Public Health England

National Cancer Intelligence Network

Cancer survival in England by stage

About Public Health England

Public Health England's mission is to protect and improve the nation's health and to address inequalities through working with national and local government, the NHS, industry and the voluntary and community sector. PHE is an operationally autonomous executive agency of the Department of Health.

Public Health England
Wellington House
133-155 Waterloo Road
London SE1 8UG
Tel: 020 7654 8000
www.gov.uk/phe
Twitter: @PHE_uk
Facebook: www.facebook.com/PublicHealthEngland

Published July 2014
PHE publications gateway number: 2014292

For queries relating to accessibility, please call 020 7654 8158
or email enquiries@ncin.org.uk

The intelligence networks

Public Health England operates a number of intelligence networks, which work with partners to develop world-class population health intelligence to help improve local, national and international public health systems.

National Cancer Intelligence Network

The National Cancer Intelligence Network (NCIN) is a UK-wide initiative, working to drive improvements in cancer awareness, prevention, diagnosis and clinical outcomes by improving and using the information collected about cancer patients for analysis, publication and research.

National Cardiovascular Intelligence Network

The National Cardiovascular Intelligence network (NCVIN) analyses information and data and turns it into meaningful timely health intelligence for commissioners, policy makers, clinicians and health professionals to improve services and outcomes.

National Child and Maternal Health Intelligence Network

The National Child and Maternal Health Intelligence Networks (NCMHIN) provides information and intelligence to improve decision-making for high quality, cost effective services. Their work supports policy makers, commissioners, managers, regulators, and other health stakeholders working on children's, young people's and maternal health.

National Mental Health Intelligence Network

The National Mental Health Intelligence Network (NMHIN) is a single shared network in partnership with key stakeholder organisations. The Network seeks to put information and intelligence into the hands of decision makers to improve mental health and wellbeing.

National End of Life Care Intelligence Network

The National End of Life Care Intelligence Network (NEoLCIN) aims to improve the collection and analysis of information related to the quality, volume and costs of care provided by the NHS, social services and the third sector to adults approaching the end of life. This intelligence will help drive improvements in the quality and productivity of services.

Contents

Executive summary

Age-standardised one-year relative survival is presented for breast, colorectal, lung, ovarian and prostate cancers diagnosed in 2012. A comparison of all-stage survival in 2012 with a baseline of 2004-07 shows increasing survival across all cancer types with an overall change of 8.3% in lung cancer, 6.5% in ovarian cancer, 6.3% in colorectal cancer, 3.5% in prostate cancer and 1.6% in breast cancer.

Comparison to the International Cancer Benchmarking Partnership (ICBP) results for 2004-07 show that one-year age-standardised survival has improved substantially in stage 3-4 breast and colon cancer and stage 1-3 non-small cell lung cancer, though there is little change for ovarian cancer. These stage-specific results though should be interpreted with caution due to the potential impact of methodological differences between the studies.

The completeness of stage at diagnosis for cancers registered in England by PHE's National Cancer Registration Service (NCRS) has improved greatly in recent years. For the latest data (2012) it is complete in 80% or more of cases of the cancers examined which allows more robust exploration of the effects of stage and other determinants of short term cancer survival.

For breast, prostate, and colorectal cancer age standardised one-year survival is above 90% for stage 1 to 3 tumours with substantially lower survival only for stage 4. However, for lung and ovarian tumours there is a marked drop in survival with each increase in stage. A reduction in the number (or improvement in stage-specific survival) of stage 4 breast, prostate, and colorectal cancers can therefore be expected to most directly impact overall one-year survival. Similarly, any stage shift or stage-specific survival improvement in lung or ovarian cancer will impact overall one-year survival for these tumours.

Females with lung cancer have a higher overall age standardised survival than males (43% vs. 36%) while for colorectal cancer males have a higher age standardised survival (81% vs. 79%). In lung cancer this appears to be driven by differences between the sexes in stage-specific survival.

Survival decreases with increasing age, in particular for people over 70. Older people with late stage tumours have substantially lower survival.

Across all cancer types examined, except prostate, there is a modest (6% or less) but statistically significant variation in survival with socio-economic deprivation. More advanced stage at presentation and lower stage-specific survival in the more deprived both appear to contribute to this.

In summary, the completeness of stage at diagnosis in cancer registrations recorded by the National Cancer Registration Service has improved radically in recent years. This allows a more robust analysis of cancer outcomes by stage in combination with age, sex and other factors than ever before. Comparison with the best historical data available shows increased one-year cancer survival, for lung and colorectal cancer in particular.

Background & Introduction

International studies of cancer survival typically show England and the UK to have a lower survival from cancer than comparable European countries. These include the continuing EUROCARE series[1] of studies published between 1985 and 2013 which cover persons diagnosed with cancer between 1978 and 2007. More recently publications by the International Cancer Benchmarking Partnership (ICBP)[2] again show that people in the UK have lower survival than other comparable European and non-European countries for breast[3], colon[4], lung[5], and ovarian[6] cancer.

Improving cancer survival is a key challenge identified by the Department of Health in *Improving Outcomes: A Strategy for Cancer*[7]. Survival has a number of determinants of which age and stage at diagnosis are two of the most important. Variation in the stage distribution may go some way in helping to explain the differences in survival reported in the ICBP. A number of initiatives focussing on early diagnosis are underway to drive a shift towards more cancers being diagnosed at an earlier stage.

Improving the collection of data on the stage at diagnosis across all cancer types was identified as a priority for cancer registration in 2010[8]. Staging completeness has improved in recent years and continues to do so following the merger of the regional cancer registration functions into the single unified National Cancer Registration Service. While variation geographically and by cancer type still exists[9] the completeness of stage at diagnosis is over 80% for breast, colorectal, lung, ovarian and prostate cancers diagnosed in 2012.

Survival analysis by TNM stage group at diagnosis for these cancer types is now more robust. This allows more accurate comparisons between England and other countries. It will also allow the frequency of early diagnosis to be investigated more comprehensively, and enable better assessment of the campaigns aimed at promoting such early diagnosis. Relative survival by stage is examined here by sex, age and income deprivation quintile for England in 2012. Some comparisons can be made to ICBP data: we examine how the survival figures for 2012 here differ from the UK 2004-2007 figures and where the 2012 survival figures would fit in to a comparison with the other countries in the ICBP study. These data will help inform further international study, helping facilitate comparisons of greater validity than has previously been possible.

