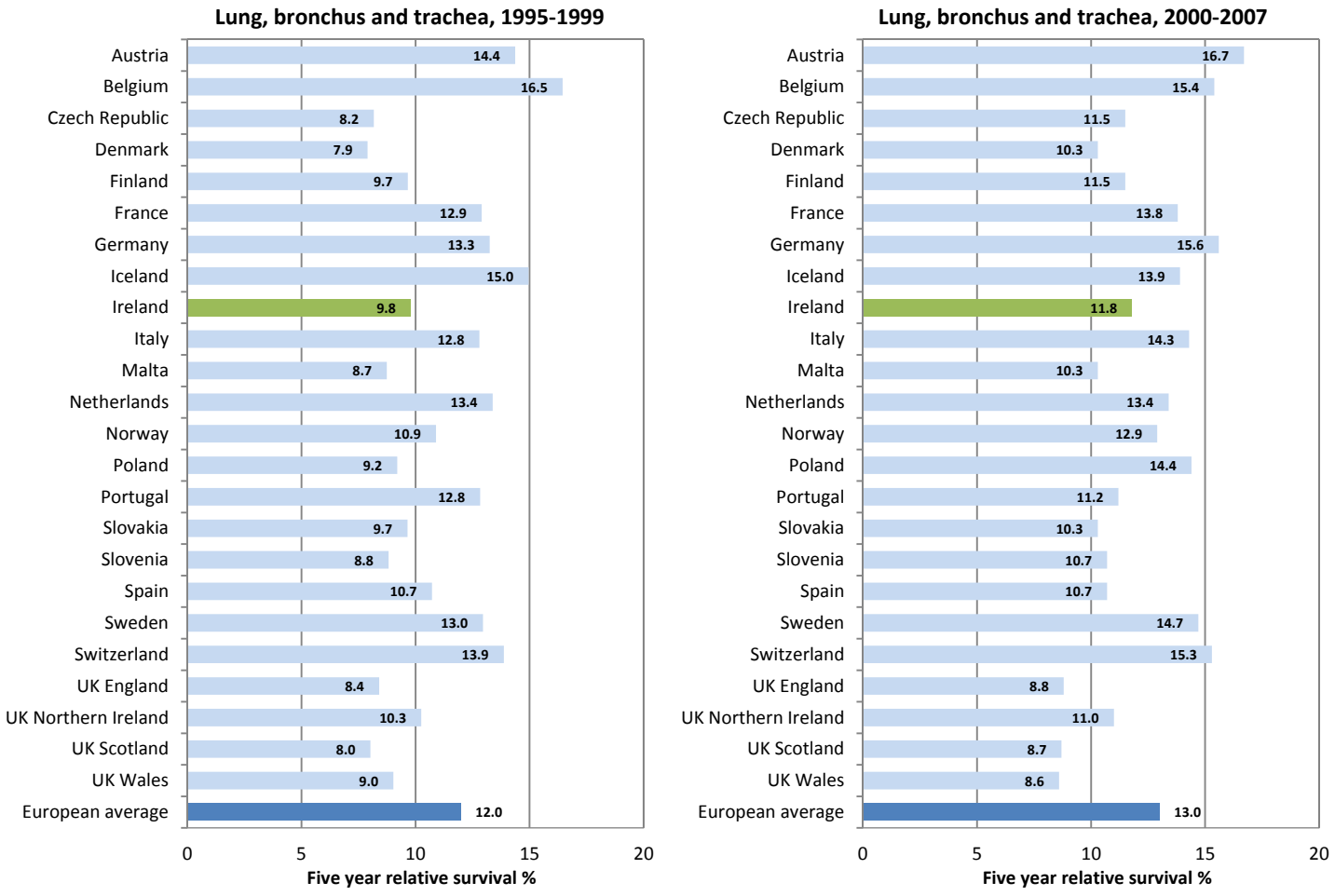


Table 6.4
Rank, % of European average and % change: cancer of the lung in Ireland 1995-1999 and 2000-2007, both sexes

Years of incidence	rank	% average	% change 1995-99/2000-07	% absolute change 1995-99/2000-07
1995-1999	14	82%		
2000-2007	12	91%	120%	2.0%

6.5 Melanoma of skin

Ireland had a 5 year relative survival of 86% for melanoma in 2000-2007 representing the 10th highest survival rate in Europe (Figure 6.5). Rates have improved in all countries except for Northern Ireland, Sweden, Norway and Iceland where survival rates were already very high in 1995-1999. Survival rates improved by over 10% in both the Czech Republic and Slovakia. Current survival rates are fairly similar across Europe and with the exception of Poland and Slovakia (the 2 countries with the lowest survival rates in 2000-2007), rates varied less than 10% between countries.

Figure 6.5
Five year relative survival: melanoma of skin in Europe, both sexes

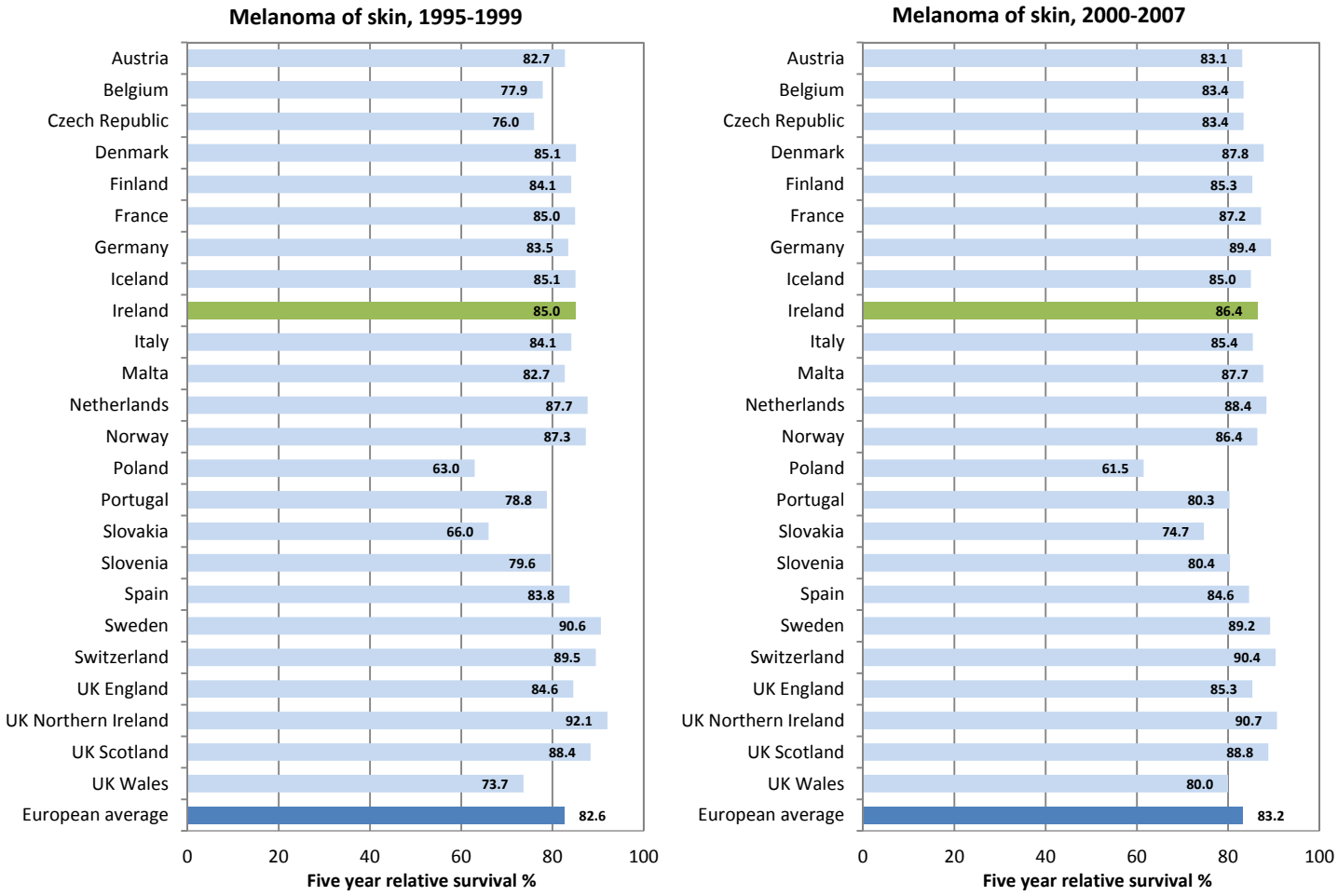


Table 6.5
Rank, % of European average and % change: melanoma of skin in Ireland 1995-1999 and 2000-2007, both sexes

Years of incidence	rank	% average	% change 1995-99/2000-07	% absolute change 1995-99/2000-07
1995-1999	9	103%		
2000-2007	10	104%	102%	1.4%

6.6 Female breast cancer

With the exception of Poland and Iceland, survival rates for female breast cancer have increased in all countries in Europe between 1995-1999 and 2000-2007 (Figure 6.6). Although survival in Ireland remains in the lower quartile of the European range, survival differences between countries have reduced considerably and Irish survival rates were only 3% lower than the European average in 2000-2007. For patients diagnosed between 2000 and 2007, highest survival rates of over 85% were found in Iceland, France, Finland, Sweden and Italy. Poorest survival was recorded in Poland and Slovakia.

Figure 6.6
Five year relative survival: female breast cancer in Europe

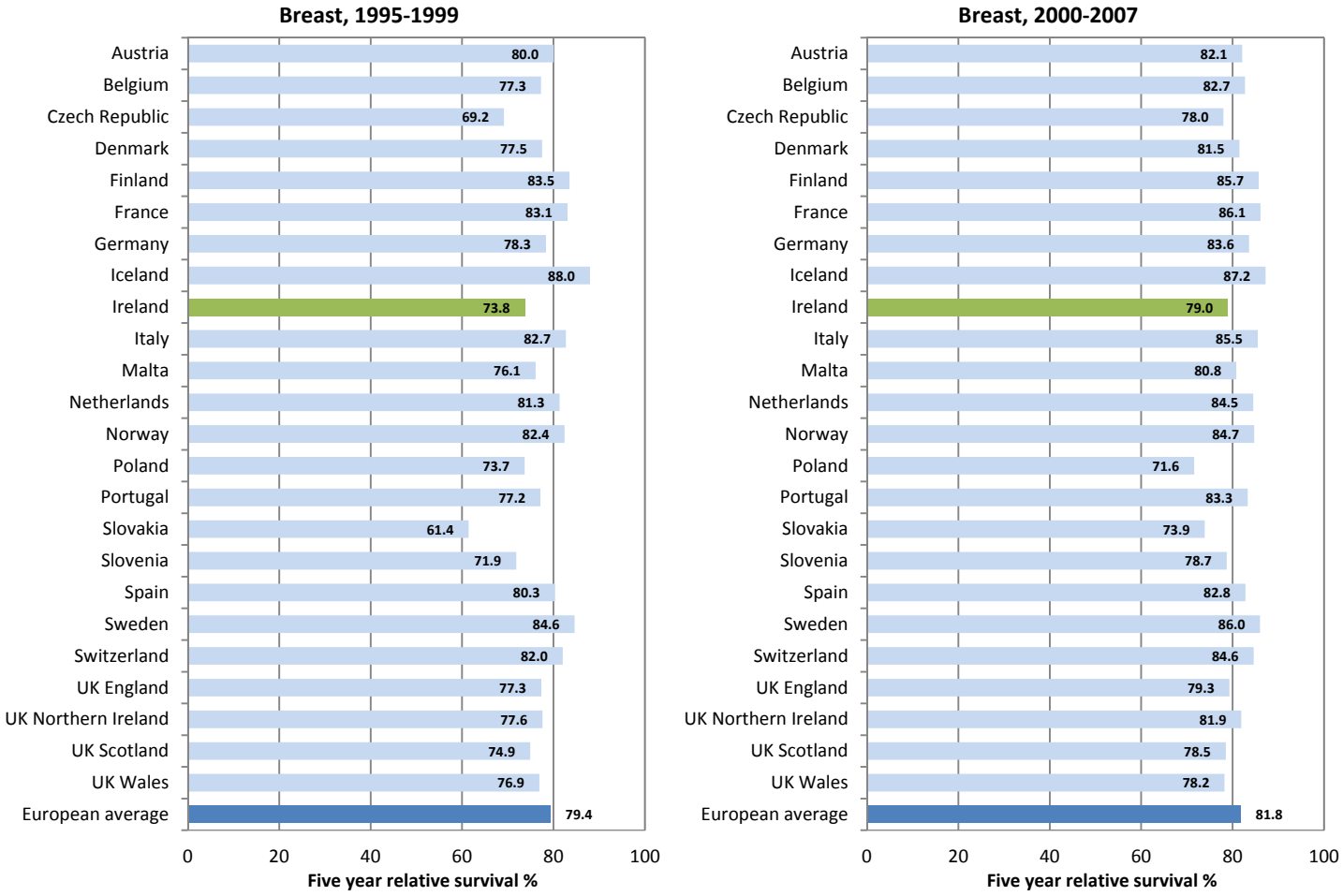


Table 6.6
Rank, % of European average and % change: female breast cancer in Ireland 1995-1999 and 2000-2007

Years of incidence	rank	% average	% change 1995-99/2000-07	% absolute change 1995-99/2000-07
1995-1999	20	93%		
2000-2007	18	97%	107%	5.2%

6.7 Cancer of the ovary

Ovarian cancer remains one of those with the poorest survival rates, with most countries reporting 5 year survival rates of less than 40% (Figure 6.7). Survival rates have improved somewhat in most countries, including Ireland, although survival in this country, at 30%, ranks as the lowest in Europe. Highest survival rates during 2000-2007 were recorded in Sweden, Finland and Belgium. The large differences in survival rates observed between countries may be influenced by variability in coding practices between registries, with particular reference to tumours of borderline malignancy which some registries may include as invasive.

Figure 6.7
Five year relative survival: cancer of the ovary in Europe

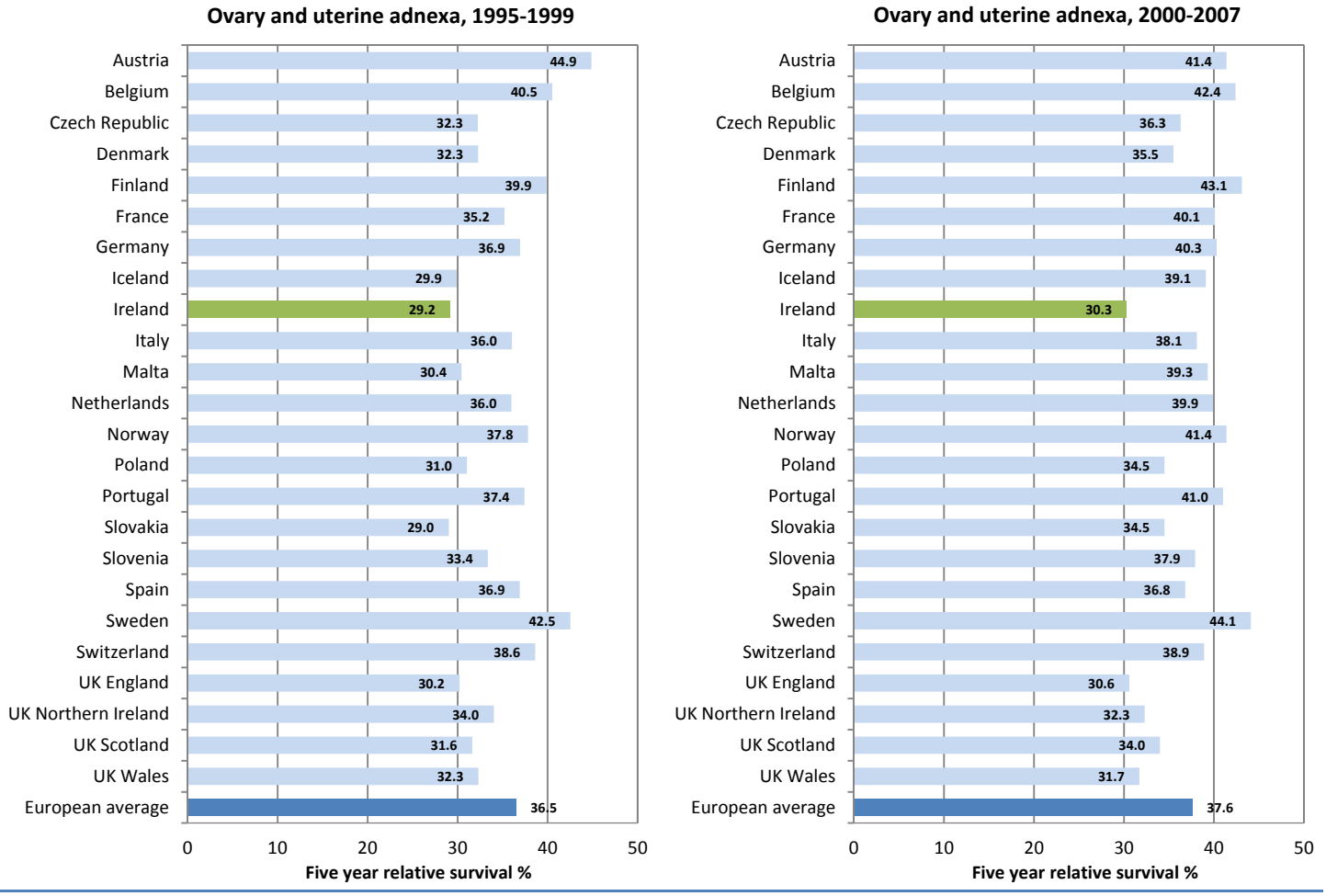


Table 6.7
Rank, % of European average and % change: cancer of the ovary in Ireland 1995-1999 and 2000-2007

Years of incidence	rank	% average	% change 1995-99/2000-07	% absolute change 1995-99/2000-07
1995-1999	23	80%		
2000-2007	24	81%	104%	1.1%

6.8 Prostate cancer

There have been considerable increases in prostate cancer survival rates over time. Five year relative survival in Europe overall has improved from 76% to 83.4% and in Ireland from 71% to 86% between 1995-1999 and 2000-2007 (Figure 6.8). At least some of this improvement in survival may be accounted for by "lead time bias" effects, where more men are diagnosed at a very early stage through PSA screening, now common in many European countries. Austria and Finland represent the countries with the highest survival rates (over 90%) while survival remains fairly poor in eastern European countries, notably Slovakia and Poland, and in Denmark. Ireland currently ranks 10th of 24 countries, with survival rates here 3% higher than the European average.

Figure 6.8
Five year relative survival: prostate cancer in Europe

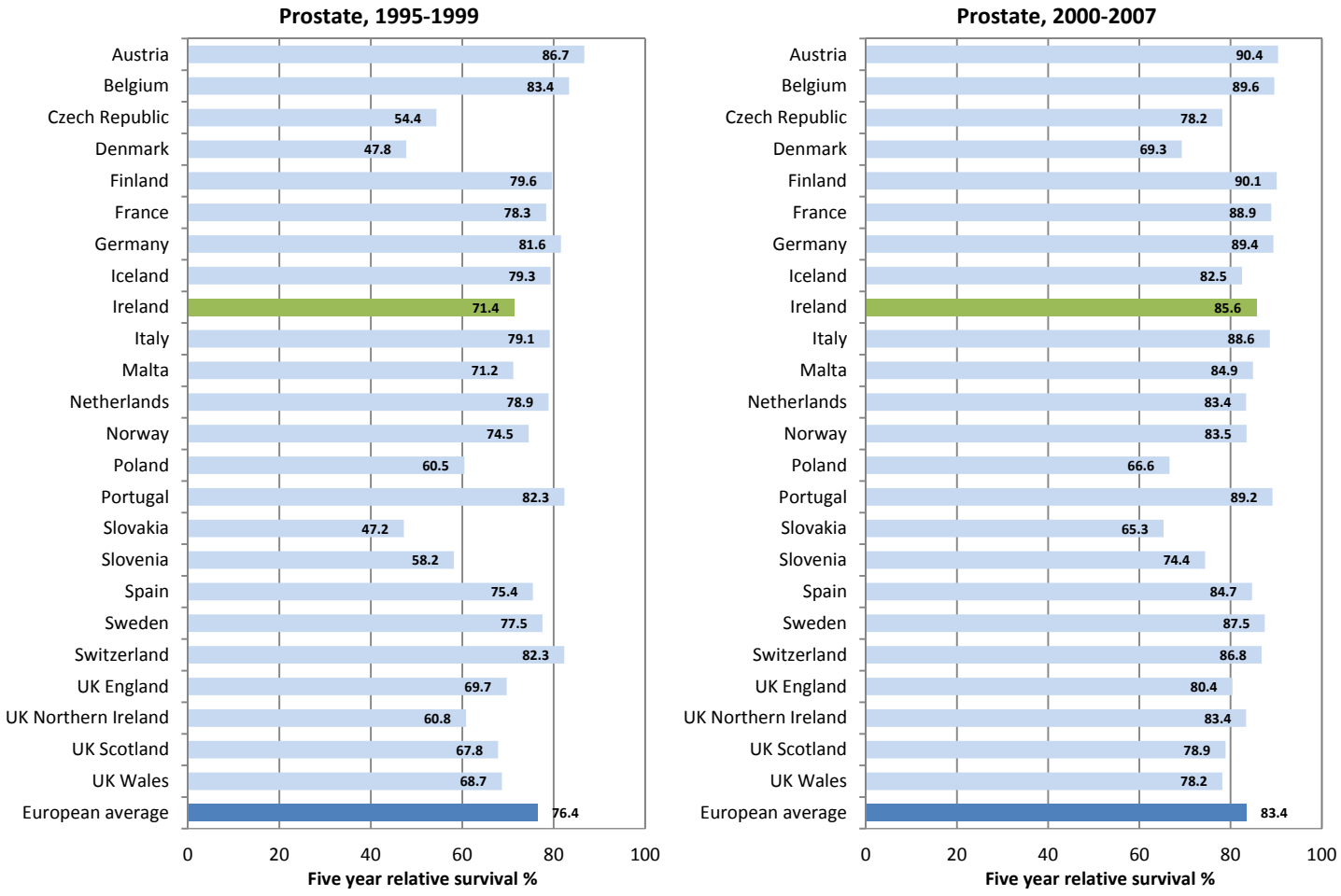


Table 6.8
Rank, % of European average and % change: cancer of the prostate in Ireland 1995-1999 and 2000-2007

Years of incidence	rank	% average	% change 1995-99/2000-07	% absolute change 1995-99/2000-07
1995-1999	14	93%		
2000-2007	10	103%	120%	14.3%

6.9 Kidney cancer

During 1995-1999, Ireland had one of the poorest survival rates for kidney cancer in Europe with rates approximately 19% lower than the European average and over 30% less than Austria, the country with the highest survival rates (Figure 6.9). Survival rates in Ireland have improved over time, similar to most other countries, although survival rates have fallen somewhat in Denmark, Malta, Spain and Northern Ireland. Highest survival rates remain in Austria, Germany, Italy and Portugal with the UK, Denmark and Malta having poorest survival overall.

Figure 6.9
Five year relative survival: kidney cancer in Europe

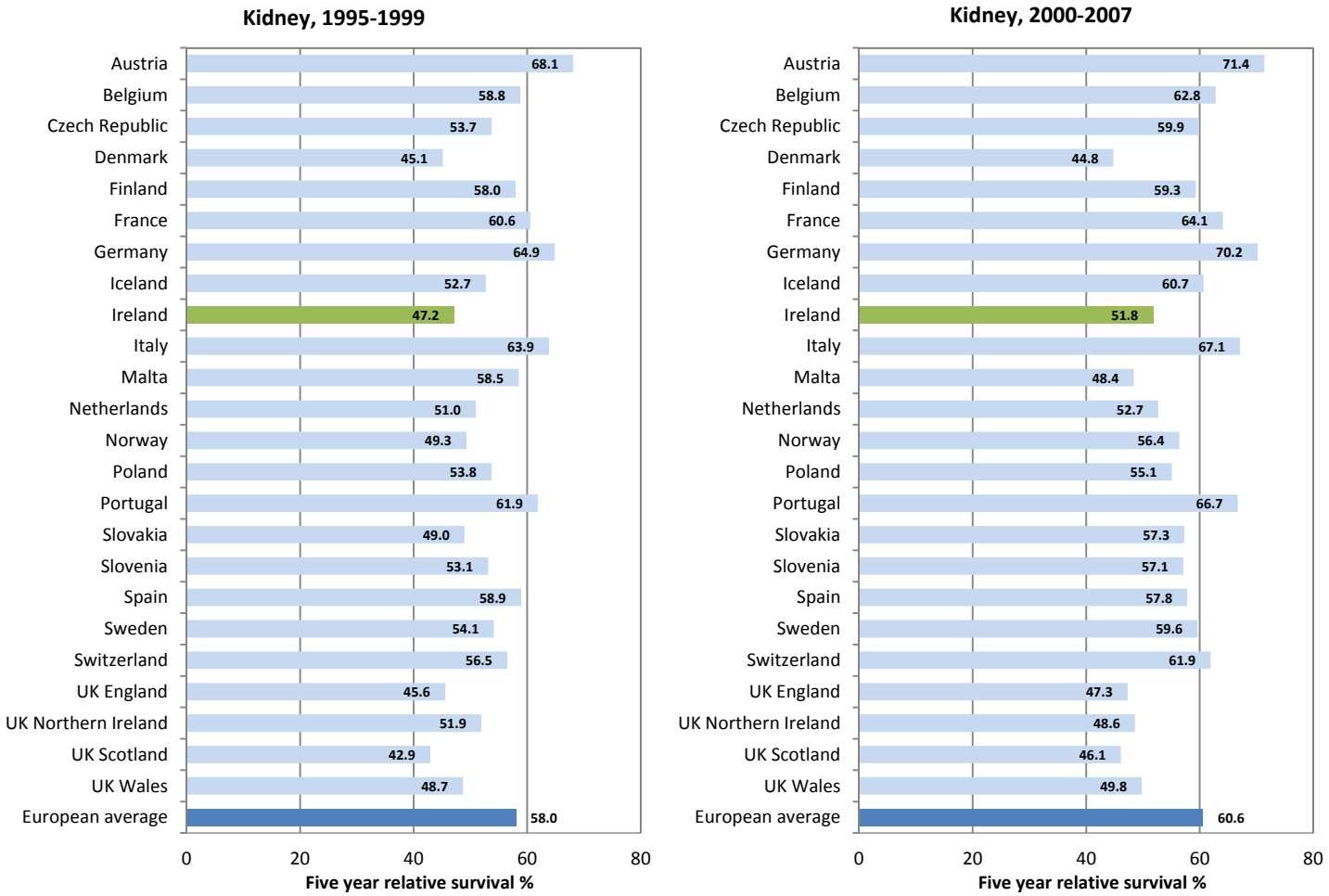


Table 6.9
Rank, % of European average and % change: cancer of the kidney in Ireland 1995-1999 and 2000-2007, both sexes

Years of incidence	rank	% average	% change 1995-99/2000-07	% absolute change 1995-99/2000-07
1995-1999	21	81%		
2000-2007	18	85%	110%	4.6%

6.10 Non-Hodgkin's lymphoma

With the exception of Malta, where survival rates fell from 56% to 48%, and Slovenia where little change was observed, 5 year relative survival for non-Hodgkin's lymphoma improved substantially from 1995-1999 to 2000-2007 in all countries (Figure 6.10). In Ireland survival increased from 48% to 63%, a relative increase of over 30%. Similarly large improvements in survival rates were observed in Denmark, France, Iceland, Slovakia and Northern Ireland. Ireland improved in ranking from 20th to 9th in Europe with current survival rates here 6% higher than the European average. 5 year survival rates in excess of 65% were recorded in Iceland, Belgium, France and Switzerland while the poorest rates—under 50%—were found in Malta, Poland and Slovakia.

