

7. MEASURING INEQUALITIES IN SMALL AREA LIFE EXPECTANCY

7.1 Introduction

Life expectancy at birth is one of the longest standing measures of health status in England and Wales,¹ the first official life tables being published by the Registrar General William Farr in 1839. Right from its origin life expectancy has been used to highlight variations in mortality experience between different geographical regions of the country and this tradition has been continued by the Office for National Statistics (ONS) in recent times.²

Life expectancy figures are widely used, not just for policy and planning purposes in the public sector but also in private sector activities such as insurance and pensions. Indeed the first ever life tables were constructed by Sir Edmund Halley for the purpose of pricing annuities. Within healthcare and Public Health, life expectancy has particular importance as it is used by a number of high profile reports, strategies and frameworks as a high level indicator of health status and health inequality.

The Marmot review into health inequalities used life expectancy to highlight that health is not experienced equally across our society, with the observation that people living in the poorest neighbourhoods will die on average 7 years earlier than those living in the richest neighbourhoods. Marmot proposed that national health outcome targets in the immediate future should cover both life expectancy (to capture years of life) and health expectancy (to capture the quality of those years).

This proposal has taken shape in the Public Health Outcomes Framework (PHOF).³ The purpose of this framework is set the vision for the whole public health system in order to provide positive health outcomes for the population and reduce inequalities in health. It includes two overarching outcomes:

- increased healthy life expectancy, i.e. taking account of the health quality as well as the length of life;
- reduced differences in life expectancy and healthy life expectancy between communities (through greater improvements in more disadvantaged communities).

One of the reasons for including life expectancy as part of the second outcome is to enable the measurement of *within-area* inequalities as well as between-area inequalities in health. It is not feasible to collect data on within-area differences in healthy life expectancy.

The high-level outcome of reduced differences in life expectancy between communities is considered to be the key element in addressing health inequalities within the PHOF. The emphasis for delivery of improvements will be on local authorities in partnership with health and wellbeing boards. They will need to measure progress against those indicators that best reflect local health need as set out in their respective Joint Strategic Needs Assessments and Joint Health and Wellbeing Strategies. It is therefore envisaged that specific progress against the measures in the PHOF will be built into the Joint Strategic Needs Assessment and Joint Health and Wellbeing Strategy as appropriate.

The PHOF update published in November 2012 includes five indicators to measure the differences in life expectancy between communities all based on the slope index of inequality. This includes the measurement of within local authority inequalities in life expectancy based on grouping lower super output areas (LSOAs) into local deprivation quintiles.⁴

The Secretary of State for Health made specific recommendations to ensure that outcomes measures within the Public Health Outcomes Framework are twinned, where appropriate, with those in the NHS Outcome Framework (NHSOF). The NHSOF provides the national accountability framework for the

outcomes that the NHS delivers. One of its underlying principles is the need to promote equality and reduce inequalities in health outcomes. Domain one of the NHSOF, preventing people from dying prematurely, includes the overarching indicator life expectancy at age 75.⁵

Prior to these outcome frameworks a previous Public Service Agreement (PSA) target was in place to reduce inequalities in life expectancy between local authorities by 10 per cent.

The purpose of this chapter is to describe life expectancy at birth within the West Midlands and look at the ways in which local variations and inequalities can be presented within local authorities.

Warwickshire County is used as an example.

7.2 Definitions

Life expectancy, when calculated from a period life table, provides a summary measure of the mortality rates in a population in the stated time period. Alternative summary measures that might be used include directly age-standardised mortality rates (DSRs) and indirectly age-standardised mortality ratios (SMRs). Life expectancy at birth is an estimate of the average number of years that a new born baby can expect to live if he or she experiences the population's age-specific mortality rates of the specified period throughout their life. It is calculated by constructing a life table. Such a table creates and follows a hypothetical cohort of new babies as they age, using the population's specified time period's age-specific mortality rates to estimate how many of the cohort survive or die at each year of age.

Life expectancy at birth should not be regarded as a prediction of the number of years that the baby can actually expect to live, both because the mortality rates of the population are likely to change in the future and because many of those babies would not reside in the same area throughout their lives.

7.3 Data sources

The Office for National Statistics (ONS) regularly publishes life expectancy data at national and local authority level.⁶ The ONS also provides trends in 3-year average life expectancy at birth and age 65 at local authority and Primary Care Trust level for the Compendium of Population Health Indicators published by the NHS Information Centre for health and social care (NHS IC).⁷ However, the ONS does not routinely calculate life expectancy for areas smaller than local authorities.

Experimental ward-level life expectancy figures for 1999-2003 were published by ONS to test the feasibility of producing figures for small geographic areas but they were not fully developed and did not meet the requirements of the UK Statistics Authority Code of Practice.⁸ At around the same time the South East Public Health Observatory published a technical report looking at the feasibility of producing small area life expectancy estimates and comparing existing life table methods.¹ Following this report the Association of Public Health Observatories (APHO) calculated and published life expectancy at birth estimates for both electoral wards and Middle Super Output Areas (MSOAs). Figures for the period 2006-10 are currently available on the Local Health page of the Network of Public Health Observatories' (formerly APHO) Health Profiles web site.⁹

For this report we have used the ONS figures for 2008-10 to describe national, regional and local authority level life expectancies and the Public Health Observatories' figures for 2006-10 for electoral ward and MSOA comparisons.

7.4 National life expectancy

England has the highest life expectancy at birth of all the constituent countries of the United Kingdom, for both males and females. For the three-year period 2008-10 these were 78.6 years for males and 82.6 years for females.