This short preliminary report also presents a brief summary of the main variation in one-year relative survival of the selected cancer types by stage, sex, age, and socio-economic deprivation. In most cases age survival figures presented in this report have been age-standardised. In addition to the figures in this report, relative survival data are available (in accompanying spread sheets) which use statistical imputation to assign tumours with an unknown stage to a stage category, as explained in the methodology section.

Results

Variation by stage and sex

The number of cases and proportion (within each sex) diagnosed at each stage is shown in Table 1. The variation by cancer type is as expected, with more than two-thirds of breast cancer presentations at stage 1 or 2 and more than two-thirds of lung cancer presentations at stage 3 or 4. The other three cancers are intermediate between these two.

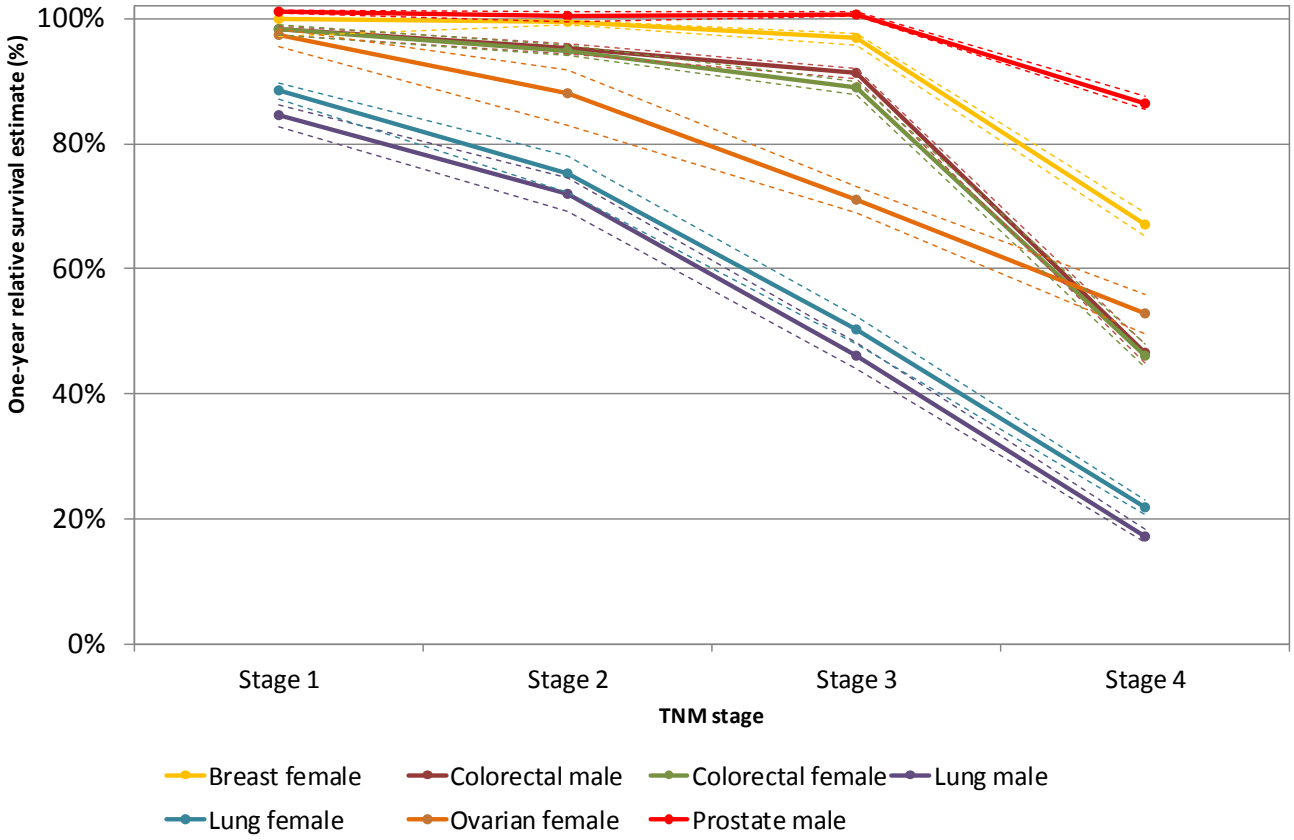
More men with colorectal cancer present at stage 1 than women (16% vs. 14%, $p<0.001$) whilst for lung cancer slightly more women present at stage 1 than men (12% vs. 15%, $p<0.001$). More men present with stage 4 lung cancer than women (50% vs. 48%, $p<0.001$).

Table 1 Numbers diagnosed in England, 2012

	Breast		Colorectal		Lung		Ovarian		Prostate	
All patients	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Male			19,215	100%	19,120	100%			36,287	100%
Female	42,071	100%	14,796	100%	15,877	100%	5,455	100%		
Stage 1										
Male			3,144	16%	2,241	12%			11,896	33%
Female	15,752	37%	2,111	14%	2,395	15%	1,711	31%		
Stage 2										
Male			4,680	24%	1,512	8%			6,269	17%
Female	14,148	34%	3,722	25%	1,128	7%	276	5%		
Stage 3										
Male			5,336	28%	3,915	20%			5,625	16%
Female	3,583	9%	3,922	27%	3,097	20%	1,567	29%		
Stage 4										
Male			4,136	22%	9,533	50%			5,836	16%
Female	2,366	6%	3,215	22%	7,618	48%	929	17%		
Unknown stage										
Male			1,919	10%	1,919	10%			6,661	18%
Female	6,222	15%	1,826	12%	1,639	10%	972	18%		

The one-year age-standardised relative survival estimates show a variety of trends depending on the cancer type, seen below in Table 2 and Figure 1. Prostate, breast and colorectal cancer all show a relatively small decline in survival for stages 1 through to 3. However, between stage 3 and 4 a large decrease is observed. Survival for prostate cancer falls from 101%[10] at stage 3 to 86% at stage 4, breast 97% to 67%, and colorectal 90% to 46%. Ovarian cancer has a more uniform decrease in age-standardised relative survival across stages, although larger falls are seen between stages 2 to 3 and 3 to 4. Lung cancer has the lowest age-standardised relative survival for all stages with a large decrease between each stage.