Figure 6.10
Five year relative survival: non-Hodgkin's lymphoma in Europe, both sexes

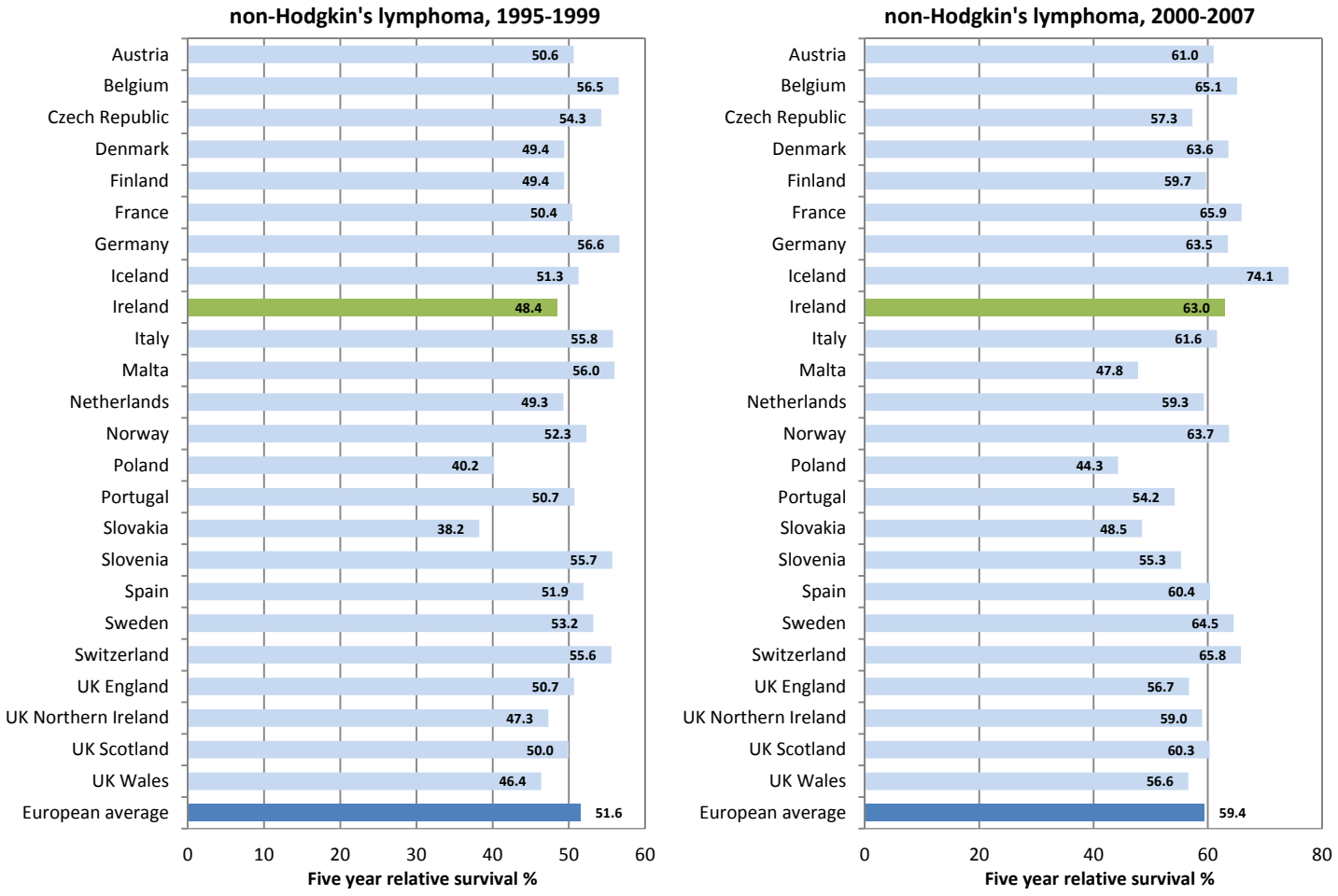


Table 6.10
Rank, % of European average and % change: non-Hodgkin's lymphoma in Ireland 1995-1999 and 2000-2007, both sexes

Years of incidence	rank	% average	% change 1995-99/2000-07	% absolute change 1995-99/2000-07
1995-1999	20	94%		
2000-2007	9	103%	130%	14.6%

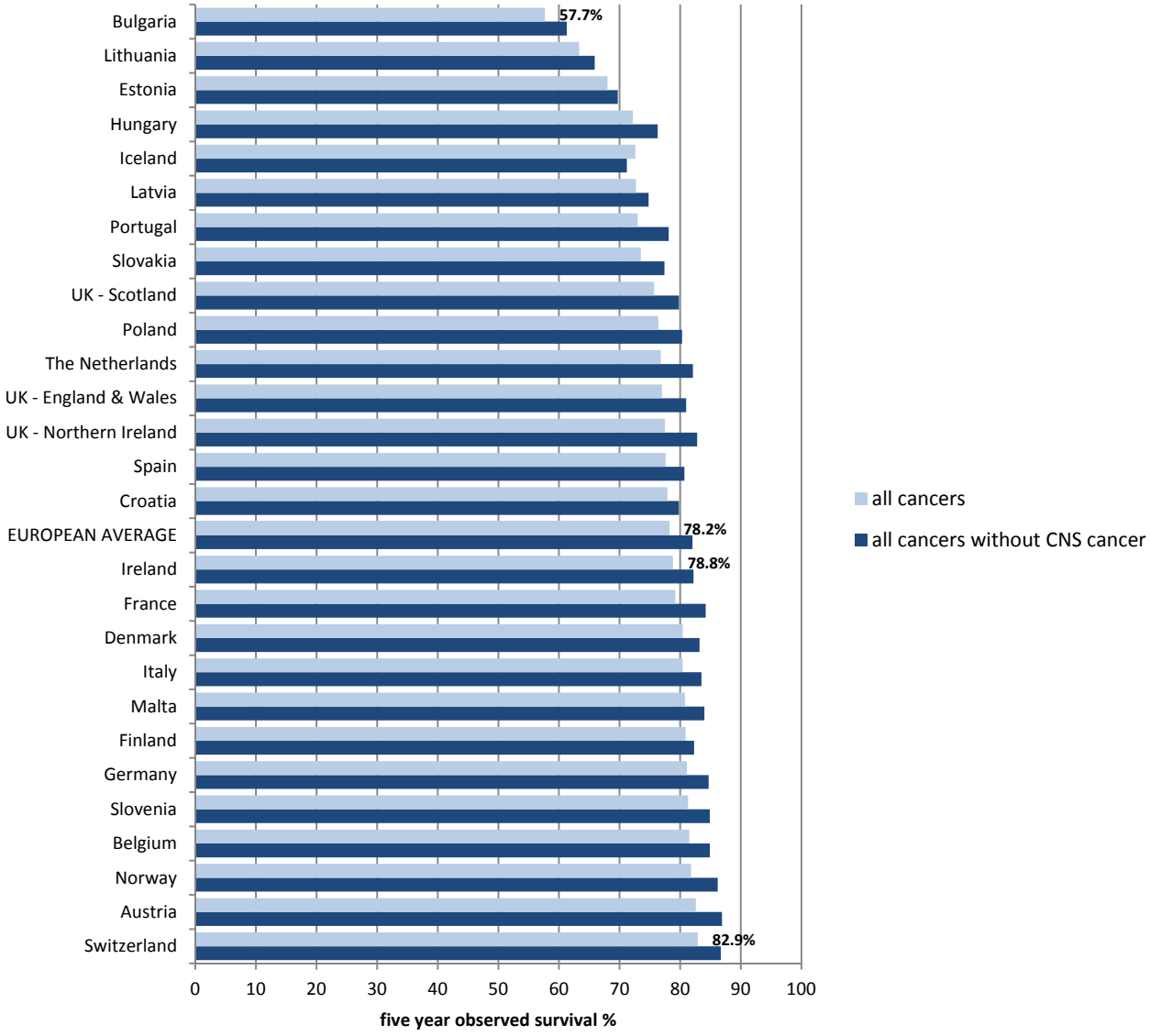
6.11 Five year observed survival for children in Europe, by tumour site: incident cases 2000-2007

The EUROCARE-5 project has recently shown that survival after childhood cancer in Europe has improved and is now better than for adults, although there is still considerable variation between countries [9]. Observed survival was reported, which in children corresponds very closely to relative survival since competing risks of death are negligible. The EUROCARE-5 group considered ten diagnostic categories, defined by the International Classification of Childhood Cancers (ICCC) third edition [21]: acute lymphoid leukaemias (ICCC category Ia), acute myeloid leukaemias (Ib), Hodgkin's lymphoma (IIa), non- Hodgkin lymphoma (IIb), CNS cancers (III), kidney (ICDO C64.9, C65.9), eye and orbit (ICDO C69), bone (ICDO C40–41), soft tissue (ICDO C49), and all remaining cancers. The categories for CNS cancers were: ependymoma and choroid plexus tumour (IIIa), astrocytomas (IIIb), intracranial and intraspinal embryonal tumours (IIIc), other gliomas (IIId), other specified intracranial or intraspinal neoplasms (IIIe), and unspecified intracranial and intraspinal neoplasms (IIIf).

The EUROCARE group analysed 59,579 cases (0-14 years), of which 945 (1.6%) cases were registered by the Irish National Cancer Registry. For all cancers combined, and diagnosed in 2000-2007, 5-year survival was 77.9% (95% CI 77.4-78.3). For all cancers combined, 5-year survival rose from 76.1% (74.4-77.7) for 1999-2001, to 79.1% (77.3-80.7) for 2005-2007 (hazard ratio 0.973, 95% CI 0.965-0.982, p<0·0001). As distinguishing between benign and malignant tumours is difficult, survival analysis by country including all cancers, with and without CNS tumours, is reproduced in Figure 6.11.

Five year survival for Irish children diagnosed with any cancer over the period 2000-2007 was 79% [75-83%] which was very close to the European average for that period. In general, for most haematological cancers, 5-year survival was high (ranging from 84% to 95%), except for acute myeloid leukaemia where only 62.7% (95% CI 60.5-64.9) of children survived for 5 years. 5-year survival for retinoblastoma was high. Survival was also good for nephroblastoma and other non-epithelial renal tumours; other renal tumours accounted for 173 (3.4%) cases. 5-year survival for CNS cancers for all of Europe was modest (57.5%, 95% CI 56.1-58.8), with little difference between diagnostic groups. As differentiating between benign and malignant tumours is difficult, the survival data between countries might not be directly comparable.

Figure 6.11
Five-year observed survival for all cancers combined with and without CNS tumours diagnosed in 2000-2007 by country, based on 57,956‡ cases, in European children (age 0–14 years)



Source: Appendix to: Childhood cancer survival in Europe 1999-2007: results of EUROCARE-5: a population-based study. G. Gatta et al. Lancet Oncol. 2014 Jan;15(1):35-47 [9]
Data includes pilocyctic tumours (borderline behaviour) which comprise 25% of CNS cases
‡Countries varied widely in how they attributed malignancy of CNS tumours. The Swedish cancer registry did not supply consistent data for CNS tumours such as to enable adequate distinction between 'all cancers' and 'all cancers without CNS cancers'. The Swedish registry data was thus excluded from this analysis. The total number of patients was reduced from 59,579 to 57,956

7. SELECTED NATIONAL CANCER REGISTRY RESEARCH PUBLICATIONS 2013

Data Completeness at the Irish National Cancer Registry

O'Brien K, Comber H, Sharp L

Irish Journal of Medical Science, PMID: 239556DOI 10.1007/s11845-013-0993-z [1]

Introduction

Population-based cancer registries play a key role in cancer control. However, the value of the data for planning and evaluation is questionable if registries fail to ascertain all of the cases. Estimation of completeness is therefore considered an important part of registration quality assurance. A survey of European registries in 2006 showed wide variability in practices and the use of unreliable methods. The Irish National Cancer Registry is a population-based cancer registry which aims to collect information on all cancers occurring in people usually resident in the Republic of Ireland. Reporting of cancer is not mandatory in Ireland but the Registry makes considerable efforts to ensure complete recording of all cases. This paper describes the current situation, after almost two decades of registration, with regard to the completeness of case ascertainment at the Registry.

Methods

Registration process

The primary source of case notification to the National Cancer Registry is active registration by tumour registration officers (TROs), who are based in hospitals around the country. All hospitals in Ireland, both public and private, provide the Registry with full access to information systems and records for this purpose. The majority of these cases are identified through histopathology reports. In public hospitals, the hospital inpatient enquiry (HIPE) system is an alternative source for cases which are not pathologically verified. The Registry also ascertains cases through records in radiotherapy units, oncology wards and day unit and other sources. Death certificates supplied by the Central Statistics Office (CSO) are the principal source of cases not diagnosed or treated in hospital; cases initially identified this way are 'death certificate notified' (DCN) cases. These are followed up either at the hospital of death or with the general practitioner who signed the certificate. If no patient or cancer can be identified to correspond to the death certificate, it is registered as a 'death certificate only' (DCO) case.

Statistical methods

Methods of ascertaining completeness fall into two broad categories—semi-quantitative and quantitative. The semi-quantitative methods include the stability of incidence over time, age-specific incidence rates of childhood cancer, comparisons of the mortality-to-incidence ratios with established registries and the number of sources per case. These do not give an estimate of completeness *per se* and quantitative methods are preferable. One of the main quantitative methods is independent case ascertainment. We examined whether cases reported in the BreastCheck programme were already registered by the Registry in the period 2000-2009. Some other approaches can give an estimate of the number of cases which escaped registration while the individual was alive. We used two death certificate based methods, the first of which uses the Lincoln-Peterson (LP) estimator, and the second of which is known as the flow method.

The main assumption of the LP estimator is that the M:I (mortality to incidence) ratio in registered patients is the same as the M:I ratio in unregistered patients. The estimate of completeness using the LP estimator is a lower bound and is made at a fixed point in time. The flow method estimates the proportion of people with a cancer diagnosis who are unregistered and a) still alive or b) have

died from non-cancer causes. It calculates these estimates using time to event methodology. Software is provided by the authors of the method. Completeness can be estimated at any time from the year of diagnosis.

We calculated completeness of registration for 2005 at the end of 2010, for all invasive cancers combined (excluding non-melanoma skin cancers) and separately for the four most common cancers; lung, breast, colorectal and prostate.

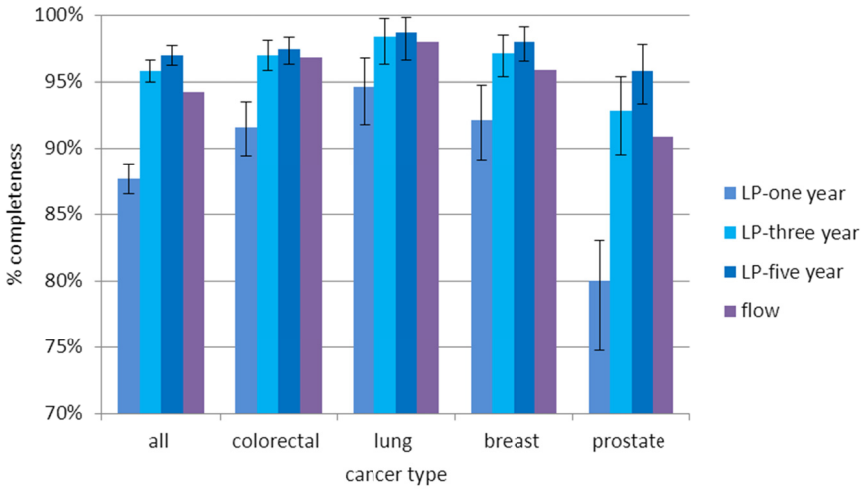
Independent case ascertainment

14 of 3,926 breast cancers diagnosed by BreastCheck had not been registered at the end of 2009 by the Registry. Eight of these 14 were ineligible for registration for a variety of reasons and 2 were registered in early 2010, so 4 cases were missed by the Registry, <1%. Completeness of breast cancer ascertainment in the screening age group (50-64) was estimated to be 99.3% by the flow method.

LP estimator and flow methods

The estimates for completeness using the LP estimator and the flow method are given in Figure 1. The flow method completeness of case ascertainment estimate was 87.7% at one year, 95.8% at three years and 97.0% at five years. The LP completeness estimate, 94.2%, for cases diagnosed in 2005, was lower than the five-year completeness as estimated by the flow method at 5 years, illustrating that the LP method provides a lower bound for estimated completeness. The LP method gave estimates of completeness which were within the confidence intervals for, but slightly lower than, the three-year flow method results for all cancers combined and also for the four individual sites. The level of completeness, as assessed by both methods, was higher for cancers with a high mortality.

Figure 1:
Estimated completeness for case ascertainment, all sites combined (excluding non-melanoma skin) and four main sites, extraction date 31/12/2010. ±95% confidence intervals



Discussion

The quantitative methods indicate that case ascertainment in the Irish National Cancer Registry in 2005 was approximately 97% at five years from the year of diagnosis. Overall completeness of registration (from the flow method) was 95.8% at three years from diagnosis and 97.0% at five years, and was above 97% for three of the four commonest cancer sites. However, independent case ascertainment suggested a level of completeness for two subsets of cases which was close to 99%. No major changes have occurred in registration practices since 2005, so the results given here are likely to be representative of current completeness levels.

There is little recent published data on overall completeness of registration against which to compare the Irish data, and the range of methodologies used is wide. Published estimates range from 94% in Austria through 96% in Scotland, 94-99% in English registries, and 99% in Norway and Iceland. Completeness of ascertainment in Ireland, as measured by the flow or LP methods, is towards the lower end of this range. In Ireland the absence of a HIPE equivalent in the private sector the heterogeneous nature of

ICT development and the fragmented nature of histopathology services all militate against completeness of ascertainment. Where favourable conditions exist, as for instance in breast screening, completeness of registration is very high.

There was close agreement between the two methods of estimation for lung cancer, since its high mortality rate enables the LP bound to be tighter for this site. Of the four cancer sites considered, completeness estimates were lowest for prostate cancer. The flow method and the LP estimator rely on various assumptions such as incidence and mortality rates being in a steady state. Fundamentally, both methods simply provide an estimate of levels of missing data; the true level of completeness cannot, by definition, be computed. Two studies have compared the LP estimator (also known as the DCN/Ajiki method) and flow methods to "true" completeness using simulated data. Silcocks et al 2007 showed that a naive LP estimator grossly underestimated completeness, while Schmidtmann 2008 concluded that a version of the LP estimator provides the least biased estimator in most situations.

Although a completeness of 97% is satisfactory for most purposes, under-ascertainment may lead to bias in the reporting of survival and the objective of the cancer registry is to aim for as close to 100% as possible. The example of the Nordic registries shows that, given the appropriate environment, this is possible. More work also needs to be done on validation, particularly of the flow method. A better estimate of the mortality to incidence ratio for registered patients would improve the LP estimator as suggested by Schmidtmann 2008.

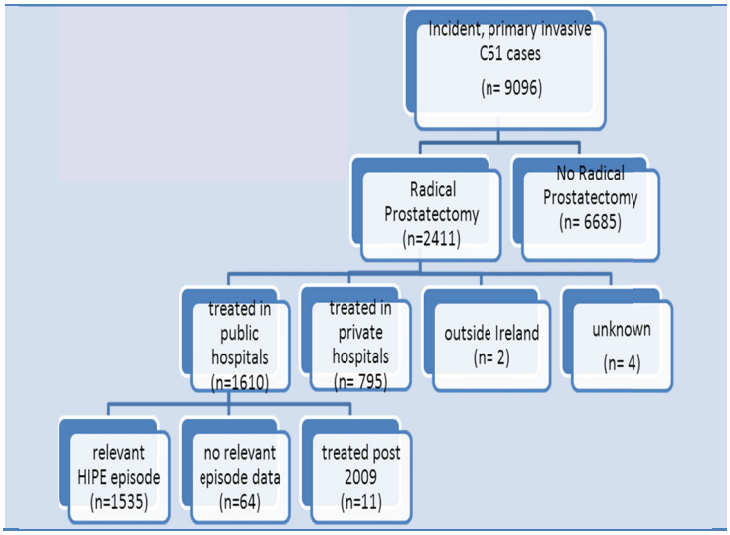
Factors predicting hospital length-of-stay after radical prostatectomy: a population-based study

Maria Kelly, Linda Sharp, Fiona Dwane, Tracy Kelleher, Frances J Drummond and Harry Comber [22]

BMC Health Serv Res 2013;13:244. doi:10.1186/1472-6963-13-244

Radical prostatectomy (RP) is a leading treatment option for localised prostate cancer. Although hospital in-patient stays account for much of the costs of treatment, little is known about population-level trends in length-of-stay (LOS). In this study we investigated factors predicting hospital LOS and readmissions in men who had RP following prostate cancer.

Figure 1:
Radical prostatectomy in men aged < 70 years at diagnosis, 2002-2008, dataset overview



Incident prostate cancers (ICD-O3: C61), diagnosed January 2002-December 2008 in men < 70 years, were identified from the Irish Cancer Registry, and linked to public hospital in-patient episodes. For those who had RP (ICD-9 CM procedure codes 60.3, 60.4, 60.5, 60.62) the associated hospital episode, the index surgery episode was identified. LOS was calculated as the number of days from date of admission to date of discharge. Patient-, tumour-, and health service-related factors predicting longer LOS (upper quartile, >9 days) were investigated using logistic regression. Patterns in day-case and in-patient readmissions within 28 days of discharge following RP were also explored.

Over the study period 9,096 prostate cancers were diagnosed in men under 70, 26.5% of whom had RP by end of follow-up 31/12/2009, (see figure 1). Two of eight public hospitals and eight of forty surgeons carried out 50% of all public-service RPs. Median LOS was 8 days (10th-90th percentile = 6-13 days) and fell significantly over time from 9 days in 2002 to 7 days in 2008, (Cuzick's non-parametric test for trend: $p < 0.001$).

Table 1: Readmissions within 28 days of discharge following RP in public hospitals by provider volume

	All	Hospital volume[1]		Surgeon volume[2]	
Volume	**N (%)**	**Lower**	**Higher**	**Lower**	**Higher**
Number of RPs	1,535	781	754	785	750
Number of readmissions[‡] (% of all RPs)	854(55.6%)	344(22.4%)	510(33.2%)	373(24.3%)	481(31.3%)
Readmission type					
Elective - day cases (% of all readmissions)	304(35.6%)	228(26.7%)	76(8.9%)	203(23.8%)	101(11.8%)
Elective - overnight (% of all readmissions)	503(58.9%)	99(11.6%)	404(53.6%)	145(17.0%)	358(41.9%)
Emergency (% of all readmissions)	47(5.5%)	17(2.0%)	30(3.5%)	25(2.9%)	22(2.6%)

[‡]excludes those who died at time of index procedure RP (n=1) or within 28 days of discharge (n=2)

[1]higher-volume hospitals are those where >49 RPs were performed per year during 2002-2008,

[2]higher-volume surgeons are those who performed >17 RPs per year during 2002-2008

In the adjusted logistic regression analyses of men treated in public hospitals (n=1535), those who were not married (OR = 1.71, 95% CI 1.25-2.34), had co-morbidities (OR = 1.64, 95% CI 1.25-2.16) or stage III-IV cancer (OR = 2.19, 95% CI 1.44-3.34) were significantly more likely to have prolonged LOS. Those treated in higher volume hospitals (annual median >49 RPs) or by higher volume surgeons (annual median >17 RPs) were significantly less likely to have prolonged LOS (OR = 0.34, 95% CI 0.26-0.45; OR = 0.55, 95% CI 0.42-0.71 respectively).

Just under 6% (n=47) of all readmissions within 28 days of discharge from the index surgery episode were emergencies (Table 1). Readmissions of any type, and overnight admissions, were more frequent in higher volume hospitals and for higher volume surgeons. Catheter removal and urine flow study were the two most common procedures for elective readmission. Catheter removal, tomography of abdomen, injection of antibiotics or anticoagulants, and endoscopic lavage of blood clots from bladder were the most common procedures for emergency readmission.

Median LOS after RP decreased between 2002 and 2008 in Ireland but it remains higher than in both England and the US. Although volumes of RPs conducted in Ireland are low, there is considerable variation between hospitals and surgeons. Hospital and surgeon volume were strong predictors of shorter LOS, after adjusting for other variables. These factors point to a need for a comprehensive review of prostate cancer service provision.

Age remains the major predictor of curative treatment non-receipt for localised prostate cancer: a population-based study

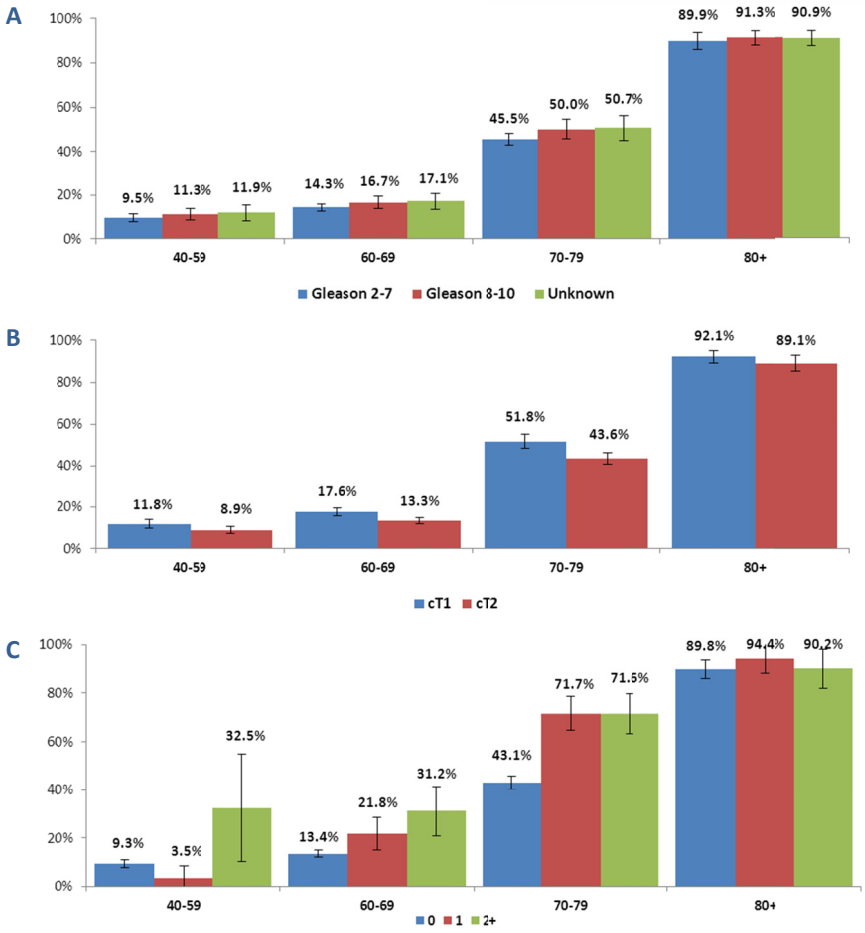
Marianna De Camargo Cancela, Harry Comber and Linda Sharp

British Journal of Cancer 109, 272-279 (9 July 2013) | doi:10.1038/bjc.2013.268 [23]

Introduction

The treatment of localised prostate cancer remains controversial. Radical prostatectomy and radiotherapy are the only treatment modalities considered to be curative. Evidence from clinical trials and population-based studies suggests that both of these treatments result in improved disease-free and patient survival, with the magnitude of the benefit depending on the risk category of the tumour. In developed countries 53% of all prostate cancers are diagnosed in men aged 70 and older. Before making treatment decisions for older patients, oncologists, radiation therapists and surgeons are advised to comprehensively evaluate patient fitness and functional status.

Figure 1.
Predicted probability of not undergoing prostate cancer curative treatment by (A) Gleason score, (B) clinical tumour stage and (C) Charlson index (0,1,2+); all by age group.



Geriatric oncology guidelines strongly recommend that treatment decisions in prostate cancer should be based on the patient's "physiological age" and not their chronological age. Despite this, some studies – mainly from North America and/or clinical series from large specialised centres – suggest that age remains a major determinant of treatment receipt.

As few population-based studies have evaluated the relationship between age and prostate cancer treatment in European populations we conducted a population-based study investigating associations between age and receipt of curative treatment in men with localised prostate cancer, and the effect of patient and tumour characteristics on treatment receipt in different age groups.

Methods

Prostate cancer cases (ICD10: C61) diagnosed 2002-2008, and with a hospital in-patient episode within one year of diagnosis were included. Comorbidity (assessed by Charlson and Elixhauser indices) was determined from diagnoses in the linked hospital in-patient data. The outcome was non-receipt of curative treatment. Logistic regression was used to estimate the odds ratio for each age-group and to explore the extent to which the effect of age was changed by the inclusion of other variables in the model.

Results

Of 9,716 men diagnosed with clinically localised prostate cancer in Ireland during 2002-2008, 5,456 (56.2%) had a HIPE record within a year of diagnosis and were included in the analysis. The percentage who did not receive curative treatment was 9.2%, 14.3%, 48.2% and 91.7% for men aged 40–59, 60–69, 70–79 and 80+ years, respectively. The adjusted percentages of not undergoing treatment are shown in Figure 1. After adjusting for clinical and socio-demographic factors, age remained the main determinant of treatment non-receipt (Table 1). Men aged 70–79 had a significant five-fold increased risk of not having curative treatment compared with men aged 60–69 (odds ratio (OR)=5.5; 95% confidence interval [4.7, 6.5]).

Table 1.
Main effects analysis: odds ratios (OR) for not undergoing curative treatment in men with prostate cancer diagnosed 2002-2008, by age-group.

	Curative treatment					
	yes	no	Univariate	Gleason and tumour size adjusted	Gleason, tumour size and Charlson adjusted	Multivariate adjusted*
Age-group	**%**	**%**	**OR**	**OR**	**OR**	**OR**
40-59	90.8	9.2	0.61 ↓	0.61 ↓	0.63 ↓	0.63 ↓
60-69	85.7	14.3	1.00	1.00	1.00	1.00
70-79	51.8	48.2	5.55 ↑	5.54 ↑	5.31 ↑	5.51 ↑
80+	8.3	91.7	66.09 ↑	64.49 ↑	59.14 ↑	57.57 ↑

* ORs adjusted for year of incidence, tumour-related clinical variables (Gleason score, tumour size), patient-related clinical variables (Charlson index), and socio-demographic variables (marital status, smoking status, and HSE area of residence). The arrows indicate statistically significant OR. ↓/↑ indicate that 95%CI excludes unity in the negative/positive direction

Conclusions

In this population-based analysis, age at diagnosis was the major predictor of receipt of curative treatment in men with clinically localised prostate cancer; this effect was little attenuated by adjustment for clinical and socio-demographic characteristics. Men aged 70 and older received curative treatment significantly less frequently than their younger counterparts. The stratified analyses showed that the factors associated with treatment receipt differed by age. The influence of clinical factors was greater for men aged 60-69 than other age-groups. Treatment receipt increased over time among men aged 70-79.

Although geriatric oncology guidelines advise clinicians to take treatment decisions based on the overall health of the patient, this analysis suggests that chronological age remains the strongest predictor of curative treatment in men with localised prostate cancer. However, there is some evidence of change in treatment levels over time, suggesting evolution in clinical practice. Whether this will impact on prostate cancer specific mortality rates remains to be established.

Hospital and surgeon caseload are associated with risk of re-operation following breast-conserving surgery.

De Camargo Cancela M, Comber H, Sharp L.

