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In brief

Forty years of Social Trends

This year's edition of ONS's flagship annual compendium *Social Trends* will be published on the 2nd July 2010 with a theme of 'Forty years of social trends in the UK'. It will include a chapter on health, which will cover a range of topics, including:

- Key health indicators such as life expectancy and completed primary immunisation courses.
- The mortality rates of major cancers and the five-year relative survival for the most common cancers.
- Smoking, drinking and drugs, focusing on adults' cigarette smoking habits and deaths related to alcohol and drug misuse.
- Health-related behaviour, which includes adults' body mass index and self-reported longstanding illness.
- Mental health, including prevalence of common mental disorders, and suicide rates.
- Sexual health, detailing the current use of contraception and new diagnoses of selected sexually transmitted infections.

This chapter, together with the other twelve chapters, will be published on the ONS website to form the 40th edition of Social Trends. This edition will also be available as a printed publication from Palgrave Macmillan, and is the final printed edition of Social Trends. All future editions will be published online only, with several chapters being updated each quarter, plus an annual Social Trends 'wrap up' article. Further Information can be found at www.statistics.gov.uk/socialtrends or email: social.trends@ons.gsi.gov.uk

Population Trends - Longitudinal Study themed edition

The March 2010 edition of *Population Trends* was an 'LS-themed' edition with a number of articles based on research using the ONS Longitudinal Study (LS). The lead article looked at the relationship between self-rated health from the 2001 Census and subsequent rates of mortality. This was the result of an exemplar project looking at drawing together data from the three separate longitudinal studies (ONS LS, Scottish LS and Northern Ireland LS) to give a UK view. Further information can be found at www.statistics.gov.uk/populationtrends/ptissue or contact: Jim Newman, 01329 444696 or email: jim.newman@ons.gsi.gov.uk

Healthcare productivity - General Practice Services

On 30 March, ONS released *Measuring Growth in the Volume of Input for General Practice Services.* This paper discusses alternative measures of the volume of general practice input. This is a component of the volume of healthcare input, measured by ONS in order to produce estimates of public service healthcare productivity.

The current approach regards general practices as an integral part of the NHS and so derives input volume growth from the growth of the labour, capital and intermediate consumption of the practices. The alternative approach considers practice input as part of the intermediate consumption of the NHS and thus derives this part of input volume growth from the growth of the items procured under contract. In the period 2005–07 the alternative method would reduce overall public service healthcare input growth by an average of 0.1 percentage points per year. The paper recommends moving to the alternative method for future healthcare input volume estimates.

There will now follow a period of consultation where stakeholders are invited to express their views on this recommendation. More information can be found at http://www.statistics.gov.uk/cci/article.asp?id=2398 or contact: Mark Chandler, 01633 456366 or email: mark.s.chandler@ons.gsi.gov.uk

English Longitudinal Study of Ageing - Wave 4 launch

Recent findings from the fourth wave of English Longitudinal Study of Ageing (ELSA) will be showcased at a launch on 23 July 2010. ELSA, a longitudinal panel survey which received substantial support from ONS and other government departments, provides a data resource on health, economic position and quality of life as people age. The launch will consist of a series of presentations highlighting major findings from the new wave of data collection, together with contributions about planned developments and collaborations with allied studies in other countries.

The study covers people who were aged 50 and over in 2008/9, and the findings will include analysis of:

- Employment patterns and expectation of future working in older people
- Quality of sleep and its relationship with social participation and health
- Changes in social care and support as people age
- How health and social circumstances vary by wealth
- Socio-demographic characteristics and wellbeing of the oldest people
- Trends in physical disability, limiting illness and perceived health
- Health protective biological measures in ELSA
- Trends in income and wealth in older people

DATE: Friday 23 July 2010, 9.30am–4.00pm

LOCATION: British Academy, 10 Carlton House Terrace, London, SW1Y 5AH.

For more information or to register attendance, please contact: Sheema Ahmed, ELSA administrator on 020 7679 1656 or email: sheema.ahmed@ucl.ac.uk

Obituary- Eileen Goddard

It is with sadness that we report the death of Eileen Goddard, who recently retired from ONS. Eileen had a long career in survey research and had been involved with the General Household Survey from its earliest days. Many users of health statistics will be aware of her work in the areas of smoking, drinking and drug use research, where she was an acknowledged specialist in survey design and analysis on these topics. She will be sadly missed on a professional and personal level by all her colleagues and friends.

Survival from twenty adult cancers in the UK and Republic of Ireland in the late twentieth century

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Abstract

Background

International studies have shown that cancer survival was generally low in the UK and the Republic of Ireland compared to western and northern European countries, but no systematic comparative analysis has been performed between the UK countries and the Republic of Ireland.

Methods

Population-based survival for 20 adult malignancies was estimated for the UK and the Republic of Ireland. Data on adults (15–99 years) diagnosed between 1991 and 1999 in England, Scotland, Wales, Northern Ireland (1993–99) and the Republic of Ireland (1994–99) were analysed. All cases were followed up until the end of 2001. Relative survival was estimated by sex, period of diagnosis and country, and for the nine regions of England. Predicted survival was estimated using the hybrid approach.

Results

Overall, cancer survival in UK and Republic of Ireland improved during the 1990s, but there was geographic variation in survival across the UK and Republic of Ireland. Survival was generally highest in Ireland and Northern Ireland and lowest in England and Wales. Survival tended to be higher in Scotland for cancers for which early detection methods were in place. In England, survival tended to be lower in the north and higher in the south.

Conclusions

The geographic variations in survival seen across the UK and Republic of Ireland are narrower than between these countries and comparable European countries. Artefact is likely to explain some, but not all of the differences across the UK and Republic of Ireland. Geographic differences in stage at diagnosis, co-morbidity and other clinical factors may also be relevant.

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Introduction

Population-based cancer survival data are available for patients diagnosed since 1971 for England and Wales (Coleman *et al.* 1999;Coleman *et al*. 2004) and for Scotland (Scottish Cancer Intelligence Unit 2000), but only since 1993 for Northern Ireland (Northern Ireland Cancer Registry 2007) and 1994 for the Republic of Ireland (Comber & Walsh 2008) It is not possible to evaluate geographical differences in cancer survival in the UK and the Republic of Ireland directly from these data, because of methodological differences between the various analyses. Survival estimates for the UK have not routinely been produced. Substantial regional variation in cancer survival has been demonstrated in England (Coleman *et al.* 1999) but this variation has not been directly compared with differences between the four countries of the UK or with the Republic of Ireland.

Here we examine cancer survival in the Republic of Ireland and the UK, for each of the four UK nations separately, and for all five countries combined. We also examine variation in survival between the nine Government Office Regions of England.

Methods and data

All persons diagnosed with one of the 20 most common cancers during the period 1991–99 in England, Scotland, Wales, 1993–99 in Northern Ireland and 1994–99 in the Republic of Ireland were eligible for inclusion. Anonymised individual records were obtained from the national cancer registries of each country. We analysed the survival of more than 1.7 million patients aged 15–99 years, 86 per cent of those were eligible for inclusion (Table 1). Follow-up was complete to 31 December 2001. Nine per cent of patients were excluded because their recorded survival time was zero, mainly patients registered from a death certificate only (DCO), whose survival time was unknown. The proportion was greater in England and Wales than in Scotland, Northern Ireland and the Republic of Ireland. A further five per cent of patients were excluded because it was not their first cancer, or for other reasons, including unknown vital status. Non-melanoma skin cancers were not considered because their registration was too patchy in the UK during the study period.

Table 1 **Exclusions (% of eligible patients) and number and percentage of all eligible cases included in the survival analyses: cancer patients diagnosed during 1991–99[a] in the United Kingdom and the Republic of Ireland**

	England				Scotland			
	Exclusions (% of eligible)		Eligible cases analysed		Exclusions (% of eligible)		Eligible cases analysed	
Malignancy	Zero survival[b]	Other[c]	No.	%	Zero survival[b]	Other[c]	No.	%
Oesophagus	9.5	4.9	42,464	85.6	3.1	7.5	6,113	89.5
Stomach	12.4	4.5	65,108	83.2	4.8	6.5	8,085	88.7
Colon	10.2	5.6	132,514	84.2	3.7	7.9	17,266	88.4
Rectum	5.8	5.2	79,828	89.0	2.2	7.2	9,307	90.6
Pancreas	21.4	4.0	38,587	74.6	9.3	6.4	4,630	84.3
Larynx (M)	4.0	22.3	12,290	73.7	1.4	8.1	1,963	90.5
Lung	14.9	4.8	236,500	80.3	6.4	7.2	36,885	86.5
Melanoma of skin	2.1	5.1	38,535	92.8	0.2	7.1	4,974	92.7
Breast (F)	5.2	5.9	252,467	88.8	2.2	6.5	27,053	91.4
Cervix	3.6	6.1	23,736	90.3	0.8	7.6	3,103	91.6
Uterus	5.0	7.8	33,297	87.2	2.3	10.1	3,388	87.6
Ovary	9.3	5.3	40,683	85.4	2.5	7.6	4,903	89.9
Prostate	7.6	4.7	145,946	87.7	3.1	6.5	14,691	90.5
Testis	0.8	2.8	12,460	96.4	0.2	1.6	1,569	98.2
Bladder	5.0	6.4	87,431	88.7	1.3	9.5	9,886	89.2
Kidney	11.2	6.8	33,386	82.0	5.3	10.2	4,365	84.5
Brain	9.1	3.7	24,506	87.2	3.6	3.9	2,702	92.5
Non-Hodgkin lymphoma	8.3	5.0	54,046	86.7	3.0	7.0	6,313	90.0
Multiple myeloma	11.5	4.5	21,553	84.1	3.7	7.1	2,407	89.2
All leukaemias	14.6	5.9	37,865	79.5	5.0	7.9	4,501	87.1
Total	**9.3**	**5.5**	**1,413,202**	**85.2**	**3.8**	**7.3**	**174,104**	**89.0**

Table 1 continued

	Wales				Northern Ireland[a]			
	Exclusions (% of eligible)		Eligible cases analysed		Exclusions (% of eligible)		Eligible cases analysed	
Malignancy	Zero survival[b]	Other[c]	No.	%	Zero survival[b]	Other[c]	No.	%
Oesophagus	10.9	4.2	2,927	85.0	3.7	3.9	993	92.4
Stomach	15.2	3.7	5,236	81.0	4.6	3.0	1,696	92.4
Colon	12.6	3.5	9,393	84.0	4.3	2.7	4,064	93.0
Rectum	6.5	3.3	5,885	90.2	1.2	3.8	2,056	95.0
Pancreas	21.1	3.7	2,670	75.2	6.8	3.0	925	90.2
Larynx (M)	4.4	24.9	888	70.7	0.4	6.1	361	93.5
Lung	18.4	5.8	15,026	75.8	5.0	2.8	5,755	92.2
Melanoma of skin	3.9	6.5	2,081	89.5	0.2	2.4	1,193	97.5
Breast (F)	5.6	4.7	17,348	89.7	1.5	1.0	5,866	97.5
Cervix	4.8	7.7	1,630	87.5	1.4	1.7	564	96.9
Uterus	7.2	5.7	2,457	87.1	3.7	4.4	767	91.9
Ovary	8.0	6.1	2,920	85.9	2.1	5.5	1,090	92.4
Prostate	7.7	4.1	9,825	88.3	2.9	2.6	3,175	94.6
Testis	1.4	3.0	735	95.6	0.3	0.9	342	98.8
Bladder	4.0	6.5	6,654	89.4	1.6	6.6	1,357	91.8
Kidney	11.3	6.2	2,395	82.5	2.8	6.1	1,013	91.1
Brain	9.3	5.0	1,808	85.8	2.3	1.4	633	96.3
Non-Hodgkin lymphoma	7.7	6.8	3,389	85.5	2.9	3.2	1,567	93.9
Multiple myeloma	11.3	5.6	1,422	83.1	2.9	3.2	625	94.0
All leukaemias	10.5	6.4	3,157	83.1	3.7	2.0	935	94.3
Total	**10.3**	**5.2**	**97,846**	**84.5**	**3.1**	**2.9**	**34,977**	**94.0**

Table 1 continued

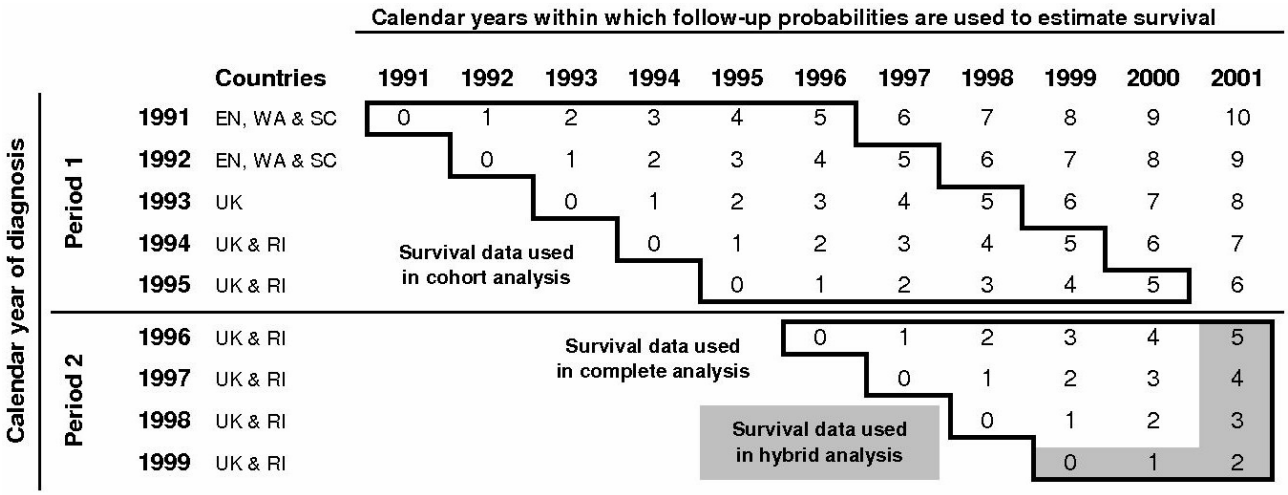
	Republic of Ireland[a]				UK and Republic of Ireland[a]			
	Exclusions (% of eligible)		Eligible cases analysed		Exclusions (% of eligible)		Eligible cases analysed	
Malignancy	Zero survival[b]	Other[c]	No.	%	Zero survival[b]	Other[c]	No.	%
Oesophagus	3.9	1.8	1,696	94.3	**8.6**	**5.0**	**54,193**	**86.4**
Stomach	5.6	2.2	2,693	92.1	**11.5**	**4.5**	**82,818**	**84.0**
Colon	4.7	2.7	6,290	92.6	**9.4**	**5.5**	**169,527**	**85.1**
Rectum	1.9	3.2	3,750	94.9	**5.3**	**5.2**	**100,826**	**89.5**
Pancreas	8.3	2.1	1,837	89.6	**19.7**	**4.1**	**48,649**	**76.2**
Larynx (M)	2.5	1.5	531	96.0	**3.7**	**20.1**	**16,033**	**76.2**
Lung	6.5	1.8	8,587	91.7	**13.7**	**5.0**	**302,753**	**81.2**
Melanoma of skin	0.1	2.7	2,232	97.3	**1.8**	**5.2**	**49,015**	**93.0**
Breast (F)	1.8	1.2	9,599	97.1	**4.8**	**5.7**	**312,333**	**89.5**
Cervix	2.0	1.5	1,024	96.5	**3.3**	**6.1**	**30,057**	**90.6**
Uterus	2.6	3.0	1,319	94.4	**4.8**	**7.6**	**41,228**	**87.5**
Ovary	3.5	3.7	1,823	92.8	**8.3**	**5.5**	**51,419**	**86.2**
Prostate	3.3	2.2	7,050	94.5	**7.0**	**4.7**	**180,687**	**88.3**
Testis	0.5	0.0	548	99.5	**0.7**	**2.5**	**15,654**	**96.7**
Bladder	2.1	4.0	2,628	93.9	**4.5**	**6.6**	**107,956**	**88.9**
Kidney	5.8	4.5	1,481	89.7	**10.2**	**7.0**	**42,640**	**82.8**
Brain	4.6	1.0	1,302	94.3	**8.4**	**3.6**	**30,951**	**88.0**
Non-Hodgkin lymphoma	2.9	1.7	2,278	95.4	**7.5**	**5.1**	**67,593**	**87.4**
Multiple myeloma	4.5	2.1	1,016	93.4	**10.4**	**4.6**	**27,023**	**85.0**
All leukaemias	3.8	2.4	1,841	93.8	**13.0**	**5.9**	**48,299**	**81.1**
Total	**3.8**	**2.2**	**59,525**	**94.0**	**8.6**	**5.5**	**1,779,654**	**86.0**

[a] Incident cases in Northern Ireland were diagnosed 1993-99, and in the Republic of Ireland 1994-99.
[b] Date of diagnosis same as date of death: some patients did die on the day of diagnosis, but most were registered solely from a death certificate, with unknown survival time.
[c] Aged 100 years or over at diagnosis, vital status or sex unknown, sex-site error, invalid dates, duplicate registration, synchronous tumour or persons who had a previous primary malignancy.