Figure 1 Age-standardised one-year relative survival estimates by TNM stage at diagnosis, cancer site, sex, England, 2012



The trends are consistent between the sexes for lung and colorectal cancer. Males have slightly, but statistically significantly, higher age-standardised relative survival for colorectal cancer, with all-stage survival 81% compared to 79% for females (p<0.001). Lung cancer survival is higher in females: 43% for all stages compared to 36% in males (p<0.001). Survival by individual stage is similarly higher in females for lung cancer and in males for Stage 3 colorectal cancer.

Table 2 One-year age-standardised relative survival estimates, 2012, England

12-month ASR survival	Breast			Colorectal			Lung			Ovarian			Prostate		
	RS (%)	95% CI		RS (%)	95% CI		RS (%)	95% CI		RS (%)	95% CI		RS (%)	95% CI	
TNM stage															
All patients															
Persons				80.2%	*79.8%*	*80.7%*	39.1%	*38.5%*	*39.7%*						
Male				81.2%	*80.6%*	*81.8%*	36.0%	*35.1%*	*36.8%*				96.9%	*96.5%*	*97.2%*
Female	95.9%	*95.7%*	*96.2%*	79.1%	*78.4%*	*79.8%*	42.6%	*41.7%*	*43.6%*	72.2%	*71.0%*	*73.4%*			
Stage 1															
Persons				98.2%	*97.6%*	*98.2%*	86.8%	*85.7%*	*86.8%*						
Male				98.2%	*97.3%*	*98.8%*	84.5%	*82.6%*	*86.2%*				101.1%	*100.8%*	*101.3%*
Female	99.9%	*97.1%*	*100.0%*	98.3%	*97.3%*	*98.9%*	88.5%	*87.1%*	*89.7%*	97.3%	*95.5%*	*98.4%*			
Stage 2															
Persons				95.0%	*94.4%*	*95.5%*	73.4%	*71.4%*	*75.3%*						
Male				95.2%	*94.4%*	*95.9%*	72.0%	*69.3%*	*74.6%*				100.3%	*99.5%*	*101.2%*
Female	99.4%	*99.0%*	*99.7%*	94.9%	*94.1%*	*95.6%*	75.3%	*72.2%*	*78.1%*	88.2%	*83.0%*	*91.8%*			
Stage 3															
Persons				90.3%	*89.6%*	*90.9%*	48.0%	*46.5%*	*49.5%*						
Male				91.3%	*90.4%*	*92.1%*	46.1%	*44.0%*	*48.1%*				100.7%	*100.3%*	*101.1%*
Female	96.8%	*95.8%*	*97.6%*	89.0%	*87.9%*	*89.9%*	50.2%	*48.0%*	*52.3%*	71.1%	*68.9%*	*73.2%*			
Stage 4															
Persons				46.4%	*45.2%*	*47.6%*	19.3%	*18.6%*	*20.1%*						
Male				46.4%	*44.8%*	*48.0%*	17.2%	*16.2%*	*18.3%*				86.5%	*85.4%*	*87.5%*
Female	67.1%	*65.1%*	*69.0%*	46.1%	*44.3%*	*47.9%*	21.9%	*20.7%*	*23.0%*	52.8%	*49.7%*	*55.9%*			
Missing stage															
Persons				64.4%	*62.6%*	*66.0%*	31.6%	*29.6%*	*33.6%*						
Male				67.1%	*64.8%*	*69.3%*	27.7%	*25.1%*	*30.4%*				94.5%	*93.1%*	*95.6%*
Female	91.9%	*91.0%*	*92.6%*	61.3%	*58.6%*	*63.8%*	36.1%	*33.1%*	*39.0%*	60.2%	*57.1%*	*63.1%*			

Variation over time

Figure 2 and Table 3 show the one-year survival for all ages combined, not standardised by age, for persons diagnosed by calendar year between 2004 and 2012.

A linear regression model for each cancer type over the period 2004-2012 shows that survival for each is increasing statistically significantly with an overall change in survival per year of between 0.3% (breast cancer) and 1.1% (lung cancer), with an overall increase of between 1.6% (breast) and 8.3% (lung). *p*-values, % change per year and % overall change are shown in Table 3. Lung cancer in particular shows the highest year-on-year change between 2011 and 2012. Confidence intervals on the relative survival by individual year are <1.4% for Ovarian and <0.6% for other cancer types.

Figure 2, one-year survival, all stage, by year of diagnosis, not standardised by age