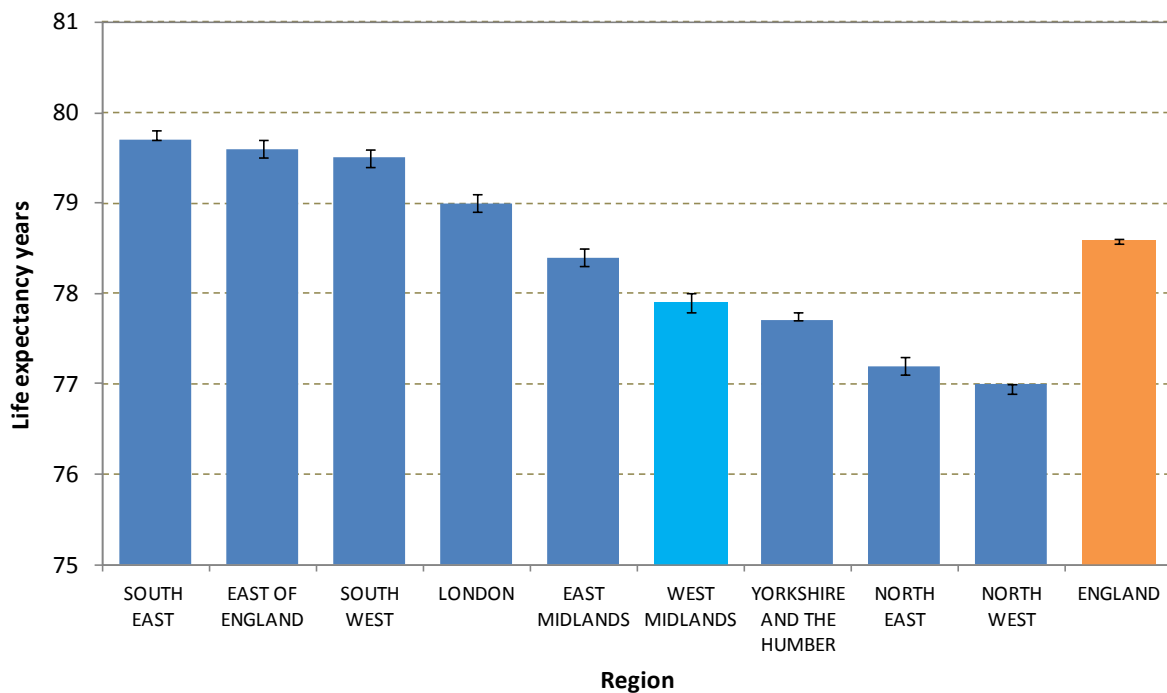
There was a difference of 11.5 years between the local authority with highest male life expectancy and that with the lowest. These were Kensington and Chelsea at 85.1 years and Blackpool at 73.6 years respectively.

For female life expectancy the range between the highest and lowest local authorities was 10.6 years. These were Kensington and Chelsea at 89.8 years and Manchester at 79.1 years respectively.²

7.5 Life expectancy in the West Midlands

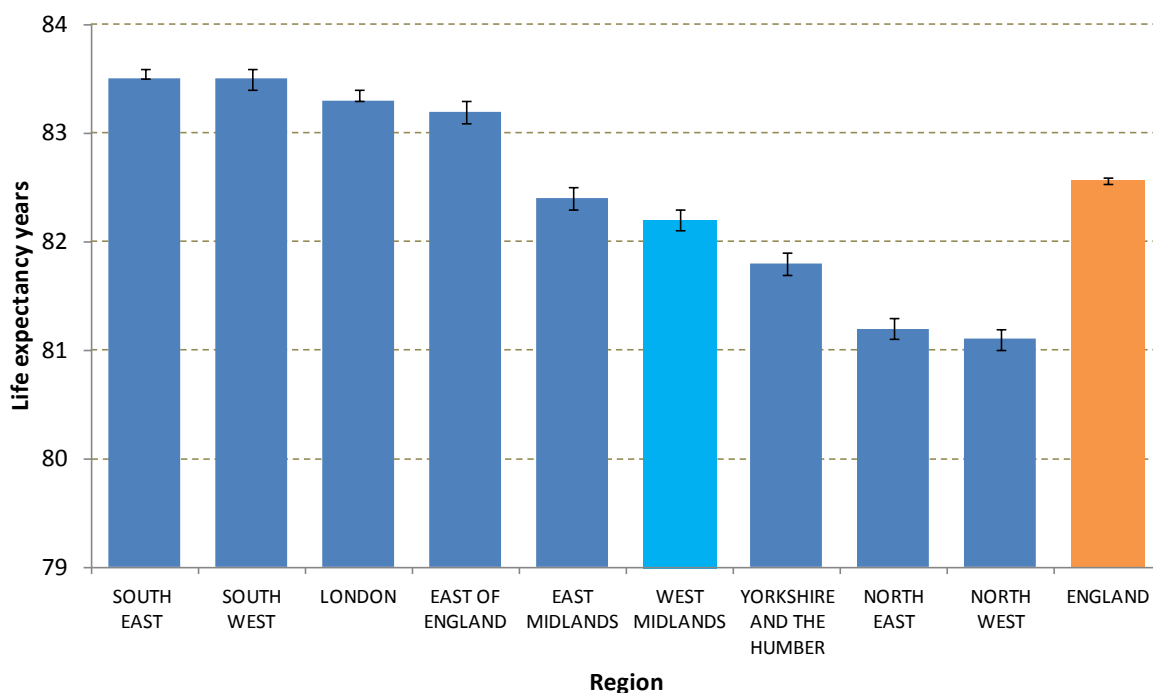
In the period 2008-10 life expectancy in the West Midlands region was lower than the national average for both males and females. For males the West Midlands figure of 77.9 years was 0.7 years lower than the national average. Compared to the other regions, the West Midlands had the fourth lowest life expectancy (Figure 7.1). For females, the West Midlands life expectancy was 82.2 years, 0.4 years lower than the national average. Again the West Midlands ranked the fourth lowest of the English regions (Figure 7.2).