Breast Cancer Res Treat. 2013 Aug;140(3):535-44. doi: 10.1007/s10549-013-2652-5. Epub 2013 Jul 28. [24]

Introduction

Surgery is the cornerstone of treatment for breast cancer. With the development of more conservative surgical techniques, many women diagnosed with breast cancer are suitable for breast-conserving surgery (BCS). One of the few disadvantages of BCS is the possibility of re-operation if the excision of the tumour is incomplete, margins are not clear of tumour cells or margins are clear but considered too close. It is therefore expected that a proportion of women who initially undergo BCS will require further surgery, often another BCS but sometimes total mastectomy (TM).

Re-resection of breast cancer has consequences–poorer cosmetic outcome, emotional distress, delay in commencement of adjuvant treatment, extended recovery period and possibly a higher risk of local and distant recurrence. For the healthcare system it represents avoidable additional costs.

Table 1.
Number and type of re-operation in patients initially undergoing BCS. Number and type of re-operations [a]

	n	% (95% CI)
BCS	513	35.6 (33.1, 38.0)
TM	760	52.7 (50.1, 55.3)
BCS+TM	118	8.2 (6.8, 9.6)
2 BCS	30	2.1 (1.3, 2.8)
2 BCS+TM	15	1.0 (0.5, 1.6)
3 BCS	5	0.3 (0.0, 0.7)
3 BCS+TM	1	0.1 (0.0, 0.2)
Total	1,442	100

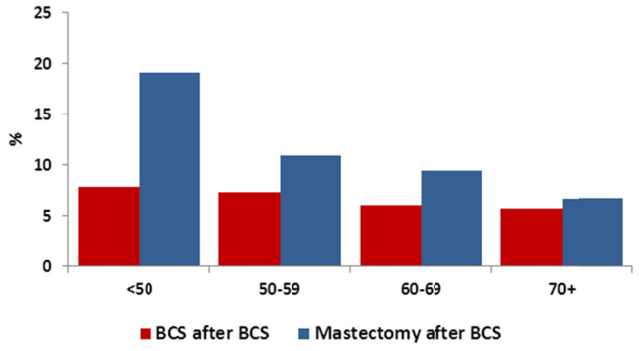
[a] Within 4 months from the initial BCS.

Few studies have explored factors associated with risk of subsequent BCS and TM separately. Some of the determinants of re-operation risk, are not modifiable. Others – such as those related to health service organisation or provision – are potentially modifiable, but have been little investigated. The aims of this study were: (i) to provide up-to-date population-based estimates of frequency of re-operation, (ii) to identify risk factors related to any type of re-operation, (iii) to identify risk factors related to subsequent TM in women who underwent re-operation.

Methods

From the National Cancer Registry we identified breast cancers diagnosed 2002-2008, for which the first surgical procedure was BCS. Cases that underwent one BCS were the baseline category and the main outcomes were two binary variables: re-resection by any reoperation and re-resection by mastectomy. For breast cancers that were re-resected more than once the most extensive resection procedure was considered. Poisson regression models with robust error variance were built and the clinical variables included were: T, N, M, subtype, grade, and screening detection. Age, area of residence, deprivation status, smoking and marital status were the socio-demographic variables included in the models. Significance of the variables was tested using Wald test to decide whether they were significant for the models.

Figure 1.
Reoperation rates by age-group (%).



Results

8,318 women underwent initial BCS and 17% (n=1442) underwent at least one reoperation. Of those who underwent reoperation 38% (n=513) had BCS and 62% (n=894) mastectomy (Table 1). Women aged <50 had a 26% greater risk (IRR 1.26, 95%CI: 1.12, 1.42) of undergoing re-operation compared to those aged 50-59 (Figure 1, Table 2). Risk of any reoperation and of mastectomy

was significantly increased in T2/3/4 cancers, with nodal involvement. HER2 over-expressing subtype was associated with any reoperation and luminal B with mastectomy (Table 2). After adjusting for these clinical factors, risk of reoperation was also significantly raised in women having surgery in low-volume hospitals by low-volume surgeons compared to those operated in high-volume hospitals by high-volume surgeons; risk of mastectomy was increased if women were operated on by a lower or intermediate volume surgeon (Table 2). Whether cancers were screen-detected was unrelated to re-resection risk.

Table 2. Risk of any reoperation and mastectomy: incidence rate ratios (IRR) for socio-demographic, healthcare and clinical factors included in the multivariate models.

	Any IRR	Mastectomy IRR		Any IRR	Mastectomy IRR
Socio-demographic and healthcare variables			**Clinical variables**		
Age			**Residual disease**		
<50	1.26 ↑	1.14 ↑	**Negative**	1.00	
50-59	1.00	1.00	**Positive**	1.31↑	_
60-69	0.82 ↓	1.01 ↔	**Unknown**	0.90↔	_
70+	0.59 ↓	0.93 ↔	**Subtype**		
Current smoker			**Luminal A**	1.00	1.00
No	1.00	1.00	**Luminal B**	1.03↔	1.13 ↑
Yes	0.83 ↓	0.86 ↓	**HER2 over-expressing**	1.60 ↑	1.12 ↔
Screen-detected			**TNBC**	0.74 ↓	0.86 ↔
No	1.00		**Unknown**	0.99↔	0.97 ↔
Yes	0.82 ↓	_	**Grade**		
Surgeon/hospital caseload			**Low/intermediate**	1.00	
HV surgeon/HV hospital	1.00	_	**High**	0.95↔	_
HV surgeon/IV hospital	1.07 ↔	_	**Unknown**	1.25 ↑	_
HV surgeon/LV hospital	1.23 ↔	_	**Tumour size**		
IV surgeon/HV hospital	1.03 ↔	_	**T1**	1.00	1.00
IV surgeon/IV hospital	0.74 ↓	_	**T2**	1.28 ↑	1.16 ↑
IV surgeon/LV hospital	1.45 ↑	_	**T3/T4**	1.86 ↑	1.52 ↑
LV surgeon/HV hospital	1.28 ↑	_	**Unknown**	0.92↔	1.37 ↑
LV surgeon/IV hospital	1.48 ↑	_	**Nodal status**		
LV surgeon/LV hospital	1.56 ↑	_	**N0**	1.00	1.00
Surgeon caseload			**N1**	1.15 ↑	1.10 ↑
HV surgeon	_	1.00	**Unknown**	0.82↔	0.87 ↔
IV surgeon	_	1.20 ↑	**Metastasis**		
LV surgeon	_	1.17 ↑	**M0**	1.00	1.00
			M1	0.37 ↓	0.94 ↔
			Unknown	0.87 ↓	0.85 ↓

Hospital caseload: HV higher-volume (>=150–250 BC surgeries/year), IV intermediate-volume (70–150 BC surgeries/year), LV lower-volume (<70 BC surgeries/year)
Surgeon caseload: HV higher-volume (>=70 BC surgeries/year), IV intermediate-volume (35–69 BC surgeries/year), LV lower-volume (third tertile:<35 BC surgeries/year)
The **arrows** indicate statistically significant IRRs. ↓/↑ indicate that 95%CI excludes unity in the negative/positive direction; ↔ that there was no significant change

Conclusions

Our study shows that surgeon and hospital volume influence risk of reoperation of any type and that surgeon volume influences the risk of subsequent TM, suggesting that some of those re-operations could have been avoided by the centralisation of breast cancer management and the development of clearer guidelines on both the selection of women for BCS and the criteria for re-operation. Women diagnosed with breast cancer should be made aware of the possibility of re-operation when undergoing BCS: population-based data like this may inform the development of information resources to help enable them make informed treatment decisions.

A population-based study of hospital length of stay and emergency readmission following surgery for non-small cell lung cancer.

Joe McDevitt, Maria Kelly, Harry Comber, Tracy Kelleher, Fiona Dwane, Linda Sharp.

Eur J Cardiothorac Surg. 2013 Oct;44(4):e253-9. doi: 10.1093/ejcts/ezt389. Epub 2013 Jul 25. [25]

Introduction

Surgery is the mainstay of treatment with curative intent for non-small cell lung cancer (NSCLC) patients who are medically fit, with lobectomy as the treatment of first choice. Length of stay (LOS) in hospital after surgery impacts on cost and hospital performance. There is little definitive information on LOS following lung cancer resection; yet, the rate of lung cancer resection (as a proportion of lung NSCLC cases) is increasing in several European countries. Internationally, there is much variation in the reported median length of stay (LOS) after NSCLC resection. Complications are common after lung resection and can result in prolonged hospitalisation and early re-admission. We conducted a population-based analysis of time trends in length of stay (LOS) to identify predictors of prolonged LOS and emergency readmission (within 28 days of discharge) following resection for NSCLC in Ireland.

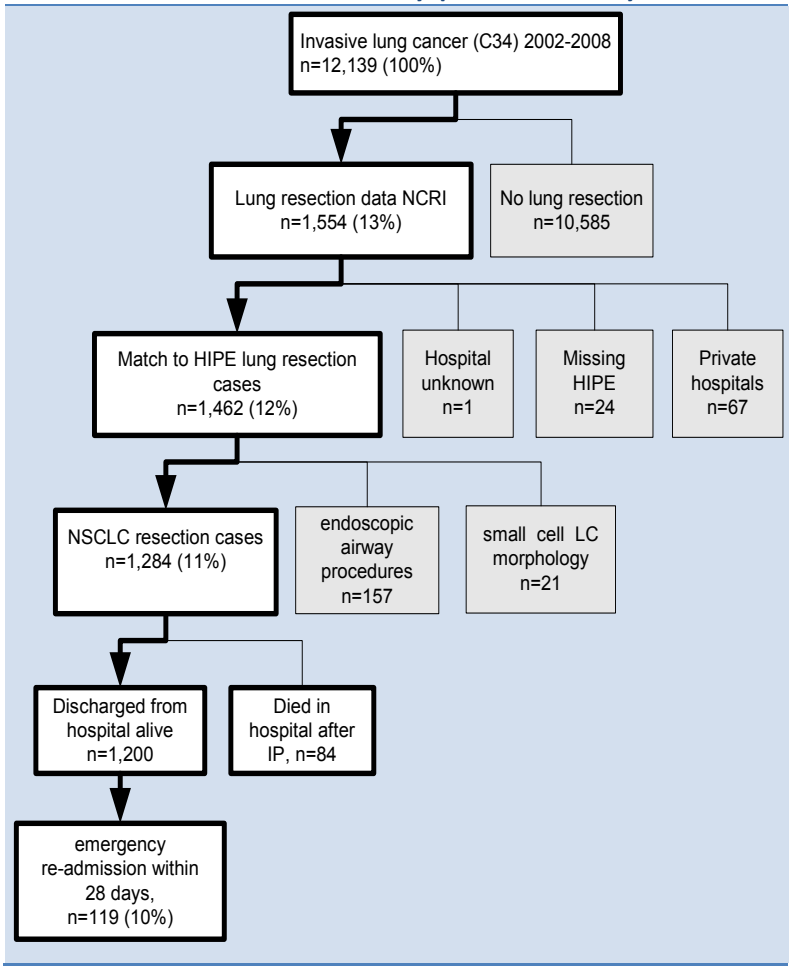
Methods

Incident lung cancers (ICDO2:C34), diagnosed 2002-2008, were identified from the National Cancer Registry (NCR) of Ireland, and linked to hospital in-patient episodes (HIPE). For those with non-small cell lung cancer who underwent lung resection, the associated hospital episode was identified. Factors predicting longer LOS (upper quartile, >20 days), and emergency readmission within 28 days of the index procedure (IP) were investigated using Poisson regression.

Results

1,284 patients underwent resection. 84 (7%) subsequently died in hospital and 1,200 (93%) were discharged. 119 of 1,200 (10%) were readmitted as an emergency within 28 days of discharge. Median LOS after the IP was 13 days (inter-decile range: 7-35). Risk of prolonged LOS was significantly greater in patients >75 years, resident in an area of highest deprivation, with 2+ comorbidities, underwent surgery in a lower volume hospital, or died in hospital subsequent to the IP. Emergency readmission was significantly more likely

Figure 1.
Patient selection: NSCLC lobectomy/pneumonectomy



in patients who were resident in an area of highest deprivation, with 2+ comorbidities, or had stage III disease or worse. The main reasons for emergency readmission were: pulmonary complications (29%), cardio/cerebrovascular events (21%), or infection (20%).

Table 1.
Factors associated with prolonged length-of-stay (LOS) and readmission in patients having resection for NSCLC: number (n) of total (N) (%) who had prolonged LOS (>20 days) & readmission, adjusted risk ratios (RR)

		PROLONGED LENGTH OF STAY (>20 days)					READMISSION WITHIN 28 DAYS				
		n	N	%	RR‡		n	N	%	RR*	
TOTAL		**312/**	**1,284**	**24%**			**119/**	**1,200**	**10%**		
AGE	**<55yr**	37/	204	18%	1		15/	201	7%		
	55-64yr	85/	423	20%	1.03	↔	42/	406	10%		
	65-74yr	128/	479	27%	1.32	↔	41/	441	9%		
	>75yr	62/	178	35%	1.55	↑	21/	152	14%		
SEX	**female**	132/	541	24%	-		50/	521	10%		
	male	180/	743	24%	-		69/	679	10%		
DEPRIVATION	**less deprived (^q1-4)**	158/	727	22%	1		57/	685	8%	1	
	most deprived (^q5)	138/	480	29%	1.30	↑	59/	441	13%	1.56	↑
	Unknown	16/	77	21%	1.03	↔	3/	74	4%	0.48	↔
COMORBIDITY	**none**	206/	931	22%	1		74/	879	8%	1	
	1	70/	264	27%	1.11	↔	30/	244	12%	1.43	↔
	2+	36/	89	40%	1.60	↑	15/	77	19%	2.38	↑
HOSPITAL VOLUME	**higher: ≥40/yr**	141/	661	21%	1					-	
	lower: <40/yr	171/	623	27%	1.24	↑				-	
DISCHARGE STATUS	**alive at discharge**	266/	1200	22%	1					-	
	died in hospital post IP	46/	84	55%	2.03	↑				-	
STAGE	**stage I/II**				-		72/	801	9%	1	
	stage III+				-		39/	281	14%	1.62	↑
	unstaged				-		8/	118	7%	0.83	↔

‡mutually adjusted for age, deprivation, comorbidity, hospital volume and discharge status & year of incidence.
*mutually adjusted for deprivation, comorbidity, stage and year of incidence
^quintiles of area-based deprivation score
The arrows indicate statistically significant RRs. ↓/↑ indicate that 95%CI excludes unity in the negative/positive direction

Conclusions

Half of the patients undergoing resection for NSCLC stay in hospital for more than 13 days. LOS is longer in Ireland when compared with other countries with published data. Deprivation, greater age, comorbidity and treatment at a lower volume hospital were identified as risk factors for prolonged LOS. Deprivation also predicted emergency readmission with 28 days, as did comorbidity and more advanced stage. Since socio-economic disadvantage is related to poorer survival from lung cancer, in the interests of equity, the reasons for the observed associations between deprivation and LOS and readmission require elucidation.

Trends in incidence of, and mortality from, cervical lesions in Ireland: Baseline data for future evaluation of the national cervical screening programme

Katie M. O'Brien, Linda Sharp

Cancer Epidemiol. 2013 Dec;37(6):830-5. doi: 10.1016/j.canep.2013.09.002. Epub 2013 Oct 12 [26].

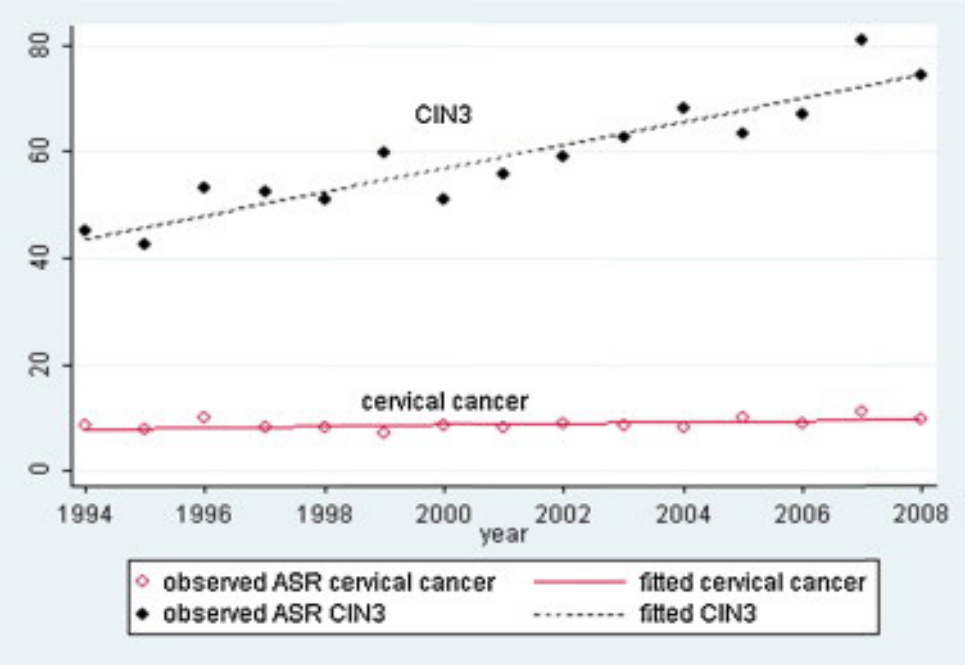
Background

The Irish national cervical screening programme, CervicalCheck, was launched in September 2008, following a pilot programme in the Mid-Western region. To facilitate future evaluations of the programme, we investigated trends and patterns in cervical cancer in the years before the national programme began, and compared incidence and mortality trends over time in Ireland with those in the countries of the United Kingdom (UK).

Methods

Details of invasive cancers (ICD10: code C53) and cervical *in situ* tumours, (ICD10: D06) were abstracted from the National Cancer Registry Ireland. Information on deaths due to cervical cancer (ICD10: C53) was downloaded from the WHO mortality database. Incidence and mortality rates were directly age standardised to the world standard population. Joinpoint software was used to estimate annual percent changes (APC) in the rates.

Figure 1.
Observed annual age-standardised rates (ASR) and modelled trends for period 1994–2008 for cervical cancer and cervical intraepithelial neoplasia, level 3 (CIN3).



Results

The age-standardised incidence rate for invasive cancer per annum increased from 8.5/100,000 in 1994–1998 to 9.5 in 2004–2008, an annual percentage change (APC) of +1.3% (Figure 1). Rates of CIN3 rose at 3.8% annually; this was most marked in women under 35.

Figure 2.
Modelled incidence trends for cervical cancer (of annual age-standardised incidence rates) for Ireland, Northern Ireland, England and Wales and Scotland

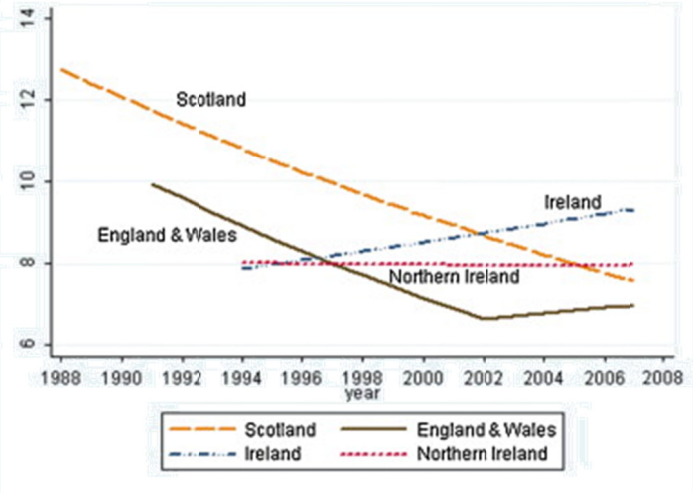
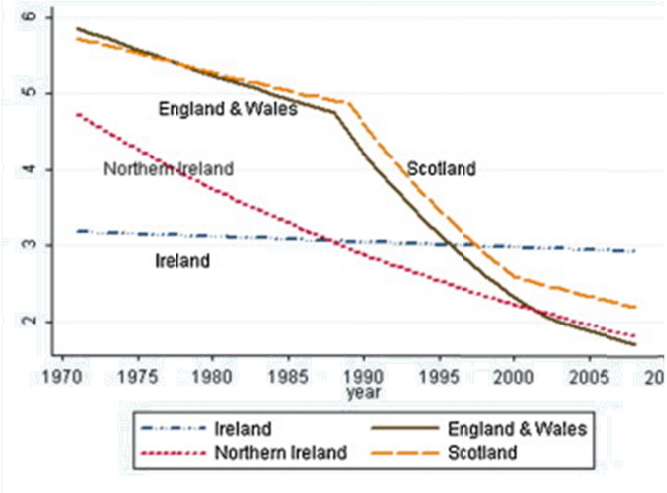


Figure 3.
Modelled mortality trends for cervical cancer (of annual age standardised mortality rates) for Ireland, Northern Ireland, England and Wales and Scotland



Conclusion

In contrast to the countries of the UK, in Ireland there was a modest rise in cervical cancer incidence during 1994–2008. The major risk factor for cervical cancer is human papillomavirus (HPV) and sexual behaviour is the primary risk factor for infection with HPV. A shift in sexual behaviour in Ireland is likely to have resulted in higher HPV prevalence, and higher cervical cancer rates. Other risk factors include smoking, oral contraceptive use, and high parity. Historic data on smoking are limited. Oral contraceptive use has increased since the end of the 1980s, while fertility has fallen, and these trends may have had a modest impact on incidence.

Opportunistic screening is likely to be the explanation for the rising incidence of CIN3; this is supported by the greater increase in incidence in younger women. In contrast to the UK, the cervical cancer mortality rate in Ireland has not fallen since the early 1970s. The countries of the UK have long-established population-based cervical cancer screening programmes. In Ireland, during the period of this study, screening was opportunistic. With opportunistic screening it is likely that some women had smear tests more often than necessary, while others had them too infrequently to offer protection. This study adds to international evidence demonstrating that opportunistic cervical cancer screening is ineffective.

Risk of several cancers is higher in urban areas after adjusting for socio-economic status (SES). Results from a two-country population-based study of 18 common cancers

L Sharp[1], D Donnelly[2], A Hegarty[3], A-E Carsin[4], S Deady[1], N McCluskey[1], A Gavin[2], H Comber[1]
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J Urban Health Bull N Y Acad Med 2014. [27]

Introduction

Although many studies suggest that cancer rates are higher in urban than rural areas, reported patterns of association differ by country, time period, site, gender and the measure of cancer burden considered. Exposure to many cancer risk factors varies across socio-economic groups and, in many countries, the socio-economic composition of urban and rural areas differs. This means that observed urban-rural variations may simply reflect socio-economic differences. We investigated urban-rural variations in the incidence of 18 common cancers–after adjusting for measures of socio-economic status–in Northern Ireland (NI) and the Republic of Ireland (RoI).

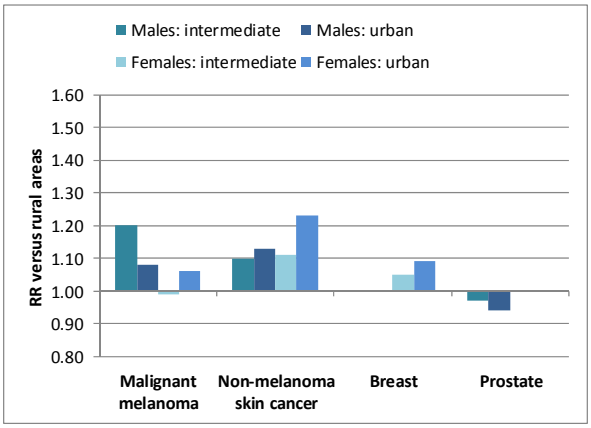
Methods

Data on cancers diagnosed 1995-2007 was abstracted from the Northern Ireland Cancer Registry and National Cancer Registry Ireland. Cases were assigned to the smallest geographic unit for which population-data is available (NI: wards; RoI: electoral divisions), based on the address at diagnosis. Population density was used as an ordinal indicator of the degree of urbanization of a geographical area. Three categories were created, each containing approximately one-third of the total population: "rural" (<1 person/hectare), "intermediate" (1-15 persons/hectare), and "urban" (>15 persons/hectare). Three markers of socio-economic status for each geographical area were obtained from NI 2001 and RoI 2002 census data: (1) unemployment–the proportion of the economically active population aged 16-74 resident in the area who were unemployed; (2) educational attainment–the proportion of people aged 16-74 resident in the area who had a university degree; and (3) elderly living alone–the proportion of people aged ≥75 resident in the area who lived alone.

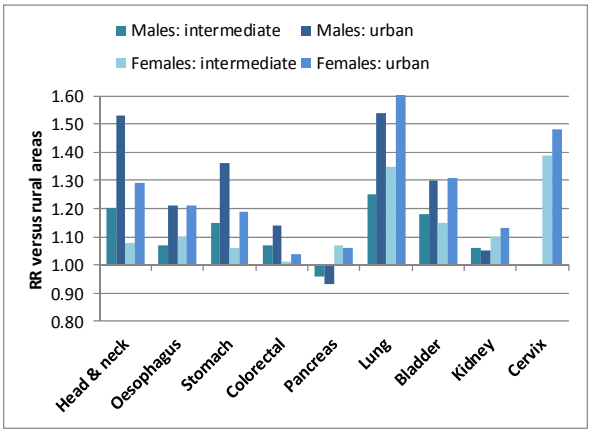
Relative risks (RR), with 95% confidence intervals, were estimated for categories for intermediate and urban (versus rural) areas, using negative binomial regression. RRs were adjusted for age, country and the three markers of socio-economic status. The results are presented in three groups: (1) cancers where incidence is generally considered to be positively associated with socio-

Figure 1:
Associations between urban-rural residence and cancer risk, relative risks (RR) for intermediate and urban areas

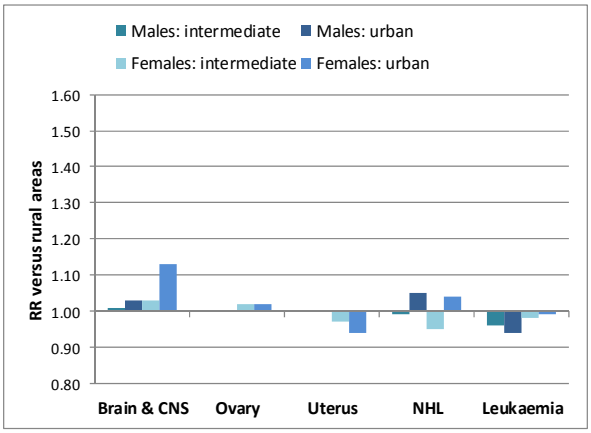
(a) cancers positively associated with SES



(c) cancers not associated with SES



(c) cancers not associated with SES



economic status; (2) cancers where incidence is generally considered to be negatively associated with socio-economic status; and (3) cancers where incidence does not vary by socio-economic status, or associations with socio-economic status are inconsistent.

Results

For two of the four cancers positively associated with socio-economic status (non-melanoma skin and breast cancer), risk increased with increasing urbanization (Figure 1(a)). For malignant melanoma, risk was slightly higher in urban than rural areas. For prostate cancer, RRs fell with increasing urbanization; men resident in urban areas had a statistically significant 6% lower risk of being diagnosed with prostate cancer than men in rural areas.

Of the nine cancers negatively associated with socio-economic status (Figure 1 (b)), one–pancreatic cancer–showed no relationship with urban-rural residence. For the eight other sites, risk was significantly higher in urban than rural residents, in at least one sex. The strongest associations (RRs raised by around 50% or more in urban areas) were seen for cancers of the head & neck (in males), lung (males and females) and cervix. Of the five cancers not associated with socio-economic status, risks for four (ovary and uterus cancer, non-Hodgkin's lymphoma (NHL) and leukaemia) did not vary significantly by urban-rural residence (Figure 1 (c)). Risk of cancers of the brain & CNS was significantly higher in urban than rural areas, but only in females.

Discussion

This study used high-quality cancer registration data and, although registration is not 100% complete, it is very unlikely that there are systematic geographical variations in completeness of a sufficient magnitude to cause the observed urban-rural differences in incidence. Socio-economic status was measured at an area-level, so there may be some misclassification and residual confounding. However, this is unlikely to be the sole explanation for the observed associations because (1) patterns of association between cancer risk and unemployment and educational attainment in this dataset were generally consistent with relationships with socio-economic status (at the area- and individual-level) reported in other developed countries and (2) incidence was higher in urban than rural areas for cancers which are positively (breast and non-melanoma skin cancer) and cancers which are negatively (for example, lung and head & neck cancer) associated with socio-economic status.

For some cancers (e.g. non-melanoma skin and prostate cancer), these raised risks are likely to be explained by variations in healthcare utilization. For others (e.g. lung, head & neck, cervix), they are probably due to geographical variations in known risk factors, most notably smoking and human papillomavirus infection. For others, there are no obvious explanations and, in the interests of greater equity, further investigation is warranted.