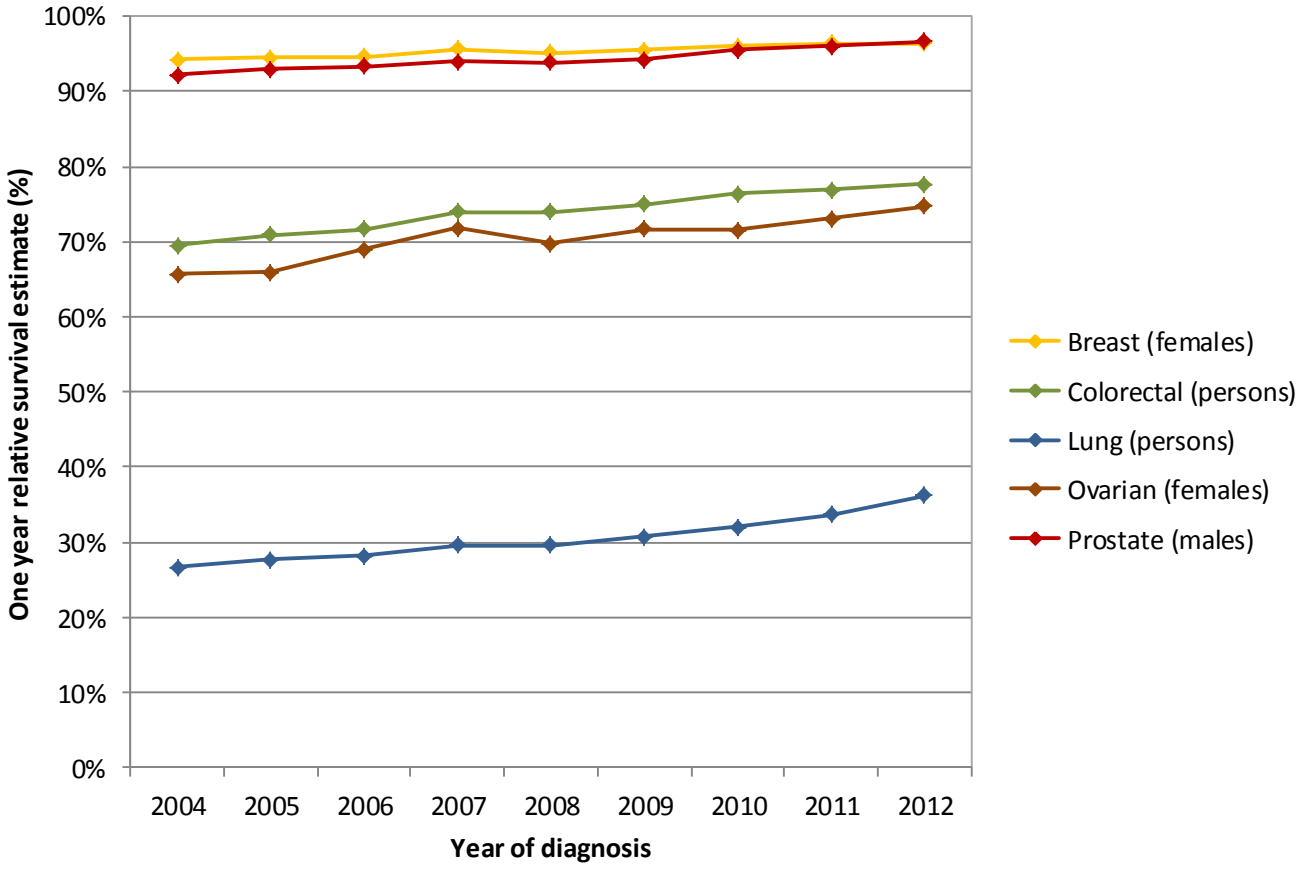


Table 3 One-year survival, all stage, by year of diagnosis, not standardised by age

	2004- 2007 combined	2004	2005	2006	2007	2008	2009	2010	2011	2012	*p* for trend	% Change per year	% Change from 2004-07 to 2012
Breast	94.8%	94.3%	94.5%	94.6%	95.6%	95.1%	95.5%	96.0%	96.4%	96.4%	0.0001	0.3	1.6
Colorectal	71.5%	69.5%	70.8%	71.7%	73.9%	73.9%	74.9%	76.4%	76.9%	77.7%	<0.0001	1.0	6.2
Lung	28.0%	26.6%	27.6%	28.2%	29.6%	29.6%	30.8%	32.0%	33.6%	36.3%	<0.0001	1.1	8.3
Ovarian	68.1%	65.7%	65.9%	68.9%	71.8%	69.7%	71.6%	71.6%	73.0%	74.7%	0.0003	1.0	6.5
Prostate	93.1%	92.1%	92.9%	93.3%	94.0%	93.9%	94.2%	95.5%	96.0%	96.6%	<0.0001	0.5	3.5

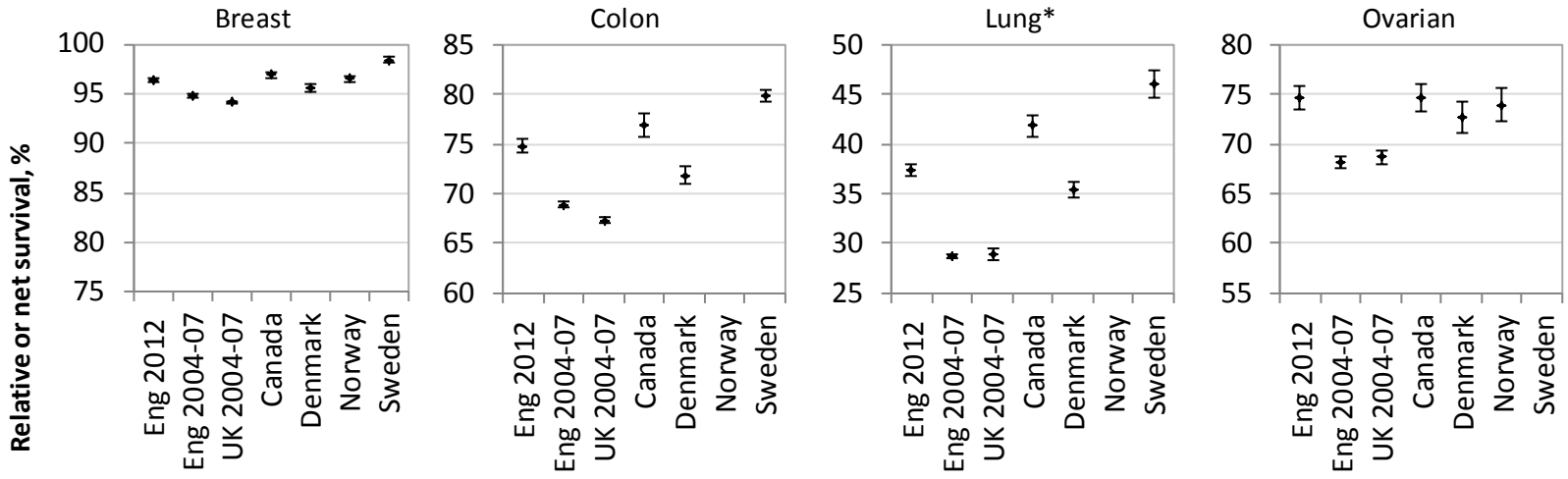
Comparison to ICBP results, 2004-2007

Figure 3 compares un-standardised one-year relative survival, for all stages combined, between the data for England in 2004-2007 and 2012, and net survival for the countries in the ICBP studies. An analysis of the validity of comparing one-year relative to net survival as reported by ICBP showed that they differ little (<0.1%).

In the ICBP period, 2004-2007, survival in the UK was substantially lower than the other countries examined. In contrast, comparing the latest survival data for England to the ICBP shows it to be broadly typical of the other countries 2004-07 figures. There is good agreement between the survival in England in 2004-07 (this study) and the UK survival in the ICBP studies.