We examined relative survival from cancer. Relative survival is one method of estimating net survival, which is the probability of survival related directly to the disease rather than the overall observed (crude) survival of the patient group. Relative survival is estimated by comparing the observed survival with the survival that would have been expected if the patients had only experienced the expected (or background) mortality by age and sex as that seen in the general population in the same country or region and calendar year. The expected mortality is given by general population life tables of all-cause mortality by the same variables. Relative survival is the most defensible method of estimating net survival in population-based studies, because it does not rely upon accurate reporting of cause of death (Ederer, Axtell, & Cutler 1961).

We used the maximum-likelihood approach for individual records (Estève *et al*. 1990) as implemented in the publicly available STATA algorithm *strel* to estimate the excess hazard of death from cancer for given time intervals after diagnosis. For any given cancer and a given sex, we used a constant interval structure to divide the follow-up time, but varied the number of intervals from 4 to 14 for different cancers according to the number of cases and the observed pattern of mortality. Cumulative relative survival up to five years after diagnosis was estimated by age group and country, using either the cohort or complete approach, for patients diagnosed during 1991–95 and 1996–99. We applied the hybrid approach (Brenner & Rachet 2004) to predict relative survival in the near future, using data for patients who were alive and under follow-up at some point during the period 2000–01 (Figure 1). The mean annual absolute percentage change in relative survival between 1991–95 and 1996–99 was estimated with variance-weighted least squares regression, taking into account the slightly shorter periods of incidence available for Northern Ireland (1993–95) and the Republic of Ireland (1994–95).

Figure 1 Structure of data used for survival analyses



Numeric values indicate the minimum number of completed years of follow-up attained for an individual diagnosed during the index year (rows) who was followed up to the end of a given calendar year (columns).

UK – United Kingdom, SC – Scotland, WA – Wales, RI – Republic of Ireland

National or regional life tables were used to estimate expected survival. For the national analyses, the Government Actuary's Department (GAD) interim life tables centred on 1991 and 1996 were used for each country in the UK (Government Actuary's Department 2004). For the Republic of Ireland, census-derived life tables centred on these same two years were used (Central Statistics Office 1995, 2004). Background mortality for patients dying during the period 1991–95 was represented by the 1991 life tables, whilst the 1996 tables were used for patients dying during the period 1996–01. Regional analyses for England were conducted using 1991 and 1998-centred region-specific life tables, described elsewhere (Coleman *et al.* 1999; Coleman *et al.* 2004). The "observed" background mortality rates are unstable and usually not available for every year of age for elderly. All life tables were therefore smoothed and extended up to 100 years of age with the

Ewbank et al. four-parameter life table system (Ewbank et al. 1983) constrained to three independent parameters.

To improve the comparability of the results, an attempt was made to age-standardise the survival estimates directly with age weights derived from the numbers of patients diagnosed with each cancer in England and Wales during the period 1986–90 (Coleman *et al.* 1999). Three broad age groups were used: under 50, 50–69 and 70 or more years at diagnosis. Finer age groups could not be applied because of the small numbers of cases and deaths in the data sets for the Republic of Ireland, Northern Ireland and Wales, and in some of the English regions. Even so, it was often impossible to produce an age-standardised estimate. Age-standardised and non-standardised estimates were very similar when both were available (data available on request), and only non-standardised rates are presented here.

We used funnel plots to examine geographic variation in one-year survival between the English regions and the other four countries (Spiegelhalter 2005). One-year survival was used because an estimate was available for every country for every malignancy. For each region or country, the estimate of one-year survival is plotted against the precision of the estimate, taken as the inverse square of its standard error. The horizontal line in each plot, the target value, is the pooled estimate of one-year survival in the UK and the Republic of Ireland combined. The 95 per cent and 99.8 per cent control limits superimposed on each plot represent approximately two and three standard deviations, respectively, from the target value at each level of precision. Survival estimates that lie within the control limits may be considered as within the geographical variation that could be expected by chance. Funnel plots may be preferable to conventionally ranked bar charts for visual comparison of a set of estimates with widely different precision.

Results

Relative survival from the twenty most common cancers generally increased between the early and late 1990s, both in the constituent countries of the UK and in the Republic of Ireland. Cancer survival, and improvements in survival, varied between the five countries (Table 2, Figures 2 and 3). Details of the numbers of patients included in the analyses, the numbers of deaths and estimates of survival at one and five years for each cancer and each calendar period are available online as Supplementary Tables 1 and 2. Survival also varied between the regions of England (Supplementary Figure 1, Supplementary Tables 3, 4 and 5).

Table 2

Five-year relative survival (%), with 95% confidence interval (CI), for patients diagnosed 1996–99, mean annual change (%)[a], between 1996–99 and 1991–95 and predictions of five-year survival for patients diagnosed 2000–01 (with 95% CI), by country, sex and site: UK and Republic of Ireland

		England						Scotland					
Malignancy	Sex	1996–99 complete		Annual % change[a]		2000–2001 hybrid		1996–99 complete		Annual % change[a]		2000–2001 hybrid	
		RS	*(CI)*			*RS*	*(CI)*	*RS*	*(CI)*			*RS*	*(CI)*
Oesophagus	M	8	(7;9)	0.3	*	8	(8;9)	10	(9;12)	0.6	*	10	(8;13)
	F	7	(7;8)	<–0.1		8	(7;9)	9	(7;12)	0.2		9	(7;12)
Stomach	M	14	(13;14)	0.5	*	14	(13;15)	14	(12;16)	0.5		13	(11;16)
	F	14	(14;15)	0.5	*	15	(14;16)	15	(13;17)	0.4		16	(13;19)
Colon	M	49	(48;50)	1.2	*	50	(49;51)	50	(47;52)	0.6		51	(48;54)
	F	48	(47;49)	1.1	*	49	(48;50)	51	(49;53)	0.9	*	53	(50;55)
Rectum	M	51	(50;52)	1.9	*	53	(51;54)	51	(48;54)	1.6	*	54	(50;58)
	F	51	(50;53)	1.5	*	52	(51;53)	53	(50;56)	1.4	*	54	(49;58)
Pancreas	M	3	(3;3)	0.1	*	3	(3;4)	3	(2;4)	<–0.1		3	(2;6)
	F	2	(2;3)	<–0.1		2	(2;3)	3	(2;4)	–0.2		4	(2;6)
Larynx	M	67	(65;68)	0.5		67	(64;69)	65	(60;69)	0.4		64	(58;70)
Lung	M	6	(6;7)	0.2	*	7	(6;7)	7	(7;8)	<–0.1		8	(7;9)
	F	7	(7;7)	0.3	*	7	(7;8)	8	(7;9)	0.4	*	9	(8;10)
Melanoma of skin	M	80	(79;82)	1.0	*	81	(79;83)	85	(81;88)	0.8		86	(81;90)
	F	91	(90;91)	0.5	*	91	(90;92)	96	(93;97)	0.8	*	96	(93;98)
Breast	F	81	(80;81)	1.0	*	82	(81;82)	80	(79;81)	0.8	*	81	(80;83)
Cervix	F	67	(66;68)	0.2		68	(66;69)	69	(66;72)	1.0	*	71	(66;75)
Uterus	F	77	(76;78)	0.8	*	78	(77;79)	79	(76;82)	0.9	*	80	(76;83)
Ovary	F	39	(38;40)	1.6	*	40	(38;41)	41	(39;44)	1.8	*	42	(39;46)
Prostate	M	73	(73;74)	3.2	*	75	(74;75)	72	(70;74)	2.6	*	74	(72;77)
Testis	M	96	(95;97)	0.3	*	96	(96;97)	98	(96;99)	0.7	*	98	(94;99)
Bladder	M	69	(68;70)	0.2		69	(67;70)	68	(65;71)	–1.2	*	62	(58;66)
	F	57	(55;58)	–0.5	*	57	(55;59)	55	(51;58)	–1.7	*	48	(43;53)
Bladder includ. non-malignant	M	70	(69;71)	0.3	*	70	(69;71)	66	(63;68)	–1.6	*	59	(56;63)
	F	58	(57;60)	–0.4	*	59	(57;61)	54	(50;58)	–1.8	*	47	(42;52)
Kidney	M	48	(46;49)	0.8	*	49	(47;50)	44	(40;48)	0.4		47	(42;52)
	F	46	(45;48)	1.2	*	47	(45;49)	48	(43;52)	1.6	*	50	(44;55)
Brain	M	13	(12;14)	–0.2		12	(11;13)	16	(13;20)	0.1		13	(10;17)
	F	14	(13;15)	–0.1		14	(12;15)	16	(12;19)	–0.5		12	(9;17)
Non-Hodgkin lymphoma	M	54	(52;55)	1.1	*	55	(53;56)	56	(53;59)	1.9	*	57	(53;62)
	F	54	(53;56)	0.9	*	55	(54;57)	54	(50;57)	1.3	*	56	(51;60)
Multiple myeloma	M	30	(28;31)	1.4	*	30	(28;32)	25	(19;32)	<–0.1		26	(19;34)
	F	27	(26;29)	1.3	*	28	(26;30)	31	(25;37)	1.3		28	(22;35)
All leukaemias	M	45	(44;46)	1.1	*	45	(43;47)	51	(47;55)	1.9	*	53	(48;58)
	F	41	(40;43)	0.6	*	41	(39;43)	43	(39;48)	–0.1		43	(37;48)

Table 2 continued

Malignancy	Sex	Wales						Northern Ireland					
		1996–99 complete		Annual % change[a]		2000–2001 hybrid		1996–99 complete		Annual % change[a]		2000–2001 hybrid	
		RS	*(CI)*			*RS*	*(CI)*	*RS*	*(CI)*			*RS*	*(CI)*
Oesophagus	M	10	(8;13)	0.8	*	11	(8;15)	12	(7;17)	1.5		12	(7;18)
	F												
Stomach	M	12	(10;15)	0.5		12	(10;15)	17	(13;21)	0.6		16	(12;21)
	F	13	(10;17)	0.4		14	(11;19)						
Colon	M	49	(46;51)	1.2	*	48	(45;52)	56	(51;60)	2.6	*	55	(50;60)
	F	46	(43;48)	1.3	*	47	(43;50)	54	(51;58)	2.3	*	54	(49;58)
Rectum	M	45	(42;49)	1.0	*	45	(41;49)	51	(45;57)	1.2		52	(45;59)
	F	49	(44;53)	1.5	*	49	(44;54)	49	(43;56)	1.3		49	(41;56)
Pancreas	M	3	(2;6)	–0.1		3	(2;6)	3	(1;6)	<–0.1		2	(1;7)
	F							3	(1;6)			3	(1;8)
Larynx	M	61	(53;67)	–0.7		61	(51;69)						
Lung	M	6	(5;8)	0.2		7	(6;9)	10	(8;12)	0.8	*	11	(9;14)
	F	6	(5;8)	0.2		7	(5;9)						
Melanoma of skin	M	67	(60;73)	–0.7		68	(60;75)	89	(80;94)	0.2		86	(75;92)
	F	84	(79;89)	0.6		83	(77;88)	96	(89;98)	0.7		94	(86;97)
Breast	F	78	(76;79)	0.6	*	78	(77;80)	80	(78;82)	1.1	*	82	(79;84)
Cervix	F	55	(51;60)	–0.9		56	(50;61)	71	(64;76)	2.5		72	(63;79)
Uterus	F	74	(70;77)	<–0.1		73	(68;77)	76	(69;81)	1.6		77	(68;83)
Ovary	F	35	(32;38)	1.2	*	35	(31;38)						
Prostate	M	64	(61;66)	2.2	*	66	(63;69)	60	(55;63)	0.7		63	(58;68)
Testis	M	96	(92;98)	1.7	*	97	(91;99)	95	(88;98)	0.8		96	(87;99)
Bladder	M	73	(70;76)	0.5		75	(70;78)	67	(60;73)	2.0		66	(57;73)
	F	65	(61;70)	1.7	*	66	(60;71)	52	(43;60)	4.1	*	44	(34;55)
Bladder includ. non-malignant	M	75	(71;77)	0.4		76	(72;79)	79	(74;83)	0.9		77	(70;82)
	F	69	(65;73)	1.9	*	68	(63;73)	68	(61;74)	2.3		63	(54;71)
Kidney	M	47	(42;52)	0.7		50	(43;56)	55	(48;62)	1.2		56	(46;65)
	F	46	(40;52)	1.6		48	(40;55)	49	(40;56)	–1.3		48	(37;58)
Brain	M	11	(8;15)	–0.7		13	(9;19)						
	F							18	(10;27)	–1.3		19	(10;31)
Non-Hodgkin lymphoma	M	46	(41;50)	<–0.1		50	(44;56)						
	F	48	(43;52)	–0.3		49	(43;55)	48	(42;55)	–0.7		51	(43;59)
Multiple myeloma	M	23	(16;31)	–1.1		26	(17;35)	26	(18;35)	0.6		30	(19;42)
	F	24	(17;32)	0.6		24	(16;34)						
All leukaemias	M	40	(36;45)	1.0		42	(36;48)	26	(19;34)	–1.6		26	(17;35)
	F	38	(32;43)	–0.4		39	(33;45)	31	(23;39)	–2.0		29	(20;39)

Table 2 continued

Malignancy	Sex	United Kingdom						Republic of Ireland						UK and R Ireland					
		1996–99 complete		Annual % change[b]		2000–2001 hybrid		1996–99 complete		Annual % change[a]		2000–2001 hybrid		1996–99 complete		Annual % change[b]		2000–2001 hybrid	
		RS	*(CI)*			*RS*	*(CI)*	*RS*	*(CI)*			*RS*	*(CI)*	*RS*	*(CI)*			*RS*	*(CI)*
Oesophagus	M	8	(8;9)	0.4	*	9	(8;10)	11	(8;14)	0.2		11	(7;15)	8	(8;9)	0.4	*	9	(8;10)
	F	8	(7;9)	<–0.1		8	(7;9)	13	(9;17)			13	(8;19)	8	(7;9)	<–0.1		8	(8;9)
Stomach	M	14	(13;14)	0.5	*	14	(13;15)							14	(13;14)	0.6	*	14	(13;15)
	F	15	(14;15)	0.5	*	15	(14;16)	19	(15;23)	0.5		18	(13;23)	15	(14;16)	0.6	*	15	(14;16)
Colon	M	49	(48;50)	1.1	*	50	(49;51)	51	(48;54)	1.3		51	(47;54)	49	(49;50)	1.1	*	50	(50;51)
	F	48	(48;49)	1.1	*	50	(49;50)	53	(51;56)	1.7	*	56	(52;59)	49	(48;49)	1.1	*	50	(49;51)
Rectum	M	51	(50;51)	1.8	*	52	(51;53)	48	(45;52)	2.5	*	51	(47;55)	50	(50;51)	1.8	*	52	(51;53)
	F	51	(50;52)	1.5	*	52	(51;53)	50	(45;54)	–1.0		53	(47;58)	51	(50;52)	1.4	*	52	(51;53)
Pancreas	M	3	(3;3)	0.1		3	(3;4)	4	(3;7)	0.1		5	(3;8)	3	(3;3)	0.1		3	(3;4)
	F	2	(2;3)	<–0.1		2	(2;3)	6	(4;8)	–0.1		7	(4;10)	3	(2;3)	<–0.1		3	(2;3)
Larynx	M	66	(64;68)	0.4		66	(64;68)	67	(59;73)	2.5		64	(54;71)	66	(64;68)	0.5	*	66	(64;68)
Lung	M	7	(6;7)	0.2	*	7	(6;7)	8	(7;9)	–0.3		8	(7;10)	7	(6;7)	0.2	*	7	(7;7)
	F	7	(7;7)	0.3	*	7	(7;8)	9	(8;11)	–0.4		10	(8;12)	7	(7;8)	0.3	*	8	(7;8)
Melanoma of skin	M	81	(79;82)	0.9	*	81	(80;83)	73	(67;78)	–0.8		73	(66;79)	80	(79;81)	0.8	*	81	(79;82)
	F	91	(90;92)	0.6	*	91	(90;92)	90	(86;93)	0.7		91	(87;94)	91	(90;92)	0.6	*	91	(90;92)
Breast	F	80	(80;81)	1.0	*	81	(81;82)	77	(75;78)	1.4	*	78	(76;80)	80	(80;81)	1.0	*	81	(81;82)
Cervix	F	67	(66;68)	0.3		67	(66;69)	68	(63;72)	2.6	*	71	(65;76)	67	(66;68)	0.3	*	68	(66;69)
Uterus	F	77	(76;78)	0.7	*	78	(76;79)	80	(77;84)	2.9	*	80	(75;84)	77	(76;78)	0.8	*	78	(77;79)
Ovary	F	39	(38;40)	1.6	*	40	(39;41)	41	(38;45)	–0.6		43	(38;47)	39	(38;40)	1.5	*	40	(39;41)
Prostate	M	72	(72;73)	3.0	*	74	(73;75)	73	(70;75)	3.8	*	77	(74;79)	72	(72;73)	3.0	*	74	(73;75)
Testis	M	96	(96;97)	0.5	*	97	(96;97)							96	(95;97)	0.4	*	96	(96;97)
Bladder	M	69	(68;70)	0.1		69	(68;70)	74	(69;78)	<–0.1		75	(69;80)	69	(68;70)	0.1		69	(68;70)
	F	57	(56;58)	–0.4	*	57	(55;58)	69	(63;74)	0.7		69	(61;76)	58	(56;59)	–0.4	*	57	(56;59)
Bladder includ. non-malignant	M	70	(70;71)	0.2		70	(69;71)	75	(71;79)	0.3		78	(72;82)	71	(70;71)	0.2		70	(69;71)
	F	59	(58;60)	–0.3		59	(58;61)	70	(64;75)	0.8		71	(63;78)	60	(59;61)	–0.2		60	(58;61)
Kidney	M	48	(46;49)	0.8	*	49	(47;50)	49	(43;54)	–0.9		48	(42;55)	48	(46;49)	0.8	*	49	(47;50)
	F	47	(45;48)	1.2	*	47	(46;49)	53	(46;59)	–0.2		53	(44;61)	47	(45;48)	1.2	*	48	(46;49)
Brain	M	13	(12;14)	–0.2		13	(12;14)	21	(17;25)	1.1		21	(16;26)	13	(13;14)	–0.1		13	(12;14)
	F	15	(14;16)	–0.1		14	(13;16)	20	(16;25)			20	(14;27)	15	(14;16)	<–0.1		15	(13;16)
Non-Hodgkin lymphoma	M	53	(52;54)	1.1	*	55	(53;56)	52	(48;56)	1.2		54	(49;60)	53	(52;54)	1.1	*	55	(53;56)
	F	54	(53;55)	0.8	*	55	(54;56)	57	(53;62)	0.5		58	(52;64)	54	(53;55)	0.8	*	55	(54;56)
Multiple myeloma	M	29	(27;31)	1.2	*	30	(28;32)	26	(20;32)	1.8		24	(17;31)	29	(27;30)	1.2	*	29	(27;31)
	F	28	(26;29)	1.2	*	28	(26;30)	26	(20;34)	0.3		23	(16;31)	28	(26;29)	1.2	*	28	(26;30)
All leukaemias	M	45	(44;46)	1.1	*	45	(43;47)	44	(38;49)	0.5		43	(36;49)	45	(43;46)	1.1	*	45	(43;46)
	F	41	(40;42)	0.4	*	41	(39;43)	49	(43;54)	0.6		47	(40;54)	41	(40;43)	0.5	*	41	(40;43)