The impact of adjustment for socio-economic status on comparisons of cancer incidence between two European countries

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Journal of Cancer Epidemiology, 2013 [49]
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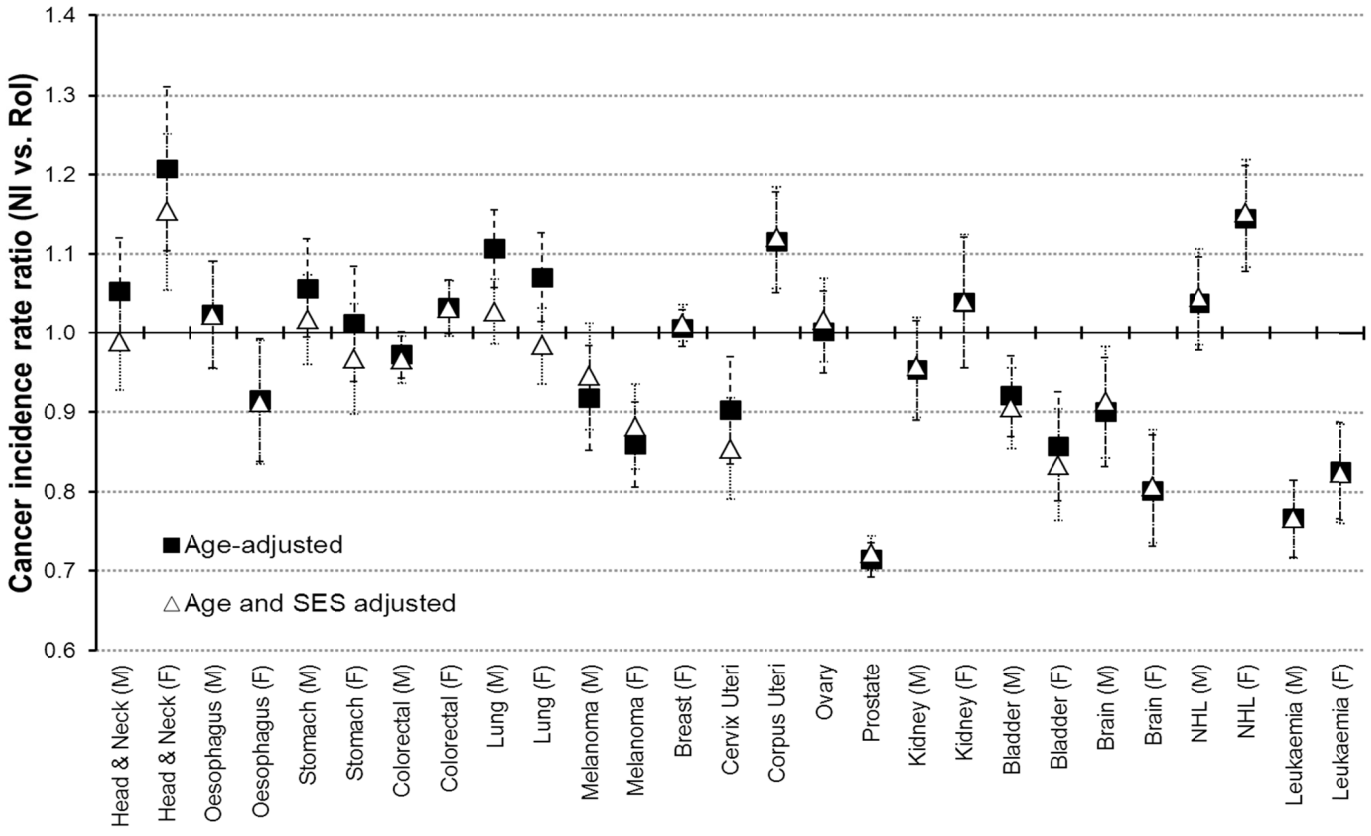
Background

Recent studies have shown differences between Northern Ireland (NI) and Republic of Ireland (RoI) in incidence rates for lung, bladder, brain, prostate, cervical, uterine and male colorectal cancer, leukaemia and female melanoma. Given the relationship between some cancers and socio-economic status (SES), the differences in cancer rates between the two countries may be partially due to different socio-economic situations in each country. We thus investigate the extent to which observed differences in cancer incidence between these two neighbouring countries are explained by socio-economic variations.

Figure 1:
Cancer incidence rate ratios with 95% confidence intervals - Northern Ireland compared to Republic of Ireland adjusted for (a) age and (b) age and socio-economic status



Methods

Data on 229,824 cases for 16 common cancers diagnosed in 1995-2007 was extracted from the cancer registries in NI and RoI. Each case was assigned a SES based upon area of residence at diagnosis. Negative binomial regression was utilized to derive the cancer incidence rate ratio comparing NI to RoI (IRR) adjusting for (i) age and (ii) age plus SES.

Results

A strong, positive relationship between cancer and SES was found for lung, head & neck, stomach, female bladder and cervical cancer, while a strong, negative relationship was found for melanoma. Weak, positive, relationships were present for male oesophageal, colorectal and bladder cancer and for female kidney cancer, while weak, negative relationships were present for breast (female only) and prostate cancers.

After adjusting for age only the risk of lung cancer among males and females and head & neck cancer, cancer of the corpus uteri and non-Hodgkin's lymphoma among females was significantly higher in NI than in RoI. Conversely the risk of melanoma, bladder cancer, brain cancer and leukaemia among males and females, prostate cancer among males, cervical cancer among females and oesophageal cancer among females was significantly lower in NI than in RoI (Fig. 1). Adjusting for SES in addition to age had a considerable impact on the cancer incidence rate ratio between NI and RoI for those cancers with a strong positive relationship with SES (lung, stomach, head & neck, cervix and female bladder). In particular before adjustment for SES lung cancer was 11% higher for males and 7% higher for females in NI than RoI, while after adjustment there was no longer a significant difference between the two countries. Cervical cancer rates however were lower in NI than in RoI after adjustment for age only (IRR: 0.90 (0.84-0.97)). This difference increased by a further 5% after adjustment for SES (IRR: 0.85 (0.79-0.92)).

Only melanoma had a strong negative relationship to SES. The melanoma IRR comparing NI and RoI changed marginally when adjusted for SES, rising from 0.92 (0.85-0.99) for males and 0.86 (0.81-0.92) for females when adjusted for age only to 0.95 (0.88-1.02) for males and 0.88 (0.83-0.94) for females when adjusted for age and SES. The remaining cancers either had no relationship to SES or had a weak relationship. For these cancers the adjustment for SES made little difference to the cancer incidence rate ratio comparing NI to RoI. (Fig. 1)

Conclusion

Socio-economic factors impact upon international comparisons of incidence for certain cancers. For four of the six cancers with a strong relationship to SES (lung cancer, head & neck cancer, stomach cancer and melanoma) the difference in incidence rates between RoI and NI was either eliminated or considerably reduced by adjustment for SES, while for two cancers (cervical and female bladder) the difference was increased. The changes in relative rate were likely to be a result of the relationship between SES and exposure to risk factors, and – for cervical cancer – availability of organised screening. Consequently we do not recommend that international comparisons are routinely adjusted for SES as this may mask underlying risk factors. However as evidenced by the elimination of lung cancer differences after SES adjustment such adjustment may be useful to identify why such differences exist. In conclusion, therefore, adjustment for SES can thus assist in elucidating international differences, but should not become a standard part of international comparisons.

A cohort study of digoxin exposure and mortality in men with prostate cancer

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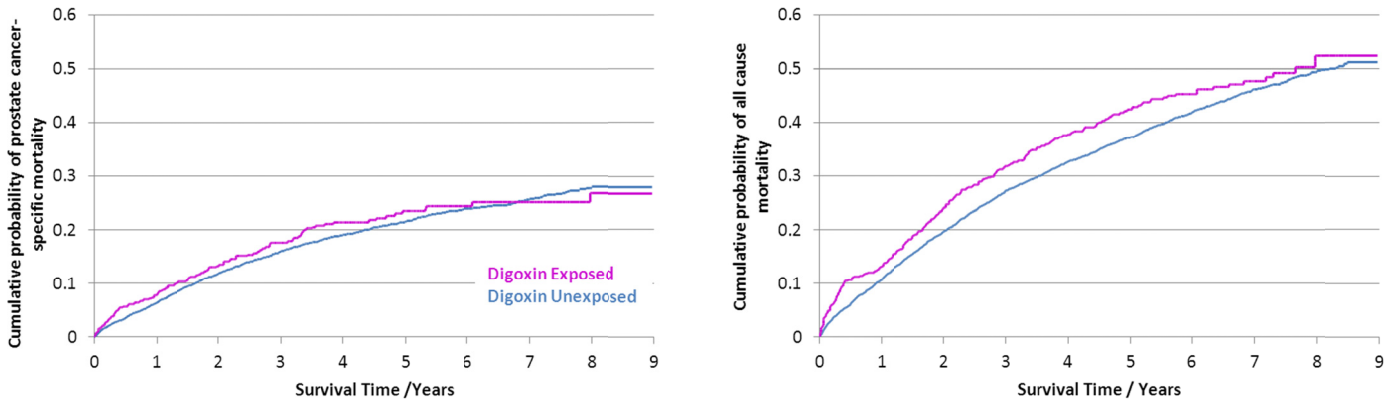
British Journal of Urology International 2013 Jun 13. doi: 10.1111/bju.12287. [28]

Background

Cancer pharmacoepidemiology bridges the disciplines of pharmacology, the study of the effects of medicines, with epidemiology, the study of diseases in a population. As many older people regularly take prescribed medicines, and prostate cancer is also prevalent in older populations, this presents an opportunity to study the association between exposure to these medicines and prostate cancer patient outcomes. Digoxin, a cardiac glycoside drug which comes from the foxglove plant and has been used since the eighteenth century to treat heart conditions, has more recently been proposed to have anti-cancer activity. Laboratory studies have proposed a number of anti-cancer mechanisms of digoxin in prostate cancer cells. Many laboratory studies have shown these effects, in relation to the development and growth of prostate tumours in mice. A study in the US has reported that men prescribed digoxin have a reduced risk of prostate cancer.

Fig. 1.
Adjusted cumulative probability curves of prostate cancer-specific and all-cause mortality



The aim of this study was to investigate in a cohort of Irish prostate cancer patients, whether men were prescribed digoxin had any survival benefit compared to those who were not prescribed digoxin.

Methods

This study was conducted using linked data from the National Cancer Registry Ireland and the pharmacy claims data of patients eligible for the General Medical Services (GMS) scheme. Men diagnosed with prostate cancer between 1/1/2001 and 31/12/2006 and with GMS eligibility for at least one year prior to their prostate cancer diagnosis were identified from the database. Pharmacy prescription claims were used to identify digoxin-exposed men at the time of prostate cancer diagnosis. Patient and tumour characteristics such as age at diagnosis, smoking status at diagnosis, tumour stage and tumour grade, were obtained from the NCRI database, and the pharmacy claims database was used to determine a comorbidity score (number of medication classes, continuous) and exposure to other prescription medicines. The date and cause of death (prostate cancer/other causes) were determined from the database, and men were followed-up from their diagnosis date to either death or 31/12/2009. Adjusted

hazard ratios (HR) and 95% confidence intervals (CI) were estimated for the association between digoxin exposure and all-cause and prostate cancer-specific mortality.

These analyses were repeated in a smaller cohort, where digoxin exposed patients were matched to digoxin unexposed patients with a similar likelihood to receive digoxin. This likelihood was determined using a propensity score, which was developed based on the patient factors and other medication associated with digoxin exposure. This is because digoxin is prescribed for atrial fibrillation and heart failure, and patients with these conditions may receive more conservative prostate cancer treatment.

Results

In total, 5,732 men with a prostate cancer diagnosis (2001-2006) were included in the study. Of these, N=391 were digoxin exposed at the time of diagnosis. Median follow-up 4.3 years. The propensity score matched cohort consisted of N=387 digoxin exposed patients matched to N=387 unexposed patients.

The association between digoxin exposure and prostate cancer-specific mortality was non-significant in the full cohort (HR=1.13, 95%CI 0.91, 1.42) and the propensity score matched cohort (HR=1.17, 95%CI 0.88, 1.57). These hazard ratios are adjusted for age at diagnosis, smoking status at diagnosis, comorbidity score, tumour stage, tumour grade, year of incidence and exposure to warfarin and statins. Adjusted HRs for all-cause mortality were increased for digoxin exposed men (HR=1.24, 95%CI 1.07, 1.43). These adjusted cumulative probability curves are presented in Fig. 1.

Discussion

These results do not suggest digoxin exposure is associated with reduced prostate cancer-specific mortality. This is in spite of the study reporting digoxin exposure to be associated with reduced prostate cancer incidence and a substantial amount of evidence from laboratory studies. This is potentially because the therapeutic doses of digoxin in humans are many times lower than those used in laboratory studies investigating the mechanisms of digoxin in prostate cancer cells. Further investigation of other cardiac glycosides which have shown anti-cancer potential may be warranted, however these studies are far more difficult to conduct as these are not used as existing medicines in patient populations and less is known about their safety and toxicity in humans.

Conclusions

Although no benefit was observed in men who received digoxin, this study adds to the evidence base regarding digoxin in prostate cancer.

A cohort study of metformin exposure and survival in patients with stage I-III colorectal cancer.

Cancer Epidemiol Biomarkers Prev. 2013 Aug;22(8):1364-73. doi: 10.1158/1055-9965.EPI-13-0347. Epub 2013 Jun 10. [29]

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[‡] National Cancer Registry Ireland, Cork, Ireland.

Background

Preclinical evidence suggests a beneficial effect of metformin in colorectal cancer. This study aimed to investigate associations between metformin exposure and colorectal cancer-specific survival using population-level data. This study also aimed to explore the influence of exposure intensity (or frequency of exposure), and co-prescription with other anti-diabetic drugs (ADD), on such associations.

Methods

Adult patients with stage I-III colorectal cancer diagnosed from 2001 to 2006 were identified from the National Cancer Registry Ireland. Use of metformin and other anti-diabetic medications was determined from linked prescription claims data from the HSE-Primary Care Reimbursement Services General Medical Services scheme. Multivariate Cox regression was used to estimate hazard ratios (HR) with 95% confidence intervals (CI) for associations between metformin exposure in the year prior to diagnosis (versus non-metformin anti-diabetic drugs) and colorectal cancer-specific mortality. Models were stratified by anti-diabetic drug co-prescription and intensity of metformin exposure.

Results

Person-time contributed by the overall diabetic group totalled 1,194 person-years; the crude colorectal cancer-specific mortality rates for metformin-exposed and unexposed patients were 70 and 97 deaths per 1,000 person-years respectively. In multivariate analyses, exposure to metformin was associated with a lower risk of colorectal cancer-specific mortality and this approached statistical significance (HR 0.61, 95% CI 0.37-1.01; Figure 1). In analyses stratified by co-prescription with non-metformin anti-diabetic drugs, metformin exposure, exclusively or co-prescribed, was associated with 39% and 30% lower risk of colorectal cancer-specific mortality respectively, but these estimates were not statistically significant (Figure 2). Significant associations between metformin use and colorectal cancer-specific mortality were observed in analyses stratified by both metformin dosing intensity and co-prescription with non-metformin anti-diabetic drugs. In comparison to diabetics not receiving metformin, the risk of colorectal cancer-specific mortality was significantly lower in patients receiving metformin exclusively at high intensity (HR 0.44, 95% CI 0.20-0.95). Use of metformin exclusively at low intensity was not associated with a lower risk of colorectal cancer-specific mortality (HR 0.81, 95%CI 0.41-1.58). No significant associations were observed for metformin exposure at either high or low intensity when co-prescribed with non-metformin anti-diabetic drugs.

Conclusion

This study provides moderate evidence of an association between metformin exposure and improved colorectal cancer survival in a diabetic population. Other recent studies have also examined associations between metformin exposure and colorectal cancer survival among diabetic patients. Two of these studies reported significant associations between metformin exposure (versus no metformin exposure) and improved survival, while the most recent study, which was restricted to post-menopausal women, did not find a significant association.

In the present study, the result for overall metformin exposure was consistent with the findings of the two previous single-centre studies of metformin exposure and survival in colorectal cancer. This study is also the first, to the authors' knowledge, to assess the presence of an exposure response effect between increasing metformin use and colorectal cancer outcomes. In analyses stratified by metformin exposure intensity there was little difference in associations between low and high intensity metformin exposure and colorectal cancer-specific mortality. However, there was a suggestion that a stronger association was present for high intensity metformin use among those patients receiving metformin exclusively. It should be noted that the number of patients in these subgroup analyses was small; hence these results require further confirmation in larger studies.

Figure 1.
Direct adjusted survival curve. Adjusted cumulative incidences of colorectal cancer–specific mortality for metformin users and nonusers in diabetic patients with stages I–III colorectal cancer. Cumulative incidences are adjusted for tumour stage, tumour grade, year of diagnosis, comorbidity score, aspirin use, exposure to non-metformin ADDs (sulfonylureas yes/no, insulin yes/no, and/or other ADDs yes/no), socioeconomic status, and radiotherapy.

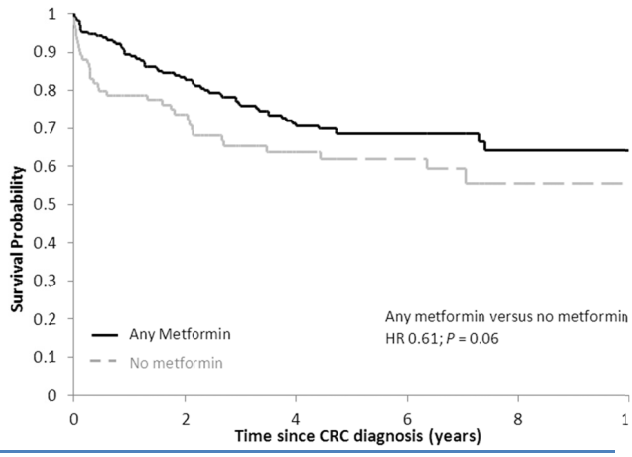
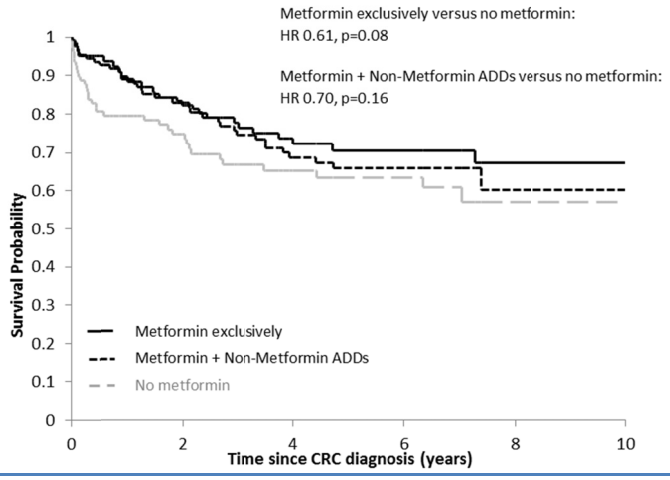


Figure 2.
Direct adjusted survival curve. Adjusted cumulative incidences of colorectal cancer–specific mortality for metformin users and nonusers in diabetic patients with stages I–III colorectal cancer; stratified by co-prescription with non-metformin ADDs. Cumulative incidences are adjusted for tumour stage, tumour grade, year of diagnosis, comorbidity score, aspirin use, socioeconomic status, and radiotherapy.



A nested case control study of adjuvant hormonal therapy persistence and compliance, and early breast cancer recurrence in women with stage I-III breast cancer

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Background

The use of adjuvant hormonal therapy (e.g. tamoxifen, anastrozole) reduces the number of women who will develop a breast cancer recurrence by 50%. However, to achieve this benefit women need to take these treatments for at least five and up to ten years. Many women find that the side effects of hormonal therapies are difficult to tolerate and discontinue treatment early because of these. Missing treatment doses (non-compliance) and early treatment discontinuation (non-persistence) are common in women prescribed hormonal therapies for breast cancer. Studies indicate that one in five women will regularly miss treatment doses and one in three women will discontinue treatment completely within 3-5 years of initiation. Little is known about the influence of these medication-taking behaviours on a woman's risk of early breast cancer recurrence. The aim of this study was to examine associations between hormonal therapy non-compliance, non-persistence and the risk of early breast cancer recurrence in women with a diagnosis oestrogen receptor positive breast cancer.

Methods

We used linked information from the National Cancer Registry Ireland and Ireland's Primary Care Reimbursement Services (PCRS) pharmacy claims database to conduct a nested case control study of associations between early breast cancer recurrence and hormonal therapy non-persistence and non-compliance. From this data we identified women between the ages of 40 and 80 years old with a diagnosis of stage I-III, ER-positive breast cancer between 1st January 2002 and 31st December 2006, who had received tumour directed surgery (lumpectomy or mastectomy) and filled at least one prescription for hormonal therapy within one year of their breast cancer diagnosis. We defined cases as women with a breast cancer recurrence within four years of hormonal therapy initiation and matched these to controls in a ratio of 1:5 by tumour stage and age (5 year calliper) using incidence density sampling without replacement. The date of recurrence for a case was assigned as the index date for each matched control. Measures of hormonal therapy persistence and compliance were calculated from linked prescription refill data. We then used conditional logistic regression to estimate odds ratios with 95% confidence intervals (CI) for associations between breast cancer recurrence and hormonal therapy medication taking behaviours. We also undertook sensitivity analyses to estimate the potential impact of misclassification of breast cancer recurrence on the primary analysis.

Results

We matched 94 women with a breast cancer recurrence to 458 controls. In multivariate analyses of hormonal therapy compliance and persistence, adjusted for prognostic tumour and patient-characteristics, breast cancer recurrence odds ratios were increased for women in the non-persistent group. Women who were non-persistent with treatment had a significantly increased adjusted recurrence odds ratio of 2.88 (95%CI [1.11, 7.46]; 8 cases, 14 controls; Table 1) in comparison to women who persisted with treatment. The results from probabilistic sensitivity analyses correcting for possible non-differential and differential misclassification of breast cancer recurrence were consistent with these findings.

Table 1.
Number and percentages of cases and control and univariate and multivariate odds ratios for breast cancer recurrence

Medication-taking behaviour	Cases (%)[a] (n= 94)	Controls (%)[a] (n=458)	Univariate odds ratio (95% CI)	Multivariate odds ratio (95% CI)[b]
Persistence and compliance[e]				
Hormonal therapy persistence[c,d]				
Persistent	86 (91.5)	444 (96.9)	**Ref**	**Ref**
Non-persistent(>180 day gap)	8 (8.5)	14 (3.1)	3.00 (1.18, 7.60)	2.88 (1.11, 7.46)
Hormonal therapy compliance[e,f]				
High (98–100%)	30 (31.9)	154 (33.6)	**Ref**	**Ref**
Intermediate (90–98%)	28 (29.8)	156 (34.1)	0.96 (0.53, 1.71)	0.95 (0.53, 1.71)
Low (0–90%)	36 (38.3)	148 (32.3)	1.24 (0.71, 2.14)	1.30 (0.74, 2.30)
Cumulative exposure				
Cumulative hormonal therapy exposure[g]				
High (98–100%)	24 (25.5)	144 (31.4)	**Ref**	**Ref**
Intermediate (90–98%)	27 (28.7)	153 (33.4)	1.04 (0.57, 1.91)	1.02 (0.55, 1.90)
Low (0–90%)	43 (45.7)	161 (35.2)	1.60 (0.91, 2.81)	1.62 (0.91, 2.88)

a. Cases: women with a breast cancer recurrence within 4 years of hormonal therapy initiation. Controls: women without a breast cancer recurrence at the time of a matched case's recurrence. Controls were randomly matched to cases in a ratio of 5:1, on tumour stage at diagnosis and age within a calliper of 5 years, using incidence density sampling without replacement.
b. Adjusted for tumour grade (low, intermediate, high and unspecified), progesterone receptor status (positive, negative and unspecified) and comorbidity score.
c. The number of consecutive non-persistent days from the last day of hormonal therapy availability to the index date, stratified as persistent (<180 day gap) and non-persistent (>180 day gap).
d. Adjusted for hormonal therapy compliance.
e. The proportion of days covered up to the first of either the date of non-persistence or the case/control index date, stratified by tertiles.
f. Adjusted for hormonal therapy persistence.
g. The proportion of days covered up to the case/control index date.

Discussion

Our results suggest that women who stop their hormonal therapy before completing at least 5 years of treatment are much more likely to have a breast cancer recurrence than women who continue to take their treatment. This raises the possibility that increasing persistence with hormonal therapy could reduce recurrence rates in women with early breast cancer. To date, however, simple educational interventions to increase the number of women who take their hormonal therapy have had limited success. It is likely that interventions targeted at modifiable risk factors for non-persistence may be required. We were not able to determine the reasons why women in our study did not take their hormonal therapy; although previous studies have reported that side effects are one of the strongest influences on a woman's decision to persist with treatment. Our research group is now working on developing ways to increase the number of women who can take their hormonal therapy for at least five years.

Conclusions

Hormonal therapy non-persistence was associated with significantly higher risk of breast cancer recurrence in women with stage I–III ER-positive early breast cancer. By implication, there is need of interventions aimed at increasing persistence with hormonal therapy.

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APPENDIX I: SUMMARY TABLE - CANCER INCIDENCE 2009-2011

ICD10 cancer site (INCIDENCE 2009-2011)	FEMALES					MALES					TOTAL				
‡all invasive cancers minus NMSC (C44) C00-C43, C45-C96 † ASR: Age standardised rate (cases)/100,000 (standardised to the European population) *cumulative risk (%) to age 75 years	annual average 2009-2011	‡% of all invasive cancer incidence	% of all registered cancer incidence	†ASR	*risk to 75yr %	annual average 2009-2011	‡% of all invasive cancer incidence	% of all registered cancer incidence	†ASR	*risk to 75yrs %	annual average 2009-2011	‡% of all invasive cancer incidence	% of all registered cancer incidence	†ASR	*risk to 75yrs %
C00: lip	4	0.1%	<0.1%	0.2	0.02	16	0.2%	0.1%	0.8	0.06	20	0.1%	0.1%	0.4	0.04
C01: base of tongue	6	0.1%	<0.1%	0.3	0.03	21	0.2%	0.1%	1.0	0.10	27	0.1%	0.1%	0.6	0.06
C02: other tongue	27	0.3%	0.2%	1.2	0.10	39	0.4%	0.2%	1.8	0.16	66	0.3%	0.2%	1.5	0.13
C03: gum	10	0.1%	0.1%	0.4	0.04	9	0.1%	0.1%	0.4	0.04	19	0.1%	0.1%	0.4	0.04
C04: floor of mouth	8	0.1%	0.1%	0.4	0.04	20	0.2%	0.1%	1.0	0.09	28	0.2%	0.1%	0.7	0.06
C05: palate	8	0.1%	<0.1%	0.3	0.03	11	0.1%	0.1%	0.5	0.05	19	0.1%	0.1%	0.4	0.04
C06: other mouth	15	0.2%	0.1%	0.6	0.05	17	0.2%	0.1%	0.8	0.07	32	0.2%	0.1%	0.7	0.06
C07: parotid	14	0.2%	0.1%	0.6	0.05	15	0.2%	0.1%	0.7	0.05	30	0.2%	0.1%	0.6	0.05
C08: other salivary	4	<0.1%	<0.1%	0.2	0.01	5	0.1%	<0.1%	0.2	0.02	8	<0.1%	<0.1%	0.2	0.02
C09: tonsil	13	0.2%	0.1%	0.6	0.05	35	0.3%	0.2%	1.7	0.14	49	0.3%	0.1%	1.2	0.10
C10: oropharynx	4	<0.1%	<0.1%	0.2	0.02	11	0.1%	0.1%	0.5	0.04	15	0.1%	<0.1%	0.4	0.03
C11: nasopharynx	4	0.1%	<0.1%	0.2	0.02	14	0.1%	0.1%	0.7	0.06	19	0.1%	0.1%	0.4	0.04
C12: pyriform	3	<0.1%	<0.1%	0.1	0.01	19	0.2%	0.1%	0.9	0.09	22	0.1%	0.1%	0.5	0.05
C13: hypopharynx	4	0.1%	<0.1%	0.2	0.01	12	0.1%	0.1%	0.6	0.05	17	0.1%	0.1%	0.4	0.03
C14: other mouth/pharynx	3	<0.1%	<0.1%	0.1	0.01	12	0.1%	0.1%	0.6	0.05	15	0.1%	<0.1%	0.4	0.03
C01-C14: all mouth & pharynx	126	1.4%	0.7%	5.4	0.45	241	2.4%	1.5%	11.5	1.00	367	1.9%	1.1%	8.4	0.72
C15: oesophagus	131	1.5%	0.7%	5.0	0.38	252	2.5%	1.5%	11.9	0.97	384	2.0%	1.1%	8.3	0.67
C16: stomach	194	2.2%	1.1%	7.5	0.51	332	3.2%	2.0%	15.6	1.20	526	2.7%	1.5%	11.3	0.85
C17: small intestine	24	0.3%	0.1%	1.0	0.07	39	0.4%	0.2%	1.8	0.16	64	0.3%	0.2%	1.4	0.11
C18: colon	707	7.9%	4.0%	27.9	2.06	855	8.3%	5.2%	40.2	3.06	1562	8.1%	4.5%	33.5	2.55
C19: rectosigmoid	70	0.8%	0.4%	2.9	0.22	108	1.1%	0.7%	5.1	0.39	178	0.9%	0.5%	3.9	0.30
C20: rectum	225	2.5%	1.3%	9.2	0.72	421	4.1%	2.6%	19.9	1.65	647	3.4%	1.9%	14.3	1.18