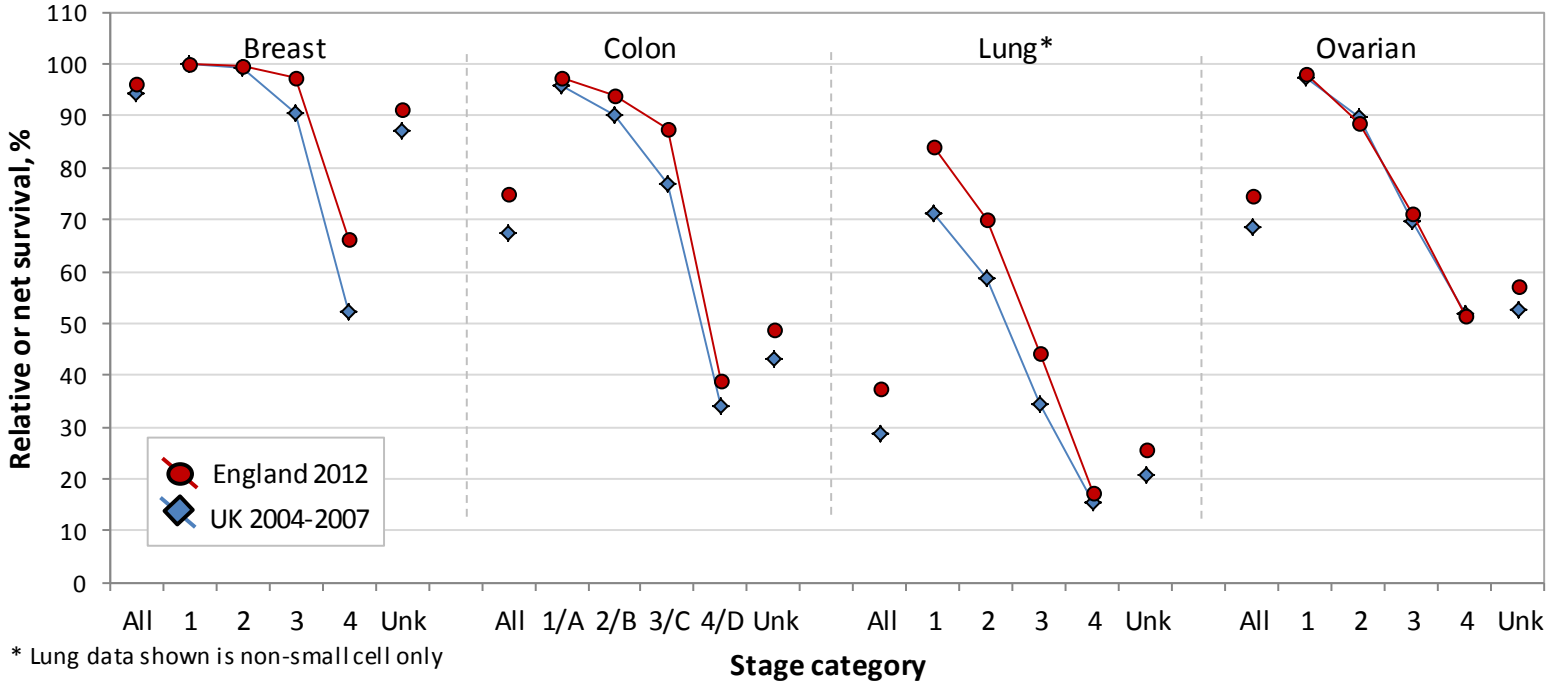
Figure 4 shows the difference between relative survival estimates by stage for England in 2012 and 2004-07, and UK data for 2004-07, as published in the ICBP studies[1-5]. Unlike the rest of this report figures 3 and 4 show data for colon (not colorectal) and non-small cell lung cancer (not all lung cancers). Breast and colon cancer exhibit the largest improvement for later stage cancers while lung cancer has greater improvements for earlier stage cancers. Ovarian cancer shows little change in stage-specific survival with the exception of unknown stage, which shows an increase in all cancers.

Figure 3 One-year unstandardised relative/net survival, all stage, in the ICBP and England data (note varying scale)



* Lung data shown is non-small cell only

Figure 4 One-year relative/net survival, by stage, in the ICBP and England 2012 data



* Lung data shown is non-small cell only

Variation by age

As well as age-standardised relative survival, age-specific relative survival rates have been calculated. As might be expected, in all cancer types and for both sexes the older age groups have lower survival, this being especially evident for the oldest age groups.

For some cancer types this is less evident until later stages, for example breast (as seen in Figure 5) and prostate cancers. For lung (Figure 6) and colorectal cancer wider gaps in survival estimates appear between the age groups at earlier stages (additional data are shown in spreadsheets accompanying this report).

Figure 6 One-year relative survival estimates by TNM stage at diagnosis, females, breast, 2012, by age