Figure 7.1: Male life expectancy at birth by region, England 2008-10



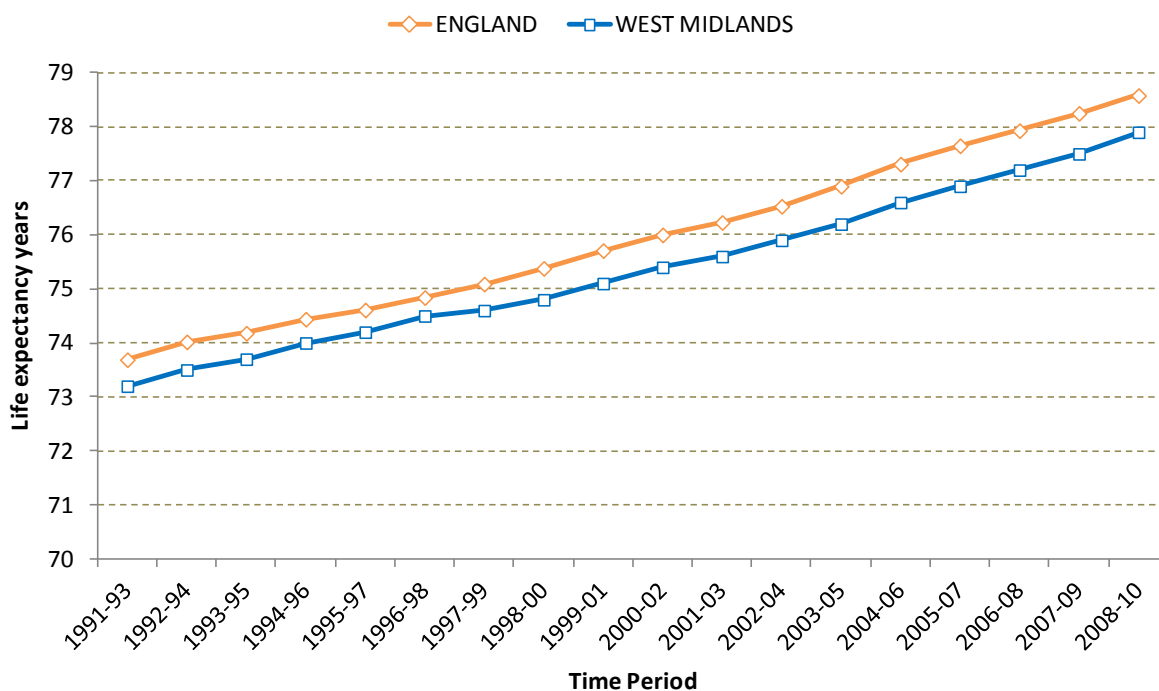
Source: Compendium of Population Health Indicators, NHS Information Centre.

Figure 7.2: Female life expectancy at birth by region, England 2008-10



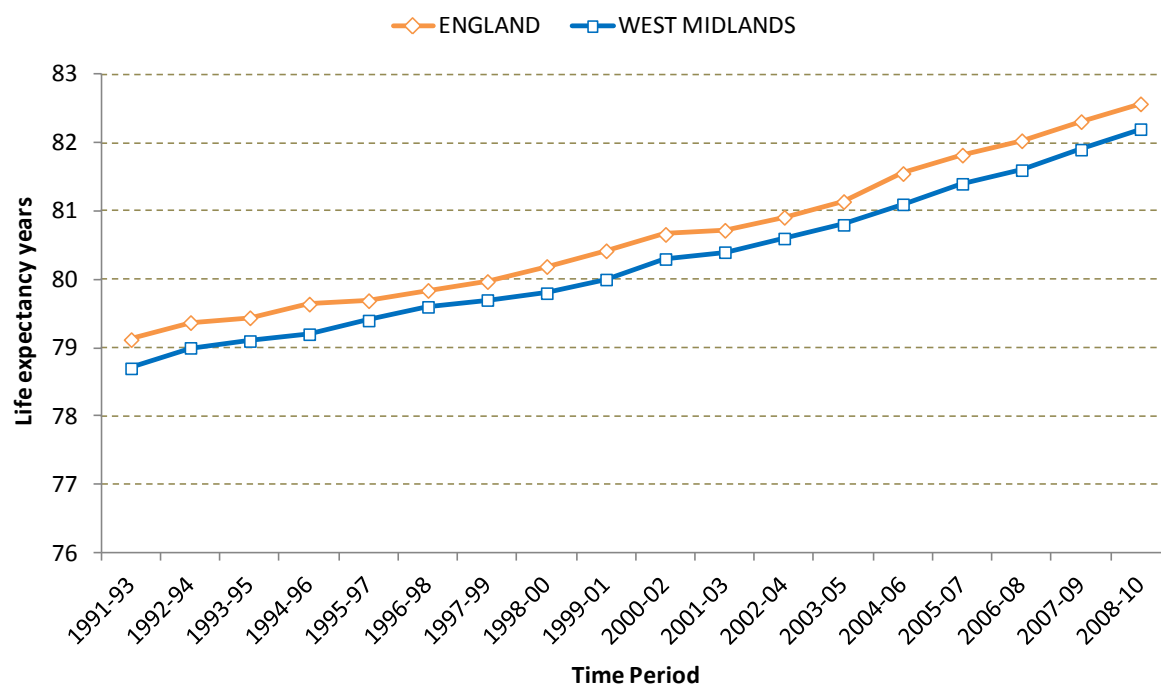
Source: Compendium of Population Health Indicators, NHS Information Centre.