ICD10 cancer site (INCIDENCE 2009-2011)	FEMALES					MALES					TOTAL				
‡all invasive cancers minus NMSC (C44) C00-C43, C45-C96 † ASR: Age standardised rate (cases)/100,000 (standardised to the European population) *cumulative risk (%) to age 75 years	annual average 2009-2011	‡% of all invasive cancer incidence	% of all registered cancer incidence	†ASR	*risk to 75yr %	annual average 2009-2011	‡% of all invasive cancer incidence	% of all registered cancer incidence	†ASR	*risk to 75yrs %	annual average 2009-2011	‡% of all invasive cancer incidence	% of all registered cancer incidence	†ASR	*risk to 75yrs %
C21: anus	28	0.3%	0.2%	1.2	0.09	21	0.2%	0.1%	1.0	0.07	49	0.3%	0.1%	1.1	0.08
C18-C21: colorectal	1031	11.5%	5.8%	41.1	3.07	1405	13.7%	8.5%	66.1	5.09	2436	12.7%	7.1%	52.8	4.07
C22: liver	64	0.7%	0.4%	2.5	0.19	132	1.3%	0.8%	6.2	0.50	196	1.0%	0.6%	4.3	0.34
C23: gallbladder	29	0.3%	0.2%	1.2	0.09	13	0.1%	0.1%	0.6	0.05	43	0.2%	0.1%	0.9	0.07
C24: other biliary	46	0.5%	0.3%	1.7	0.10	49	0.5%	0.3%	2.3	0.16	95	0.5%	0.3%	2.0	0.13
C25: pancreas	225	2.5%	1.3%	8.7	0.62	253	2.5%	1.5%	12.0	0.93	478	2.5%	1.4%	10.3	0.77
C26: other digestive	19	0.2%	0.1%	0.7	0.05	16	0.2%	0.1%	0.8	0.05	35	0.2%	0.1%	0.7	0.05
C30: nasal cavity/middle ear	6	0.1%	<0.1%	0.2	0.02	8	0.1%	0.1%	0.4	0.03	14	0.1%	<0.1%	0.3	0.02
C31: sinuses	2	<0.1%	<0.1%	0.1	0.01	8	0.1%	0.1%	0.4	0.02	10	0.1%	<0.1%	0.2	0.01
C32: larynx	21	0.2%	0.1%	0.9	0.08	133	1.3%	0.8%	6.4	0.55	154	0.8%	0.5%	3.6	0.31
C33: trachea	2	<0.1%	<0.1%	0.1	0.01	1	<0.1%	<0.1%	0.1	<0.01	3	<0.1%	<0.01%	0.1	<0.01
C34: lung	904	10.1%	5.1%	37.0	2.93	1261	12.3%	7.6%	59.5	4.63	2165	11.3%	6.3%	47.1	3.77
C37: thymus	3	<0.1%	<0.1%	0.2	0.01	4	<0.1%	<0.1%	0.2	0.02	8	<0.1%	<0.1%	0.2	0.02
C38: mediastinum	5	0.1%	<0.1%	0.2	0.01	10	0.1%	0.1%	0.4	0.03	14	0.1%	<0.1%	0.3	0.02
C40: bones, joints of limbs	4	0.1%	<0.1%	0.2	0.01	13	0.1%	0.1%	0.6	0.05	17	0.1%	0.1%	0.4	0.03
C41: bones, joints head	6	0.1%	<0.1%	0.2	0.02	12	0.1%	0.1%	0.5	0.04	18	0.1%	0.1%	0.4	0.03
C43: melanoma of skin	485	5.4%	2.7%	20.3	1.60	367	3.6%	2.2%	17.0	1.33	852	4.4%	2.5%	18.6	1.47
C44: non-melanoma skin (NMSC)	3810	-	21.4%	152.7	11.13	4764	-	28.9%	223.9	15.75	8575	-	25.0%	184.8	13.41
C45: mesothelioma	6	0.1%	<0.1%	0.3	0.02	30	0.3%	0.2%	1.4	0.12	36	0.2%	0.1%	0.8	0.07
C46: Kaposi's sarcoma	1	<0.1%	<0.01%	0.0	<0.01	5	0.1%	<0.1%	0.2	0.02	6	<0.1%	<0.1%	0.1	0.01
C47: peripheral nerves	3	<0.1%	<0.1%	0.2	0.01	2	<0.1%	<0.1%	0.1	<0.01	5	<0.1%	<0.1%	0.1	0.01
C48: peritoneum	14	0.2%	0.1%	0.6	0.05	4	<0.1%	<0.1%	0.2	0.01	18	0.1%	0.1%	0.4	0.03
C49: connective tissues	42	0.5%	0.2%	1.8	0.14	66	0.6%	0.4%	3.0	0.21	108	0.6%	0.3%	2.3	0.17
C50: breast	2781	31.0%	15.6%	123.7	9.69	23	0.2%	0.1%	1.1	0.08	2805	14.6%	8.2%	63.9	5.04

ICD10 cancer site (INCIDENCE 2009-2011)	FEMALES					MALES					TOTAL				
‡all invasive cancers minus NMSC (C44) C00-C43, C45-C96 † ASR: Age standardised rate (cases)/100,000 (standardised to the European population) *cumulative risk (%) to age 75 years	annual average 2009-2011	‡% of all invasive cancer incidence	% of all registered cancer incidence	†ASR	*risk to 75yr %	annual average 2009-2011	‡% of all invasive cancer incidence	% of all registered cancer incidence	†ASR	*risk to 75yrs %	annual average 2009-2011	‡% of all invasive cancer incidence	% of all registered cancer incidence	†ASR	*risk to 75yrs %
C51: vulva	46	0.5%	0.3%	1.8	0.14	-	-	-	-	-	46	0.2%	0.1%	1.0	0.07
C52: vagina	10	0.1%	0.1%	0.4	0.03	-	-	-	-	-	10	0.1%	<0.1%	0.2	0.02
C53: cervix	328	3.7%	1.8%	14.1	1.09	-	-	-	-	-	328	1.7%	1.0%	7.1	0.55
C54: corpus uteri	400	4.5%	2.3%	18.0	1.63	-	-	-	-	-	400	2.1%	1.2%	9.2	0.83
C55: uterus NOS	26	0.3%	0.1%	1.1	0.09	-	-	-	-	-	26	0.1%	0.1%	0.6	0.04
C56: ovary	344	3.8%	1.9%	14.7	1.21	-	-	-	-	-	344	1.8%	1.0%	7.7	0.61
C57: other female genital	15	0.2%	0.1%	0.6	0.05	-	-	-	-	-	15	0.1%	<0.1%	0.3	0.02
C58: placenta	3	<0.1%	<0.1%	0.1	0.01	-	-	-	-	-	3	<0.1%	<0.1%	0.1	<0.01
C60: penis	-	-	-	-	-	28	0.3%	0.2%	1.3	0.09	28	0.2%	0.1%	0.6	0.05
C61: prostate	-	-	-	-	-	3267	31.9%	19.8%	156.4	13.50	3267	17.0%	9.5%	74.8	6.91
C62: testis	-	-	-	-	-	172	1.7%	1.0%	7.1	0.52	172	0.9%	0.5%	3.6	0.26
C63: other male genital	-	-	-	-	-	4	<0.1%	<0.1%	0.2	0.01	4	<0.1%	<0.1%	0.1	0.01
C64: kidney	181	2.0%	1.0%	7.6	0.65	329	3.2%	2.0%	15.6	1.28	509	2.7%	1.5%	11.4	0.96
C65: renal pelvis	7	0.1%	<0.1%	0.3	0.02	13	0.1%	0.1%	0.6	0.05	20	0.1%	0.1%	0.4	0.04
C66: ureter	8	0.1%	<0.1%	0.3	0.02	9	0.1%	0.1%	0.4	0.04	17	0.1%	0.1%	0.4	0.03
C67: bladder	131	1.5%	0.7%	5.0	0.35	318	3.1%	1.9%	14.9	1.03	450	2.3%	1.3%	9.5	0.68
C68: other urinary	2	<0.1%	<0.1%	0.1	<0.01	2	<0.1%	<0.1%	0.1	0.01	4	<0.1%	<0.1%	0.1	0.01
C69: eye	16	0.2%	0.1%	0.7	0.05	18	0.2%	0.1%	0.8	0.06	33	0.2%	0.1%	0.7	0.06
C70: meninges	7	0.1%	<0.1%	0.3	0.02	6	0.1%	<0.1%	0.3	0.02	13	0.1%	<0.1%	0.3	0.02
C71: brain	139	1.6%	0.8%	6.0	0.48	182	1.8%	1.1%	8.4	0.70	322	1.7%	0.9%	7.2	0.59
C72: spinal cord	8	0.1%	<0.1%	0.3	0.02	3	<0.1%	<0.1%	0.1	0.01	11	0.1%	<0.1%	0.2	0.02
C73: thyroid	159	1.8%	0.9%	6.9	0.55	54	0.5%	0.3%	2.5	0.21	213	1.1%	0.6%	4.7	0.38
C74: adrenal	7	0.1%	<0.1%	0.3	0.02	11	0.1%	0.1%	0.5	0.03	18	0.1%	0.1%	0.4	0.03
C75: other endocrine	5	0.1%	<0.1%	0.2	0.01	9	0.1%	0.1%	0.4	0.03	13	0.1%	<0.1%	0.3	0.02

ICD10 cancer site (INCIDENCE 2009-2011)	FEMALES					MALES					TOTAL				
‡all invasive cancers minus NMSC (C44) C00-C43, C45-C96 † ASR: Age standardised rate (cases)/100,000 (standardised to the European population) *cumulative risk (%) to age 75 years	annual average 2009-2011	‡% of all invasive cancer incidence	% of all registered cancer incidence	†ASR	*risk to 75yr %	annual average 2009-2011	‡% of all invasive cancer incidence	% of all registered cancer incidence	†ASR	*risk to 75yrs %	annual average 2009-2011	‡% of all invasive cancer incidence	% of all registered cancer incidence	†ASR	*risk to 75yrs %
C76: ill-defined site	11	0.1%	0.1%	0.4	0.02	6	0.1%	<0.1%	0.3	0.02	17	0.1%	0.1%	0.4	0.02
C80: unknown primary site	250	2.8%	1.4%	9.1	0.60	233	2.3%	1.4%	10.9	0.70	484	2.5%	1.4%	9.9	0.65
C81: Hodgkin's lymphoma	67	0.7%	0.4%	2.9	0.22	74	0.7%	0.5%	3.3	0.26	140	0.7%	0.4%	3.1	0.24
C82: follicular non-Hodgkin's lymphoma	82	0.9%	0.5%	3.6	0.31	81	0.8%	0.5%	3.8	0.31	162	0.8%	0.5%	3.7	0.31
C83: diffuse non-Hodgkin's lymphoma	132	1.5%	0.7%	5.5	0.45	172	1.7%	1.0%	8.0	0.62	304	1.6%	0.9%	6.7	0.53
C84: peripheral and cutaneous T cell lymphoma	21	0.2%	0.1%	0.9	0.07	35	0.3%	0.2%	1.7	0.13	56	0.3%	0.2%	1.2	0.10
C85: other and unspecified NHL	82	0.9%	0.5%	3.4	0.27	87	0.9%	0.5%	4.0	0.30	169	0.9%	0.5%	3.7	0.29
C82-C85: all non-Hodgkin's lymphoma	317	3.5%	1.8%	13.3	1.10	375	3.7%	2.3%	17.5	1.36	692	3.6%	2.0%	15.3	1.23
C81-C85: all lymphoma	383	4.3%	2.2%	16.2	1.32	449	4.4%	2.7%	20.8	1.62	832	4.3%	2.4%	18.4	1.46
C88: malignant immunoproliferative disease	8	0.1%	<0.1%	0.3	0.03	10	0.1%	0.1%	0.5	0.04	18	0.1%	0.1%	0.4	0.03
C90: multiple myeloma	101	1.1%	0.6%	3.9	0.29	140	1.4%	0.9%	6.6	0.50	241	1.3%	0.7%	5.2	0.39
C91: lymphoid leukaemia	101	1.1%	0.6%	4.3	0.34	160	1.6%	1.0%	7.5	0.56	261	1.4%	0.8%	5.8	0.45
C92: myeloid leukaemia	72	0.8%	0.4%	3.0	0.23	106	1.0%	0.6%	4.9	0.36	178	0.9%	0.5%	3.9	0.30
C93: monocytic leukaemia	2	<0.1%	<0.1%	0.1	<0.01	1	<0.1%	<0.1%	<0.1	<0.01	3	<0.1%	<0.1%	0.1	<0.01
C94: other specified leukaemia	3	<0.1%	<0.1%	0.1	0.01	5	0.1%	<0.1%	0.3	0.02	8	<0.1%	<0.1%	0.2	0.01
C95: unspecified leukaemia	14	0.2%	0.1%	0.5	0.03	15	0.2%	0.1%	0.7	0.04	30	0.2%	0.1%	0.6	0.03
C91-C95: all leukaemia	191	2.1%	1.1%	8.0	0.60	288	2.8%	1.7%	13.4	0.98	479	2.5%	1.4%	10.5	0.79
C96: other lymphoid and haematopoietic	1	<0.1%	<0.1%	<0.1	<0.01	2	<0.1%	<0.1%	0.1	0.01	3	<0.1%	<0.1%	0.1	<0.01
D03: in situ: melanoma	254	-	1.4%	10.9	0.93	215	-	1.3%	10.1	0.87	469	-	1.4%	10.4	0.90
D04: in situ: carcinoma of skin	921	-	5.2%	35.6	2.76	572	-	3.5%	26.8	2.04	1492	-	4.4%	31.6	2.41
D05: in situ: breast	340	-	1.9%	16.1	1.33	1	-	<0.1%	<0.1	<0.01	341	-	1.0%	8.1	0.67
D06: in situ: cervix	2847	-	16.0%	110.8	7.66	-	-	-	-	-	2847	-	8.3%	55.9	3.94
D32-D33: benign: brain & CNS	114	-	0.6%	4.9	0.40	44	-	0.3%	2.0	0.15	157	-	0.5%	3.5	0.28
D42-D43: uncertain: brain & CNS	29	-	0.2%	1.3	0.10	28	-	0.2%	1.3	0.10	57	-	0.2%	1.3	0.10

ICD10 cancer site (INCIDENCE 2009-2011)	FEMALES					MALES					TOTAL				
‡all invasive cancers minus NMSC (C44) C00-C43, C45-C96 † ASR: Age standardised rate (cases)/100,000 (standardised to the European population) *cumulative risk (%) to age 75 years	annual average 2009-2011	‡% of all invasive cancer incidence	% of all registered cancer incidence	†ASR	*risk to 75yr %	annual average 2009-2011	‡% of all invasive cancer incidence	% of all registered cancer incidence	†ASR	*risk to 75yrs %	annual average 2009-2011	‡% of all invasive cancer incidence	% of all registered cancer incidence	†ASR	*risk to 75yrs %
D00-D48 (excluding D codes specified above)	516	-	2.9%	21.7	1.71	638	-	3.9%	29.8	2.26	1154	-	3.4%	25.1	1.98
D00-D48: All non-invasive cancers	5020	-	28.2%	201.3	14.15	1497	-	9.1%	70.1	5.32	6517	-	19.0%	136.0	9.88
C00-C43, C45-C96: All invasive, minus NMSC	8967	100.0%	50.4%	377.8	26.01	10248	100.0%	62.1%	483.3	33.02	19215	100.0%	56.0%	425.0	29.51
C00-C96: All invasive cancers	12777	-	71.8%	530.5	34.25	15012	-	90.9%	707.2	43.57	27790	-	81.0%	609.9	38.97
C00-D48: All registered cancers	17797	-	100.0%	731.7	43.55	16509	-	100.0%	777.3	46.57	34306	-	100.0%	745.9	45.00

APPENDIX II: SUMMARY TABLE - CANCER DEATHS 2011

ICD10 CANCER SITE (DEATHS 2011)	FEMALES					MALES					TOTAL				
‡All invasive cancer deaths C00-C96 †ASR: Age standardised rate (mortality)/100,000 (standardised to the European population) *cumulative risk (%) of death to age 75 years	deaths 2011	‡% of all invasive cancer deaths	% of all registered cancer deaths	†ASMR	*risk of death to 75yrs	deaths 2011	‡% of all invasive cancer deaths	% of all registered cancer deaths	†ASMR	*risk of death to 75yrs	deaths 2011	‡% of all invasive cancer deaths	% of all registered cancer deaths	†ASMR	*risk of death to 75yrs
C00: lip	0	0.0%	0.0%			0	0.0%	0.0%			0	0.0%	0.0%		
C01: base of tongue	0	0.0%	0.0%			4	0.1%	0.1%	0.2	0.02	4	0.1%	0.1%	0.1	0.01
C02: other tongue	13	0.3%	0.3%	0.4	0.03	20	0.4%	0.4%	0.9	0.09	33	0.4%	0.4%	0.7	0.06
C03: gum	3	0.1%	0.1%	0.1	0.01	3	0.1%	0.1%	0.1	0.01	6	0.1%	0.1%	0.1	0.01
C04: floor of mouth	2	0.1%	0.1%	0.1	0.00	7	0.2%	0.2%	0.3	0.04	9	0.1%	0.1%	0.2	0.02
C05: palate	2	0.1%	0.1%	0.1	0.01	2	0.0%	0.0%	0.1	0.01	4	0.1%	0.1%	0.1	0.01
C06: other mouth	5	0.1%	0.1%	0.2	0.02	10	0.2%	0.2%	0.4	0.03	15	0.2%	0.2%	0.3	0.02
C07: parotid	7	0.2%	0.2%	0.2	0.01	8	0.2%	0.2%	0.4	0.01	15	0.2%	0.2%	0.3	0.01
C08: other salivary	3	0.1%	0.1%	0.1	0.01	4	0.1%	0.1%	0.2	<0.01	7	0.1%	0.1%	0.1	<0.01
C09: tonsil	2	0.1%	0.1%	0.1	0.01	8	0.2%	0.2%	0.4	0.03	10	0.1%	0.1%	0.2	0.02
C10: oropharynx	0	0.0%	0.0%			16	0.4%	0.3%	0.8	0.06	16	0.2%	0.2%	0.3	0.03
C11: nasopharynx	1	<0.1%	<0.1%	0.1	0.00	9	0.2%	0.2%	0.4	0.04	10	0.1%	0.1%	0.2	0.02
C12: pyriform	3	0.1%	0.1%	0.1	0.02	5	0.1%	0.1%	0.2	0.02	8	0.1%	0.1%	0.2	0.02
C13: hypopharynx	2	0.1%	0.1%	0.1	<0.01	2	<0.1%	<0.1%	0.1	<0.01	4	0.1%	0.1%	0.1	<0.01
C14: other mouth/pharynx	4	0.1%	0.1%	0.2	0.01	18	0.4%	0.4%	0.8	0.09	22	0.3%	0.3%	0.5	0.05
C01-C14: all mouth & pharynx	47	1.2%	1.1%	1.8	0.13	116	2.5%	2.5%	5.3	0.45	163	1.9%	1.8%	3.4	0.29
C15: oesophagus	127	3.1%	3.1%	4.4	0.28	232	5.1%	4.9%	10.6	0.80	359	4.1%	4.1%	7.3	0.54
C16: stomach	118	2.9%	2.8%	4.1	0.25	209	4.6%	4.4%	9.5	0.65	327	3.8%	3.7%	6.6	0.45
C17: small intestine	12	0.3%	0.3%	0.4	0.01	10	0.2%	0.2%	0.4	0.01	22	0.3%	0.3%	0.4	0.01
C18: colon	254	6.2%	6.1%	8.5	0.52	290	6.3%	6.2%	13.1	0.84	544	6.3%	6.1%	10.6	0.68
C19: rectosigmoid	106	2.6%	2.6%	4.1	0.29	193	4.2%	4.1%	8.7	0.67	299	3.5%	3.4%	6.2	0.47
C20: rectum	65	1.6%	1.6%	2.3	0.13	121	2.6%	2.6%	5.4	0.31	186	2.2%	2.1%	3.7	0.22
C21: anus	5	0.1%	0.1%	0.2	0.01	6	0.1%	0.1%	0.3	0.01	11	0.1%	0.1%	0.2	0.01

ICD10 CANCER SITE (DEATHS 2011)	FEMALES					MALES					TOTAL				
‡All invasive cancer deaths C00-C96 †ASR: Age standardised rate (mortality)/100,000 (standardised to the European population) *cumulative risk (%) of death to age 75 years	deaths 2011	‡% of all invasive cancer deaths	% of all registered cancer deaths	†ASMR	*risk of death to 75yrs	deaths 2011	‡% of all invasive cancer deaths	% of all registered cancer deaths	†ASMR	*risk of death to 75yrs	deaths 2011	‡% of all invasive cancer deaths	% of all registered cancer deaths	†ASMR	*risk of death to 75yrs
C18-C21: colorectal	430	10.6%	10.3%	15.0	0.94	610	13.3%	13.0%	27.6	1.83	1040	12.0%	11.7%	20.7	1.38
C22: liver	119	2.9%	2.9%	4.3	0.29	142	3.1%	3.0%	6.4	0.49	261	3.0%	2.9%	5.3	0.39
C23: gallbladder	17	0.4%	0.4%	0.6	0.04	8	0.2%	0.2%	0.4	0.03	25	0.3%	0.3%	0.5	0.04
C24: other biliary	7	0.2%	0.2%	0.3	0.02	9	0.2%	0.2%	0.4	0.02	16	0.2%	0.2%	0.3	0.02
C25: pancreas	222	5.5%	5.3%	8.0	0.51	256	5.6%	5.4%	11.5	0.84	478	5.5%	5.4%	9.8	0.67
C26: other digestive	71	1.7%	1.7%	2.4	0.13	76	1.7%	1.6%	3.4	0.20	147	1.7%	1.7%	2.8	0.16
C30: nasal cavity/middle ear	2	0.1%	0.1%	0.1	0.01		0.0%	0.0%			2	0.0%	0.0%	<0.1	<0.01
C31: sinuses	1	<0.1%	<0.1%	<0.1	0.01	4	0.1%	0.1%	0.2	0.02	5	0.1%	0.1%	0.1	0.01
C32: larynx	5	0.1%	0.1%	0.2	0.02	52	1.1%	1.1%	2.4	0.18	57	0.7%	0.6%	1.2	0.10
C33: trachea	1	<0.1%	<0.1%	<0.1	<0.01	1	<0.1%	<0.1%	<0.1	<0.01	2	0.0%	0.0%	<0.1	<0.01
C34: lung	760	18.7%	18.3%	29.0	2.16	1088	23.7%	23.1%	49.0	3.61	1848	21.3%	20.8%	38.0	2.88
C37: thymus	2	0.1%	0.1%	0.1	0.01	2	<0.1%	<0.1%	0.1	0.01	4	0.1%	0.1%	0.1	0.01
C38: mediastinum	0	0.0%	0.0%			0	0.0%	0.0%			0	0.0%	0.0%		
C39: other chest	0	0.0%	0.0%			1	<0.1%	<0.1%	<0.1	0.00	1	0.0%	0.0%	0.0	0.00
C40: bones, joints of limbs	0	0.0%	0.0%			2	0.0%	0.0%	0.1	0.00	2	0.0%	0.0%	0.0	0.00
C41: bones, joints head and trunk	7	0.2%	0.2%	0.3	0.02	10	0.2%	0.2%	0.5	0.03	17	0.2%	0.2%	0.4	0.03
C43: melanoma of skin	73	1.8%	1.8%	2.8	0.20	83	1.8%	1.8%	3.8	0.29	156	1.8%	1.8%	3.2	0.24
C44: non-melanoma skin	25	0.6%	0.6%	0.8	0.02	46	1.0%	1.0%	2.2	0.11	71	0.8%	0.8%	1.4	0.06
C45: mesothelioma	6	0.2%	0.1%	0.2	0.02	20	0.4%	0.4%	0.9	0.06	26	0.3%	0.3%	0.5	0.04
C46: Kaposi's sarcoma	0	0.0%	0.0%			0	0.0%	0.0%			0	0.0%	0.0%		
C47: peripheral nerves	1	0.0%	0.0%	0.1	<0.01	0	0.0%	0.0%			1	0.0%	0.0%	0.0	<0.01
C48: peritoneum	11	0.3%	0.3%	0.4	0.03	1	<0.1%	<0.1%	0.1	0.00	12	0.1%	0.1%	0.2	0.02
C49: connective tissues	22	0.5%	0.5%	0.9	0.09	34	0.7%	0.7%	1.5	0.10	56	0.7%	0.6%	1.2	0.09
C50: breast	690	16.9%	16.6%	26.5	2.00	7	0.2%	0.2%	0.3	0.03	697	8.0%	7.9%	14.3	1.03
C51: vulva	17	0.4%	0.4%	0.5	0.03	-	-	-	-	-	17	0.2%	0.2%	0.3	0.02

ICD10 CANCER SITE (DEATHS 2011)	FEMALES					MALES					TOTAL				
‡All invasive cancer deaths C00-C96 †ASR: Age standardised rate (mortality)/100,000 (standardised to the European population) *cumulative risk (%) of death to age 75 years	deaths 2011	‡% of all invasive cancer deaths	% of all registered cancer deaths	†ASMR	*risk of death to 75yrs	deaths 2011	‡% of all invasive cancer deaths	% of all registered cancer deaths	†ASMR	*risk of death to 75yrs	deaths 2011	‡% of all invasive cancer deaths	% of all registered cancer deaths	†ASMR	*risk of death to 75yrs
C52: vagina	6	0.2%	0.1%	0.2	0.02	-	-	-	-	-	6	0.1%	0.1%	0.1	0.01
C53: cervix	98	2.4%	2.4%	4.1	0.33	-	-	-	-	-	98	1.1%	1.1%	2.1	0.16
C54: corpus uteri	83	2.0%	2.0%	3.2	0.26	-	-	-	-	-	83	1.0%	0.9%	1.7	0.13
C55: uterus NOS	21	0.5%	0.5%	0.8	0.05	-	-	-	-	-	21	0.2%	0.2%	0.4	0.02
C56: ovary	278	6.8%	6.7%	11.1	0.88	-	-	-	-	-	278	3.2%	3.1%	5.8	0.44
C57: other female genital	11	0.3%	0.3%	0.5	0.04	-	-	-	-	-	11	0.1%	0.1%	0.2	0.02
C58: placenta	0	0.0%	0.0%			-	-	-	-	-	0	0.0%	0.0%		
C60: penis	-	-	-	-	-	6	0.1%	0.1%	0.3	0.02	6	0.1%	0.1%	0.1	0.01
C61: prostate	-	-	-	-	-	563	12.3%	12.0%	25.5	1.06	563	6.5%	6.4%	10.5	0.52
C62: testis	-	-	-	-	-	4	0.1%	0.1%	0.2	0.01	4	0.1%	0.1%	0.1	0.01
C63: other male genital	-	-	-	-	-	1	0.0%	0.0%	0.1	0.00	1	0.0%	0.0%	0.0	0.00
C64: kidney	53	1.3%	1.3%	2.0	0.16	150	3.3%	3.2%	6.8	0.48	203	2.3%	2.3%	4.2	0.32
C65: renal pelvis	1	<0.1%	<0.1%	0.1	0.00	1	<0.1%	<0.1%	0.1	0.00	2	0.0%	0.0%	0.0	0.00
C66: ureter	4	0.1%	0.1%	0.1	0.01	5	0.1%	0.1%	0.2	0.00	9	0.1%	0.1%	0.2	0.00
C67: bladder	91	2.2%	2.2%	2.9	0.13	129	2.8%	2.7%	5.8	0.27	220	2.5%	2.5%	4.1	0.20
C68: other urinary	5	0.1%	0.1%	0.1	0.01	3	0.1%	0.1%	0.1	0.01	8	0.1%	0.1%	0.2	0.01
C69: eye	3	0.1%	0.1%	0.1	0.01		0.0%	0.0%			3	0.0%	0.0%	0.1	0.01
C70: meninges	1	<0.1%	<0.1%	<0.1	<0.01	1	<0.1%	<0.1%	<0.1	<0.01	2	0.0%	0.0%	<0.1	<0.01
C71: brain	106	2.6%	2.6%	4.3	0.35	153	3.3%	3.3%	6.8	0.58	259	3.0%	2.9%	5.5	0.46
C72: spinal cord	1	<0.1%	<0.1%	<0.1	<0.01		0.0%	0.0%			1	<0.1%	<0.1%	0.0	<0.01
C73: thyroid	17	0.4%	0.4%	0.6	0.04	12	0.3%	0.3%	0.5	0.05	29	0.3%	0.3%	0.6	0.04
C74: adrenal	7	0.2%	0.2%	0.3	0.02	3	0.1%	0.1%	0.1	0.01	10	0.1%	0.1%	0.2	0.01
C75: other endocrine	0	0.0%	0.0%			3	0.1%	0.1%	0.1	0.02	3	<0.1%	<0.1%	0.1	0.01
C76: ill-defined site	15	0.4%	0.4%	0.5	0.04	15	0.3%	0.3%	0.7	0.03	30	0.4%	0.3%	0.6	0.03
C80: unknown primary site	176	4.3%	4.2%	6.2	0.42	141	3.1%	3.0%	6.4	0.42	317	3.7%	3.6%	6.3	0.42