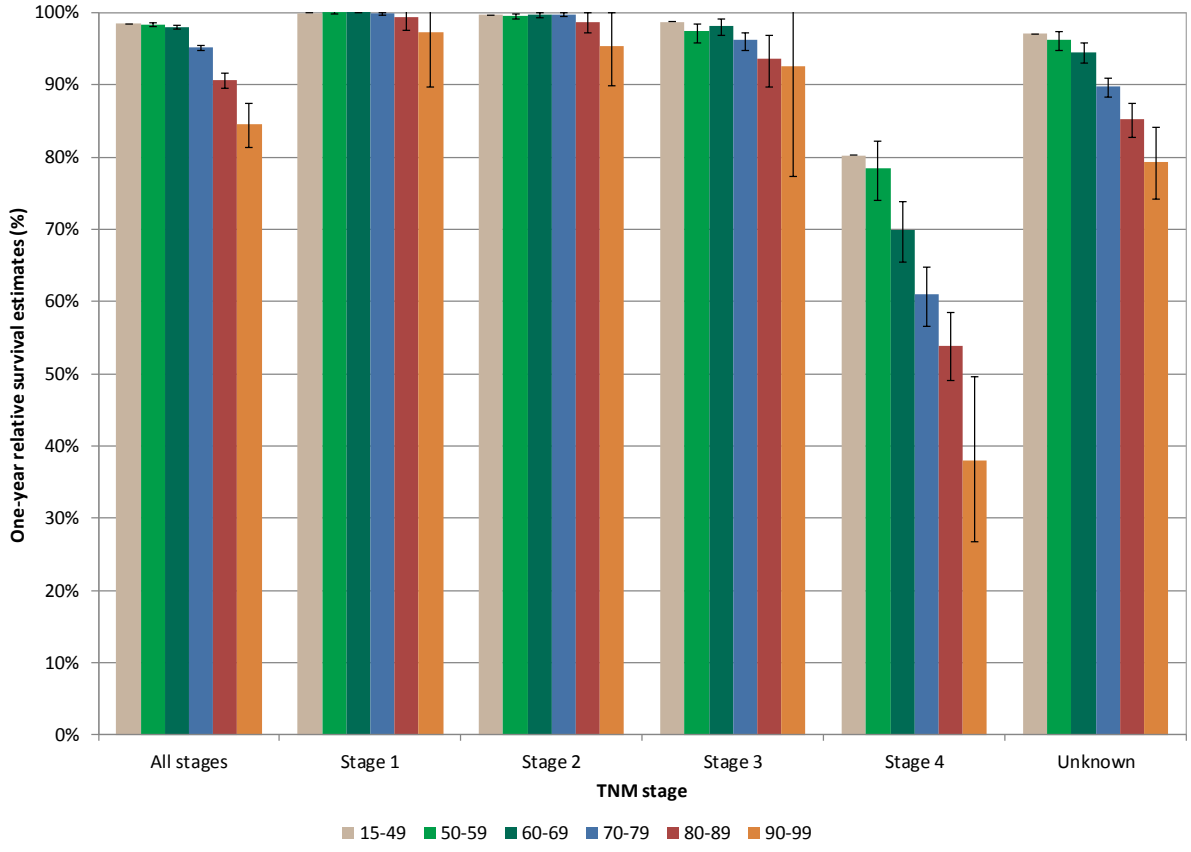
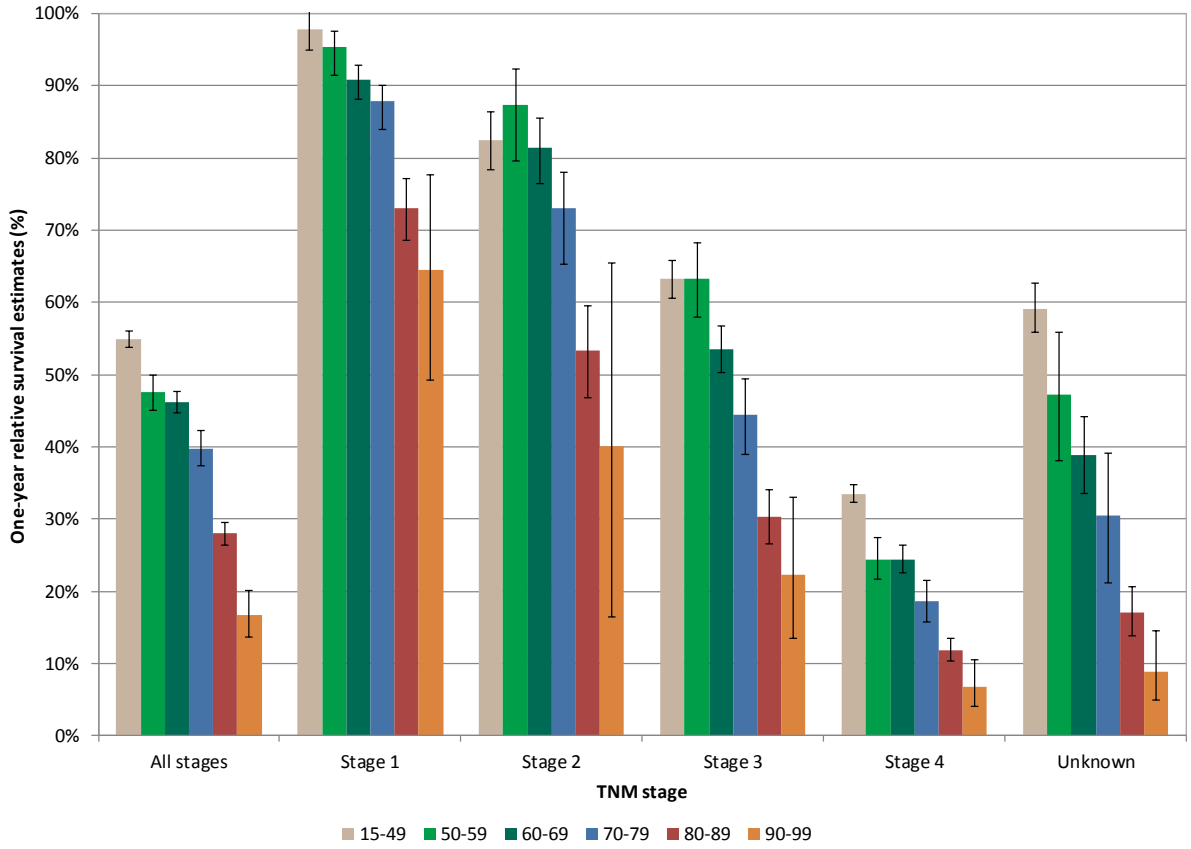


Figure 6 One-year relative survival estimates by TNM stage at diagnosis, females, lung, 2012, by age