Figure 7.3: Male life expectancy at birth, England and the West Midlands 1991-93 to 2008-10



Source: Compendium of Population Health Indicators, NHS Information Centre.

Figure 7.4: Female life expectancy at birth, England and the West Midlands 1991-93 to 2008-10



Source: Compendium of Population Health Indicators, NHS Information Centre.

The difference between the regional and national male life expectancies has been consistent over the past two decades, though there is some evidence that it is slowly increasing. Over the period from 1991-93 to 2008-10 male life expectancy in the West Midlands has improved by 4.7 years – nationally the improvement has been 4.9 years (Figure 7.3).

Over the same time period the regional female life expectancy has also been consistently lower than the national average. The overall regional improvement is 3.5 years, marginally higher than the national improvement of 3.4 years (Figure 7.4).

7.6 Life expectancy by local authority

Within the West Midlands in the period 2008-10 there was a 5.1 year range between the local authority district with the highest male life expectancy and that with the lowest. These were Solihull at 80.6 years and Sandwell at 75.5 years respectively (Table 7.1). The five local authorities with the highest male life expectancies were Solihull, Stratford-upon-Avon, Wychavon, Warwick and Malvern Hills. The five with the lowest were Sandwell, Stoke-on-Trent, Wolverhampton, Birmingham and Walsall.

For females the range between the highest and lowest life expectancies was 4.1 years, from Warwick’s 84.3 years to Stoke-on-Trent’s 80.2 years. The highest female life expectancies were seen in Warwick, Wychavon, Solihull, Herefordshire and Stratford-upon-Avon. The lowest were seen in Stoke-on-Trent, Sandwell, Wolverhampton, Birmingham and Coventry.

Figure 7.6 and Figure 7.7 map the geographical variation in the local authority life expectancy for males and females respectively. There is a clear geographic divide with higher expectancies in the less deprived rural areas particularly in the south and west of the Region. Low life expectancies are concentrated in the more deprived urban local authorities, particularly in the former West Midlands

Metropolitan County area covered by Birmingham, the Black Country and Coventry.

Table 7.1: Life expectancy at birth by local authority and gender, West Midlands 2008-10