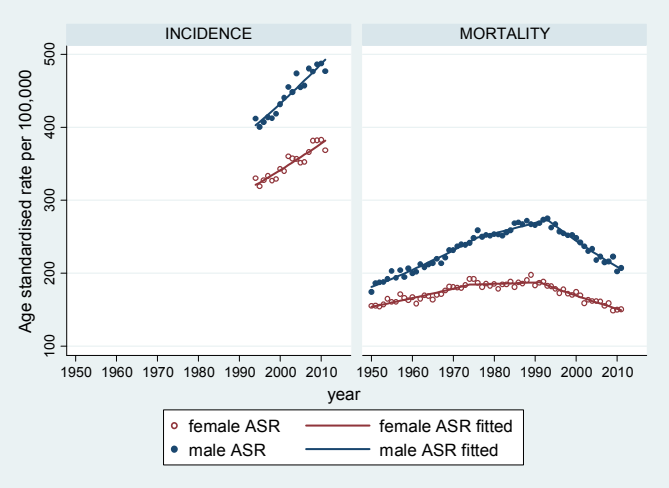
ICD10 CANCER SITE (DEATHS 2011)	FEMALES					MALES					TOTAL				
‡All invasive cancer deaths C00-C96 †ASR: Age standardised rate (mortality)/100,000 (standardised to the European population) *cumulative risk (%) of death to age 75 years	deaths 2011	‡% of all invasive cancer deaths	% of all registered cancer deaths	†ASMR	*risk of death to 75yrs	deaths 2011	‡% of all invasive cancer deaths	% of all registered cancer deaths	†ASMR	*risk of death to 75yrs	deaths 2011	‡% of all invasive cancer deaths	% of all registered cancer deaths	†ASMR	*risk of death to 75yrs
C81: Hodgkin's lymphoma	13	0.3%	0.3%	0.5	0.02	11	0.2%	0.2%	0.5	0.03	24	0.3%	0.3%	0.5	0.03
C82: follicular non-Hodgkin's lymphoma	4	0.1%	0.1%	0.2	0.01	10	0.2%	0.2%	0.5	0.02	14	0.2%	0.2%	0.3	0.02
C83: diffuse non-Hodgkin's lymphoma	10	0.3%	0.2%	0.4	0.04	18	0.4%	0.4%	0.8	0.05	28	0.3%	0.3%	0.6	0.04
C84: peripheral and cutaneous T cell lymphoma	4	0.1%	0.1%	0.1	0.01	10	0.2%	0.2%	0.5	0.03	14	0.2%	0.2%	0.3	0.02
C85: other and unspecified NHL	114	2.8%	2.7%	4.1	0.26	102	2.2%	2.2%	4.6	0.27	216	2.5%	2.4%	4.3	0.26
C82-C85: all non-Hodgkin's lymphoma	132	3.2%	3.2%	4.7	0.32	140	3.1%	3.0%	6.3	0.37	272	3.1%	3.1%	5.4	0.34
C81-C85: all lymphoma	145	3.6%	3.5%	5.2	0.34	151	3.3%	3.2%	6.8	0.41	296	3.4%	3.3%	5.9	0.37
C88: malignant immunoproliferative disease	1	<0.1%	<0.1%	0.0	<0.01	2	<0.1%	<0.1%	0.1	0.01	3	<0.1%	<0.1%	0.1	<0.01
C90: multiple myeloma	72	1.8%	1.7%	2.4	0.14	88	1.9%	1.9%	3.9	0.25	160	1.9%	1.8%	3.1	0.20
C91: lymphoid leukaemia	27	0.7%	0.7%	0.8	0.03	52	1.1%	1.1%	2.4	0.14	79	0.9%	0.9%	1.5	0.08
C92: myeloid leukaemia	51	1.3%	1.2%	1.8	0.13	85	1.9%	1.8%	3.8	0.20	136	1.6%	1.5%	2.7	0.16
C93: monocytic leukaemia	0	0.0%	0.0%			0	0.0%	0.0%			0	0.0%	0.0%		
C94: other specified leukaemia	0	0.0%	0.0%			0	0.0%	0.0%			0	0.0%	0.0%		
C95: unspecified leukaemia	8	0.2%	0.2%	0.3	0.02	5	0.1%	0.1%	0.2	0.01	13	0.2%	0.2%	0.2	0.01
C91-C95: all leukaemia	86	2.1%	2.1%	2.9	0.17	142	3.1%	3.0%	6.4	0.35	228	2.6%	2.6%	4.4	0.26
C96: other lymphoid/haematopoietic	0	0.0%	0.0%			0	0.0%	0.0%			0	0.0%	0.0%		
D00-D48: All non-invasive cancer deaths	91		2.2%	2.9	0.13	114		2.4%	5.1	0.24	205		2.3%	3.8	0.19
C00-C96: All invasive cancer deaths	4074	100.0%	97.8%	150.9	10.14	4592	100.0%	97.6%	207.5	12.92	8666	100.0%	97.7%	174.9	11.52
C00-D48: Total cancer deaths (invasive & non-invasive)	4165		100.0%	153.7	10.26	4706		100.0%	212.6	13.12	8871		100.0%	178.7	11.68

Mortality data provided by the Central Statistics Office (www.cso.ie)

APPENDIX III: TRENDS IN INCIDENCE: 1994-2011 AND MORTALITY: 1950-2011 or 1994‡2011

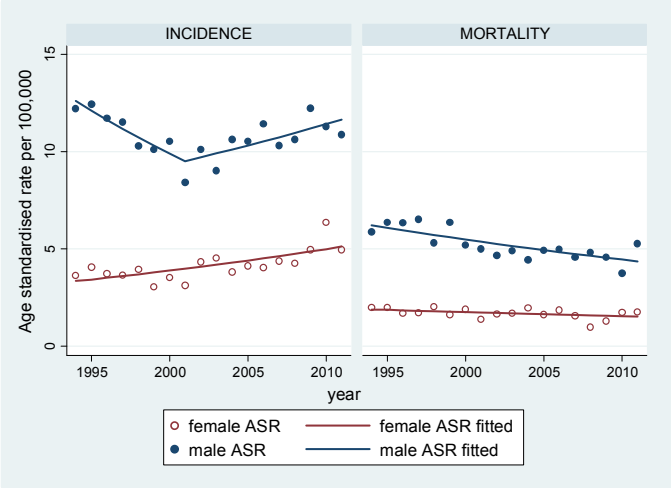
Figure III, a-c: Trends in incidence: 1994-2011 and mortality: 1950-2011[a] or 1994-2011, by cancer site

a. All invasive cancers, excluding NMSC



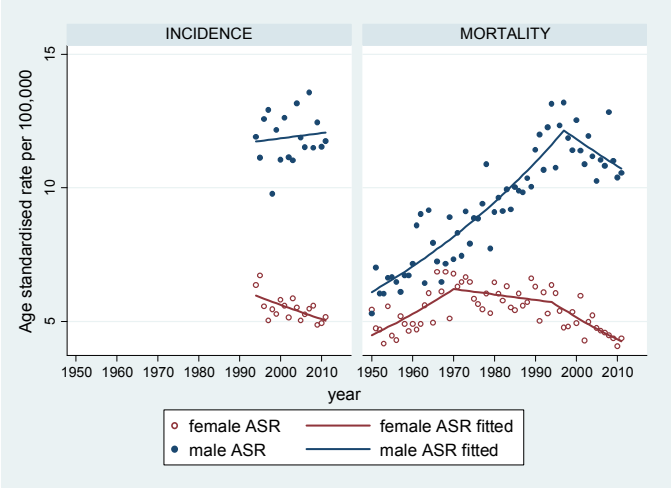
sex	inc/mort	from-to	APC	95%CI	p-value	trend[b]
female	incidence	[1994-2011]	1.0	[0.8,1.2]	<0.0001	↑
male	incidence	[1994-2011]	1.2	[1.0,1.4]	<0.0001	↑
female	mortality	[1950-1974]	0.8	[0.6,0.9]	<0.0001	↑
female	mortality	[1974-1991]	0.1	[-0.1,0.3]	0.38	↔
female	mortality	[1991-2011]	-1.1	[-1.3,-1.0]	<0.0001	↓
male	mortality	[1950-1976]	1.2	[1.1,1.4]	<0.0001	↑
male	mortality	[1976-1993]	0.5	[0.3,0.8]	<0.0001	↑
male	mortality	[1993-2011]	-1.6	[-1.7,-1.4]	<0.0001	↓

b. Mouth and pharynx: C01-14



sex	inc/mort	from-to	APC	95%CI	p-value	trend[b]
females	incidence	[1994-2011]	2.5	[1.3,3.8]	<0.001	↑
males	incidence	[1994-2001]	-3.9	[-6.3,-1.5]	<0.001	↓
males	incidence	[2001-2011]	2.1	[0.7,3.4]	<0.001	↑
females	mortality	[1994-2011]	-1.2	[-2.6,0.2]	0.08	↔
males	mortality	[1994-2011]	-2.1	[-3.0,-1.1]	<0.001	↓

c. Oesophagus: C15:



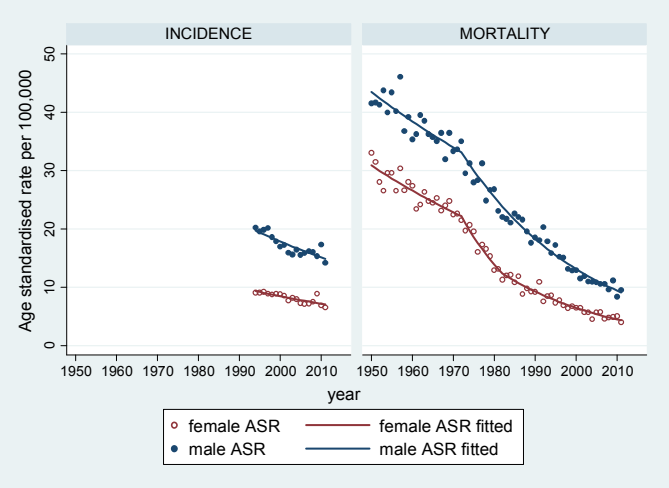
sex	inc/mort	from-to	APC	95%CI	p-value	trend[b]
females	incidence	[1994-2011]	-1.0	[-1.7,-0.4]	<0.001	↓
males	incidence	[1994-2011]	0.2	[-0.6,0.9]	0.636	↔
females	mortality	[1950-1970]	1.6	[0.8,2.5]	<0.001	↑
females	mortality	[1970-1994]	-0.3	[-0.9,0.2]	0.22	↔
females	mortality	[1994-2011]	-1.7	[-2.5,-0.9]	<0.0001	↓
males	mortality	[1950-1997]	1.5	[1.3,1.7]	<0.0001	↑
males	mortality	[1997-2011]	-0.9	[-1.8,0.0]	0.0603	↔

a. mortality data was available for a number of common cancer sites for the period 1950-2011, otherwise mortality data was limited to the period 1994-2011

b. trend‡: ↑=significant increase, ↓=significant decrease, ↔=change was not significant, at the 95% level. APC and trend calculated using the Joinpoint regression program

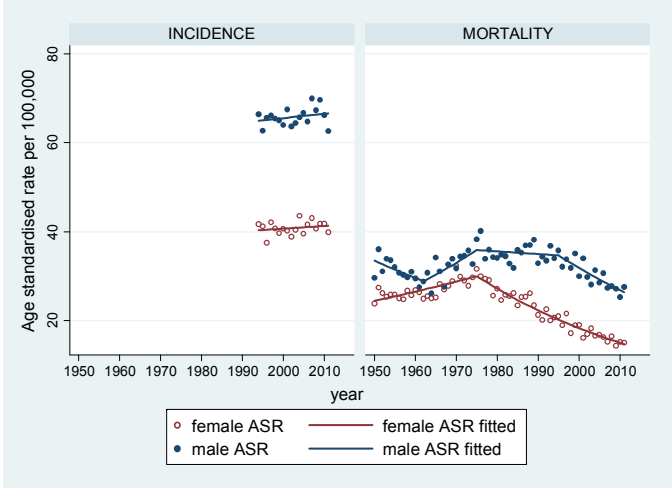
Figure III, d-f: Trends in incidence: 1994-2011 and mortality: 1950-2011[a] or 1994-2011, by cancer site

d. Stomach: C16



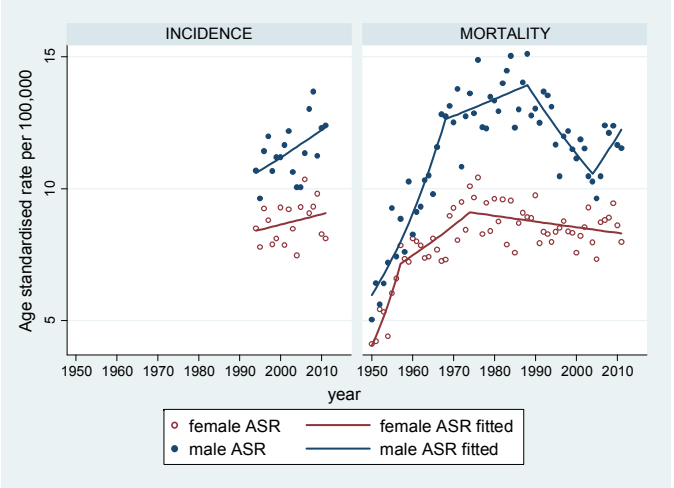
sex	inc/mort	from-to	APC	95%CI	p-value	trend[b]
females	incidence	[1994-2011]	-1.6	[-2.3,-1.0]	<0.0001	↓
males	incidence	[1994-2011]	-1.6	[-2.2,-1.1]	<0.0001	↓
females	mortality	[1950-1972]	-1.5	[-1.9,-1.1]	<0.0001	↓
females	mortality	[1972-1982]	-5.7	[-7.3,-4.0]	<0.0001	↓
females	mortality	[1982-2011]	-3.5	[-3.9,-3.2]	<0.0001	↓
males	mortality	[1950-1972]	-1.2	[-1.6,-0.9]	<0.0001	↓
males	mortality	[1972-2011]	-3.2	[-3.4,-3.0]	<0.0001	↓

e. Colorectum: C18-21



sex	inc/mort	from-to	APC	95%CI	p-value	trend[b]
female	incidence	[1994-2011]	0.1	[-0.2,0.5]	0.38	↔
male	incidence	[1994-2011]	0.2	[-0.2,0.5]	0.31	↔
female	mortality	[1950-1975]	0.8	[0.5,1.1]	<0.0001	↑
female	mortality	[1975-2011]	-2.0	[-2.1,-1.8]	<0.0001	↓
male	mortality	[1950-1962]	-1.2	[-2.3,-0.1]	<0.05	↓
male	mortality	[1962-1975]	1.7	[0.6,2.8]	<0.05	↑
male	mortality	[1975-1995]	-0.2	[-0.7,0.3]	0.49	↔
male	mortality	[1995-2011]	-1.7	[-2.3,-1.1]	<0.0001	↓

f. Pancreas: C25



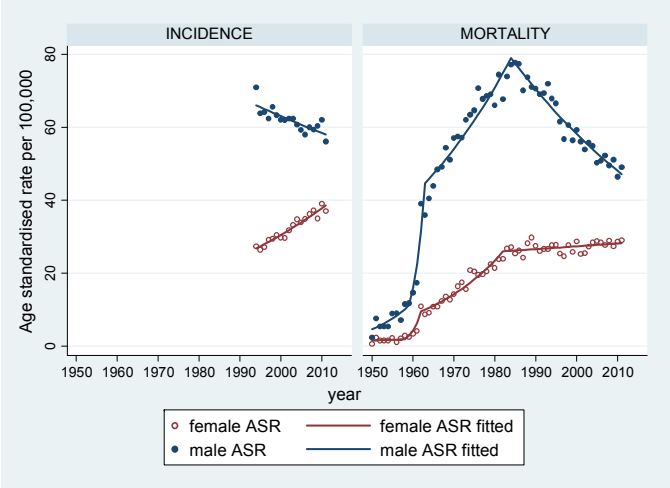
sex	inc/mort	from-to	APC	95%CI	p-value	trend[b]
females	incidence	[1994-2011]	0.4	[-0.4,1.3]	0.29	↔
males	incidence	[1994-2011]	0.9	[0.1,1.7]	<0.05	↑
females	mortality	[1950-1957]	8.5	[4.0,13.2]	<0.001	↑
females	mortality	[1957-1974]	1.4	[0.5,2.4]	<0.001	↑
females	mortality	[1974-2011]	-0.2	[-0.5,0.0]	<0.05	↓
males	mortality	[1950-1968]	4.3	[3.3,5.2]	<0.0001	↑
males	mortality	[1968-1988]	0.5	[-0.2,1.1]	0.13	↔
males	mortality	[1988-2004]	-1.7	[-2.6,-0.8]	<0.001	↓
males	mortality	[2004-2011]	2.1	[-0.5,4.8]	0.11	↔

a. mortality data was available for a number of common cancer sites for the period 1950-2011, otherwise mortality data was limited to the period 1994-2011

b. trend: ↑=significant increase, ↓=significant decrease, ↔=change was not significant, at the 95% level. APC and trend calculated using the Joinpoint regression program

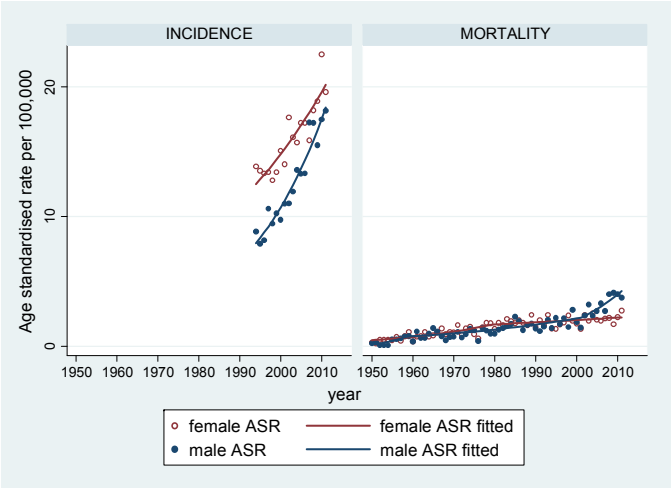
Figure III, g-i: Trends in incidence: 1994-2011 and mortality: 1950-2011[a] or 1994-2011, by cancer site

g. Lung: C34



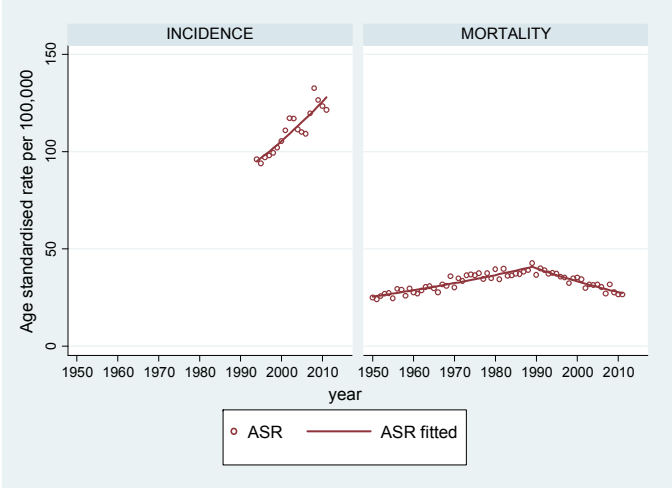
sex	inc/mort	from-to	APC	95%CI	p-value	trend[b]
females	incidence	[1994-2011]	2.2	[1.8,2.5]	<0.0001	↑
males	incidence	[1994-2011]	-0.8	[-1.1,-0.5]	<0.0001	↓
females	mortality	[1950-1958]	2.7	[-6.1,12.2]	0.55	↔
females	mortality	[1958-1962]	48.9	[12.0,97.9]	<0.05	↑
females	mortality	[1962-1982]	5.1	[4.4,5.9]	<0.0001	↑
females	mortality	[1982-2011]	0.3	[0.0,0.5]	<0.05	↑
males	mortality	[1950-1959]	10.2	[5.0,15.6]	<0.0001	↑
males	mortality	[1959-1963]	41.3	[22.5,62.9]	<0.0001	↑
males	mortality	[1963-1984]	2.8	[2.3,3.2]	<0.0001	↑
males	mortality	[1984-2011]	-1.9	[-2.2,-1.6]	<0.0001	↓

h. Melanoma of skin: C43



sex	inc/mort	from-to	APC	95%CI	p-value	trend[b]
female	incidence	[1994-2011]	2.8	[2.1,3.6]	<0.0001	↑
male	incidence	[1994-2011]	5.1	[4.3,5.8]	<0.0001	↑
female	mortality	[1950-1979]	4.4	[2.9,6.0]	<0.0001	↑
female	mortality	[1979-2011]	0.9	[0.2,1.5]	<0.05	↑
male	mortality	[1950-1958]	21.3	[2.0,44.1]	<0.05	↑
male	mortality	[1958-2001]	2.6	[1.9,3.3]	<0.0001	↑
male	mortality	[2001-2011]	6.8	[3.4,10.3]	<0.001	↑

i. Female breast: C50

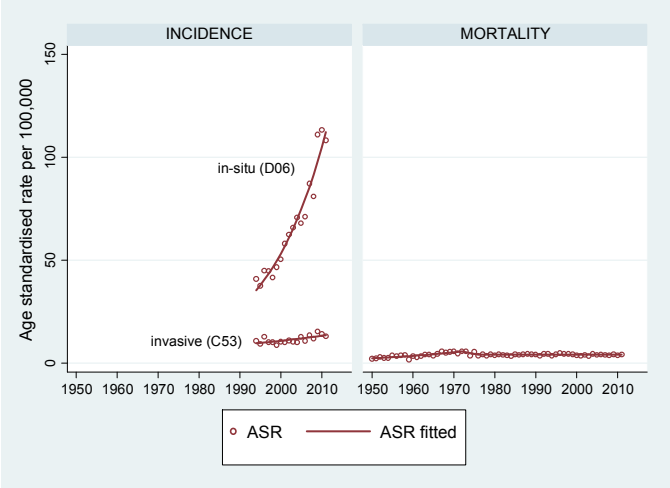


inc/mort	from-to	APC	95%CI	p-value	trend[b]
incidence	[1994-2011]	1.8	[1.3,2.2]	<0.0001	↑
mortality	[1950-1989]	1.2	[1.0,1.4]	<0.0001	↑
mortality	[1989-2011]	-1.8	[-2.1,-1.5]	<0.0001	↓

a. mortality data was available for a number of common cancer sites for the period 1950-2011, otherwise mortality data was limited to the period 1994-2011
b. trend: ↑=significant increase, ↓=significant decrease, ↔=change was not significant, at the 95% level. APC and trend calculated using the Joinpoint regression program

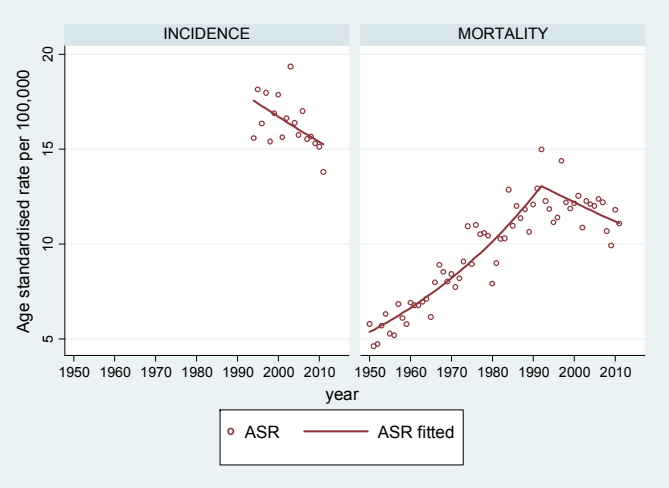
Figure III, j-l: Trends in incidence: 1994-2011 and mortality: 1950-2011[a] or 1994-2011, by cancer site

j. Cervix: C53



k. Corpus uteri: C54

l. Ovary: C56



site	inc/mort	from-to	APC	95%CI	p-value	trend
Invasive: cervix	incidence	[1994-2011]	2.1	[0.9,3.2]	<0.05	↑
in situ: cervix	incidence	[1994-2011]	7.0	[6.1,8.0]	<0.0001	↑
Invasive: cervix	mortality	[1950-1972]	4.1	[3.0,5.2]	<0.0001	↑
Invasive: cervix	mortality	[1972-1976]	-8.2	[-22.3,8.6]	0.10	↔
Invasive: cervix	mortality	[1976-2011]	0.0	[-0.4,0.4]	0.95	↔

inc/mort	from-to	APC	95%CI	p-value	trend[b]
incidence	[1994-2011]	2.4	[1.6,3.1]	<0.0001	↑
mortality	[1994-2011]	2.1	[0.9,3.4]	<0.05	↑

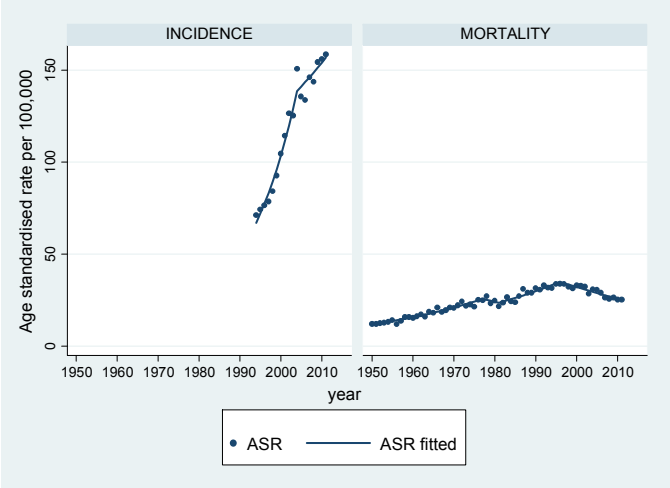
inc/mort	from-to	APC	95%CI	p-value	trend[b]
incidence	[1994-2011]	-0.8	[-1.5,-0.1]	<0.05	↓
mortality	[1950-1992]	2.1	[1.9,2.4]	<0.0001	↑
mortality	[1992-2011]	-0.9	[-1.5,-0.2]	<0.05	↓

a. mortality data was available for a number of common cancer sites for the period 1950-2011, otherwise mortality data was limited to the period 1994-2011

b. trend: ↑=significant increase, ↓=significant decrease, ↔=change was not significant, at the 95% level. APC and trend calculated using the Joinpoint regression program

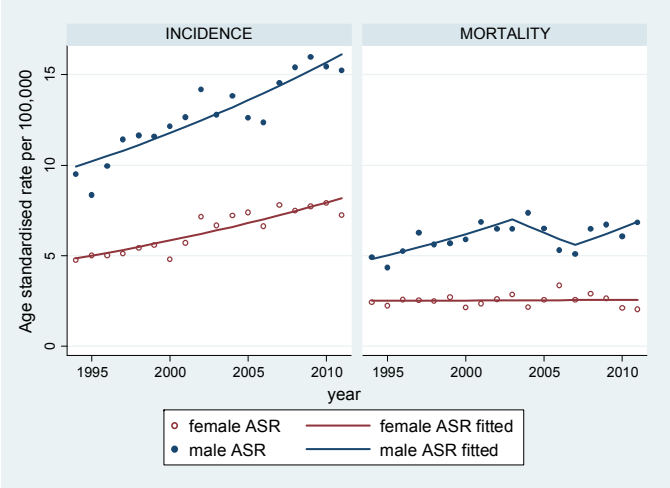
Figure III, m-o: Trends in incidence: 1994-2011 and mortality: 1950-2011[a] or 1994-2011, by cancer site

m. Prostate: C61



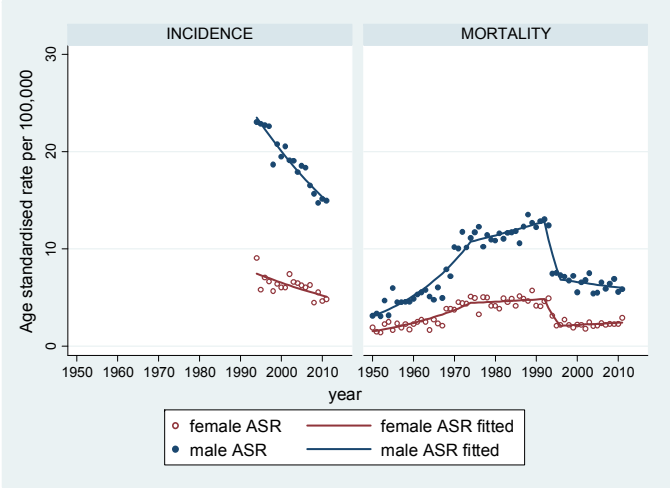
inc/mort	from-to	APC	95%CI	p-value	trend[b]
incidence	[1994-2004]	7.5	[6.5,8.6]	<0.0001	↑
incidence	[2004-2011]	1.8	[0.5,3.0]	<0.001	↑
mortality	[1950-1977]	2.9	[2.5,3.2]	<0.0001	↑
mortality	[1977-1981]	-2.0	[-9.2,5.8]	0.60	↔
mortality	[1981-1996]	2.6	[2.0,3.3]	<0.0001	↑
mortality	[1996-2011]	-2.1	[-2.6,-1.6]	<0.0001	↓

n. Kidney: C64



sex	inc/mort	from-to	APC	95%CI	p-value	trend[b]
female	incidence	[1994-2011]	3.1	[2.3,3.9]	<0.0001	↑
male	incidence	[1994-2011]	2.9	[2.2,3.6]	<0.0001	↑
female	mortality	[1994-2011]	0.1	[-1.2,1.5]	0.84	↔
male	mortality	[1994-2003]	4.3	[1.9,6.7]	<0.001	↑
male	mortality	[2003-2007]	-5.5	[-15.2,5.3]	0.27	↔
male	mortality	[2007-2011]	5.4	[-1.0,12.1]	0.89	↔

o. Bladder: C67

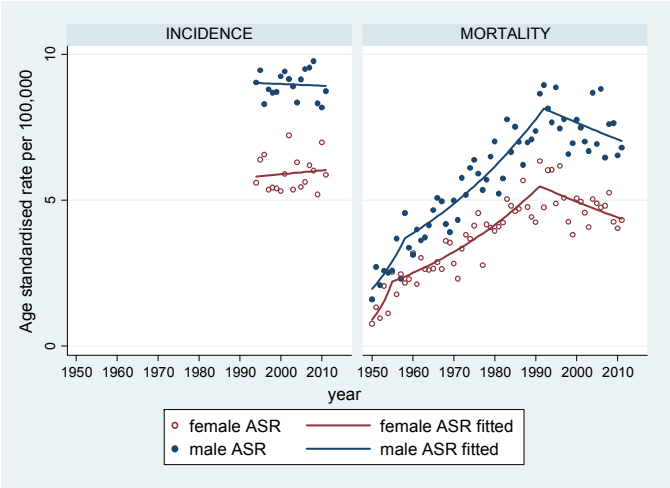


sex	inc/mort	from-to	APC	95%CI	p-value	trend[b]
females	incidence	[1994-2011]	-2.2	[-3.4,-1.0]	<0.001	↓
males	incidence	[1994-2011]	-2.6	[-3.1,-2.2]	<0.0001	↓
females	mortality	[1950-1974]	4.5	[3.4,5.6]	<0.0001	↑
females	mortality	[1974-1992]	0.5	[-0.8,1.8]	0.46	↔
females	mortality	[1992-1996]	-18.8	[-33.4,-0.9]	<0.05	↓
females	mortality	[1996-2011]	1.0	[-0.8,2.7]	0.26	↔
males	mortality	[1950-1974]	5.3	[4.4,6.3]	<0.0001	↑
males	mortality	[1974-1992]	1.0	[0.0,2.0]	0.057	↔
males	mortality	[1992-1996]	-14.5	[-26.7,-0.3]	<0.05	↓
males	mortality	[1996-2011]	-0.9	[-2.3,-0.5]	<0.001	↓

a. mortality data was available for a number of common cancer sites for the period 1950-2011, otherwise mortality data was limited to the period 1994-2011
b. trend: ↑=significant increase, ↓=significant decrease, ↔=change was not significant, at the 95% level. APC and trend calculated using the Joinpoint regression program