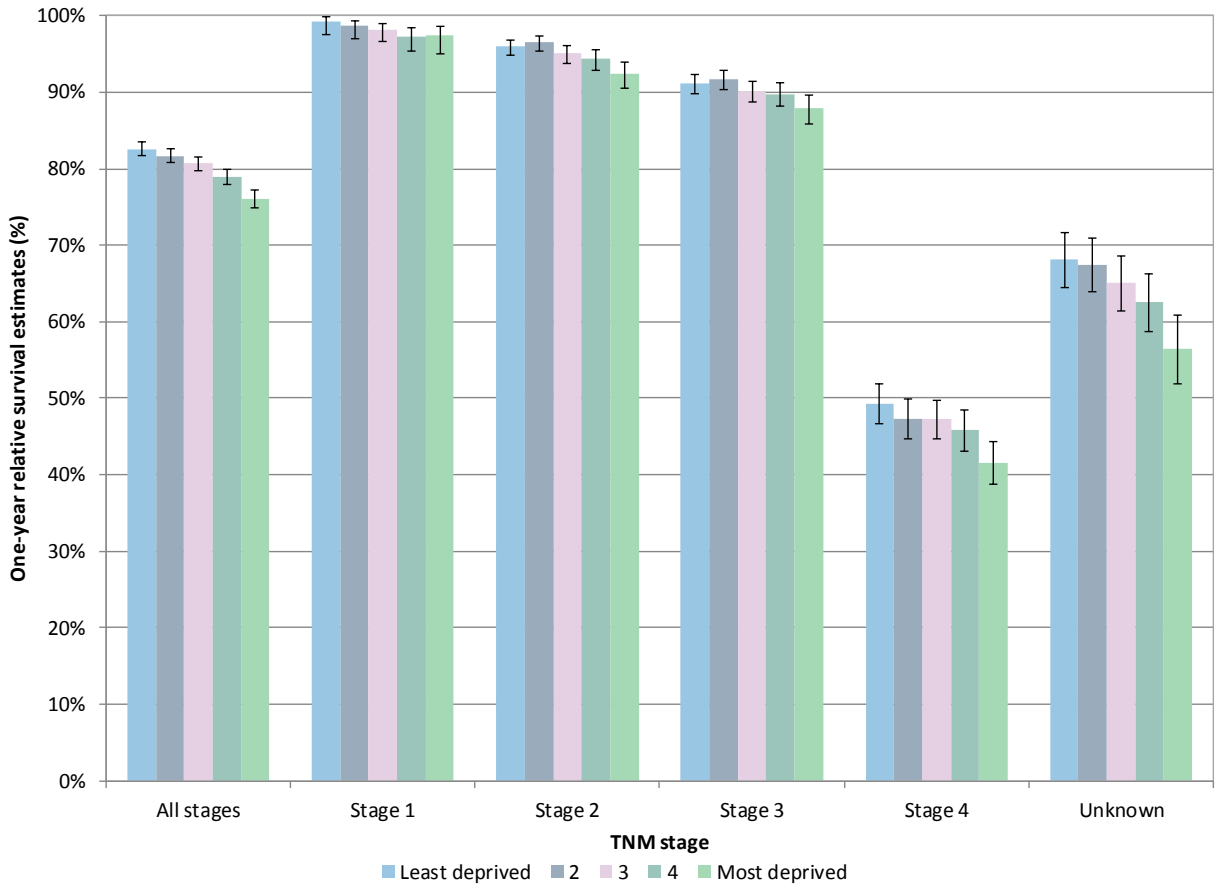
Relative survival estimates have been calculated for the most detailed age groups: aged 15-49 and then by decade to age 99, as seen in figures 5 and 6. The difference in the all-stage relative survival between those aged 80-89 years and those aged 90-99 is statistically significant in all cancer types examined for both sexes, ie the oldest of the old have worse outcomes. The same pattern can be seen in stage-specific relative survival for many combinations of cancer type, sex and stage although there are often large confidence intervals associated with this final group due to the comparatively low numbers of persons in the oldest age group.

Variation by socio-economic deprivation

Trends between deprivation quintiles for age-standardised relative survival show a less clear pattern than age variation, and differ to a larger extent between cancer types. Prostate cancer outcomes did not vary with deprivation with the least and most deprived quintiles both having 97% survival for all stages combined. There was only a slight decrease in survival for breast cancer with the least and most deprived quintiles having 97% and 95% survival for all stages combined, although a greater decline from 76% to 72% was seen within stage 4. Ovarian cancer survival declined from 76% to 70% between the least and most deprived quintiles, but this pattern was not repeated across individual stages; low numbers for this type prevent any firm conclusions being drawn from the deprivation data at this level. Lung cancer survival fell from 43% to 37% between the least and most deprived quintiles, but this pattern was less consistent

across individual stages. Colorectal cancer also showed a marked decline from 83% to 76% between the least and most deprived quintiles, with this pattern repeated across individual stages. The deprivation breakdown for colorectal cancer can be seen in Figure 7.

Figure 7 One-year relative survival estimates by TNM stage at diagnosis, persons, colorectal, 2012, by deprivation quintile



Trend analysis gave statistical support to the observed differences between the deprivation quintiles for breast, lung, colorectal and ovarian cancers for all stages combined (respective R^2 values of 0.84, 0.94, 0.89 and 0.86). Prostate cancer showed no statistically significant variation between deprivation quintiles for all stages combined.

Discussion

The data presented here demonstrate a substantial improvement in the completeness of staging data collected by the NCRS in England. The analysis clarifies the expected patterns of survival, which falls as stage increases for all cancers, both sexes, all age groups and all deprivation quintiles. This supports the work underpinning early diagnosis campaigns, with survival estimates shown to be better for the cancers examined here diagnosed at earlier stage.

Survival has increased 8.3% in lung, 6.5% in ovarian, 6.2% in colorectal, 3.5% in prostate and 1.6% in breast cancer, with greater absolute increases occurring in the poorer survival cancers. Comparison to the ICBP analysis for 2004-2007 shows an increase in stage-specific survival at early stage for lung cancer and later stage for colorectal cancer. For ovarian cancer there has been little improvement in stage-specific survival, which may imply that the increase in survival is due to increased diagnosis at an earlier stage. Caution in interpretation should be exercised due to the potential effect of methodological differences between the ICBP and this study. However, the overall all-stage survival reported by ICBP for the UK in 2004-07 is similar to that calculated here for England.

Of the overall change in lung cancer 2.6% occurred between 2011 and 2012; this may partly reflect improved data capture by the NCRS from the National Lung Cancer Audit. Further improvement survival in lung, ovarian, and colorectal cancers could be brought about either by improving stage-specific survival or by increasing the proportion diagnosed at earlier stage.

The change in prostate (3.5%) and breast cancer (1.6%) is smaller, though these cancers now have overall 1-year survival in excess of 95%. Further improvement in one-year survival for these cancers could be achieved by reducing the proportion or improving the survival of tumours diagnosed at stage 4, as one-year survival for stage 1-3 is close to 100%.

The survival estimates for England in 2012 are more in line with those of the ICBP countries, albeit in a comparison across time and between countries (and also, to some extent, across methodologies). Further benchmarking against 2012 data for these countries will be beneficial.