[a] Annual absolute percentage change calculated by dividing the absolute difference in survival between 1991–95 and 1996–99 by the number of years between the mid-point of each calendar period. Figures take into account the slightly shorter periods of diagnosis available for Northern Ireland (1993–95) and the Republic of Ireland (1994–95).

[b] Incident cancer cases were collected from 1993 in Northern Ireland and from 1994 in the Republic of Ireland. However, in order to produce a single UK-wide estimate of the annual percentage change, it was necessary to assume that all countries provided data from 1991.

* $p<0.05$

Blank cells indicate that five-year survival could not be estimated. This occurs in cases where the population is very small, or when the cancer is particularly lethal.

Figure 2a **Range in one-year relative survival (%) by country, for (a) cancers with good prognosis (one-year survival 50% or higher) and (b) cancers with poor prognosis (one-year survival less than 50%): patients diagnosed in the UK and Republic of Ireland 1996–99**

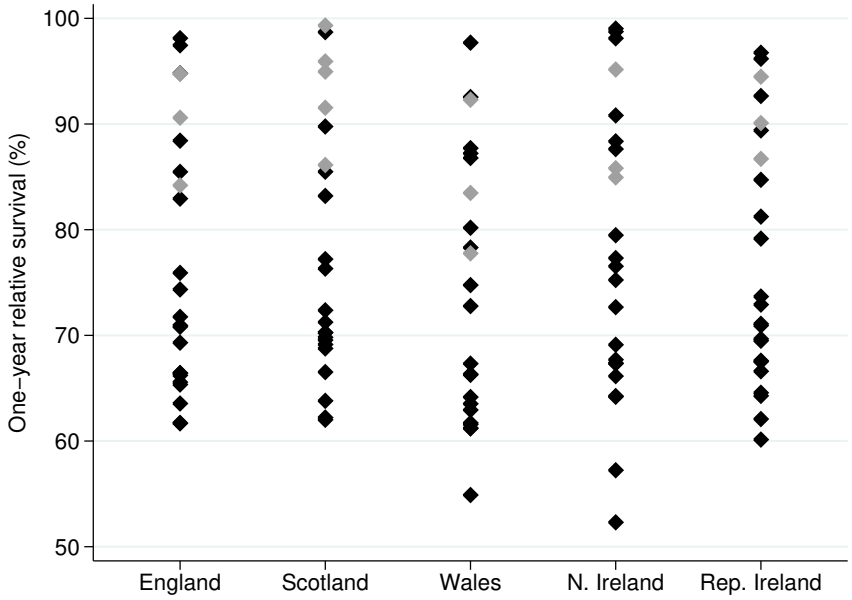
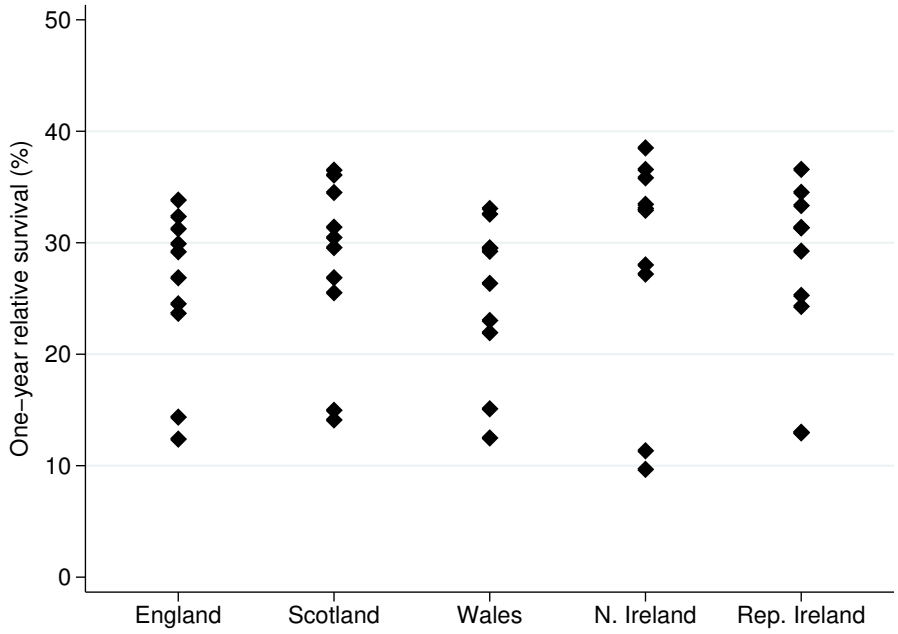
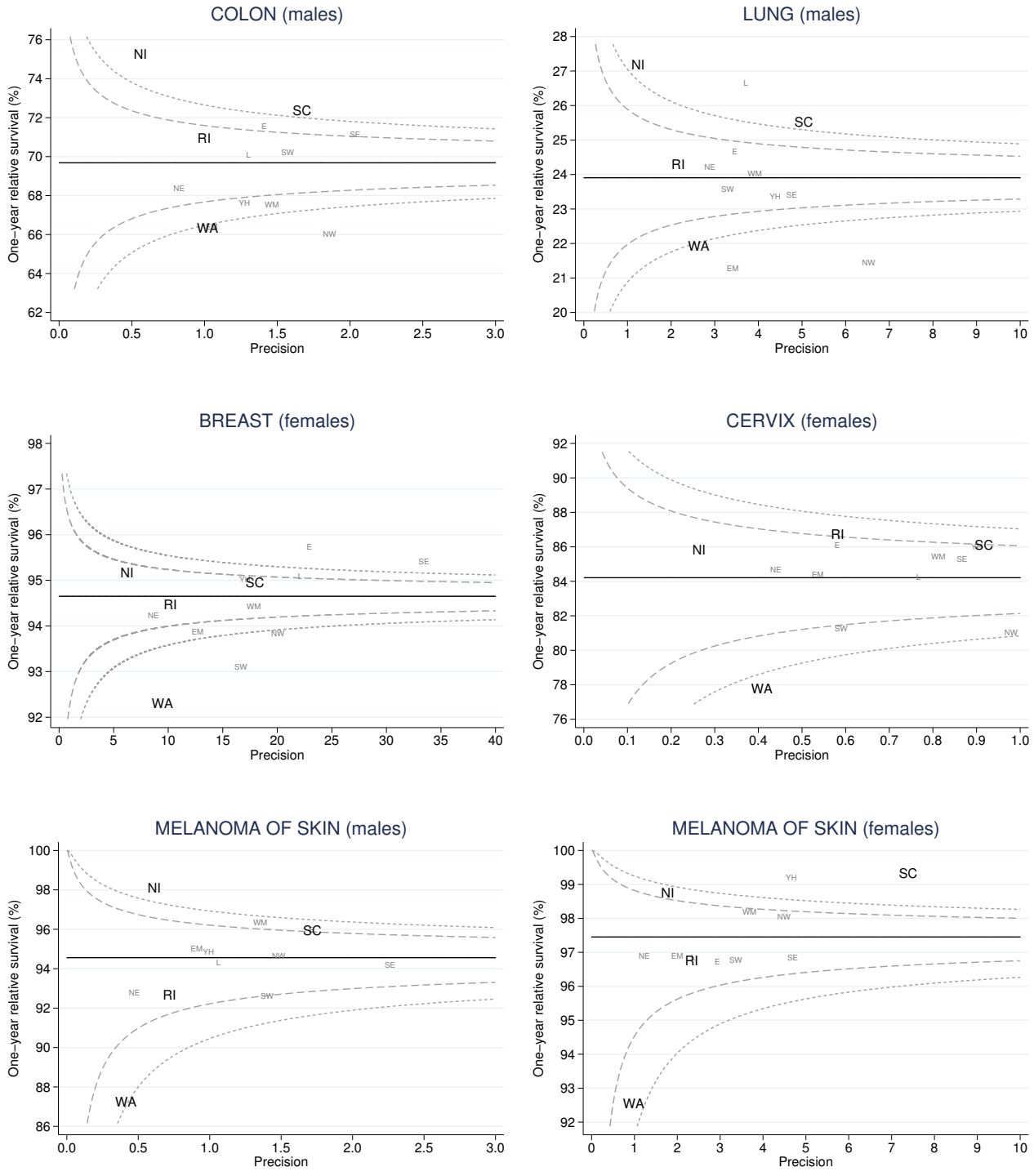


Figure 2b



Grey data points indicate cancers for which active early detection programmes were in place during this period (breast, prostate, cervix and, in Scotland, melanoma).

Figure 3 **Funnel plots showing the geographical variation in one-year relative survival for patients diagnosed during 1996–99 in the UK and Republic of Ireland: selected cancers**



In each case the horizontal line indicates the estimate for the UK and Republic of Ireland combined with 95% (inner) and 99.8% (outer) confidence intervals.

UK – United Kingdom, EN – England, NI – Northern Ireland, RI – Republic of Ireland, SC – Scotland, WA – Wales; E – Eastern, EM – East Midlands, L – London, NE – North East, NW – North West, SE – South East, SW – South West, WM – West Midlands, YH –Yorkshire and Humber.

The pathological classification and coding of bladder tumours changed markedly during the 1990s, and this had a substantial effect on survival estimates. The proportion of tumours coded as *in situ* (behaviour code 2) or uncertain if benign or malignant (code 1) increased from three per cent in 1991 to more than seven per cent in 1999 in the data as a whole, with the percentage in any given year in the separate countries ranging from less than 1 per cent in Scotland during the years 1991–93 to greater than 50 per cent in Northern Ireland in 1993. *In situ* bladder tumours have very high survival and are routinely excluded from survival estimates for invasive bladder cancers. The data for bladder cancer were analysed both with and without these tumours. Inclusion of bladder cancer classified as *in situ* or of uncertain malignancy led to higher survival estimates in all countries and regions, and it substantially changed the estimates for Northern Ireland (Table 2), and the Eastern region of England (Supplementary Table 4). Given the extreme geographic and temporal variation in the behaviour coded for bladder cancers in the UK and the Republic of Ireland, we judged that survival estimates including tumours coded as *in situ* or of uncertain malignancy were more comparable, and those results are presented here.

Annual increases in relative survival were greatest in England, Northern Ireland and the Republic of Ireland and smallest in Wales and Scotland. The largest overall improvements were observed for cancers of the colon, rectum and prostate. Decreasing or stable survival rates were also observed, but the only observed decline that was statistically significant at the 5 per cent level was that for bladder cancer in Scotland and in England for females: this trend was seen both with and without non-invasive malignancies.

Among patients diagnosed during 1996–99, five-year survival tended to be higher in the Republic of Ireland and Northern Ireland and lower in England and Wales. However, this pattern varied by cancer site. International differences were greatest for cancers of the colon, cervix, prostate, bladder and brain, for melanoma of the skin, multiple myeloma and all the leukaemias combined, whilst differences were smallest for cancers of the stomach, pancreas, breast, uterus, testis and kidney, and for non-Hodgkin lymphoma. Northern Ireland displayed the widest range in survival between different cancers, as would be expected for the country with the smallest population. Despite their smaller populations, Scotland and the Republic of Ireland displayed a similar range of survival to that seen in England, both for cancers with moderate or good prognosis (one-year survival greater than 50 per cent, Figure 2(a)) and for cancers with poorer prognosis (one-year survival less than 50 per cent, Figure 2(b)). Survival tended to be higher in Scotland for cancers for which screening or other early detection methods were in place during this period (breast, cervix, prostate and, in Scotland, melanoma).

There was geographic variation in one-year survival for most cancers in both sexes (Figure 3, Supplementary Figure 2). There was also some significant regional variation within England. One-year survival for melanoma was significantly higher in Scotland and in Northern Ireland than in the regions of England, the Republic of Ireland or Wales. There was also substantial variation in one-year survival from prostate and bladder cancers. The least variation was observed for cancers of the kidney, pancreas, brain, testis and uterus.

Survival tended to be lower in the northern regions of England and higher in the southern regions (Supplementary Figure 1, Supplementary Tables 3 and 4). The largest regional variation was

observed for multiple myeloma, all leukaemias combined, bladder, kidney and brain, while regional variation was least marked for cancers of the breast, pancreas, uterus and testis, and melanoma of the skin.

The proportion of cases with a recorded survival of zero was higher in England (particularly in the Thames region, about 25 per cent of the English population) than in Scotland, Northern Ireland or the Republic of Ireland. We therefore re-analysed the English data excluding cases from the Thames Cancer Registry. This slightly reduced the survival estimates for England.

Discussion

We have shown that the prognosis for patients diagnosed with one of the twenty most common cancers improved between the early and late 1990s in the four constituent countries of the UK and in the Republic of Ireland, and that the survival of patients diagnosed in Scotland and Ireland was generally higher than in England and Wales. Regional variations were also evident in England.

It is important to evaluate the possible role of artefact in explaining differences in cancer survival. Survival will be over-estimated if the linkage of death notifications with registered cancer cases is inefficient. However, we consider it unlikely that variation in the completeness of this linkage between the various national cancer registries is sufficient of itself to explain fully the geographic patterns of survival. Each registry regularly links its cancer patient data to data on deaths occurring in the same country in order to determine which patients have died, and when. The death of a registered cancer patient may be missed if they moved from one country to another after cancer diagnosis. The impact of such migration on survival estimates is likely to be very small: linkages for England and Wales are performed on a single database and regular cross-checks are carried out with the database for Scotland.

Survival is also sensitive to the proportion of ‘zero survival’ cases excluded from analysis. This category generally includes both patients with ‘true’ zero survival, who are known to have died on the day of diagnosis and whose cancer registration record reflects that fact, and patients who were registered only from a death certificate (DCO registrations), and for whom the date of diagnosis and the duration of survival are thus unknown. Both categories were excluded from analysis, because they were not distinguishable in the datasets analysed. Patients whose cancer was registered as a DCO tend to have had shorter survival than patients who were registered in life (Berrino *et al.* 1995). A high proportion of zero survival cases excluded from analysis may therefore lead to inflation of the survival estimate. In this study, England and Wales had the highest proportion of zero survival cases, but generally lower survival. In a sensitivity analysis in which the registry with the highest proportion of zero survival cases was excluded, the differences in survival between England and the other countries increased, rather than declined. Differences in the proportion of zero survival cases are therefore unlikely to explain why survival in England and Wales is generally lower than in Scotland, Northern Ireland or the Republic of Ireland.

Estimation of survival may also be influenced by the accuracy and comparability of the rules used to establish the date of diagnosis. For any given patient, several points on the diagnostic pathway could have been used to determine the point of diagnosis, for example, the day of first reported

symptoms, the day of biopsy, the day of a confirmatory laboratory test, or the first day of treatment. During the period in question, the date of diagnosis was defined slightly differently by the five national cancer registries. This may have led to small artefactual differences in survival. The greatest differences are likely to be between Scotland, which always used the earliest date available, and the other four nations, where the date of the event with the highest priority was used. This may have slightly inflated the estimates for Scotland in comparison to the other parts of the UK or Republic of Ireland, particularly for short-term survival and for lethal cancers. Differences in selection of the date of diagnosis do bias survival estimates up to a year after diagnosis (Dickman & Hakulinen 1997), but the impact is much smaller than the geographical differences observed here.