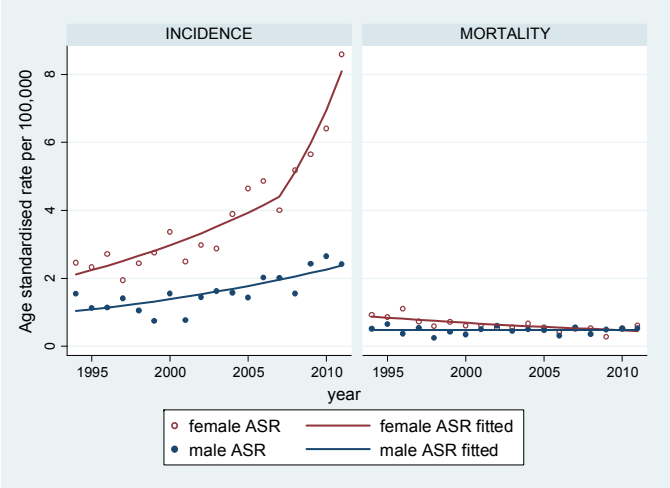
Figure III, p-r: Trends in incidence: 1994-2011 and mortality: 1950-2011[a] or 1994-2011, by cancer site

p. Brain: C71



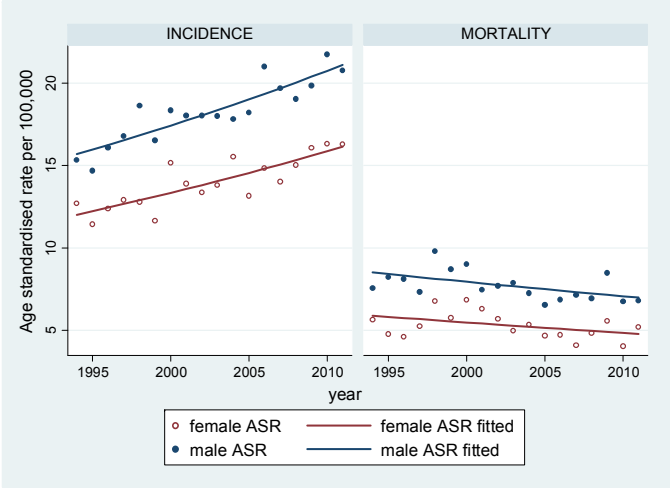
sex	inc/mort	from-to	APC	95%CI	p-value	trend[b]
females	incidence	[1994-2011]	0.2	[-0.8,1.2]	0.64	↔
males	incidence	[1994-2011]	-0.1	[-0.6,0.5]	0.80	↔
females	mortality	[1950-1955]	19.4	[-0.7,43.5]	0.058	↔
females	mortality	[1955-1991]	2.6	[2.0,3.1]	<0.0001	↑
females	mortality	[1991-2011]	-1.1	[-2.0,-0.3]	<0.001	↓
males	mortality	[1950-1958]	8.3	[2.1,14.8]	<0.05	↑
males	mortality	[1958-1992]	2.4	[1.9,2.8]	<0.0001	↑
males	mortality	[1992-2011]	-0.8	[-1.5,0.0]	<0.05	↓

q. Thyroid: C73



sex	inc/mort	from-to	APC	95%CI	p-value	trend[b]
females	incidence	[1994-2007]	5.8	[3.3,8.3]	<0.001	↑
females	incidence	[2007-2011]	16.4	[6.4,27.5]	<0.05	↑
males	incidence	[1994-2011]	5.0	[2.9,7.2]	<0.001	↑
females	mortality	[1994-2011]	-3.8	[-5.6,-2.1]	<0.001	↓
males	mortality	[1994-2011]	0.0	[-2.0,2.1]	0.97	↔

r. Lymphoma (total):C81-C85



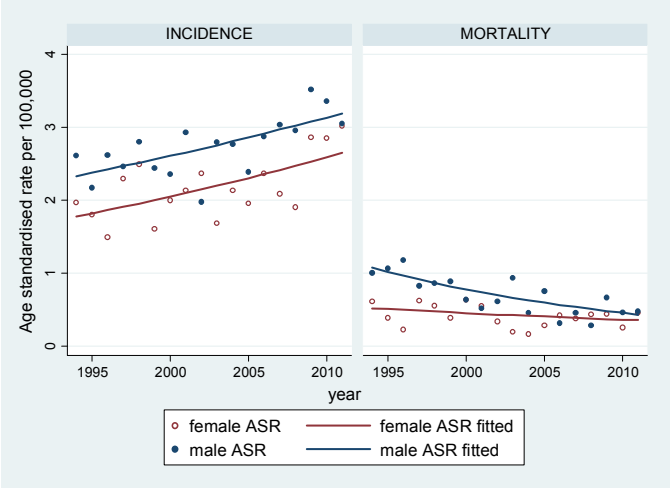
sex	inc/mort	from-to	APC	95%CI	p-value	trend[b]
females	incidence	[1994-2011]	1.8	[1.1,2.4]	<0.001	↑
males	incidence	[1994-2011]	1.8	[1.3,2.2]	<0.001	↑
females	mortality	[1994-2011]	-1.2	[-2.6,0.2]	0.08	↔
males	mortality	[1994-2011]	-1.2	[-2.1,-0.2]	<0.05	↓

a. mortality data was available for a number of common cancer sites for the period 1950-2011, otherwise mortality data was limited to the period 1994-2011

b. trend: ↑=significant increase, ↓=significant decrease, ↔=change was not significant, at the 95% level. APC and trend calculated using the Joinpoint regression program

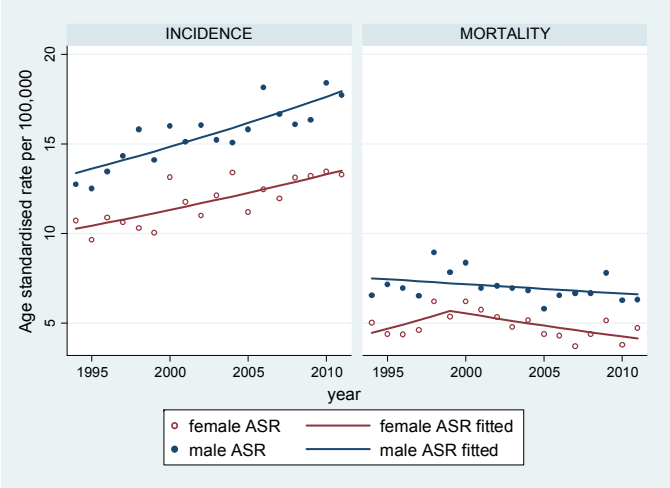
Figure III, s-u: Trends in incidence: 1994-2011 and mortality: 1950-2011[a] or 1994-2011, by cancer site

s. Hodgkin' disease: C81



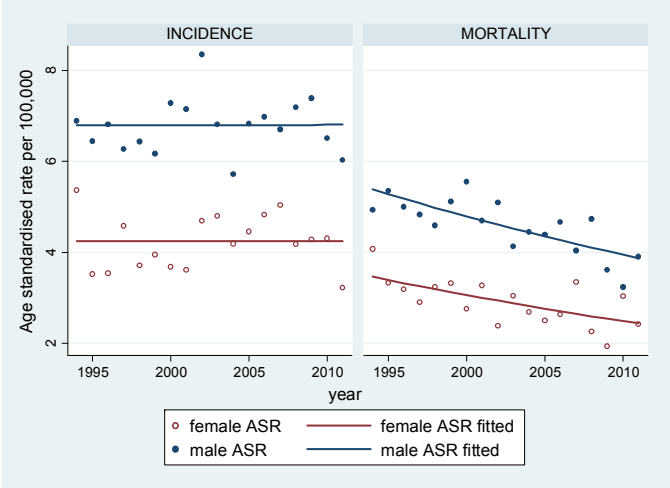
sex	inc/mort	from-to	APC	95%CI	p-value	trend[b]
female	incidence	[1994-2011]	2.4	[0.8,3.9]	<0.05	↑
male	Incidence	[1994-2011]	1.9	[0.8,2.9]	<0.05	↑
female	mortality	[1994-2011]	-2.2	[-5.2,0.8]	0.14	↔
male	mortality	[1994-2011]	-5.2	[-7.5,-2.9]	<0.001	↓

t. Non-Hodgkin's lymphoma: C82-C95



sex	inc/mort	from-to	APC	95%CI	p-value	trend[b]
female	incidence	[1994-2011]	1.6	[1.0,2.3]	<0.0001	↑
male	incidence	[1994-2011]	1.7	[1.2,2.3]	<0.0001	↑
female	mortality	[1994-1999]	4.9	[-4.0,14.7]	0.26	↔
female	mortality	[1999-2011]	-2.6	[-4.7,-0.5]	<0.05	↓
male	mortality	[1994-2011]	-0.7	[-1.8,0.3]	0.41	↔

u. Multiple myeloma: C90



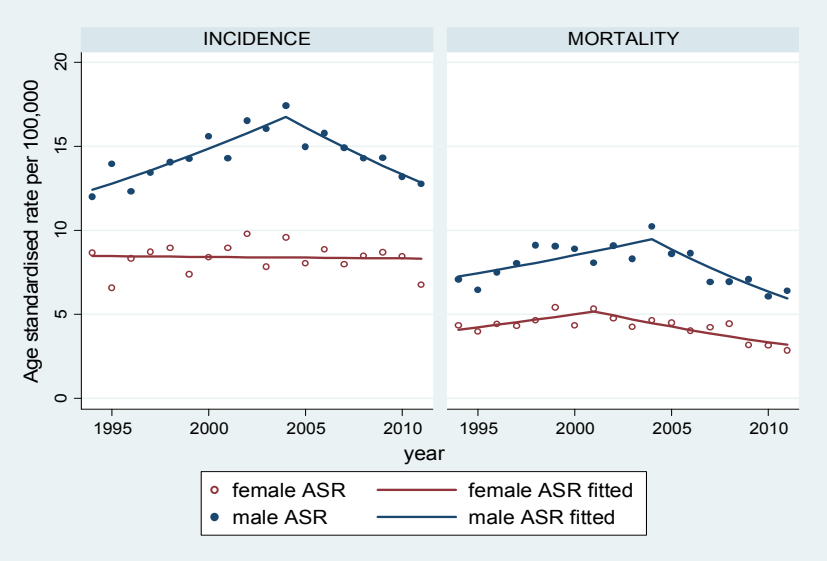
sex	inc/mort	from-to	APC	95%CI	p-value	trend[b]
female	incidence	[1994-2011]	0.0	[-1.4,1.4]	0.96	↔
male	incidence	[1994-2011]	0.0	[-0.9,0.9]	0.98	↔
female	mortality	[1994-2011]	-2.1	[-3.3,-0.8]	<0.05	↓
male	mortality	[1994-2011]	-1.9	[-2.8,-1.0]	<0.05	↓

a. mortality data was available for a number of common cancer sites for the period 1950-2011, otherwise mortality data was limited to the period 1994-2011

b. trend: ↑=significant increase, ↓=significant decrease, ↔=change was not significant, at the 95% level. APC and trend calculated using the Joinpoint regression program

Figure III, v: Trends in incidence: 1994-2011 and mortality: 1950-2011[a] or 1994-2011, by cancer site

v. Leukaemia (total):C91-C95



sex	inc/mort	from-to	APC	95%CI	p-value	trend[b]
female	incidence	[1994-2011]	-0.1	[-1.1,0.9]	0.81	↔
male	incidence	[1994-2004]	3.0	[1.9,4.2]	<0.001	↑
male	incidence	[2004-2011]	-3.7	[-5.4,-2.0]	<0.001	↓
female	mortality	[1994-2001]	3.4	[-0.8,7.8]	0.10	↔
female	mortality	[2001-2011]	-4.7	[-7.0,-2.4]	<0.001	↓
male	mortality	[1994-2004]	2.7	[0.7,4.8]	<0.05	↑
male	mortality	[2004-2011]	-6.4	[-9.3,-3.4]	<0.001	↓

a. mortality data was available for a number of common cancer sites for the period 1950-2011, otherwise mortality data was limited to the period 1994-2011
b. trend: ↑=significant increase, ↓=significant decrease, ↔=change was not significant, at the 95% level. APC and trend calculated using the Joinpoint regression program

APPENDIX IV: TREND SUMMARY FOR IRELAND: INCIDENCE AND MORTALITY

Time trend summary-annual percentage change (APC) in age standardised rate (ASR) of incidence (1994-2011) and mortality‡ (1950-2011 or 1994-2011)

	FEMALES						MALES						M&F					
	incidence			mortality			incidence			mortality			incidence			mortality		
trend[a]	period	APC	trend	Period	APC	trend	period	APC	trend	period	APC	trend	period	APC	trend	period	APC	trend
all invasive, excluding NMSC	[1994-2011]	1.0	↑	[1950-1974]	0.8	↑	[1994-2011]	1.2	↑	[1950-1976]	1.2	↑	[1994-2011]	1.2	↑	[1950-1975]	1.0	↑
				[1974-1991]	0.1	↔				[1976-1993]	0.5	↑				[1975-1992]	0.3	↑
				[1991-2011]	-1.1	↓				[1993-2011]	-1.6	↓				[1992-2011]	-1.3	↓
mouth & pharynx	[1994-2011]	2.5	↑	[1994-2011]	-1.2	↔	[1994-2001]	-3.9	↓	[1994-2011]	-2.1	↓	[1994-2001]	-3.1	↓	[1994-2011]	-1.8	↓
							[2001-2011]	2.1	↑				[2001-2011]	2.9	↑			
oesophagus	[1994-2011]	-1.0	↓	[1950-1970]	1.6	↑	[1994-2011]	0.2	↔	[1950-1997]	1.5	↑	[1994-2011]	-0.1	↔	[1950-1994]	1.0	↑
				[1970-1994]	-0.3	↔				[1997-2011]	-0.9	↔				[1994-2011]	-1.0	↓
				[1994-2011]	-1.7	↓												
stomach	[1994-2011]	-1.6	↓	[1950-1972]	-1.5	↓	[1994-2011]	-1.6	↓	[1950-1972]	-1.2	↓	[1994-2011]	-1.6	↓	[1950-1970]	-1.3	↓
				[1972-1982]	-5.7	↓				[1972-2011]	-3.2	↓				[1970-2011]	-3.6	↓
				[1982-2011]	-3.5	↓												
colorectal	[1994-2011]	0.1	↔	[1950-1975]	0.8	↑	[1994-2011]	0.2	↔	[1950-1962]	-1.2	↓	[1994-2011]	0.2	↔	[1950-1962]	-0.7	↔
				[1975-2011]	-2.0	↓				[1962-1975]	1.7	↑				[1962-1975]	1.4	↑
										[1975-1995]	-0.2	↔				[1975-1995]	-1.1	↓
										[1995-2011]	-1.7	↓				[1995-2011]	-1.8	↓
pancreas	[1994-2011]	0.4	↔	[1950-1957]	8.5	↑	[1994-2011]	0.9	↑	[1950-1968]	4.3	↑	[1994-2011]	0.8	↑	[1950-1957]	7.6	↑
				[1957-1974]	1.4	↑				[1968-1988]	0.5	↔				[1957-1976]	2.0	↑
				[1974-2011]	-0.2	↓				[1988-2004]	-1.7	↓				[1976-2005]	-0.7	↓
										[2004-2011]	2.1	↔				[2005-2011]	1.7	↔
lung	[1994-2011]	2.2	↑	[1950-1958]	2.7	↔	[1994-2011]	-0.8	↓	[1950-1959]	10.2	↑	[1994-2011]	0.4	↑	[1950-1959]	9.5	↑
				[1958-1962]	48.9	↑				[1959-1963]	41.3	↑				[1959-1963]	40.9	↑
				[1962-1982]	5.1	↑				[1963-1984]	2.8	↑				[1963-1983]	3.1	↑
				[1982-2011]	0.3	↑				[1984-2011]	-1.9	↓				[1983-2011]	-1.1	↓
melanoma of skin	[1994-2011]	2.8	↑	[1950-1979]	4.4	↑	[1994-2011]	5.1	↑	[1950-1958]	21.3	↑	[1994-2011]	3.8	↑	[1950-1959]	16.1	↑
				[1979-2011]	0.9	↑				[1958-2001]	2.6	↑				[1959-2011]	2.5	↑
										[2001-2011]	6.8	↑						

[a] trend: ↑=significant increase, ↓=significant decrease, ↔=change was not significant, at the 95% level, APC and trend calculated using the Joinpoint regression program

Time trend summary-annual percentage change (APC) in age standardised rate (ASR) of incidence (1994-2011) and mortality‡ (1950-2011 or 1994-2011)

	FEMALES						MALES						M&F					
	incidence			mortality			incidence			mortality			incidence			mortality		
trend[a]	period	APC	trend	Period	APC	trend	period	APC	trend	period	APC	trend	period	APC	trend	period	APC	trend
non-melanoma skin (NMSC)	[1994-2001]	-0.5	↔				[1994-2001]	-1.9	↓				[1994-2001]	-1.2	↓			
	[2001-2011]	2.7	↑				[2001-2011]	3.3	↑				[2001-2011]	3.1	↑			
breast (female)	[1994-2011]	1.8	↑	[1950-1989]	1.2	↑												
				[1989-2011]	-1.8	↓												
cervix	[1994-2011]	2.1	↑	[1950-1972]	4.1	↑												
				[1972-1976]	-8.2	↔												
				[1976-2011]	0.0	↔												
corpus uteri	[1994-2011]	2.4	↑	[1994-2011]	2.1	↑												
ovary	[1994-2011]	-0.8	↓	[1950-1992]	2.1	↑												
				[1992-2011]	-0.9	↓												
prostate							[1994-2004]	7.5	↑	[1950-1977]	2.9	↑						
							[2004-2011]	1.8	↑	[1977-1981]	-2.0	↔						
										[1981-1996]	2.6	↑						
										[1996-2011]	-2.1	↓						
testis							[1994-2011]	2.9	↑	[1994-2011]	-4.9	↓						
kidney	[1994-2011]	3.1	↑	[1994-2011]	0.1	↔	[1994-2011]	2.9	↑	[1994-2003]	4.3	↓	[1994-2011]	3.1	↑	[1994-2011]	0.9	↑
										[2003-2007]	-5.5	↔						
										[2007-2011]	5.4	↔						
bladder	[1994-2011]	-2.2	↓	[1950-1974]	4.5	↑	[1994-2011]	-2.6	↓	[1950-1974]	5.3	↑	[1994-2011]	-2.4	↓	[1950-1974]	5.0	↑
				[1974-1992]	0.5	↔				[1974-1992]	1.0	↔				[1974-1992]	0.6	↔
				[1992-1996]	-18.8	↓				[1992-1996]	-14.5	↓				[1992-1996]	-16.6	↓
				[1996-2011]	1.0	↑				[1996-2011]	-0.9	↔				[1996-2011]	-0.1	↔
brain	[1994-2011]	0.2	↔	[1950-1955]	19.4	↔	[1994-2011]	-0.1	↔	[1950-1958]	8.3	↑	[1994-2011]	0.0	↔	[1950-1958]	9.1	↑
				[1955-1991]	2.6	↑				[1958-1992]	2.4	↑				[1958-1992]	2.4	↑
				[1991-2011]	-1.1	↓				[1992-2011]	-0.8	↓				[1992-2011]	-1.0	↓
thyroid	[1994-2007]	5.8	↑	[1994-2011]	-3.8	↓	[1994-2011]	5.0	↑	[1994-2011]	0.0	↔	[1994-2001]	0.8	↔	[1994-2011]	-2.3	↓
	[2007-2011]	16.4	↑										[2001-2011]	10.0	↑			
lymphoma (total)	[1994-2011]	1.8	↑	[1994-2011]	-1.2	↔	[1994-2011]	1.8	↑	[1994-2011]	-1.2	↓	[1994-2011]	1.8	↑	[1994-2011]	-1.2	↓
Hodgkin's lymphoma	[1994-2011]	2.4	↑	[1994-2011]	-2.2	↔	[1994-2011]	1.9	↑	[1994-2011]	-5.2	↓	[1994-2011]	2.1	↑	[1994-2011]	-3.7	↓

Time trend summary-annual percentage change (APC) in age standardised rate (ASR) of incidence (1994-2011) and mortality‡ (1950-2011 or 1994-2011)

	FEMALES						MALES						M&F					
	incidence			mortality			incidence			mortality			incidence			mortality		
trend[a]	period	APC	trend	Period	APC	trend	period	APC	trend	period	APC	trend	period	APC	trend	period	APC	trend
non-Hodgkin's lymphoma	[1994-2011]	1.6	↑	[1994-1999] [1999-2011]	4.9 -2.6	↑ ↓	[1994-2011]	1.7	↑	[1994-2011]	-0.7	↔	[1994-2011]	1.7	↑	[1994-2011]	-1.0	↔
multiple myeloma	[1994-2011]	0.0	↔	[1994-2011]	-2.1	↓	[1994-2011]	0.0	↔	[1994-2011]	-1.9	↓	[1994-2011]	0.1	↔	[1994-2011]	-1.9	↓
leukaemia	[1994-2011]	-0.1	↔	[1994-2001] [2001-2011]	3.4 -4.7	↔ ↓	[1994-2004] [2004-2011]	3.0 -3.7	↑ ↓	[1994-2004] [2004-2011]	2.7 -6.4	↑ ↓	[1994-2004] [2004-2011]	2.4 -3.1	↑ ↓	[1994-1999] [1999-2004] [2004-2011]	5.1 -0.2 -5.6	↑ ↔ ↓
in situ: breast	[1994-2011]	9.4	↑															
in situ: cervix	[1994-2011]	7.0	↑															

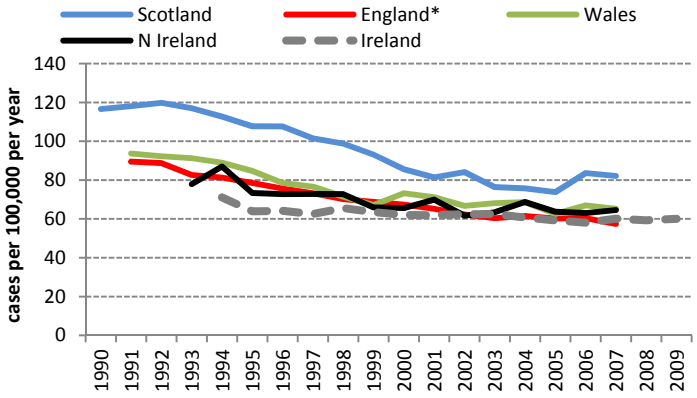
Note: The NCR was founded in 1994. Mortality data provided by the Central Statistics Office (www.cso.ie)

‡ mortality data was available for a number of common cancer sites for the period 1950-2011, otherwise mortality data was limited to the period 1994-2011

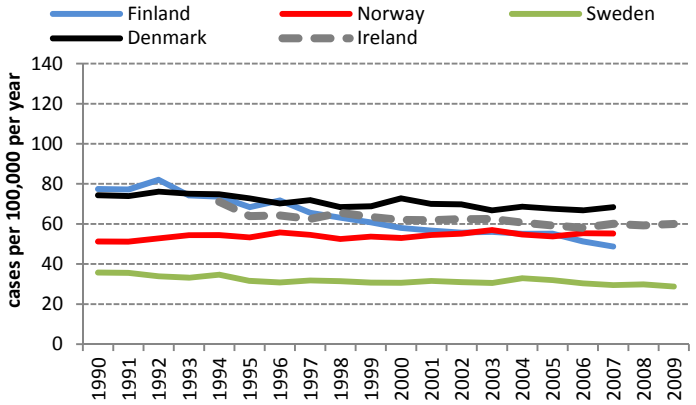
APPENDIX V: INCIDENCE TRENDS IN EUROPE BETWEEN 1990 AND 2009 FOR 5 COMMON CANCERS

Figure V-1a Lung cancer, males

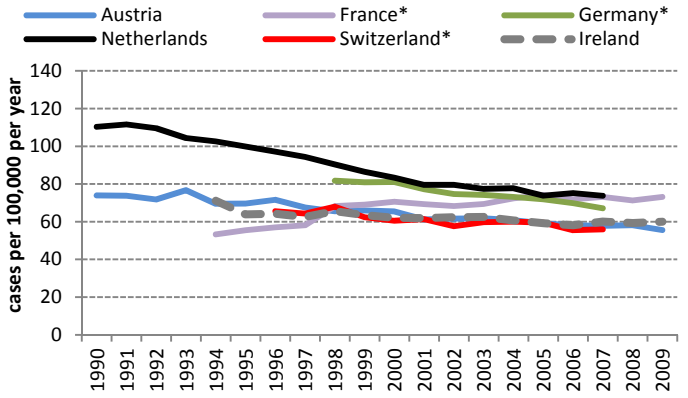
(a) UK and Ireland



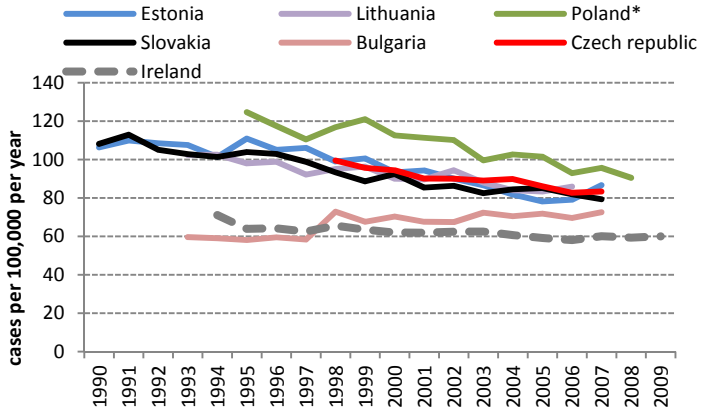
(b) Scandinavia



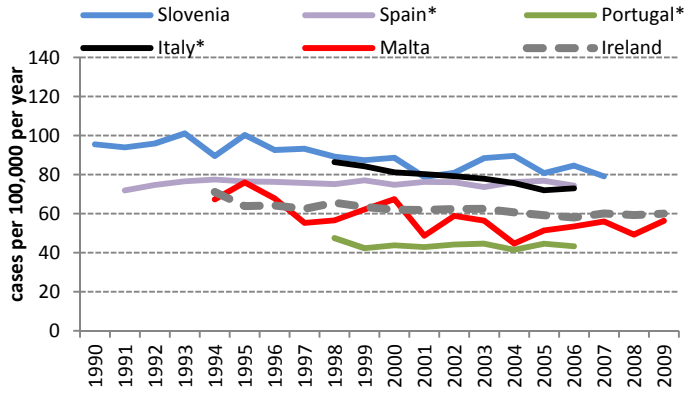
(c) Western Europe



(d) Eastern Europe



(e) Southern Europe/Mediterranean

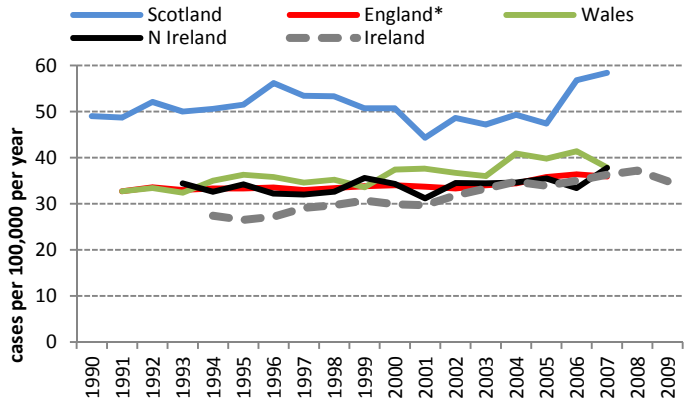


Source: ECO EUREG [7]

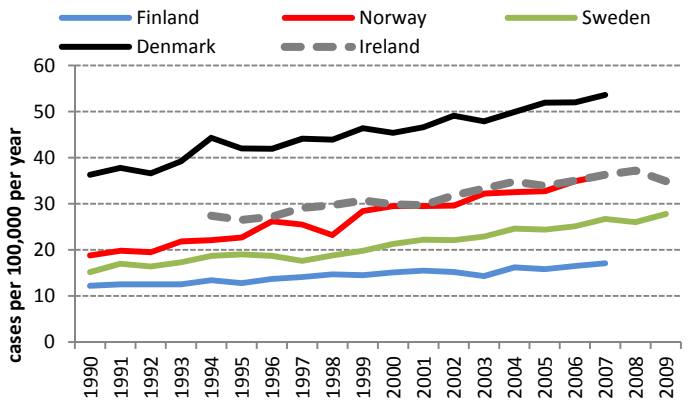
* countries represented by individual registries or registry groups. A full list of these are provided in Appendix VI