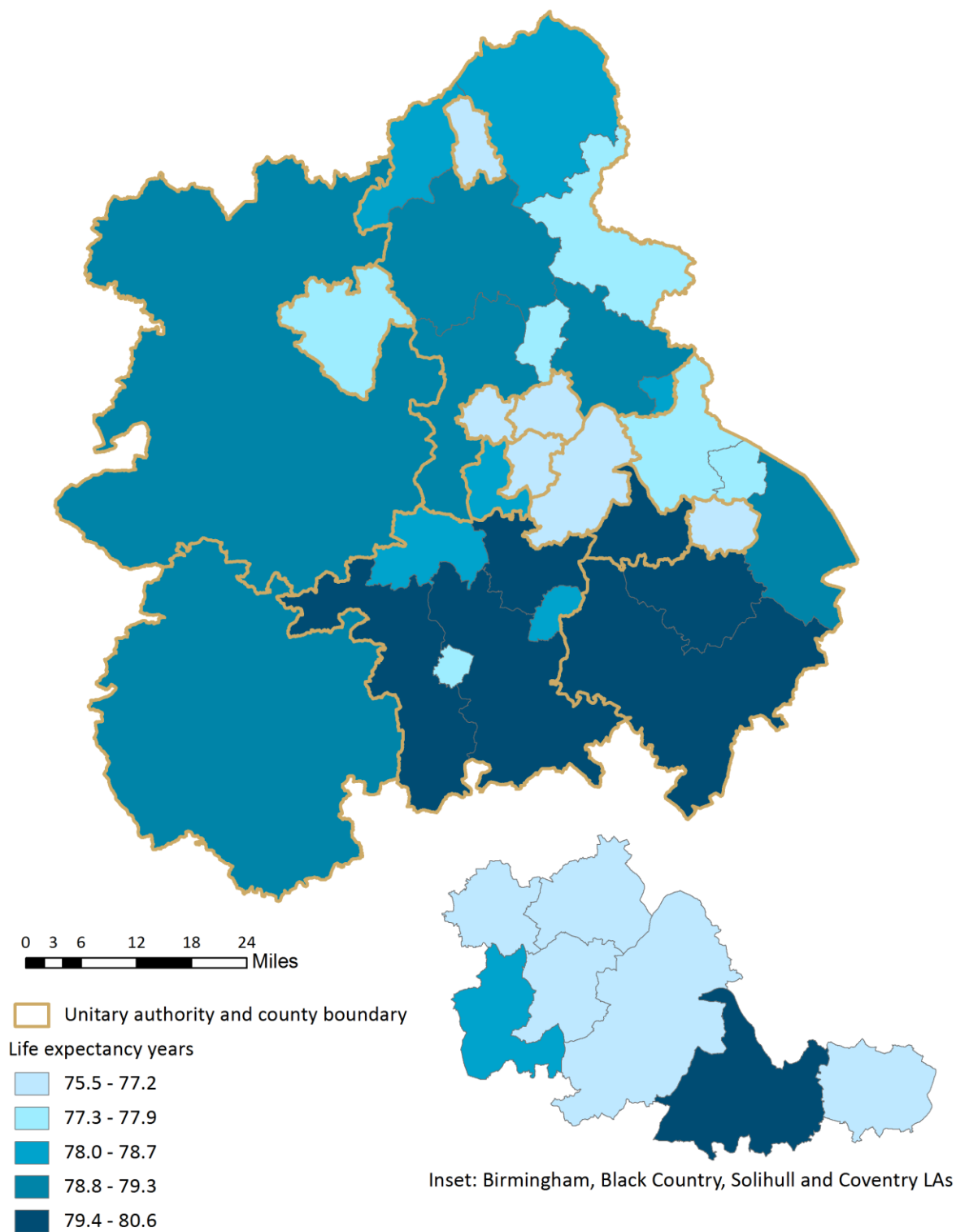
ONS Area code	LA Name	Males			Females		
		Life Expectancy	95% confidence limits		Life Expectancy	95% confidence limits	
			Lower	Upper		Lower	Upper
E12000005	WEST MIDLANDS	77.9	77.8	78.0	82.2	82.1	82.3
E06000019	Herefordshire, County of UA	79.3	78.8	79.8	83.6	83.1	84.1
E06000051	Shropshire UA	78.8	78.4	79.2	82.9	82.6	83.3
E06000021	Stoke-on-Trent UA	76.2	75.7	76.6	80.2	79.8	80.6
E06000020	Telford and Wrekin UA	77.5	76.9	78.0	82.1	81.6	82.7
E10000028	Staffordshire						
E07000192	Cannock Chase	77.3	76.7	78.0	81.7	81.1	82.3
E07000193	East Staffordshire	77.4	76.7	78.1	83.0	82.4	83.6
E07000194	Lichfield	78.8	78.1	79.5	81.8	81.1	82.4
E07000195	Newcastle-under-Lyme	78.3	77.6	78.9	81.8	81.2	82.4
E07000196	South Staffordshire	79.1	78.4	79.7	82.8	82.2	83.4
E07000197	Stafford	79.1	78.5	79.7	83.3	82.8	83.8
E07000198	Staffordshire Moorlands	78.4	77.7	79.2	82.6	82.0	83.3
E07000199	Tamworth	78.7	77.8	79.5	82.7	82.0	83.4
E10000031	Warwickshire						
E07000218	North Warwickshire	77.9	77.0	78.8	82.2	81.4	82.9
E07000219	Nuneaton and Bedworth	77.5	76.9	78.1	81.9	81.4	82.5
E07000220	Rugby	78.8	78.1	79.5	82.7	82.0	83.4
E07000221	Stratford-on-Avon	80.4	79.8	81.0	83.5	82.9	84.1
E07000222	Warwick	79.9	79.3	80.4	84.3	83.8	84.9
E11000005	West Midlands (Met County)						
E08000025	Birmingham	76.8	76.5	77.0	81.6	81.4	81.8
E08000026	Coventry	77.2	76.8	77.6	81.6	81.2	82.0
E08000027	Dudley	78.1	77.7	78.5	82.5	82.1	82.8
E08000028	Sandwell	75.5	75.1	76.0	80.8	80.4	81.2
E08000029	Solihull	80.6	80.2	81.1	83.8	83.3	84.2
E08000030	Walsall	76.9	76.5	77.3	81.9	81.5	82.3
E08000031	Wolverhampton	76.7	76.3	77.2	80.8	80.3	81.2
E10000034	Worcestershire						
E07000234	Bromsgrove	79.6	78.9	80.2	82.7	82.0	83.3
E07000235	Malvern Hills	79.8	79.0	80.5	83.4	82.7	84.0
E07000236	Redditch	78.0	77.3	78.8	82.6	81.8	83.3
E07000237	Worcester	77.7	77.0	78.4	82.4	81.8	83.1
E07000238	Wychavon	80.3	79.7	80.9	84.0	83.4	84.5
E07000239	Wyre Forest	78.6	77.9	79.3	82.8	82.2	83.4

Source: Compendium of Population Health Indicators, NHS Information Centre.