The variations in survival could in theory be due to confounding by age, since relative survival varies with age, and the age profile of cancer patients can differ between populations. Age standardisation would have minimised differences in survival due to these factors. It was not possible to perform comparable age standardisation for all datasets here, but where both types of analysis were feasible, differences between the standardised and non-standardised estimates were small, and variations in survival between the five countries were still evident (data not shown).

It is conceivable that a higher proportion of tumours registered in Scotland, Northern Ireland and the Republic of Ireland are, in fact, *in situ* than is the case in England and Wales. This is unlikely to explain the observed differences in full, because the proportion of tumours verified microscopically is highest in Scotland and in the Republic of Ireland, similar in Northern Ireland and England, with Wales having a much lower proportion (Curado *et al*. 2007; Personal communication to LM Woods from C White, received 20 May 2009). This suggests that, if anything, the proportion of *in situ* cases misclassified as invasive, and therefore artificial inflations in survival, are likely to be greatest in England, Wales and Northern Ireland.

Scotland and Northern Ireland had especially high relative survival from melanoma. This is likely to be due to a combination of active campaigns of earlier detection (Mackie & Hole 1992), and better ascertainment of thin lesions, which have a good prognosis. Better ascertainment of such tumours in Scotland has been suggested by a previous audit study of patients diagnosed during 1987-89 in seven health districts in England and one health board in Scotland (Melia *et al*. 1995). The high completeness of registration in Scotland probably reflects the close working relationship between the Scottish Cancer Registry and the Scottish Melanoma Group, which runs a specialist tumour registry. Lower melanoma survival in Wales may be due either to later diagnosis than in the other countries (patients in Wales would have thicker tumours) or because treatment in Wales is not as good (distribution of tumour thickness would be similar to that in other countries). The Welsh Cancer Intelligence Unit is currently working with dermatologists to obtain more detailed data on tumour thickness.

Although the variations in survival between the UK nations and the Republic of Ireland are not as great as those observed globally (Coleman *et al.* 2008) or within Europe (Berrino *et al.* 2007), there appears to be an overall pattern of lower survival in England and Wales than in the other countries. Three broad causal explanations for this difference in survival may be considered. First, delays in diagnosis may be shorter, patients present at an earlier stage of disease in Scotland, Northern

Ireland and the Republic of Ireland than in England or Wales. Second, access to diagnosis investigations and treatment and/or the quality or organisation of cancer care services may be better in Scotland and Ireland. Third, the underlying characteristics of the cancer patient population may differ in such a way that treatment is more effective in Scotland and Ireland. To evaluate these hypotheses, it would be necessary to obtain more detailed information on pre-diagnosis symptoms, tumour stage at diagnosis, diagnostic tests performed, treatment received and co-morbidity than are routinely captured by the national cancer registry in each country. Such information could be used to examine the impact of delay, treatment, co-morbidity and cancer control policy parameters upon differences in cancer patient survival between the UK nations and the Republic of Ireland. Such detailed information has recently become available in all the UK countries and the Republic of Ireland.

Conclusion

This paper reports cancer survival comparisons between the countries of the UK, the regions of England and the Republic of Ireland for the twenty most common malignancies. We have documented lower cancer survival in England and Wales than in Scotland, Northern Ireland and the Republic of Ireland. Cancer survival in the UK and the Republic of Ireland improved during the 1990s. By the end of the twentieth century there was still geographic variation in survival across the UK and the Republic of Ireland, with the lowest survival in the North of England: regional differences in survival within England are often wider than the differences between the five countries. Despite standardised treatment protocols in England, survival has generally been lower than in Scotland, Northern Ireland and the Republic of Ireland. Artefact is only likely to explain a small component of these differences. Geographic differences in stage at diagnosis, co-morbidity and other clinical factors may also be relevant, particularly if they influence the clinical decision to provide more effective but more aggressive treatment.

Acknowledgements

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Variations in life expectancy between rural and urban areas of England, 2001–07

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Abstract

Background

This study was part of a wider project commissioned by the Department for Environment, Food and Rural Affairs (Defra) to examine inequalities in health outcomes in rural areas. It investigated variations in life expectancy at birth between rural and urban areas of England, taking the effect of deprivation into account. The study aimed to produce results which provide specific evidence of the needs of rural communities, as they have often been overlooked in previous research.

Methods

The Rural and Urban Area Classification (RUAC) 2004 and the Index of Multiple Deprivation (IMD) 2007 were used to categorise area types at the Lower Super Output Area (LSOA) level. Population and mortality data used were produced by the Office for National Statistics (ONS). Abridged life tables were constructed to calculate period life expectancy at birth for males and females, for the years 2001 to 2007 combined. Confidence intervals (95%) were also produced.

Results

For the 2001–07 period, life expectancy at birth in England was 76.9 years for males and 81.3 years for females. However, when deprivation was examined, results between the most deprived and least deprived quintiles varied by 7.8 years for men and 5.4 years for women.

Overall, life expectancy was higher in rural areas than in urban areas. Deprivation had a considerable impact on the results and wide inequalities were evident, particularly in men and in urban areas. In both area types, males living in the less deprived quintiles had similar life expectancies to females living in the more deprived quintiles.

Within rural area types, life expectancy was higher in village and dispersed settlements than in town and fringe areas. There were large differences between the fourth and fifth (most deprived) quintiles in village and dispersed settlements, which shows that there may be acute pockets of deprivation within this area type that need to be addressed.

In terms of sparsity, there was little difference in life expectancy between densely and less densely populated localities within rural and urban areas. However, variations were observed when deprivation was taken into account and greater differences were evident in less sparse areas than in sparse areas.

Conclusions

There were clear inequalities in life expectancy between rural and urban areas in England. There were also intricate differences *within* area types, which can be overlooked when only examining differences *between* them. The results were consistent with the findings of previous studies and demonstrated that it is important to examine differences in life expectancy in both area and deprivation contexts.

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Introduction

This study was part of a project commissioned by the Department for Environment, Food and Rural Affairs (Defra) to investigate inequalities in health outcomes in rural areas of England. Past research into geographical health inequalities in the UK has often focused on variations between administrative areas, sometimes incorporating measures of socio-economic circumstances. There has been relatively little analysis into health inequalities between rural and urban areas, or particularly within rural areas.

The main aim of this project was to examine health advantages and disadvantages in different types of rural areas. This was done by investigating a number of health indicators (including access to services, mortality and life expectancy) to produce results which provide evidence of the needs of rural communities, which can then be addressed through public policy and delivery.

This particular study investigated differences in period life expectancy at birth in England according to different rural and urban area types within the Rural and Urban Area Classification (RUAC) 2004. The effect of deprivation within each area, measured using the Index of Multiple Deprivation (IMD) 2007, was also examined. The analyses utilised the latest population and mortality data, aggregated over the 2001–07 period, to provide a more detailed and robust examination of variations in life expectancy between rural and urban areas than has been produced previously.

Background

There is a common notion of a 'rural idyll' and associated beliefs that rural populations are healthier than their urban counterparts. Various environmental, social and economic factors are often thought to contribute to better rural health. For instance, the availability of clean air, green space and the opportunity for healthy exercise is widely considered to have significant health advantages. Rural areas also experience less deprivation and there is increasing evidence of gentrification (whereby better-off people migrate to the countryside and displace those who are less affluent) in rural settlements (Commission for Rural Communities 2008; Joseph Rowntree Foundation 2000). However, these observations may mask important differences within rural areas, which mean that inequalities are sometimes hidden by favourable averages (Haynes and Gayle 2000).

Rural populations tend to be older than those in urban areas. Ageing is strongly associated with greater healthcare needs, although it has been suggested that rural communities receive relatively less funding than urban areas, meaning that rural health needs may go unmet (Commission for Rural Communities 2008). Rural dwellers are also affected by issues such as the centralisation of services in urban localities, meaning that access to health and social care services can be compromised at key stages for those living in rural areas. Suppositions that people in rural areas experience better health advantages are therefore frequently challenged (Asthana *et al.* 2002).

Life expectancy

Life expectancy at birth has been used as a measure of the health status of the population in England and Wales since the 1840s, and was employed in some of the earliest reports of the

Registrar General to illustrate the differences in mortality experienced by populations in different parts of the country (Toson and Baker 2003).

At present, the Office for National Statistics (ONS) reports annually on life expectancy figures for the United Kingdom (UK), constituent countries and sub-national areas down to local authority level. Results are calculated as three-year averages in accordance with methodological recommendations (Toson and Baker 2003). Life expectancy at birth in the UK is generally higher for females than males and is higher in the south compared with the north (Kyte and Gordon 2009; Office for National Statistics 2009a). For 2006–08, life expectancy in England was highest in the South East, South West and East of England and lowest in the North West and North East. At local authority level, broad inequalities were evident and figures ranged from 73.6 years to 84.3 years for males and from 78.8 years to 88.9 years for females.

In addition to the standard annual figures, results have also been periodically produced to examine life expectancy within smaller geographical areas. ONS calculated life expectancy at ward-level in England and Wales as experimental statistics for the 1999–03 period, aiming to identify a suitable methodology for use with small populations, to establish a minimum population size to make the calculations feasible, and to consider the effects of having no deaths in some age groups (Toson and Baker 2003). The study explored various methods and concluded that Chiang's revised methodology should be used for all sub-national life expectancy calculations, calculations should not be performed for areas with populations of less than 5,000, and that if there are no deaths in the final age band, a value based on national age-specific death rates should be inserted. These recommendations have been followed in this study to calculate life expectancy for rural and urban areas.

While the annual figures provide a useful indicator of health outcomes and are used for monitoring changes and variations in the population's life expectancy, it is not possible to assess specific rural and urban community needs using the results because these areas are not neatly distributed within administrative geographical areas.

At present, there are relatively few studies that have focused on variations in life expectancy between and within rural and urban areas of England and in areas with different levels of deprivation (Charlton 1996; Raleigh and Kiri 1997; Woods *et al.* 2005; Gartner *et al.* 2007). On the whole, they have reported that life expectancies are higher in rural and less deprived areas and lower in urban and more deprived areas, regardless of the time period under investigation. However, the studies are based on differing area and deprivation classifications and the results are now dated. This study develops previous work by using the government's current area and deprivation classifications, and the latest population and mortality data to present a detailed and robust analysis of variations in life expectancy between rural and urban areas in England.

Rural and urban

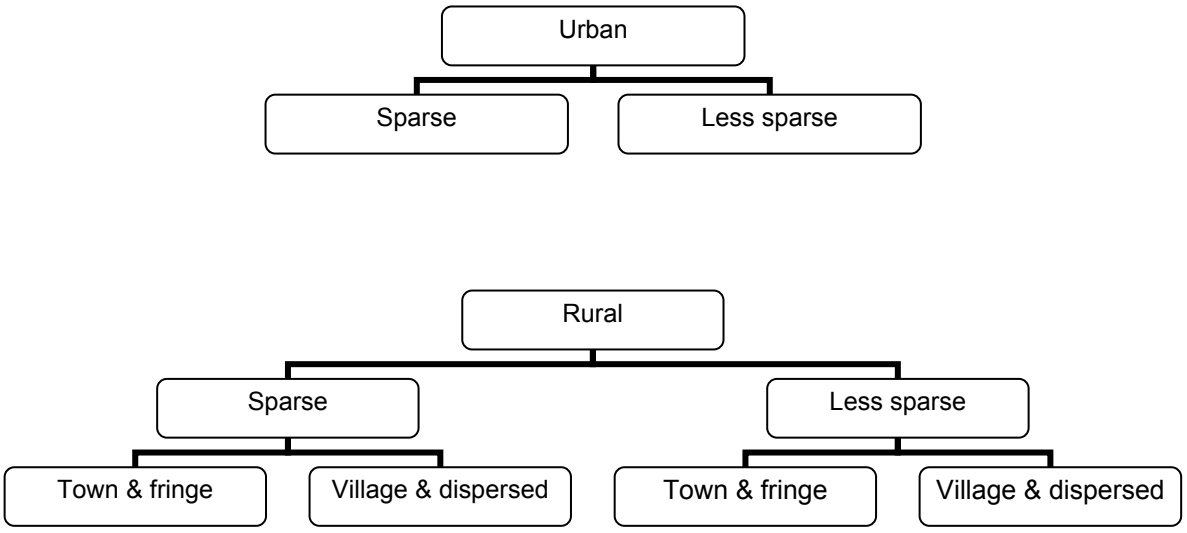
There are numerous definitions and conceptualisations in the literature of what constitutes *rural* and *urban*. The way in which these concepts are defined and understood influences the methods and findings of research (Higgs 1999). For statistical and analytical purposes various classifications have been developed in past research to categorise urban and rural areas. For example, Haynes and Gayle (2000) constructed four urban and rural typologies based on ward

population sizes and distance to a district general hospital. In another example, Huff *et al.* (1999) developed a classification based on the grouping of enumeration districts into urban areas and their subsequent total population sizes. However, such classifications are often devised for individual studies and are therefore limited in the extent to which they can be compared. Further, they are often biased towards urban areas (Barnett *et al.* 2002).

Official classifications of rural and urban areas have been periodically produced by UK government departments. The Rural and Urban Area Classification 2004 for England and Wales was sponsored and developed by various agencies (including Defra, ONS and The Countryside Agency) to overcome the weaknesses identified in previous rural and urban definitions. In particular, rural definitions based on socio-economic circumstances were regarded as unsuitable (The Countryside Agency *et al.* 2004).

In the RUAC, areas with a population of 10,000 or more were categorised as urban, whereas rural settlements were identified according to household and residential land use and densities (Bibby and Shepherd 2004). Areas were then defined according to settlement types and context (sparsity). The classes ‘sparse’ and ‘less sparse’ can be interpreted as ‘less densely populated’ and ‘densely populated’ respectively. The smallest geography which areas were classified at was 2001 Census Output Areas, which can then be aggregated to larger geographies. Output area boundaries remained stable over the 2001–07 period. Based on sparsity and settlement types, a two-tiered classification can then be structured for rural areas. Box 1 shows the urban and rural classes used in this study.

Box 1 Rural and Urban Area Classification 2004

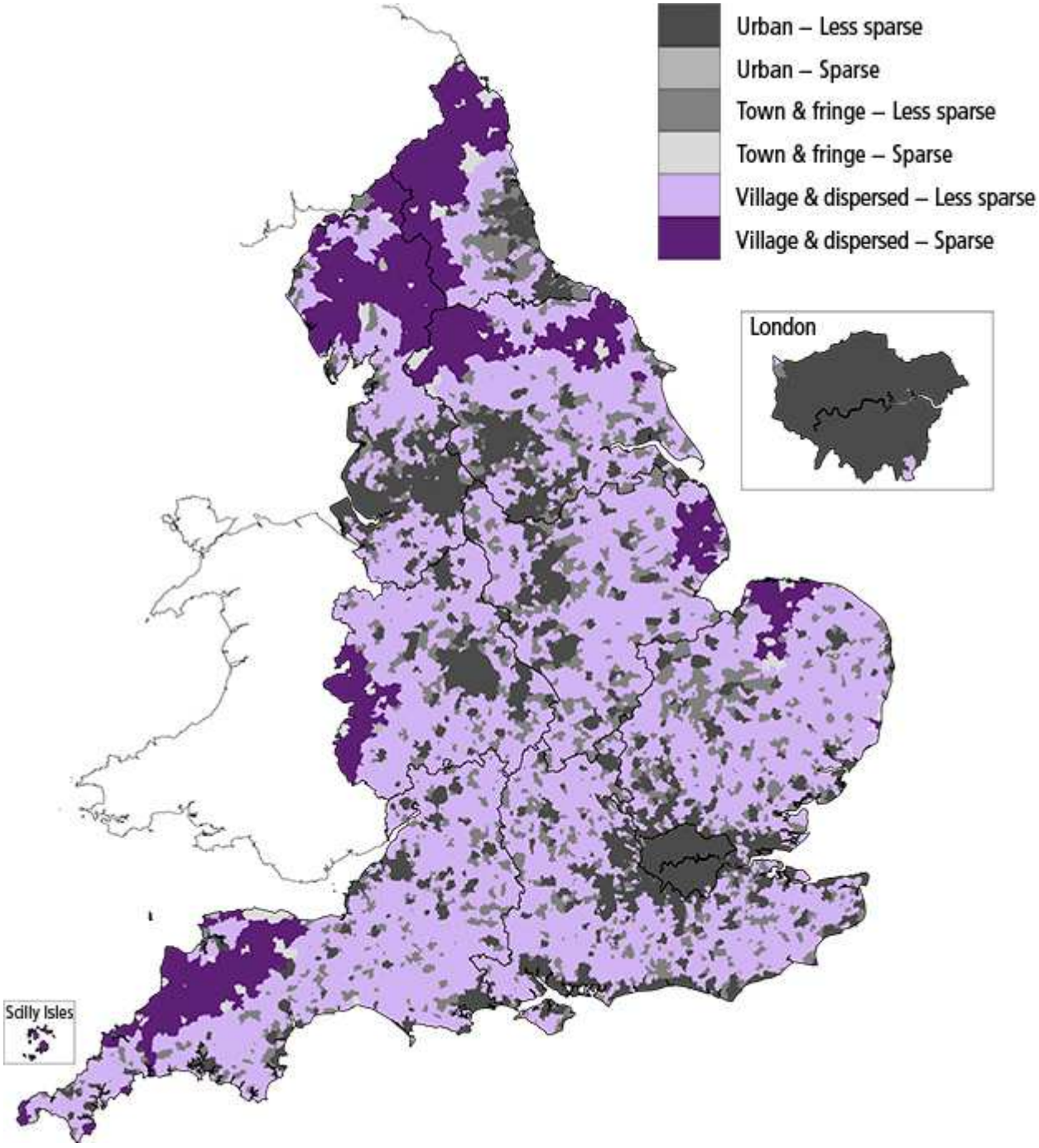


Source: Adapted from Bibby and Shepherd (2004)

The RUAC is a detailed and flexible classification that enables statistical analyses to be performed for a simple rural/urban dichotomy, sparse and less sparse areas, different settlement types, or for the individual classes, depending on the level of analysis required. It improves previous classifications by incorporating a strong rural element and enables more sophisticated analyses to be conduced *within* rural areas than has arguably been previously possible. As the national standard measure, the use of the RUAC allows statistical indicators to be compared across different topical areas.