Figure V-1b Lung cancer, females

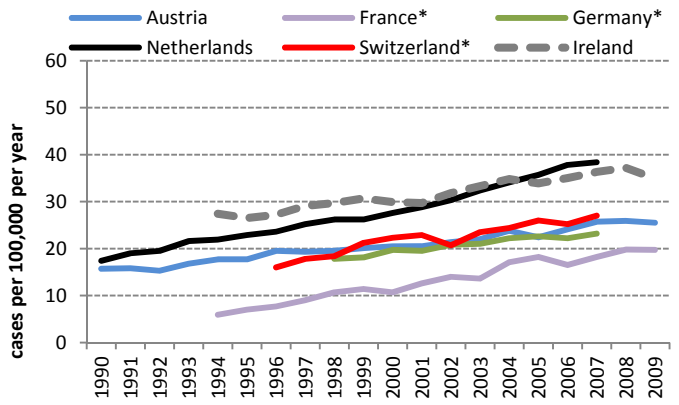
(a) UK and Ireland



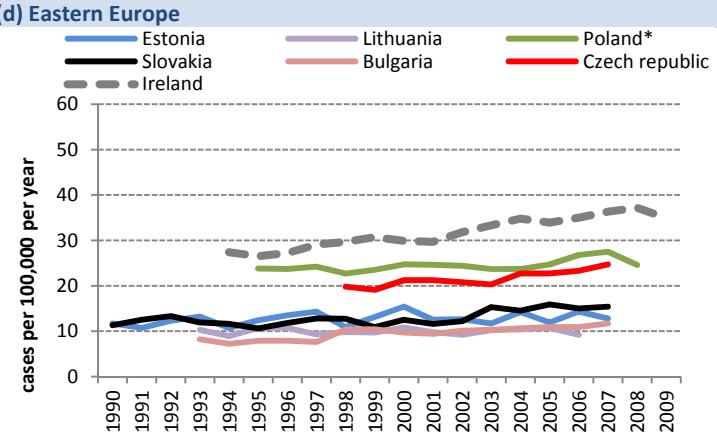
(b) Scandinavia



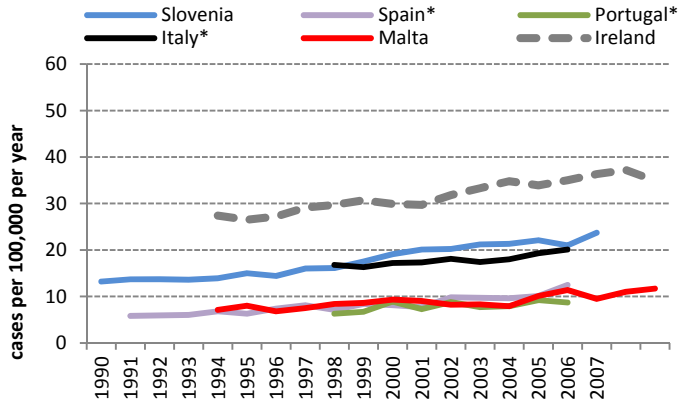
(c) Western Europe



(d) Eastern Europe



(e) Southern Europe/Mediterranean

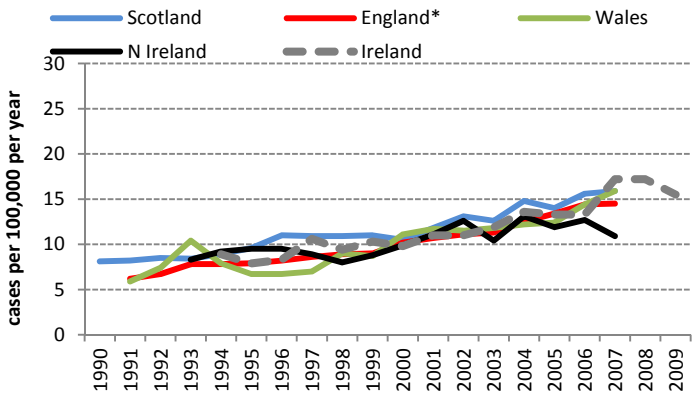


Source: ECO EUREG [7]

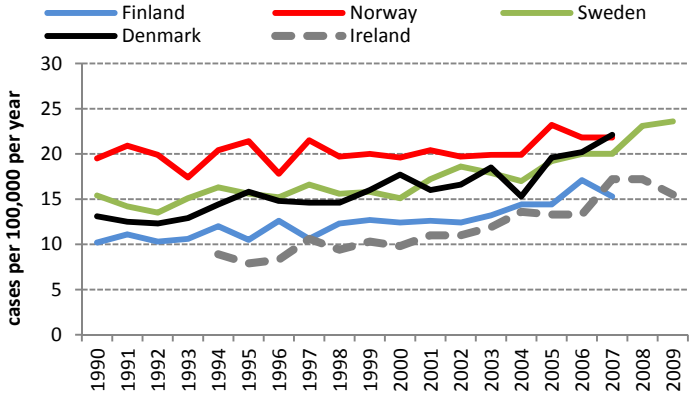
* countries represented by individual registries or registry groups. A full list of these are provided in Appendix VI

Figure V-2a Melanoma of skin, males

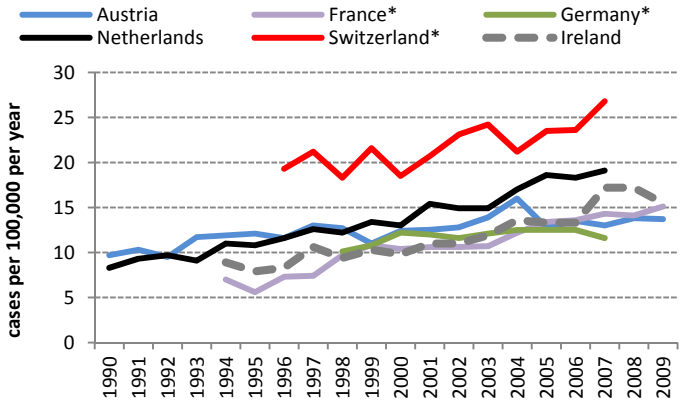
(a) UK and Ireland



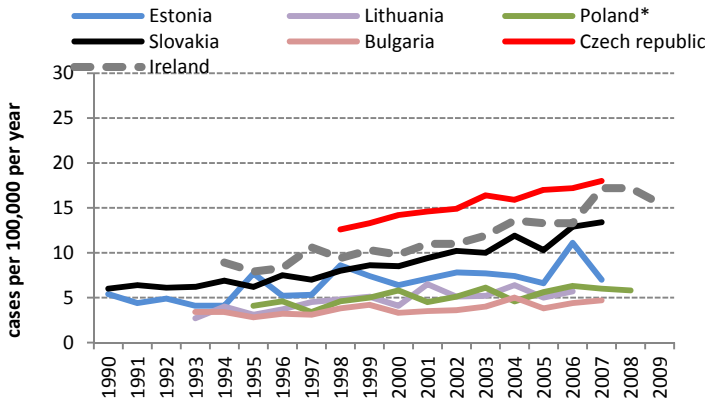
(b) Scandinavia



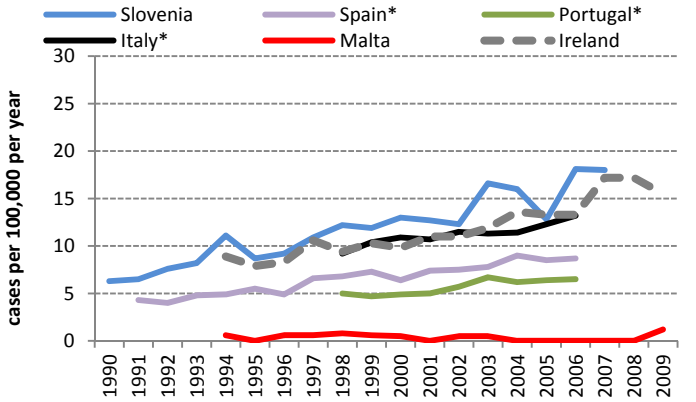
(c) Western Europe



(d) Eastern Europe



(e) Southern Europe/Mediterranean

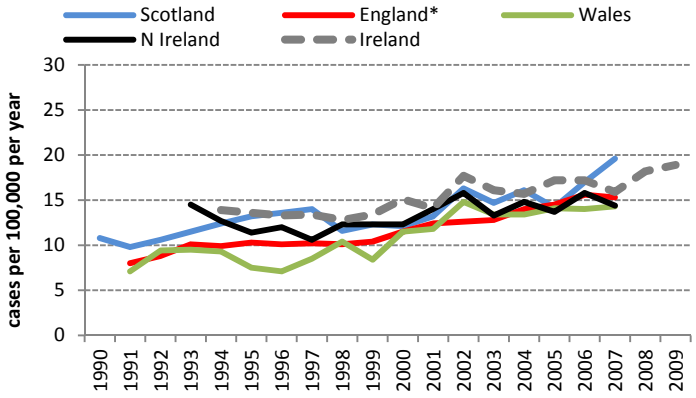


Source: ECO EUREG [7]

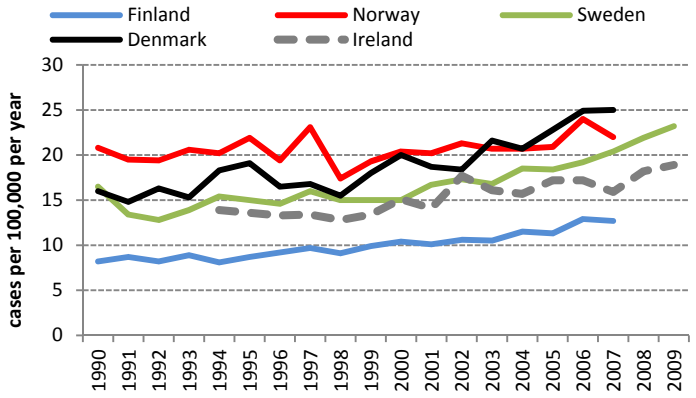
* countries represented by individual registries or registry groups. A full list of these are provided in Appendix VI

Figure V-2b Melanoma of skin, females

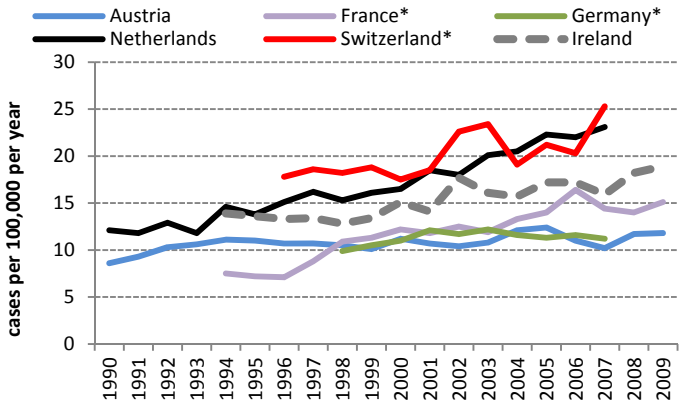
(a) UK and Ireland



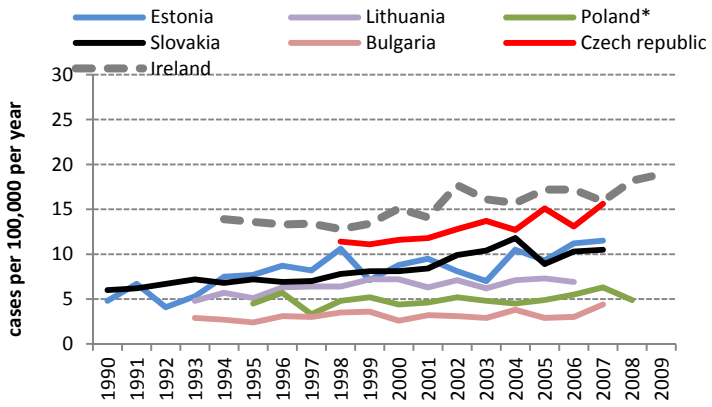
(b) Scandinavia



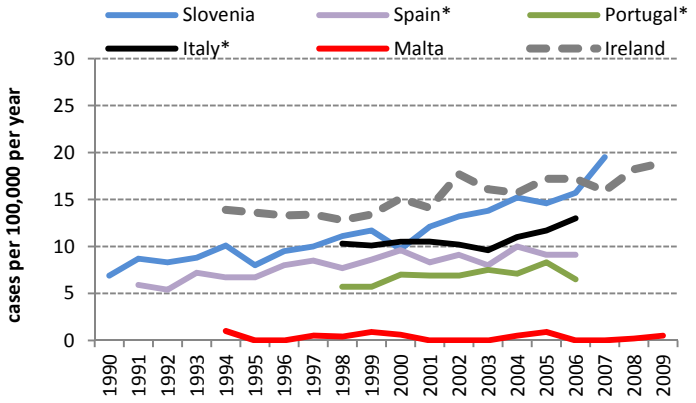
(c) Western Europe



(d) Eastern Europe



(e) Southern Europe/Mediterranean

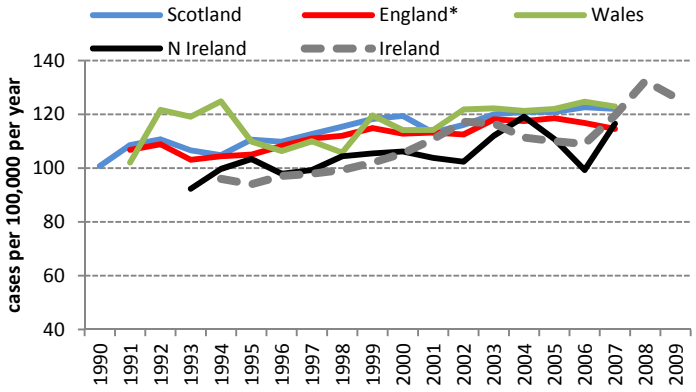


Source: ECO EUREG [7]

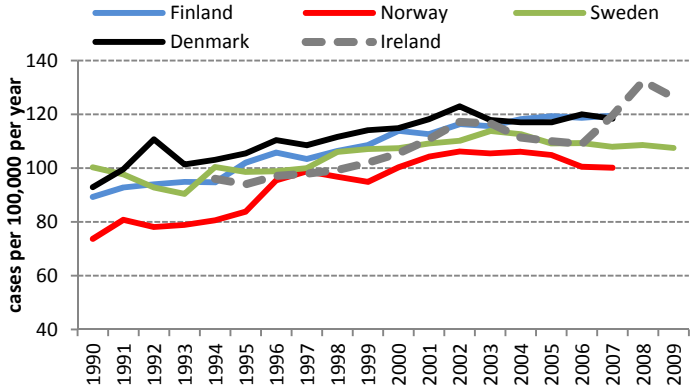
*countries represented by individual registries or registry groups. A full list of these are provided in Appendix VI

Figure V-3 Female breast cancer

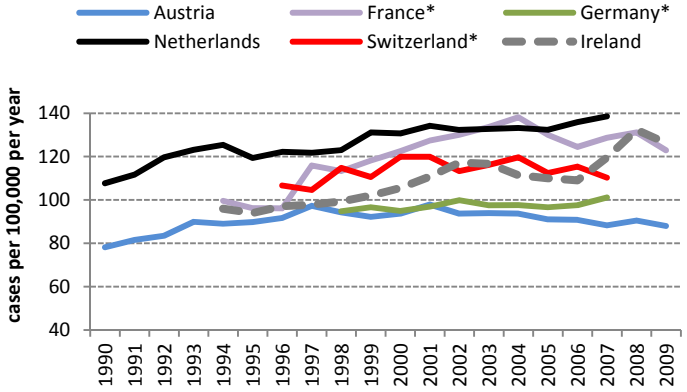
(a) UK and Ireland



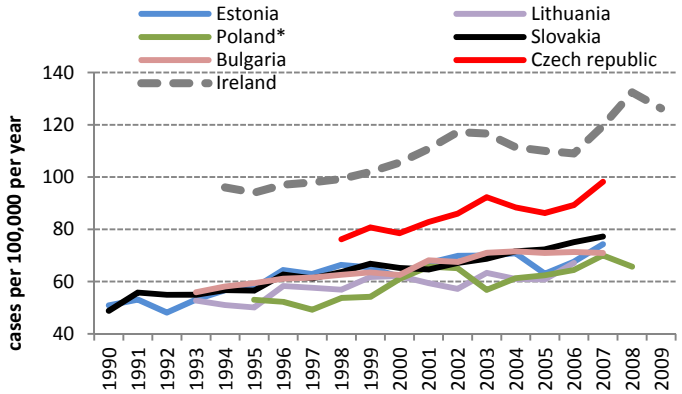
(b) Scandinavia



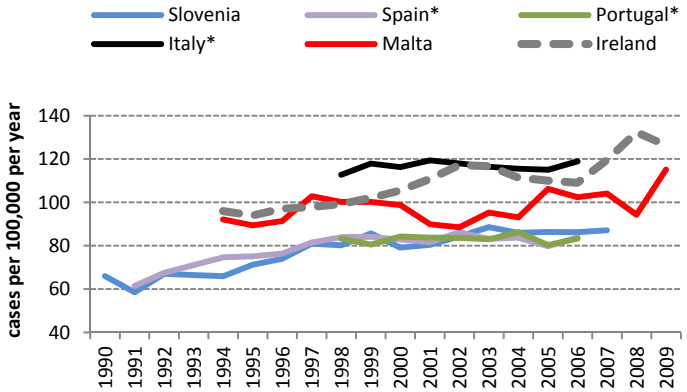
(c) Western Europe



(d) Eastern Europe



(e) Southern Europe/Mediterranean

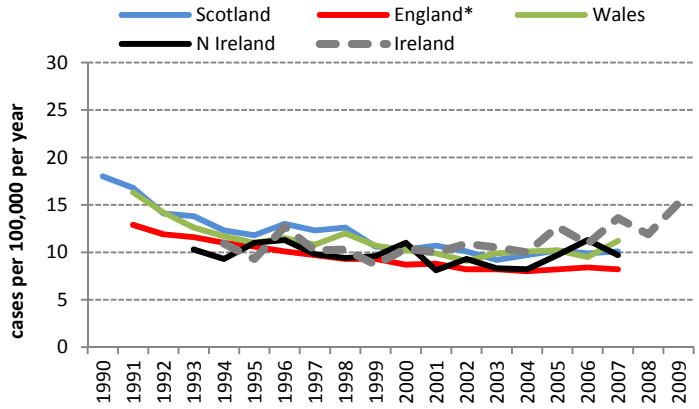


Source: ECO EUREG [7]

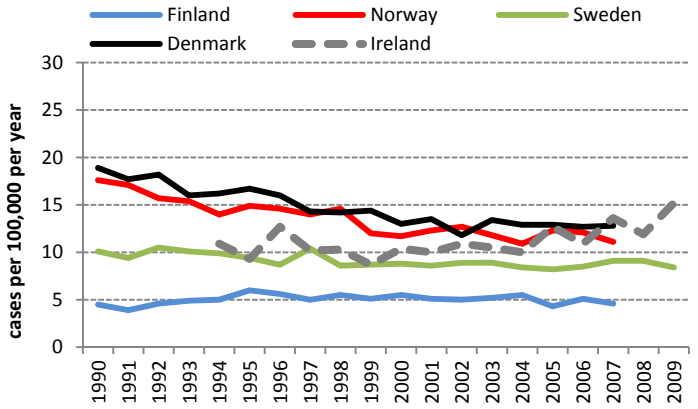
* countries represented by individual registries or registry groups. A full list of these are provided in Appendix VI

Figure V-4 Cancer of the cervix

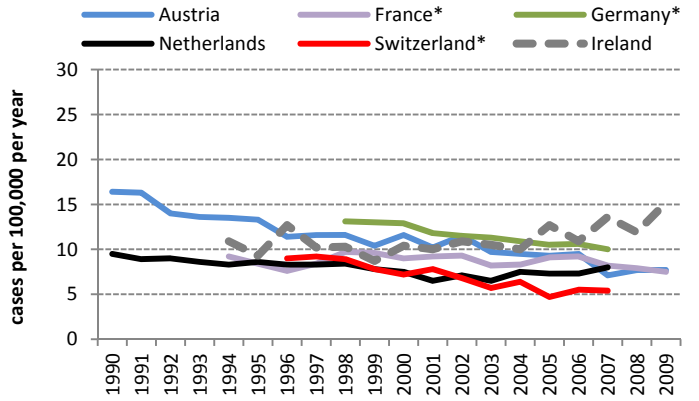
(a) UK and Ireland



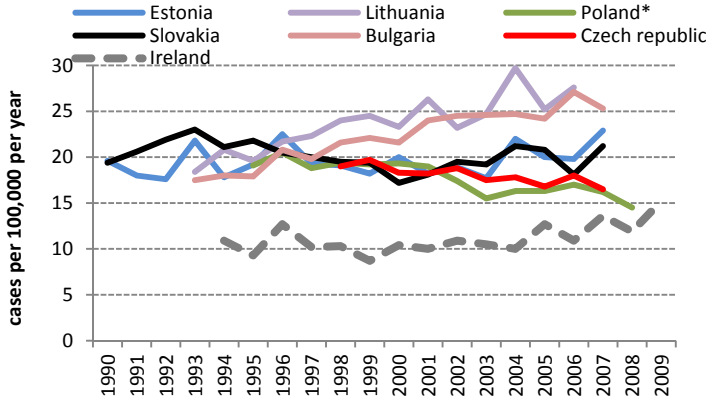
(b) Scandinavia



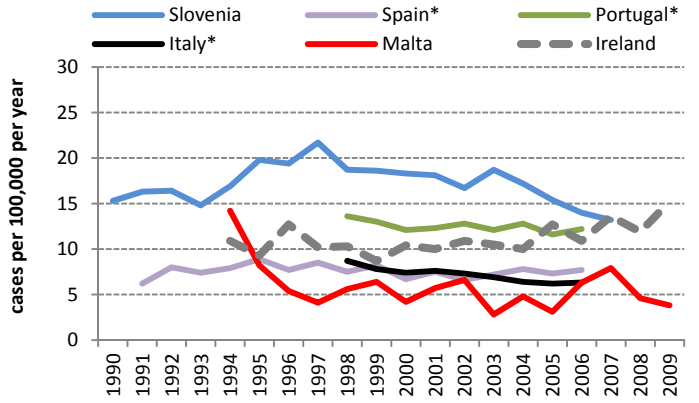
(c) Western Europe



(d) Eastern Europe



(e) Southern Europe/Mediterranean

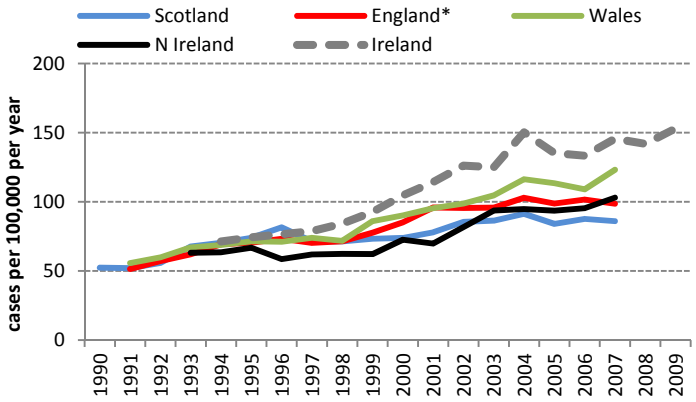


Source: ECO EUREG [7]

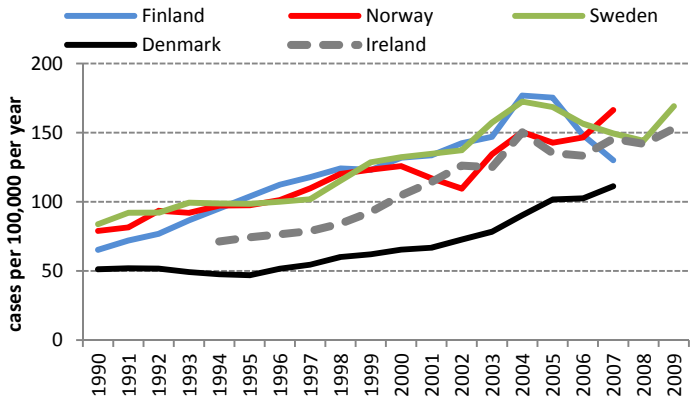
* countries represented by individual registries or registry groups. A full list of these are provided in Appendix VI

Figure V-5 Prostate cancer

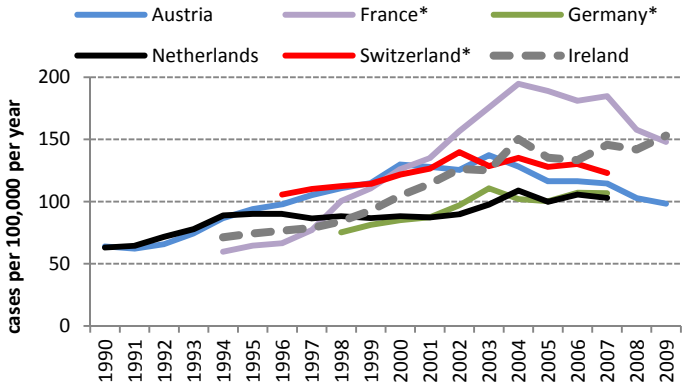
(a) UK and Ireland



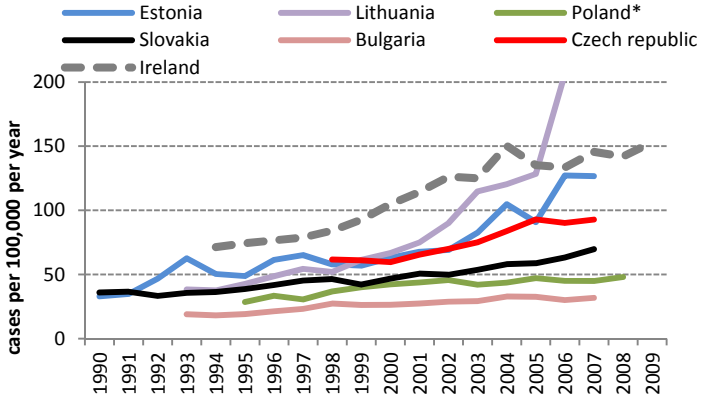
(b) Scandinavia



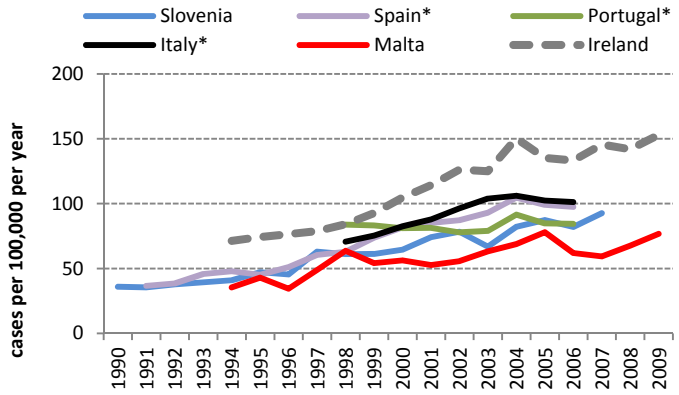
(c) Western Europe



(d) Eastern Europe



(e) Southern Europe/Mediterranean



Source: ECO EUREG [7]

* countries represented by individual registries or registry groups. A full list of these are provided in Appendix VI

APPENDIX VI: List of countries and registries included in extract for trends in incidence

Country	Incidence Years
AUSTRIA	1990-2009
BULGARIA	1993-2007
CZECH REPUBLIC	1998-2007
DENMARK	1978-2007
ESTONIA	1968-2007
FINLAND	1953-2007
FRANCE*	1994-2009
Doubs, Herault, Isere, Loire, Manche, Haut-Rhin, Somme, Tarn	
GERMANY*	1998-2007
Berlin, Brandenburg, Mecklenburg, Saxony, Saxony-Anhalt, Thüringen, Hamburg, NRW, Saarland, Schleswig-Holstein	
IRELAND	1994-2009
ITALY*	1998-2006
Biella, Reggio Emilia, Ferrara, NECSN, Latina, Modena, Naples, Parma, Ragusa, Romagna, Sassari, Sondrio, Trento, Turin, Umbria, Varese	
LITHUANIA	1993-2006
MALTA	1994-2009
NETHERLANDS	1989-2007
NORWAY	1953-2007
POLAND*	1995-2008
Kielce, Lower Silesia	
PORTUGAL*	1998-2006
Azores, South	
SLOVAKIA	1978-2007
SLOVENIA	1983-2007
SPAIN*	1991-2006
Albacete, Basque Country, Girona, Granada, Murcia	
SWEDEN	1960-2009
SWITZERLAND*	1996-2007
Geneva , Graubunden Glarus, St Gallen-Appenzell, Ticino, Zurich	
UK, ENGLAND*	1991-2007
East, North-West, North & Yorkshire, Oxford, South-West, Thames, Trent, West Midlands	
UK, NORTHERN IRELAND	1993-2007
UK, SCOTLAND	1975-2007
UK, WALES	1991-2007
EUROPE OVERALL (25 countries listed above)	1998-2006
*countries represented by the cancer registries listed in italics	
Source: ECO EUREG [7]	

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