Figure 7.5: Key to West Midlands local authority districts



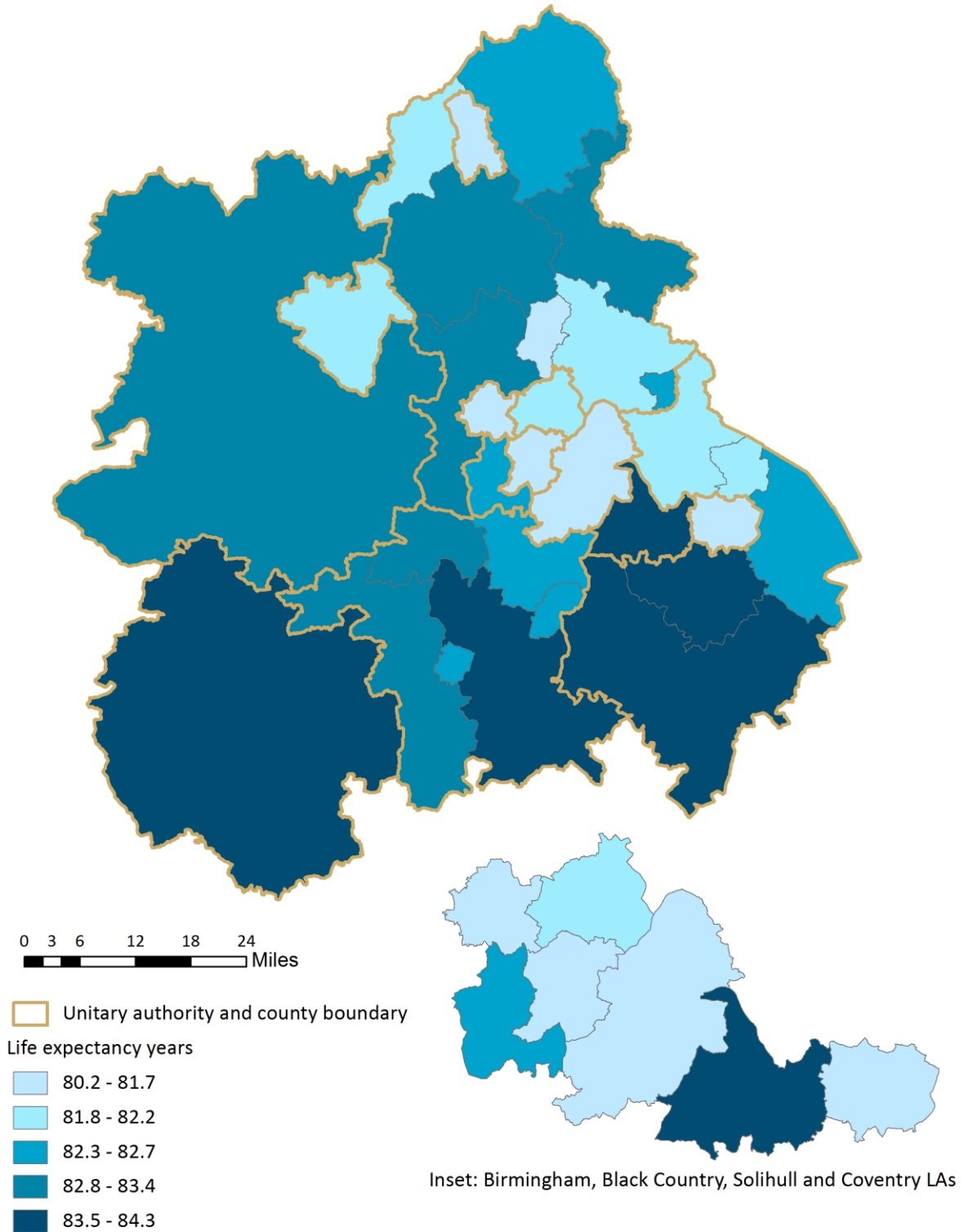
Figure 7.6: Male life expectancy at birth by local authority, West Midlands 2008-10



Source:
Compendium of Public Health Indicators,
NHS Information Centre

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Figure 7.7: Female life expectancy at birth by local authority, West Midlands 2008-10



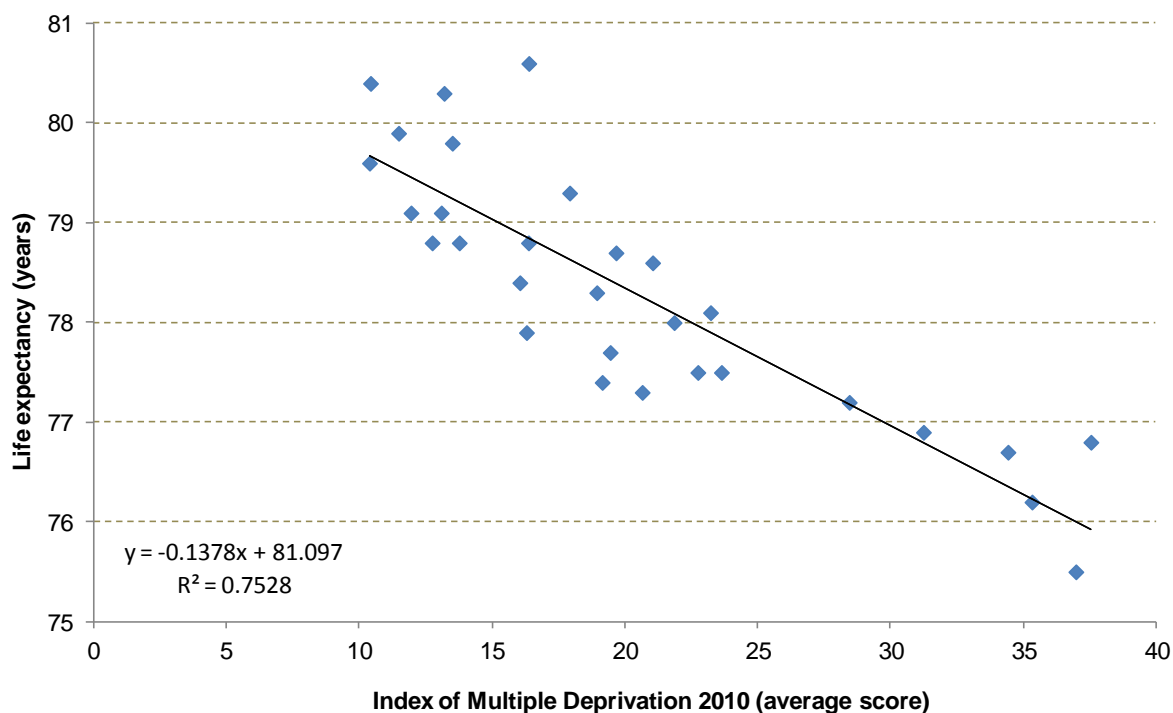
Source:
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Figure 7.8 presents the relationship within the West Midlands between male life expectancy and deprivation, as measured by the Index of Multiple Deprivation (IMD) 2010 average score. It demonstrates a strong and statistically significant negative correlation (Pearson R coeff. = - 0.87; $p < 0.001$) between the two with more deprived authorities (i.e. those with higher IMD scores) having lower male life expectancies.