A map of England illustrating the RUAC at the Lower Super Output Area (LSOA) level is displayed in Figure 1. The map shows that densely populated urban areas are concentrated in and around London, Greater Manchester, Merseyside, and Tyne and Wear. There are also large urban concentrations within Yorkshire and the Humber and the Midlands. In contrast, sparse village and dispersed areas are mainly located in the North of England, particularly around Cumbria. There are also rural pockets on the east coast, in the south east, and in the west of the country. Approximately 80 per cent of the population lived in urban areas and 20 per cent lived in rural areas during the 2001–07 period.

Figure 1 **LSOAs in England by the RUAC 2004**



Deprivation

To understand health variations between rural and urban areas further, analyses of deprivation permit a more in-depth exploration of inequalities within specific area types, which may be hidden by favourable averages of health (Haynes and Gale 2000). Like the concepts of *rural* and *urban*, *deprivation* has been defined and measured in a variety of ways. The term is often used interchangeably with others such as *disadvantage*, *inequality*, *poverty* and *social exclusion* (Asthana *et al.* 2002). Broadly, there are two types of deprivation: economic and social, which manifest through numerous indicators such as income, education and health.

Several indices have been developed and employed in previous studies to quantify indicators of deprivation (for example Jarman 1983; Townsend *et al.* 1988; Carstairs and Morris 1989). However, they have been widely criticised for having an urban bias, meaning that rural issues have often been overlooked, which has potential implications for resource allocation and service planning (Martin *et al.* 2000). Perhaps the most notable criticism levelled against the Townsend and Carstairs-Morris indices concerns the car-ownership indicator. It is argued that rural residents are more reliant on cars than urban dwellers (Gilthorpe and Wilson 2003). Although car-ownership may be a good indicator of wealth in cities, high levels of ownership in rural areas may misrepresent the socio-economic conditions because it is often due to a lack of public transport provision rather than wealth (Haynes and Gale 2000).

The Index of Multiple Deprivation was introduced in 2000. The car-ownership variable was excluded as a deprivation measure, mainly due to criticisms like those above. Uniquely, it included geographical access to services as a measure of deprivation, which is an element that was previously overlooked (Jordan *et al.* 2004). The more recent IMD 2004 and IMD 2007 contain an additional domain of crime. The IMD 2007, used in this study, brings together 38 different indicators which fall within seven domains. The domains each have an associated weight and they are combined to create the overall deprivation index. The domains and weights are shown in Box 2.

Box 2 Index of Multiple Deprivation 2007

Domain	Domain weight
Income deprivation	22.5%
Employment deprivation	22.5%
Health deprivation and disability	13.5%
Education, skills and training deprivation	13.5%
Barriers to housing and services	9.3%
Crime	9.3%
Living environment deprivation	9.3%

Source: Communities and Local Government (2008)

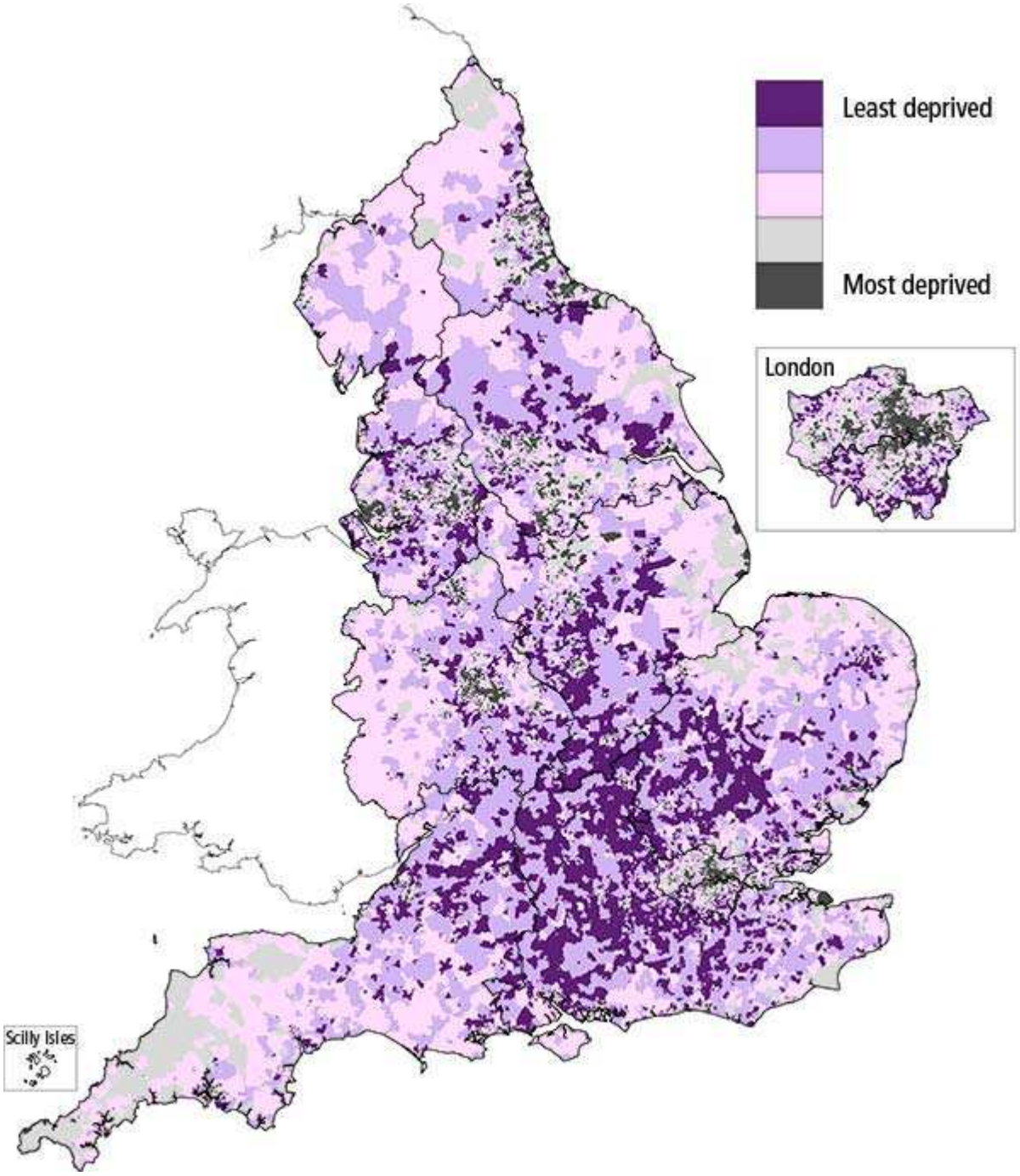
The IMD has been used in various studies to report differences in health outcomes, generally finding better health in the least deprived areas and worse health in the most deprived. For instance, the IMD 2004 was used in a study to determine whether differences between rural and urban mortality were evident once deprivation was taken into account (Gartner *et al*. 2008). When adjustments for deprivation were made in a logistic regression analysis, it was found that differences in mortality were significantly reduced in males, but less so in females. Gartner also investigated the impact of deprivation on mortality rates by including and excluding the health domain, using the income domain only, and using the Townsend index, finding little effect on the

overall results (unpublished). Such studies demonstrate the importance of incorporating deprivation measures when examining differences between rural and urban areas.

A map of England illustrating the IMD 2007 at LSOA level is displayed in Figure 2. It shows that the least deprived areas are mainly located in the southern and eastern regions, while the most deprived areas are located in and around urban concentrations (as shown in Figure 1). There are also a lot of deprived localities in eastern and southern coastal areas, which are often associated with older and seachange populations.

Based on the IMD 2007, the Commission for Rural Communities (2008) state that, on average, rural areas have less concentrated deprivation than urban areas. In terms of sparsity, they observe that levels of deprivation within sparse towns and villages are similar to the levels of deprivation experienced in urban areas. Areas with the least deprivation are identified in ‘commuter belt’ areas and in the centre of the South of England, where income levels are highest (Commission for Rural Communities 2008).

Figure 2 **LSOAs in England by the IMD 2007**



Methods

Rural and Urban Area Classification (RUAC) 2004

The RUAC 2004 was used in this study to classify areas in England at the LSOA level. There are 32,482 LSOAs in England, with an average population of 1,500 people. Using this classification, results were produced for England, the rural/urban dichotomy, settlement types and sparsity contexts.

Index of Multiple Deprivation (IMD) 2007

The IMD 2007 was additionally employed in this study to assess the impact of deprivation on life expectancies within rural and urban areas. Based on this Index, each LSOA has a total deprivation score and is ranked from 1 (least deprived) to 32,482 (most deprived). The LSOAs were split into approximately equal quintiles for analysis in this study.

Table 1 shows the number of LSOAs in each deprivation quintile according to the six classes of the RUAC. For rural areas, there are more LSOAs in the least deprived quintiles and fewer in the most deprived areas. The urban LSOAs are distributed more evenly across the deprivation quintiles.

Table 1 **Number of LSOAs in England by RUAC 2004 and IMD 2007 quintile, 2001–07**

RUAC 2004			IMD 2007					
Dichotomy	Context	Settlement	Least	2	3	4	Most	Total
Urban	Sparse	≥10,000 population	2	12	18	27	11	70
	Less sparse	≥10,000 population	4,704	4,471	4,996	5,873	6,341	26,385
Rural	Sparse	Town & fringe	17	40	56	38	1	152
		Village & dispersed	5	36	128	57	1	227
	Less Sparse	Town & fringe	1,118	799	571	317	124	2,929
		Village & dispersed	652	1,139	727	184	17	2,719
Total			6,498	6,497	6,496	6,496	6,495	32,482

These categories have small populations and were therefore excluded from the sparsity context life expectancy calculations.

Life expectancy figures were calculated by IMD 2007 quintiles for each of the RUAC groups outlined above. However, two categories (least deprived urban sparse areas and most deprived rural sparse areas) were excluded from the calculations for methodological reasons because they have small populations (Toson and Baker 2003).

Populations and mortality data

The population data used were unpublished, experimental mid-year LSOA population estimates split by sex and five-year age group, produced by ONS. ONS mortality data for persons whose

usual place of residence was in England, by sex and five-year age group were also used. The data were combined for the years 2001 to 2007 to ensure that the numbers were large enough, particularly in areas with fewer LSOAs, to ensure that the results calculated were sufficiently robust.

Calculation of period life expectancy

Abridged life tables were constructed using standard methods (Newell 1994; Shyrock and Siegel 1976). Separate tables were constructed for males and females, and for each analysis with and without the inclusion of IMD 2007 quintiles. The tables were created using annual mid-year population estimates and numbers of deaths registered in each calendar year, which were aggregated over the 2001–07 period. A detailed description of the standard methods and notation associated with the calculation of life expectancy can be found on the Government Actuary's Department website (Government Actuary's Department, online a, online b).

Confidence intervals were calculated using the method developed by Chiang (1968). A report detailing research undertaken by ONS to compare methodologies to allow the calculation of confidence intervals for life expectancy at birth has been published in the National Statistics Methodology Series (Toson and Baker 2003). Confidence intervals are a measure of the statistical precision of an estimate and show the range of uncertainty around the estimated figure. Calculations based on small numbers of events, as is the case in some areas in this analysis, are often subject to random fluctuations. As a general rule, if the confidence interval around one figure overlaps with the interval around another, we cannot say with certainty that there is more than a chance difference between the two figures. Confidence intervals are represented by error bars on the charts below.

An example of a life table constructed using the same method used to calculate life expectancy and confidence intervals in this article can be found on the ONS website (Office for National Statistics 2005).

Interpretation of results

All figures presented are period life expectancies. Period expectation of life at a given age for an area in a given time period is an estimate of the average number of years a person of that age would survive if he or she experienced the particular area's age-specific mortality rates for that time period throughout the rest of his or her life. The figures reflect mortality among those living in the area in each time period, rather than mortality among those born in each area. It is not therefore the number of years a person in the area in each time period could actually expect to live, both because the death rates of the area are likely to change in the future and because many of those in the area may live elsewhere for at least some part of their lives.

Period life expectancy at birth is also not a guide to the remaining expectation of life at any given age. For example, if female life expectancy was 80 years for a particular area, the life expectancy of women aged 65 years in that area would exceed 15 years. This reflects the fact that survival from a particular age depends only on the mortality rates beyond that age, whereas survival from birth is based on mortality rates at every age.

Results

Life expectancy in rural and urban areas

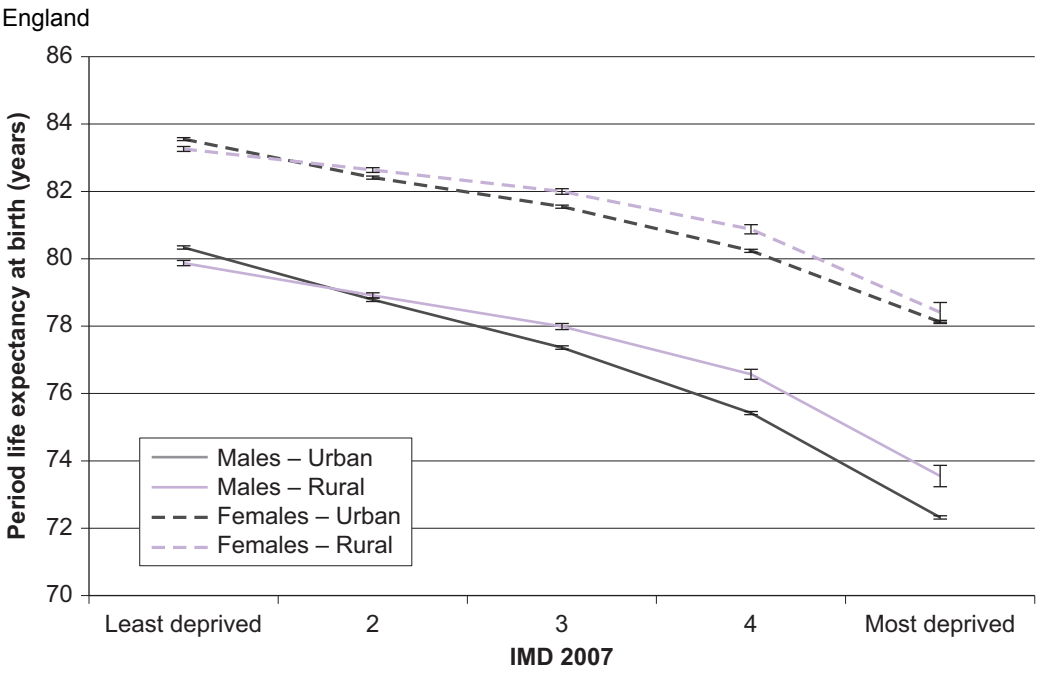
For 2001-07, life expectancy at birth for males in England was 76.9 years. For females, life expectancy was 4.4 years higher at 81.3 years. However, when the figures were calculated by IMD 2007 quintiles, wide variations were observed. Life expectancy for males ranged from 72.4 years in the most deprived areas to 80.2 years in the least deprived areas. For females, expectation of life varied from 78.1 years in the most deprived to 83.5 years in the least deprived areas. This showed differences of 7.8 years and 5.4 years respectively, indicating broader inequalities among males than females.

Using the RUAC 2004, England was divided into dichotomous rural and urban areas. Life expectancy was higher in rural areas than in urban areas for both males and females. For men, life expectancy was 78.6 years in rural areas and 76.5 years in urban areas. The respective figures for women were 82.4 years and 81.0 years. The difference in life expectancy between the areas was wider among males (2.1 years) than females (1.4 years).

When deprivation quintiles were included in the calculations, more detailed differences in life expectancy were evident. Figure 3 shows that in the least deprived quintile, the life expectancy of both males and females was slightly higher in urban areas than in the least deprived rural areas. However, in the other quintiles, life expectancy was lower in urban areas for both men and women. Although the differences between rural and urban areas were relatively small, the gaps in life expectancy tended to be wider between the more deprived quintiles, particularly in males.