The breakdown of the 2012 data reveals a number of disparities between equality groupings. Between the sexes, differences in age-standardised survival exist: lung cancer one-year survival for all stages is 43% for females compared to 36% for males. For colorectal cancer all-stage survival is higher in males than females (81% compared to 79%). This variation is seen for each stage for lung but only stage 3 for colorectal

cancer and may be driven by factors not considered such as disparity between the sexes in route of presentation. The differing stage distribution in males and females will also contribute to the disparity in overall survival.

Both increasing age and stage result in lower survival, and these factors exacerbate each other with the oldest age group with most advanced stage having the poorest survival. Considering other variables, such as co-morbidities and levels of radical treatment may help better to understand and tackle the survival gap between age groups.

All-stage survival for breast, colorectal, lung and ovarian cancer shows statistically significantly lower survival with increasing socio-economic deprivation. These differences are probably associated with later stage diagnoses in more deprived patients as well as lower stage-specific survival, which may again be due to higher levels of co-morbidity and poorer general health.

These data can help inform the debate on early diagnosis and help target campaigns to promote stage shifts within cancer types to further improve survival. Further updates to the ICBP will help put the results in an international context, helping to direct examination of other countries campaigns and treatment methods.

Methodology

Records for 156,131 cases of Breast (C50), Colorectal (C18-20), Lung (C33), Ovarian (C56) and Prostate (C61) cancer diagnosed in 2012 were extracted from the English National Cancer Registration Service database CAS (Cancer Analysis System). 3,310 cases were excluded for being "Death Certificate Only" (DCO) cancers, stage 0, below 15 years of age or above 99 years of age or, for 11 cases, for failures of data quality. TNM stage group (ie, stage 1-4) completeness in the remaining tumours was 86% (including mapping from FIGO stage for ovarian).
Multiple imputation (10 iterations) was used to model the stage for cases where it was missing with imputation variables: *former cancer registry area; sex; income deprivation quintile; metastatic status; age*; and *survival interval*. Table 4 shows the changes by stage and type after this imputation was carried out.

Table 4 Differences by stage and cancer type following multiple imputation

Cancer site	Stage 1	Stage 2	Stage 3	Stage 4	Total (missing stage)
Breast	4.28%	3.30%	2.47%	4.73%	**14.79%**
Colorectal	2.16%	2.26%	2.29%	4.31%	**11.01%**
Lung	1.47%	1.61%	2.13%	4.96%	**10.17%**
Ovarian	4.88%	4.60%	2.97%	5.37%	**17.82%**
Prostate	5.92%	5.39%	4.72%	2.32%	**18.36%**
Total	**3.57%**	**3.22%**	**2.91%**	**4.14%**	**13.84%**

All cancer types save for prostate had the largest increase in stage 4 cancers, with the largest change in prostate being for stage 1.

One-year age-standardised and non-standardised relative survival estimates were calculated on the imputed and non-imputed datasets segmented by cancer type, sex, age, and socio-economic deprivation using the Ederer II method[11]. Survival is calculated in intervals of: diagnosis to 1 month, 1-3 months, 3-6 months and 6-12 months.

The lifetables used[12] were available up to 2009 and later years used background mortality from 2009. Sensitivity analysis suggests this may bias the results by of the order of 0.2%.

Age-standardisation used the method of Corazziari *et al.*[13] using the program *strs*[14]. All survival analysis was carried out using STATA 12.1[15].

Deprivation quintiles were assigned according to the income domain scores of the Indices of Multiple Deprivation (IMD) datasets, 2010. The quintiles were numbered such that deprivation was presented from the least deprived (1) to the most deprived (5).

References

1. EUROCARE publication list (2014)

2. Cancer survival in Australia, Canada, Denmark, Norway, Sweden, and the UK, 1995—2007 (the International Cancer Benchmarking Partnership): an analysis of population-based cancer registry data. Coleman et al. (2011) The Lancet Vol. 377: 9760.

3. Breast cancer survival and stage at diagnosis in Australia, Canada, Denmark, Norway, Sweden and the UK, 2000-2007: a population-based study. ICPB Module 1 working Group. (2013) British journal of cancer, 108 (5). pp. 1195-208.

4. Stage at diagnosis and colorectal cancer survival in six high-income countries: A population-based study of patients diagnosed during 2000-2007. ICPB Module 1 working Group. (2013) Acta oncologica (Stockholm, Sweden), 52 (5). pp. 919-32.

5. Lung cancer survival and stage at diagnosis in Australia, Canada, Denmark, Norway, Sweden and the UK: a population-based study, 2004-2007. ICPB Module 1 working Group. (2013) Thorax, 68 (6). pp. 551-64.

6. Stage at diagnosis and ovarian cancer survival: Evidence from the International Cancer Benchmarking Partnership. ICPB Module 1 working Group. (2012) Gynecologic oncology, 127 (1). pp. 75-82.

7. Improving Outcomes: A Strategy for Cancer (2011)

8. Public Accounts Committee Transcript: Delivering the Cancer Reform Strategy. (Q24 and Q100-102 of http://www.publications.parliament.uk/pa/cm201011/cmselect/cmpubacc/uc667-i/uc66701.htm)

9. Interpreting geographic variation by cancer stage (2014)

10. Note that prostate has age-standardised relative survival estimates greater than 100% for some stages and survival times. A proportion greater than 100% means that the survival for men with prostate cancer is in some cases higher than the general population. This may occur due to the use of PSA testing in a relatively healthy cohort, or a change to a healthier lifestyle following diagnosis.

11. Estimating and modelling relative survival. Dickman, P. Coviello, E. Hills, M. The Stata Journal (2013) vv, Number ii, pp. 1-25. (http://pauldickman.com/survival/strs.pdf)

12. Cancer Research UK Cancer Survival Group (2006). Life tables for cancer survival analysis. Downloaded from www.lshtm.ac.uk/ncde/cancersurvival/tools.htm June 2014. Department of Non-Communicable Disease Epidemiology, London School of Hygiene & Tropical Medicine, UK

13. Corazziari I, Quinn M, Capocaccia R. 2004. Standard cancer patient population for age standardising survival ratios. Eur J Cancer 40:2307-2316.

14. Dickman PW, Sloggett A, Hills M, Hakulinen T (2004) Regression models for

relative survival. Stat Med 23: 51–64.

15. StataCorp (2007) Stata Statistical Software: Release 10. College Station, Texas, USA.