A similarly strong correlation exists between female life expectancy and deprivation (Pearson R coeff. = - 0.78; $p < 0.001$) although the gradient of the relationship is not quite as steep.

Figure 7.8: Male life expectancy vs. IMD 2010 by local authority, West Midlands 2008-10



Source: Compendium of Population Health Indicators, NHS Information Centre; Indices of Deprivation 2010, Department for Communities and Local Government.

7.7 Small area geography

Below local authority level there are a multitude of geographies can be used to bring more localised issues into focus. Areas can be geographically divided by a variety of methods including administrative, postal, health and statistical boundaries.¹⁰

The most commonly used small area geographies for the analysis of health information are electoral wards and Super Output Areas (SOAs). Electoral wards are key building block for the administrative geography of England being the constituency areas for the election of local government councillors. As such they are politically relevant areas for local authorities and councillors, they generally reflect natural boundaries of local communities and they have meaningful names which are (usually) recognisable to local people. Disadvantages of electoral wards as units of analysis include their large range in population size and their frequent boundary changes which often cause problems when trying to match numerator and denominator data and/or measuring changes over time.

To improve the comparability and usefulness of small area statistics the Neighbourhood Statistics section of the ONS developed a statistical geography hierarchy based on stable small area building

blocks called 2001 Super Output Areas (SOAs). These come in two levels: Lower Super Output Areas (LSOAs) and the larger Middle Super Output Areas (MSOAs).¹¹ These later became the standard units for presenting local statistical information across National Statistics.

Table 7.2 provides a comparison of the electoral ward and SOA geographies in the West Midlands. Across the region there are 719 wards with a mean population of approximately 7,800. However it can be seen that the average ward population size varies almost eight-fold between local authorities from 3,400 in the Malvern Hills to 26,800 in Birmingham.¹² The MSOAs are similar in number, 735, to the electoral wards and consequently have a similar mean population size of 7,600. However the variation in the mean population size across local authorities is much smaller, ranging from 6,200 in Wychavon to 9,200 in Warwick. Each MSA is made up of a number of LSOAs of which there are 3,487 across the region with a mean population of almost 1,600.

Table 7.2: Comparison of electoral ward and Super Output Area geographies in the West Midlands

Local Authority	Population	Number of:			Average Population by:		
		Wards	MSOAs	LSOAs	Ward	MSOA	LSOA
Birmingham	1,073,000	40	131	639	26,800	8,200	1,700
Bromsgrove	93,600	23	14	58	4,100	6,700	1,600
Cannock Chase	97,500	15	13	60	6,500	7,500	1,600
Coventry	317,000	18	42	195	17,600	7,500	1,600
Dudley	312,900	24	43	201	13,000	7,300	1,600
East Staffordshire	113,600	21	15	72	5,400	7,600	1,600
Herefordshire, County of	183,500	40	23	116	4,600	8,000	1,600
Lichfield	100,700	26	12	58	3,900	8,400	1,700
Malvern Hills	74,600	22	11	45	3,400	6,800	1,700
Newcastle-under-Lyme	123,900	24	16	80	5,200	7,700	1,500
North Warwickshire	62,000	17	7	38	3,600	8,900	1,600
Nuneaton and Bedworth	125,300	17	18	81	7,400	7,000	1,500
Redditch	84,200	12	13	55	7,000	6,500	1,500
Rugby	100,100	20	12	61	5,000	8,300	1,600
Sandwell	308,100	24	38	186	12,800	8,100	1,700
Shropshire	306,100	63	39	193	4,900	7,800	1,600
Solihull	206,700	17	29	134	12,200	7,100	1,500
South Staffordshire	108,100	25	14	68	4,300	7,700	1,600
Stafford	130,900	26	16	80	5,000	8,200	1,600
Staffordshire Moorlands	97,100	27	13	59	3,600	7,500	1,600
Stoke-on-Trent	249,000	20	34	159	12,500	7,300	1,600
Stratford-on-Avon	120,500	31	15	73	3,900	8,000	1,700
Tamworth	76,800	10	10	51	7,700	7,700	1,500
Telford and Wrekin	166,600	33	23	108	5,000	7,200	1,500
Walsall	269,300	20	39	167	13,500	6,900	1,600
Warwick	137,600	20	15	86	6,900	9,200	1,600
Wolverhampton	249,500	20	33	158	12,500	7,600	1,600
Worcester	98,800	15	14	63	6,600	7,100	1,600
Wychavon	116,900	32	19	78	3,700	6,200	1,500
Wyre Forest	98,000	17	14	65	5,800	7,000	1,500
West Midlands region	5,601,900	719	735	3,487	7,800	7,600	1,600

Source: 2011 Census. Populations have been rounded to the nearest 100.

<http://www.ons.gov.uk/ons/search/index.html?newquery=census+pp04+table>

One disadvantage of using MSOAs has been the lack of local names for the areas. To address this a succession of national and regional consultations co-ordinated by the West Midlands Cancer Intelligence Unit (WMCIU) have been undertaken and have resulted in an unofficial list of names for MSOAs in the West Midlands.¹³

Comparing the numbers of electoral wards and MSOAs within each of the local authorities it can be seen that within the more rural and suburban authorities the MSOAs tend to be larger in population size and therefore fewer in number than the electoral wards. In the urban authorities the opposite tends to be the case with MSOAs providing greater geographical detail than electoral wards.