In males, life expectancy in urban areas ranged from 72.3 years in the most deprived quintile to 80.3 years in the least deprived, compared with 73.5 years and 79.9 years respectively in rural areas. The variations were much smaller in females, with life expectancy ranging from 78.1 years to 83.6 years in the most deprived to the least deprived urban areas and from 78.4 years to 83.3 years respectively in rural areas. The figures show that inequalities were widest among men in urban areas (8.0 years).

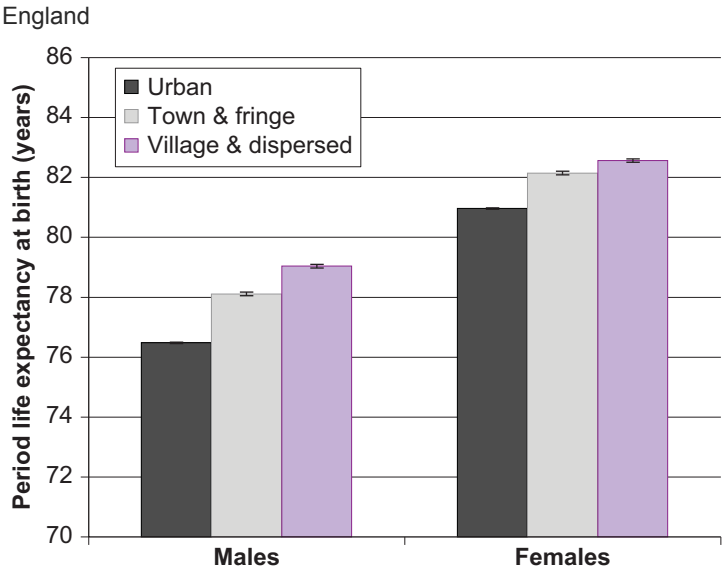
Figure 3 **Period life expectancy at birth by sex and rural/urban dichotomy of the RUAC 2004 and IMD 2007 quintile, England, 2001–07**



Life expectancy in rural and urban settlement types

To provide further detail of variations within rural areas, life expectancy was calculated by the three settlement types of the RUAC 2004: urban, town and fringe, and village and dispersed areas. Figure 4 shows that the expectation of life for males and females was highest in village and dispersed areas and lowest in urban areas.

Figure 4 Period life expectancy at birth by sex and settlement type of the RUAC 2004, England, 2001–07



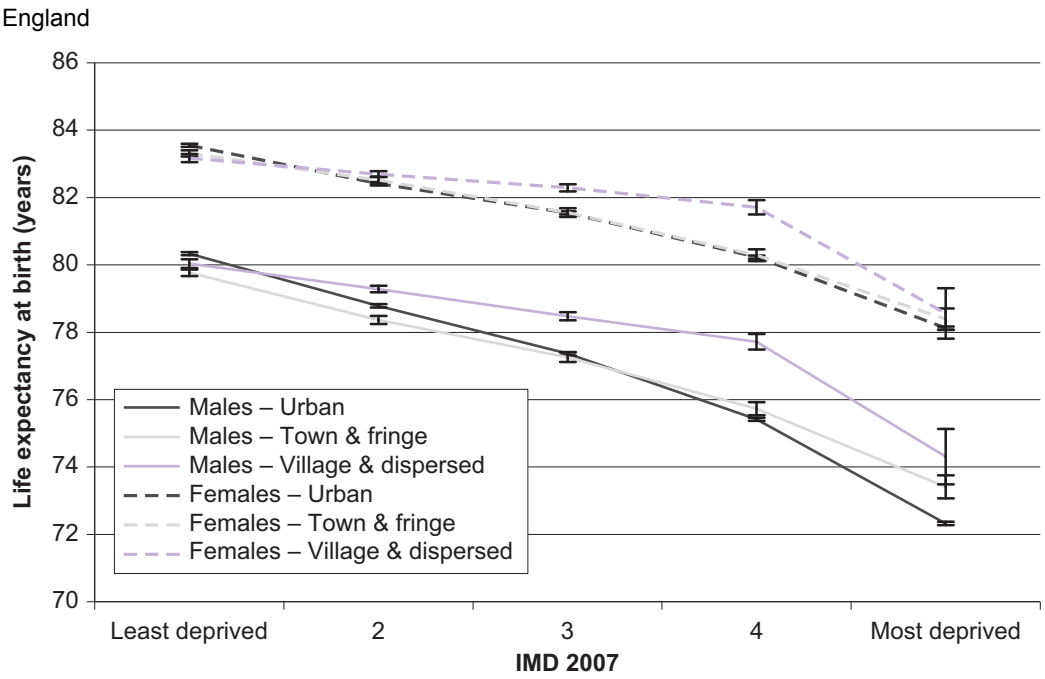
When deprivation quintiles were included in the calculations, Table 2 shows that the life expectancy of males was highest in the least deprived urban areas. However, it was lowest in the most deprived urban areas, showing that the widest inequalities in life expectancy across the three settlement types were in urban areas. From the second deprivation quintile, male life expectancy was highest in village and dispersed areas. For this area type, there was a notable difference of 3.4 years between the fourth and fifth (most deprived) quintiles, compared with just 2.3 years between the first (least deprived) and fourth quintile. However, in comparison with urban and town and fringe areas, there was still smaller variation in life expectancy in village and dispersed settlements.

There was a similar trend in life expectancy by settlement type and deprivation quintile in females. Table 2 shows that expectation of life was highest in the least deprived and lowest in the most deprived urban areas, although the latter result was not significant. In quintiles 2 to 5 (most deprived), life expectancy was highest in village and dispersed settlements and lowest in urban areas, although Figure 5 shows that life expectancy in urban and town and fringe areas had a very similar pattern, differing by less than four months within each deprivation quintile.

Table 2 Period life expectancy at birth by sex and rural/urban settlement type of the RUAC 2004 and IMD 2007 quintile, England, 2001–07

Settlement type	IMD 2007	Male life expectancy at birth	Lower 95% confidence interval	Upper 95% confidence interval	Female life expectancy at birth	Lower 95% confidence interval	Upper 95% confidence interval
Urban	Least	80.3	80.3	80.4	83.6	83.5	83.6
	2	78.8	78.7	78.8	82.4	82.4	82.5
	3	77.4	77.3	77.4	81.5	81.5	81.6
	4	75.4	75.4	75.5	80.2	80.2	80.3
	Most	72.3	72.3	72.4	78.1	78.1	78.2
Town & fringe	Least	79.8	79.7	79.9	83.3	83.2	83.4
	2	78.4	78.2	78.5	82.5	82.4	82.6
	3	77.3	77.1	77.4	81.6	81.4	81.7
	4	75.7	75.5	75.9	80.3	80.1	80.5
	Most	73.4	73.1	73.7	78.4	78.1	78.7
Village &	Least	80.0	79.9	80.2	83.2	83.0	83.3
dispersed	2	79.3	79.2	79.4	82.7	82.6	82.8
	3	78.5	78.4	78.6	82.3	82.2	82.4
	4	77.7	77.5	78.0	81.7	81.5	81.9
	Most	74.3	73.5	75.1	78.6	77.8	79.3

Figure 5 **Period life expectancy at birth by sex and rural/urban settlement type of the RUAC 2004 and IMD 2007 quintile, England, 2001–07**



In each settlement type, the differences across the deprivation quintiles were much smaller in females than in males. For females, life expectancy varied by 5.5 years in urban areas, 4.9 years in town and fringe areas, and by 4.6 years in village and dispersed settlements. In males, the differences were 8.0 years, 6.4 years and 5.7 years respectively.

When compared with the England figures, the results for life expectancy across all deprivation quintiles in urban areas are very similar, which may be reflective of the fact that approximately 80 per cent of the population between 2001–07 lived in urban settlements. Although rural areas have fewer residents, variation was evident within different settlement types, with village and dispersed areas experiencing higher life expectancies across the four lowest deprivation quintiles than town and fringe areas. Apart from those in the least deprived quintile, figures for the expectation of life in village and dispersed settlements were above the England average.

Life expectancy in rural and urban sparsity contexts

For further analysis, the RUAC 2004 was split into four sparsity contexts: urban less sparse/sparse and rural less sparse/sparse. Figure 6 shows that life expectancy was highest in rural less sparse areas for males (78.6 years) and in rural sparse areas for females (82.7 years), although variations between rural areas were small and the confidence intervals for males in rural contexts showed that the differences in life expectancy were not significant. The lowest life expectancies were in urban sparse areas for males (76.1 years) and in urban sparse and less sparse areas for females (81.0 years). For both sexes, life expectancy in each of the rural sparsity contexts was above the England average. However, within both rural and urban areas, sparse areas were not significantly different to less sparse areas.

Figure 6 **Period life expectancy at birth by sex and rural/urban sparsity context of the RUAC 2004, England, 2001–07**

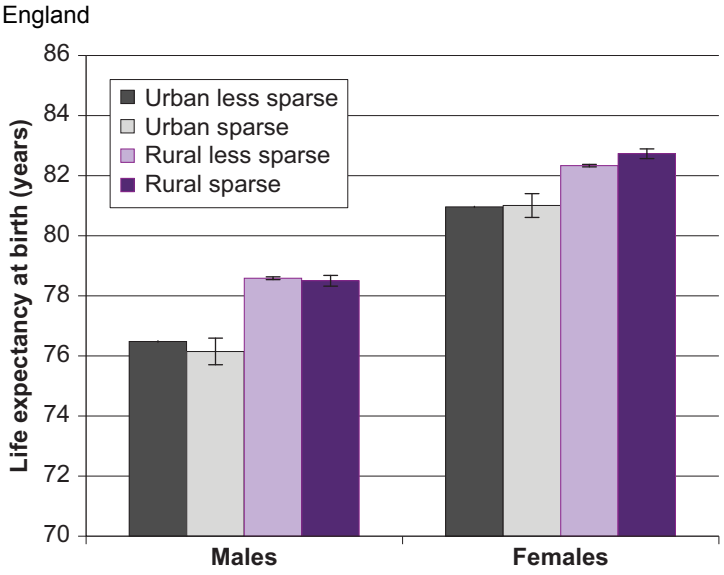


Table 3 shows the life expectancy results for sparsity contexts by deprivation quintile. Results were not calculated for the least deprived urban sparse and the most deprived rural sparse areas due to small populations. The results showed wide variations between the least and most deprived categories. For males, life expectancy was highest in the least deprived urban less sparse areas (80.3 years), although the figure was only 0.4 years higher than life expectancy in the corresponding rural sparse and less sparse areas (79.9 years), and the upper confidence interval in the least deprived rural sparse category was highest at 80.5 years. In contrast, expectation of life was lowest in the most deprived less sparse urban areas (72.3 years). A similar pattern was observed in females, however, the differences between the highest and lowest life expectancies in each sparsity context were smaller. Although not all deprivation quintiles were included in the results, there was less variation in life expectancy in sparse areas than in less sparse areas.

The steepest gradient in life expectancy between the least deprived and most deprived areas was observed in the less sparse urban areas for both males (8.0 years) and females (5.5 years). In men, the differences in other areas ranged by 6.4 years in rural less sparse areas, 6.2 years in urban sparse areas, and 2.1 years in rural sparse areas. The differences were much smaller in women, ranging by 4.9 years, 2.9 years and 1.1 years for the respective areas. However, not all deprivation quintiles were included in these gradients.

Table 3 **Period life expectancy at birth by sex and rural/urban sparsity context of the RUAC 2004 and IMD 2007 quintile, England, 2001–07**

Sparsity context	IMD 2007	Male life expectancy at birth	Lower 95% confidence interval	Upper 95% confidence interval	Female life expectancy at birth	Lower 95% confidence interval	Upper 95% confidence interval
Urban less sparse	Least	80.3	80.3	80.4	83.6	83.5	83.6
	2	78.8	78.7	78.8	82.4	82.4	82.5
	3	77.4	77.3	77.4	81.5	81.5	81.6
	4	75.4	75.4	75.5	80.2	80.2	80.3
	Most	72.3	72.3	72.4	78.1	78.1	78.2
Urban sparse	Least						
	2	79.4	78.6	80.3	81.2	80.2	82.2
	3	77.4	76.5	78.4	82.3	81.5	83.1
	4	75.6	74.8	76.3	80.9	80.3	81.5
	Most	73.2	72.1	74.3	79.4	78.5	80.3
Rural less sparse	Least	79.9	79.8	80.0	83.3	83.2	83.3
	2	78.9	78.8	79.0	82.6	82.5	82.7
	3	77.9	77.8	78.0	81.9	81.8	81.9
	4	76.3	76.1	76.5	80.6	80.4	80.7
	Most	73.5	73.2	73.8	78.4	78.1	78.7
Rural sparse	Least	79.9	79.2	80.5	82.8	82.1	83.5
	2	79.0	78.6	79.4	83.2	82.8	83.5
	3	78.5	78.3	78.8	82.9	82.7	83.2
	4	77.8	77.4	78.2	82.1	81.8	82.5
	Most						

These categories have small populations and were therefore excluded from the life expectancy calculations.

Discussion

Summary of main findings

For the 2001–07 period, life expectancy in England was 76.9 years for males and 81.3 years for females. The inclusion of IMD 2007 deprivation quintiles in the calculations had a large impact on the results, which varied by 7.8 years for men and 5.4 years for women between the least and most deprived quintiles. Males living in the less deprived quintiles had similar life expectancies to females living in the more deprived quintiles in both urban and rural areas.

Overall, life expectancy was higher in rural areas than urban areas for both males and females. When the impact of deprivation within different area types was examined, wide inequalities were

evident, particularly among men and in urban areas. Although the expectation of life was highest in the least deprived urban areas, it was also lowest in the most deprived urban areas, showing wide disparities within this area type. Deprivation in rural areas had seemingly less effect on the rural life expectancy figures as there was smaller variation between the least and most deprived quintiles.

Within rural settlement types, life expectancy was higher in village and dispersed areas than town and fringe areas. However, in village and dispersed communities, there was a large difference between the fourth and fifth deprivation quintiles, although the confidence intervals in the most deprived quintile were wide. Nonetheless, this shows that there may be pockets of acute deprivation within this settlement type that need to be addressed.

In terms of rural and urban sparsity contexts, the longest life expectancies were in rural less sparse areas for both sexes. Although not all categories could be included in the deprivation analysis, the results still showed broad variations, with life expectancy being highest in the least deprived urban less sparse areas and lowest in the most deprived urban less sparse areas. Patterns of life expectancies within sparse areas were not clear, even though seven years of data were aggregated. The nature of the areas may mask small pockets of deprivation and poor health which are difficult to capture, and this is reflected in the large confidence intervals surrounding figures for this area type.

Comparison to other studies

The findings of this study were consistent with results and reports from previous research which found that life expectancy is generally higher in rural areas and in less deprived areas, and lower in urban and more deprived areas (Charlton 1996; Gartner *et al.* 2007; Woods *et al.* 2005).

Using the OPCS91 area classification (Wallace *et al.* 1995), Charlton (1997) reported that in 1981 and 1992, life expectancy at birth in England and Wales was lowest in urban areas, particularly in manufacturing and mining areas, while it was highest in the most prosperous, growth and rural areas. Gartner *et al.* (2007) also found that in Wales for 1999-03, there were more urban wards within the fifth of areas with the lowest life expectancies and more rural wards in the highest fifths. Within rural areas of the RUAC 2004, it was also showed that life expectancy was higher in sparse rural wards compared with less sparse rural wards. However, no clear trend was evident between sparse and less sparse rural areas of England in the current study, even when deprivation was taken into account.

In terms of deprivation, studies which have investigated differences in life expectancy across different types of geographical areas (e.g. government office regions and health authorities) have found greater inequalities between the more deprived areas than between lesser deprived areas, and larger variations between men than women (Woods *et al.* 2005; Raleigh and Kiri 1997). These findings are consistent with those in the current study.

Over time, some studies report that while improvements have been made, gaps in life expectancy between areas with the highest and lowest results have increased (Charlton 1996; Raleigh and Kiri 1997). ONS sub-national life expectancy figures calculated from 1991–93 to 2006–08 show that it improved in all local authorities over this period, by 4.2 years on average for men and by 2.9 years on average for women (Office for National Statistics 2009b). However, although variations in life

expectancies between government office regions in England have reduced, differences between local authorities with the highest and lowest life expectancies have widened over this period. Though, when Kensington and Chelsea was excluded from the 2006–08 figures, the differences in the widths of inequality between the two time periods reduced from 2.4 years to 1.0 year for males and from 3.5 years to 0.4 years for females. Due to the availability of LSOA population estimates (from 2001 onwards only) and the number of years for which data needed to be aggregated in the current study, it was not possible to compare time periods. This is highlighted below as a limitation of the analysis.

Limitations of the analysis

An ecological approach was taken to this study, whereby aggregated data about the population in terms of area and deprivation measures were used to produce life expectancy results, to give an indication of average health outcomes. However, this method is susceptible to the ecological fallacy, which means that assumptions about individuals cannot be made from results relating to aggregate data (Bryman 2008). This limitation is also emphasised by the claim that the poor health of individuals can be masked by favourable averages of the surrounding population (Haynes and Gale 2000).

The use of LSOA-level data in this analysis partly minimises this limitation as LSOAs are based on small, approximately equal population sizes. However, rural LSOAs generally cover a larger geographical area in comparison with urban LSOAs, meaning that urban areas are more likely to be homogeneous and include people with similar characteristics. This may have had some effect on the results and account, in part, for larger inequality gaps in urban areas.

Life expectancy at birth figures are based on the current population and mortality rates of a given area. The results are an estimate of the number of years a person would survive if he or she experienced the area's age-specific mortality rates for the rest of his or her life. The methodology takes no account of migration, which may make a significant difference to the results, particularly as there is a tendency for healthier people to migrate while the less healthy stay at home (O'Reilly *et al*. 2007). However, this type of analysis would not be possible within the current death registration system in England as it is the area of usual residence of the deceased that is recorded on death certificates, which does not necessarily reflect the area where they spent most of their life.

This study was based on the assumption that area-based classifications and deprivation-based measures are appropriate and accurate to define and distinguish between different areas. However, limitations and associated methodological issues have been raised in previous work (for example Higgs 1999; Romeri *et al.* 2006). At the individual-level, socio-economic circumstances and health outcomes, even within small areas, may vary greatly and are not necessarily concentrated in, for example, deprived inner city areas or affluent rural settlements. However, the use of small area LSOAs in this analysis is a substantial improvement on previous studies carried out using larger geographical areas.

To improve the current study, the calculation of time series data would enable comparisons to be made over different periods and determine whether inequalities within different area types persist. However, data aggregated over a number of years is required to calculate robust results so further

analyses may be limited in terms of meaningfulness and timeliness. A further option, which would be feasible to build upon this study, would be to include life expectancy at age 65 results in the analysis, particularly as rural populations tend to be older than urban populations.

Although life expectancy figures are a useful indicator of health outcomes, Higgs (1999) states that 'more research is needed to establish the types of factors that are unique to rural areas that may be impacting on health experience and health status' (1999, p.218).

As part of the wider Defra project into inequalities in health outcomes in rural areas, further studies examining differences in mortality, the relationship between self-perceived health and migration and the influence of socio-economic status, and the association between access to health services and the outcomes of heart attacks (survived or died) have been conducted (Forthcoming).

Conclusion

This study reports on variations in life expectancy at birth for males and females in England over the 2001–07 period, by RUAC 2004 and IMD 2007 categories. The results established clear inequalities both between and within rural and urban areas. Life expectancy at birth improved with increasing rurality and those born in village and dispersed areas could expect to live longer than those in town and fringe areas. In terms of sparsity contexts, the highest life expectancies were in less sparse rural areas, although perhaps due to their very nature, results were unclear for both rural and urban sparse areas. Urban areas experienced lower life expectancies over the 2001–07 period compared with rural areas (apart from those in the least deprived quintile) and when the impact of deprivation was considered, urban areas had the widest gaps between the highest and lowest figures, particularly in men.

The results of this study reflect those reported in earlier studies, that people living in rural settlements and in the least deprived areas are expected to live longer than those living in urban and in the most deprived areas. They show that it is important to examine differences in life expectancies in both area and deprivation contexts. Within rural areas, there were intricate differences between life expectancies, which are often overlooked when analysing all rural areas together. The results provide useful evidence of health outcomes experienced within rural and urban areas, which may be used to inform future policy.

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Monitoring inequalities in health expectancies in England – small area analyses from the Census 2001 and General Household Survey 2001–05

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Abstract

Background

Deprivation and ill health are intimately linked. Monitoring this relationship in detail and with sufficient frequency is key in attempts to reduce health inequalities through more efficient targeting of healthcare resources. This study explores the potential of the General Household Survey (GHS) to provide an inter-censal measure of health expectancies in small areas experiencing differing degrees of deprivation.

Methods

The prevalence of health status and the health expectancy of males and females at birth and at age 65 by quintiles of small area deprivation are estimated. Comparisons are made between census 2001 and GHS 2001-05 to inform the suitability of the latter as an inter-censal measure of health expectancy across small areas. Comparisons are also made between the health expectancies of people living in more and less deprived areas.

Results

Reports of 'good' and 'fairly good' health fell and health expectancies declined as deprivation increased. Consistency between census and GHS data indicates that the latter is a suitable source for the inter-censal measurement of health expectancies across quintiles of deprivation. At birth, people living in the least deprived areas can expect more than 12 additional years of life in good or fairly good health than those in the most deprived areas, at age 65 the difference was more than four years. In terms of the proportion of life spent in favourable health states; at birth, those living in the least deprived areas could expect to spend around 91 per cent or more of their lives in good or fairly good health compared to 82 per cent for those in the most deprived areas. At age 65, people in the least deprived areas could expect to spend around 82 per cent of their remaining life in good or fairly good health compared to 69 per cent or less for those in the most deprived areas.

Conclusions

This study represents the first use of the Index of Multiple Deprivation (IMD) 2004 in the measurement of health expectancy across small areas. Both the census and GHS highlighted substantial differences in the health status and health expectancies of people experiencing differing degrees of ecological deprivation. These findings serve as a useful measure and benchmark in the targeting and assessment of interventions designed to ameliorate health inequalities.

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Introduction

The relationship between ecological (area based) measures of deprivation and health status measures are often used to determine the presence and scale of health inequality within national populations. These findings are used to assess different health needs and inform the targeting of health resources to reduce health inequalities.

The decennial census of the UK population provides a robust data source with which to explore health inequalities across a number of factors, including area-based deprivation. However, such analyses are only possible at ten year intervals, reducing scope to monitor progress during the inter-censal period. To assess change in health inequalities at more frequent intervals, alternative sources must be explored. Ideally a source should align closely with the census and be sufficiently large in sample terms to enable accurate estimates of populations of interest computed previously using census data.

This report explores the potential of the General Household Survey (GHS) to provide an accurate inter-censal measure of inequality in health expectancies across groups of small areas that experience differing levels of deprivation.

The Department of Health (DH) funded this project as part of a wider programme of work, focusing on the measurement of inequalities in health.

Background

There is a clear relationship between composite measures of health status, such as health expectancies (HE), and measures of socio-economic position (White *et al*. 1999, Melzer *et al*. 2000, Mackenbach *et al*. 2008). However, the incomplete assignment of socio-economic position at an individual level in death registrations, and the absence of inter-censal population estimates disaggregated by socio-economic position, restricts analyses of HE by the National Statistics Socio-economic Classification (NS-SEC), for example, mainly to longitudinal data sources.

To overcome this limitation, measures of deprivation assigned to small areas have often been used as alternative indicators of socio-economic position and several studies report a clear, linear association between health and level of deprivation, however each is defined (Bajekal 2005, O'Reilly, Rosato and Patterson 2005, Wood *et al*. 2006, Morgan and Baker 2006, Rasulo, Bajekal and Yar 2007). Measures of disadvantage based on area deprivation combine individual and environmental characteristics at a given point in time and provide a greater depth of analysis than measures based on occupation and employment status alone (MacIntyre, MacIver and Sooman 1993, Bajekal 2005).

The decennial census provides a wealth of data to explore the relationship between health and area deprivation, however its use to measure change over time is restricted to ten year intervals. Inter-censal analyses provide the opportunity to monitor progress in reducing inequalities in health at more frequent intervals.

Identifying a consistent and continual annual data source of sufficient size and complexity that is coherent with the decennial census is key to producing an inter-censal measure of inequalities in health expectancy. For such a measure to be worthwhile for informing policy, it must be: temporally distinct from the census year; deliverable at least once between census years; able to clearly and precisely distinguish between area deprivation clusters. One likely source is the GHS; which is now the General lifestyle module (GLF) of the Integrated Household Survey (IHS). This survey carries a general health question consistent with the Census 2001, and is currently in use to inform national estimates of Healthy Life Expectancy (HLE). With an annual sample of approximately 20,000 people in England, this survey is small compared to the census, but the data collected over several years can be combined to produce a larger aggregated dataset. In national estimates of HE, for example, current practice is to combine three years of GHS/GLF survey data (Smith, Olatunde and White 2010).

A further concern surrounds the measure of deprivation used in assessing health inequality. Previous studies have used the Carstairs index (Carstairs and Morris 1991) to define distinct geographical areas of deprivation, both at census and inter-censally using the Health Survey for England (HSE) (Bajekal 2005, Rasulo, Bajekal and Yar 2007). However, it is not possible to update the Carstairs index after 2001; an integral component, namely the Registrar General's Social Class (RGSC), has ceased collection in national surveys. Moreover, there is a lack of comparability between the census 2001 and HSE due to differences in the question used to capture general health prevalence in the population.

The Index of Multiple Deprivation (IMD), first introduced in 1999 for electoral wards, is a viable alternative to the Carstairs index; providing a numeric indicator of ecological deprivation based on

relative scores across a number of distinct domains such as income, employment and health. In 2004 the IMD was updated to allow for analysis at Lower Super Output Area (LSOA) geographies (Noble *et al.* 2004) see Box 1.

GHS data can be readily assigned to LSOA level deprivation groupings according to IMD 2004 through postcode matching. Restricting the analysis to quintiles of deprivation and combining five years of GHS data provides a sample of approximately 20,000 people for each quintile, which is sufficient for calculating an inter-censal estimate of health expectancy. Moreover, after the initial five year aggregated period, it is feasible to update the measure prior to the Census 2011, using subsequent years of GHS/GLF data to track change in the gap in health expectancies.

This study assesses the potential of using the GHS as a data source for the inter-censal measurement of inequalities in HE across quintiles of ecological deprivation as defined by IMD 2004. The initial focus compares health status prevalence and HLE by age and gender for each quintile of deprivation calculated from Census 2001 data and GHS 2001–05 (centred on 2003) data. The similarity of quintile specific estimates and therefore the inequality using each data source will indicate the usefulness of the GHS to provide an inter-censal measure of the inequality in HE by area deprivation.

Methods

The analyses in this report contain the prevalence of self-reported health status among the private household population of England; residents of communal establishments are excluded because the GHS does not survey the institutional population. The suitability of the five year aggregated GHS data to provide an inter-censal measure of HE between areas experiencing different degrees of deprivation is assessed by comparing the conformity of its estimates of health status prevalence and health expectancy with those based on the Census 2001 data. Boxes 2, 3 and 4 provide brief descriptions of the survey data and methods used during this study.

Box 1 Area deprivation

IMD 2004 combines seven distinct domains of data to produce a single measure of relative deprivation for each LSOA in England; similar measures have also been constructed for Wales, Northern Ireland and Scotland (Noble *et al*. 2001; 2003, National Assembly for Wales 2005). LSOAs are relatively homogenous in terms of population size and structure; each has approximately 1,500 residents. In this study, the 32,482 LSOAs in England are ranked into quintiles in order to achieve a sufficiently large sample size for subsequent analyses of survey data. Although these quintiles represent a continuum of relative deprivation, there is likely to be a significant degree of heterogeneity within each, such that (for example) those at the bottom of quintile 1 are more closely related to those at the top of quintile 2 than those at the top of quintile 1.

The IMD has been criticised as conceptually difficult when used in health related studies since it includes a 'health' domain to calculate relative levels of area deprivation (Morgan and Baker 2006). Therefore, measurements of health using the IMD as a geographical 'anchor' may potentially suffer from 'mathematical-coupling' where the integral health domain of the IMD influences the relationship with the health outcome under investigation. Recent studies, however, have found little evidence to support this effect, concluding that the presence or absence of the health domain in the IMD 2004 has little or no effect on observed health inequalities, particularly when using general health, limiting chronic illness and/or mortality as outcome measures (Adams and White 2006, Gartner *et al*. 2008).

Box 2 Survey data

Data relating to residents of private households in England were collected from Census 2001 and the GHS 2001–05. An aggregation of five years of GHS data achieves a sufficiently large sample for meaningful analysis across quintiles of deprivation. A similar approach is used in the annual ONS estimates of health expectancies for England.

Census and GHS records were mapped to LSOA geographical boundaries using a postcode identifier, and assigned to the relevant quintile of the IMD 2004 for that area. Census and GHS populations were evenly distributed across deprivation quintiles, each quintile contributing around one–fifth of the population/survey sample (see Table 1).

Residents of communal establishments were excluded from the census data to allow better comparison with the GHS which does not collect this data. It should be noted, however, that mortality data used to calculate HE includes deaths in both private household and communal establishment populations.

Table 1 The number and distribution of private household residents in England responding to the Census in 2001 and to the GHS in 2001–05 by IMD 2004 area deprivation quintile

England Numbers/ Per cent

Deprivation quintile	Census 2001[1]		GHS 2001–2005	
	Persons (000's)	Per cent	Persons	Per cent
1 – Least deprived	9,694	20.1	20,847	21.4
2	9,682	20.1	19,831	20.3
3	9,631	20.0	19,536	20.0
4	9,596	19.9	18,249	18.9
5 – Most deprived	9,645	20.0	18,896	19.4
Total	48,248	100	97539	100

1 Source: Census 2001. Crown Copyright applies unless otherwise stated, Copyright@ons.gov.uk

Box 3 Health status prevalence

The prevalence of health status by sex and five year age–band was derived from responses to the following general health question asked in both census 2001 and GHS 2001-05:

'Over the last 12 months would you say your health has on the whole been….

Good

Fairly Good

Not good

In this analysis, a binary measure of general health is used to distinguish states of 'good' and 'poor' health; specifically, responses to the general health question were dichotomised by collapsing those reporting 'good' or 'fairly good' health into a single state of 'good' health. The remainder were classified as being in 'poor' health. In comparisons of health status prevalence between census and GHS, data were age standardised to the European standard population to control for the possibility of differences in the age structure between the 2001 census and the GHS samples used.

Box 4 Health expectancies (HE); healthy life expectancy (HLE) and disability free life expectancy (DFLE)

HLE is partly derived from health status prevalence (see Box 3) and partitions life expectancy (LE) into periods of 'good' and 'not good' health. DFLE is partly derived from reports of limiting long–standing/term illness.

HE were calculated using the Sullivan method, combining prevalence and mortality data and mid-year population estimates (MYPE) (Sullivan 1971, Jagger 1996). LSOA level MYPE and mortality data are not available prior to 2001, therefore estimates of HLE derived from Census 2001 data use mortality data only from 2001 and the Census population was used as a proxy measure of the MYPE. For estimates of HLE and DFLE based on the GHS, all data (survey, mortality and MYPE) were aggregated over the period 2001-05.

Comparisons were made between census and GHS based estimates of HLE for males and females at birth and at age 65 across deprivation quintiles.

Results

Comparison of health status prevalence and HLE by area deprivation quintile according to Census 2001 and GHS 2001–05

Health Status prevalence

Both Census and GHS data showed a similar, consistent pattern of increasing prevalence of 'poor' health with rising levels of deprivation and a greater degree of inequality between extremes of deprivation for males compared to females (see Table 2).

Table 2 Comparison of age standardised rates of 'poor' health amongst residents of private households in England by IMD 2004 quintile and sex, Census 2001 and GHS 2001–05

England Per cent

Deprivation quintile	Census 2001[1]		GHS 2001–2005	
	Males	Females	Males	Females
1 – Least deprived	4.4	4.9	5.9	7.2
2	5.6	6.0	7.8	8.7
3	7.0	7.3	8.6	10.1
4	9.2	9.4	11.2	12.5
5 – Most deprived	13.2	13.1	16.4	16.8
Ratio (5/1)	3.0	2.7	2.8	2.3
95% CI of ratio	3.0–3.0	2.7–2.7	2.6–3.0	2.2–2.5
England	7.7	7.9	9.6	10.8

Significant difference between males and females

Significant difference between males and females and Census 2001 and GHS 2001–05

1. Source: Census 2001. Crown Copyright applies unless otherwise stated, Copyright@ons.gov.uk

At national level, the prevalence of 'poor' health was somewhat higher according to the GHS compared to the census and the gender gap was also more pronounced. Approximately 8 per cent of males and females were in 'poor' health according to census and around 10 and 11 per cent of males and females, respectively, were in 'poor' health according to the GHS.

Compared to the census, the prevalence of 'poor' health was higher for both males and females in the GHS in each quintile of deprivation and this difference was greatest in those living in the most deprived areas. As with national figures, the gender gap was also more pronounced in the GHS compared to the census at each quintile of deprivation.

In the 2001 Census, the prevalence of 'poor' health for males living in the most deprived fifth of LSOAs was three times higher than for males living in the least deprived areas. For females the equivalent inequality was narrower; the prevalence of 'poor' health in the most deprived areas being 2.7 times higher than in the least deprived areas.

Similarly, in the GHS the prevalence of 'poor' health for males in the most deprived areas was 2.8 times higher than in the least deprived areas. The equivalent inequality was again less pronounced for females, the prevalence of 'poor' health being just 2.3 times higher in the most compared to the least deprived areas.

Healthy life expectancy

As with health prevalence, census and GHS estimates of HLE showed similar and consistent patterns across the deprivation quintiles and between the sexes. For both sources, each quintile of deprivation in the cohorts of males or females at birth or at age 65 was significantly different. Estimates of HLE got significantly worse with increasing levels of deprivation and were lower at

birth and at age 65 for males compared to females. In addition, the difference between the extremes of deprivation was greater for males than for females (see Table 3).

Table 3 Census 2001 and GHS 2001–05 estimates of HLE for males and females at birth and at age 65

England — Years/ Per cent

Deprivation quintile	Males						Females					
	Census 2001			GHS 2001-05			Census 2001			GHS 2001-05		
At birth	HLE	Lower 95 per cent CI	Upper 95 per cent CI	HLE	Lower 95 per cent CI	Upper 95 per cent CI	HLE	Lower 95 per cent CI	Upper 95 per cent CI	HLE	Lower 95 per cent CI	Upper 95 per cent CI
1- Least deprived	**74.8**	74.7	74.8	**73.8**	73.3	74.2	**77.4**	77.4	77.4	**75.9**	75.4	76.3
2	**72.6**	72.5	72.6	**71.2**	70.7	71.6	**75.6**	75.6	75.7	**73.3**	72.8	73.8
3	**70.5**	70.4	70.5	**69.5**	69.0	69.9	**73.7**	73.7	73.7	**71.8**	71.3	72.3
4	**67.1**	67.1	67.1	**65.7**	65.2	66.2	**70.8**	70.8	70.8	**68.6**	68.1	69.2
5 - Most deprived	**61.7**	61.6	61.7	**59.5**	58.9	60.0	**66.2**	66.1	66.2	**63.7**	63.1	64.3
Range	**13.1**	13.1	13.1	**14.3**	13.6	15.0	**11.2**	11.2	11.3	**12.2**	11.4	13.0
England	**69.3**	69.3	69.3	**68.0**	67.8	68.3	**72.8**	72.8	72.8	**70.7**	70.5	71.0
At age 65												
1- Least deprived	**15.0**	15.0	15.0	**15.0**	14.6	15.3	**17.1**	17.1	17.1	**17.2**	16.8	17.5
2	**14.0**	14.0	14.0	**13.9**	13.5	14.2	**16.2**	16.2	16.2	**15.7**	15.3	16.1
3	**13.1**	13.0	13.1	**13.0**	12.6	13.3	**15.3**	15.3	15.3	**15.3**	15.0	15.7
4	**11.7**	11.7	11.7	**11.5**	11.1	11.8	**14.1**	14.1	14.1	**13.8**	13.4	14.2
5 - Most deprived	**10.0**	10.0	10.0	**9.5**	9.1	9.9	**12.4**	12.4	12.4	**12.3**	11.9	12.7
Range	**5.0**	5.0	5.0	**5.5**	4.9	6.0	**4.7**	4.7	4.8	**4.8**	4.3	5.4
England	**12.8**	12.8	12.8	**12.7**	12.5	12.8	**15.0**	15.0	15.0	**14.9**	14.7	15.1

Significant difference in HLE between Census and GHS

HLE was lower for males and females at birth in the GHS compared to census; but estimates at age 65 were similar in both data sources. At national level, HLE for males at birth according to census was around 69 years, significantly higher than in the GHS where HLE was approximately 68 years. Similarly HLE was significantly higher at census for females at birth; 72.8 years compared to the GHS at 70.7 years.

By deprivation quintile, estimates of HLE at birth for males and females were also significantly greater in the census compared to the GHS. Additionally, the inequality of HLE between the least and most deprived quintiles was greater in the GHS than in the census; 14.3 vs. 13.2 years for males and 12.2 and 11.2 years for females in the GHS and census respectively. The difference in the scale of inequality between genders, however, was similar at around 2 years in each data source.

At age 65, estimates of HLE for males and females according to census and GHS data were largely equivalent. Nationally at this age, HLE was 12.8 and 12.7 years for males and 15.0 and 14.9 years for females according to census and GHS based data respectively.

For each quintile at age 65, estimates of HLE for males and females were comparable across sources with one exception: among females in quintile 2, HLE was significantly higher at 16.2 years according to census compared to only 15.7 years according to the GHS.

Confidence intervals (CI), signifying the precision of estimates of HLE, were substantially narrower for census based estimates compared to those derived from the GHS. However the 95 per cent CI surrounding estimates based on GHS data are broadly in line with ONS national HLE series for England – i.e. approximately 1 year at birth and 0.7–0.8 of a year at age 65.

HLE and DFLE by deprivation quintile according to the GHS 2001–05

Healthy Life Expectancy

For the most part, salient points relating to HLE by deprivation quintile according to the GHS 2001–05 are detailed above in the comparison of census and GHS data. Further comparisons of life expectancy (LE), HLE and DFLE and the proportions of life spent either in good or fairly good health or free from a limiting long–standing illness or disability by quintile of deprivation according to GHS 2001–05 are shown in table 4.

Table 4 LE, HLE and DFLE for males and females at birth and at age 65 by area deprivation; GHS 2001–05

England Years/ Per cent

Deprivation quintile										
	At birth	LE	HLE	Lower 95 per cent CI	Upper 95 per cent CI	Proportion of life in 'Good'/'Fairly good' Health (%)	DFLE	Lower 95 per cent CI	Upper 95 per cent CI	Proportion of life free from a limiting long-standing illness or disability (%)
Males	1- Least deprived	**79.8**	**73.8**	73.3	74.2	92.4	**67.7**	67.2	68.3	84.9
	2	**78.5**	**71.2**	70.7	71.6	90.7	**65.3**	64.7	65.8	83.1
	3	**77.2**	**69.5**	69.0	69.9	90.0	**63.7**	63.1	64.2	82.5
	4	**75.2**	**65.7**	65.2	66.2	87.3	**59.8**	59.2	60.4	79.5
	5 - Most deprived	**72.1**	**59.5**	58.9	60.0	82.5	**54.3**	53.6	54.9	75.2
	Range	**7.7**	**14.3**	13.6	15.0	..	**13.5**	12.7	14.3	..
	At age 65									
	1- Least deprived	**18.2**	**15.0**	14.6	15.3	82.2	**12.0**	11.6	12.4	65.8
	2	**17.4**	**13.9**	13.5	14.2	79.6	**11.0**	10.6	11.4	63.2
	3	**16.8**	**13.0**	12.6	13.3	77.4	**10.4**	10.0	10.8	61.9
	4	**15.8**	**11.5**	11.1	11.8	72.5	**9.0**	8.6	9.4	56.9
	5 - Most deprived	**14.6**	**9.5**	9.1	9.9	65.3	**7.5**	7.1	7.9	51.3
	Range	**3.6**	**5.5**	4.9	6.0	..	**4.5**	3.9	5.1	..
Females	1- Least deprived	**83.3**	**75.9**	75.4	76.3	91.1	**69.2**	68.6	69.8	83.1
	2	**82.3**	**73.3**	72.8	73.8	89.1	**67.2**	66.6	67.7	81.6
	3	**81.4**	**71.8**	71.3	72.3	88.2	**66.5**	65.9	67.1	81.7
	4	**80.0**	**68.6**	68.1	69.2	85.8	**62.2**	61.5	62.8	77.7
	5 - Most deprived	**77.9**	**63.7**	63.1	64.3	81.8	**57.7**	57.1	58.4	74.1
	Range	**5.4**	**12.2**	11.4	13.0	..	**11.4**	10.6	12.3	..
	At age 65									
	1- Least deprived	**20.8**	**17.2**	16.8	17.5	82.5	**13.4**	12.9	13.8	64.3
	2	**20.2**	**15.7**	15.3	16.1	77.8	**12.7**	12.3	13.1	63.2
	3	**19.6**	**15.3**	15.0	15.7	78.2	**12.4**	12.0	12.8	63.4
	4	**18.9**	**13.8**	13.4	14.2	73.3	**10.4**	10.0	10.9	55.4
	5 - Most deprived	**17.8**	**12.3**	11.9	12.7	69.3	**9.4**	8.9	9.8	52.6
	Range	**3.0**	**4.8**	4.3	5.4	..	**4.0**	3.4	4.6	..

As with HLE, LE declined with increasing levels of deprivation; however the difference between the least and most deprived quintiles was much narrower. The range in LE at birth between the least and most deprived areas was around half that of HLE at birth (range in LE at birth: 7.7 years for males and 5.4 years for females) and two–thirds that of HLE at age 65 for both sexes (range in LE at age 65: 3.6 years for males and 3 years for females).

The proportion of life spent in good or fairly good health, that is, HLE divided by LE, was broadly similar for males and females in each quintile of deprivation but between quintiles this proportion varied notably. At birth, males and females in the least deprived quintiles could expect to spend approximately 91 to 92 per cent of their lives in good or fairly good health, but for the most deprived quintiles this fell to just 81 to 82 per cent; a difference of around 10 per cent between the extremes of deprivation.

For males, in particular, the greatest difference exists between the most (quintile 5) and next most (quintile 4) deprived areas, where the proportional difference was almost as great as that between quintiles 1 to 4 combined.

At age 65, differences in the estimated proportion of remaining life spent in good or fairly good health between quintiles was more extreme than at birth. At this age, the gap between the least and most deprived areas was around 17 per cent for males and 13 per cent for females; however, the incremental change between quintiles was on the whole smoother than at birth.

Disability Free Life Expectancy

As with HLE, there were clear and significant differences between estimates of DFLE in each quintile of deprivation within the cohorts of males and females at birth and at age 65. DFLE was observed to decrease with increasing level of deprivation. Males at birth and at age 65 had significantly lower estimates than females in each quintile and the inequality in estimated DFLE between the least and most deprived quintile was narrower for females than for males (see Table 4).

At birth, males and females living in the least deprived areas could expect some 13.5 (males) or 11.4 (females) more years of life free from a limiting long–standing illness or disability than their counterparts in the most deprived areas. At age 65, the inequality in DFLE between the least and most deprived quintiles was approximately 4.5 years for males and 4.0 years for females. This difference was of a similar magnitude to the inequality between quintiles seen with HLE although the 95 per cent CIs were a little wider, at around 1.1–1.2 years at birth and 0.8–0.9 years at age 65.

At birth, males and females in the least deprived areas could expect to spend around 9–10 per cent more of their lives without a disability than those in the most deprived areas. At age 65, these differences are larger: 14 per cent for males and 12 per cent for females (see Table 4).

Discussion

This report explores the potential of the GHS to provide an adequate inter-censal measure of health inequality between advantaged and disadvantaged populations, defined using the IMD 2004 measure of deprivation at small area level. Initially, comparisons of health status prevalence and

HLE for area-based deprivation quintiles in each data source were undertaken to assess level of conformity. These represent the first use of LSOA level geographical groupings in health expectancy reporting by ONS and provide further supporting evidence of the relationship between deprivation and health found in previous investigations. The strong association of deprivation and health status and health expectancies are consistent with previous research; increasing levels of deprivation equate to shorter lives, and longer periods of life in states of poor health and disability in both absolute and relative terms.

Census 2001 data clearly distinguishes between level of health status and health expectancy by quintile of deprivation. Significantly fewer people residing in the least deprived areas reported poor health than their counterparts experiencing greater deprivation. The reporting of poor health increased in a predominantly linear pattern with increasing deprivation, which produces a substantial gap between the least and most deprived quintiles. In fact these data show that in 2001 there were three times as many people reporting poor health in the most compared to the least deprived areas.

Similar and consistent differentials were found using the GHS in 2001–05, although the prevalence of poor health was greater in each quintile and the inequality between the least and most deprived areas was slightly narrower, significantly so for females.

Survey data were age-standardised and so differences in the ages of respondents between the GHS and census would not account for the differences observed. Differences in the design of the census and GHS however, in addition to the wider time period applying to GHS data, may contribute to the observed differences in the prevalence of poor health between sources.

There is evidence to suggest that respondents completing self-administered questionnaires (such as the census) are subject to ‘primacy effects’ whereby the uppermost choices in a list are more likely to be selected. In contrast, respondents in face-to-face interviews (such as the GHS) are more likely to be influenced by ‘recency effects’ where the answers at the bottom of a list are more likely to be selected (Bowling 2005). Such effects could go some way to explain the differences between the census and GHS in this study. Other likely contributors to the observed differences include interviewer prompting in the GHS and proxy effects in the census data whereby forms may be completed by one household member on behalf of another.

It is also noteworthy that studies have shown that face-to-face interviews result in more positive and socially desirable responses, particularly for health status and behaviour, compared with self-administered questionnaires (Bowling 2005). In the GHS, responses to the general health question may vary with other forms of bias such as interviewer characteristics and the social setting in which questions are asked. In contrast, the self-completion nature of the census may present a cognitive burden on respondents as it assumes a certain level of literacy, understanding of the question and ability to recall events without probing. Given the complex interaction of mode effects and responses to the general health question, it is difficult to disentangle their impact on the reported prevalence of poor health in this study.

The patterns in health status prevalence rates were also observed in estimates of HLE. For the census, there was again a clear linear relationship between deprivation and estimates of life spent in good or fairly good health. HLE decreased significantly with each declining quintile leading to a

substantial gap in HLE between those in the least compared to the most deprived areas. Female HLE was significantly higher than for males at birth and at age 65 in each deprivation quintile although the inequality in estimates between the least and most deprived areas was narrower.

For the reasons noted above and because of differences in mortality and mid-year population estimate data used in their construction, estimates of HLE derived from GHS 2001–05 and Census 2001 cannot be directly compared; however, the relationships between HLE and deprivation, between males and females and between areas of deprivation within each cohort at birth and at age 65 are consistent between the GHS and census.

In the GHS 2001–05, the scale of inequality in HE (HLE and DFLE) between the least and most deprived quintiles was substantial. Some 11 to 14 years of HLE separated people residing in the least and most deprived quintiles. Males and females at birth living in the least deprived areas between 2001 and 2005 could expect to spend approximately 91 to 94 per cent of their lives in good or fairly good health compared with only 82 to 86 per cent in the most deprived areas. At age 65, these differences were more pronounced; those in the least deprived areas can expect to spend 82 to 84 per cent of their remaining lives in good or fairly good health states compared with just 65 to 70 per cent for those in the most deprived areas. Similar patterns were observed for DFLE.

The scale of inequality was greater for men than for women at each point in life examined. This concurs with previous evidence on inequalities in LE and HE by socio-economic position. However, the pattern of inequality across social classes or NS-SEC classes in women is more irregular than the predominantly linear pattern in men (Langford and Johnson 2009, White, Van Galen and Chow 2003). However, by area deprivation, the pattern is predominantly linear for both sexes and therefore provides a better indication of graduated need.

The estimates reported here are broadly consistent with those found in a study using Carstairs deprivation twentieths to identify health inequalities between electoral ward groupings (Rasulo, Bajekal and Yar 2007, Morris and Carstairs 1991). In this study, differences in HLE at birth between the least and most deprived twentieth of wards for males and females respectively were 13.4 and 11.8 years at birth and 5.2 and 4.7 years at age 65. The finer gradation used in that study did not lead to an undue difference in the scale of inequality, suggesting breakdowns of areas into fifths on the basis of level of deprivation are adequate for determining the presence of inequality and its scale. The similar findings serve to verify the approach taken here.

As with other studies, results here also show that measures of longevity alone underestimate the magnitude of inequality between areas or extremes of deprivation when compared with measures which combine mortality and morbidity data into a summary index of quality and quantity of life. The gaps in inequality found in HLE and DFLE were much wider than those found in LE. The gaps in HLE and DFLE at birth between the least and the most deprived areas were approximately twice as great as those observed for LE.

We now intend to extend this analysis to cover more recent years of the GHS/GLF in an attempt to monitor changes in health inequalities over time. This planned work will focus on DFLE as the measure of inequality as the general health question used to inform estimates of HLE in this study

was discontinued in the GHS in 2007; replaced by a EU-harmonised question (Smith and White 2009).

Limitations of GHS data

Of primary concern is the precision of estimates of HLE computed by pooling five years of survey data to form quintiles of deprivation populations. This precision is determined by the width of the 95 per cent CIs surrounding estimates of HLE. Ideally the 95 per cent CI should be less than +/- 1 year at birth and less than +/- 0.5 years at age 65 in order to detect real changes over time. The estimates surrounding GHS based estimates of HLE presented here are a little wider than this target, but broadly equivalent to national estimates of HLE for England and considerably narrower than national estimates for Wales and Scotland. The CIs would become narrower with each additional year of survey data but this would make the time period of the estimate much less desirable as an inter-censal measure.

Despite the fact that the CI's are a little larger than desired, the similarities in the differentials and relationships by deprivation quintile, gender and age between the data sources used in this study, indicates that the GHS is a suitable source for an inter–censal measure health expectancy by quintile of area deprivation. The precision of inter-censal estimates in the near future will improve as data from the Integrated Household Survey core module becomes available for use. This source has a considerably larger sample compared with the GHS/GLF used in this analysis.

Conclusions

The GHS is a useful data source to inform inter–censal estimates of HLE across quintiles of ecological deprivation as defined by IMD 2004 as the pattern observed by level of deprivation concurs with that reported using the Census 2001.

This report provides estimates of LE, HLE and DFLE at birth and age 65 by quintile of deprivation across England for the period 2001–05. As such it provides further evidence of the importance of material deprivation for health outcomes; the clustering of deprivation found in very small population units such as LSOAs serves to guide the targeting of interventions to mitigate differences and set benchmarks to monitor change.

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