Electoral ward level is the smallest geographical area for which population life expectancy estimates have been published by the ONS. The Network of Public Health Observatories has published life expectancies for both electoral ward and MSOA geographies on its Local Health web site. The Public Health Observatory figures have been used for the following small area analyses.

7.8 Life expectancy by small area

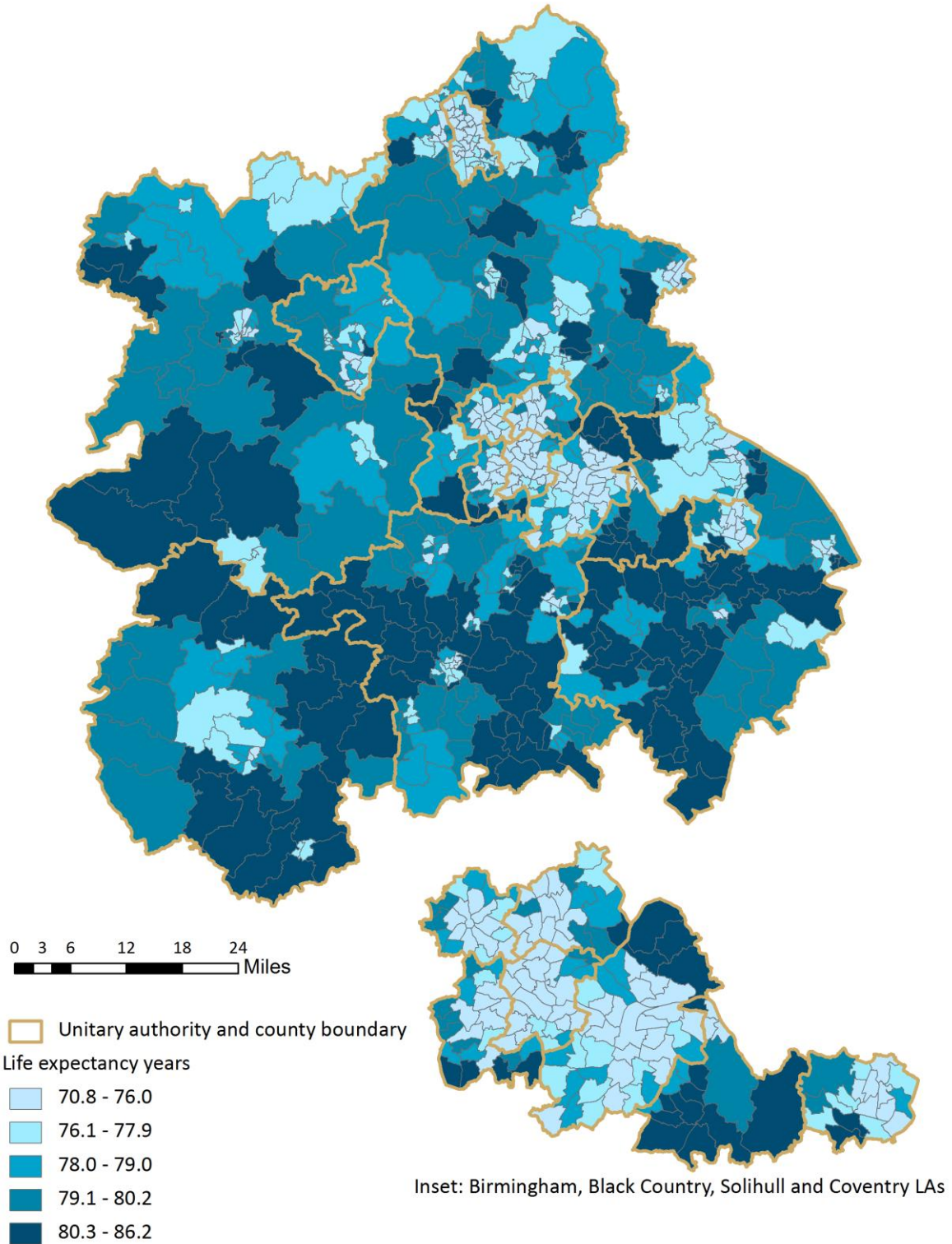
Figure 7.9 and Figure 7.10 map male life expectancy across the West Midlands by electoral ward and MSOA respectively. Also shown on the maps are the upper-tier local authority boundaries, i.e. the County Councils, Unitary Authorities and Metropolitan Districts. The electoral wards and MSOAs are banded into quintiles based on all the life expectancies for such areas in the West Midlands. As is to be expected the two maps show a similar geographical pattern across the region. The electoral ward provides greater granularity in the rural areas where wards are generally smaller than MSOAs and the MSOA map shows greater detail in the urban areas such as Birmingham where the opposite is true.

A clear observation from both maps is that within all the individual local authorities, irrespective of their overall life expectancy experience, there exists significant variation between their local communities. All the local authorities have MSOAs that fall into the highest life expectancy quintile in the region and others that fall into the lowest. Some areas are more homogenous than others – the counties of Shropshire, Herefordshire, Worcestershire and Warwickshire, and the Unitary Authority of Solihull MSOAs or electoral wards with high life expectancies predominate. The few areas with low life expectancies are concentrated in the towns. In the electoral ward map in particular towns such as Hereford, Worcester, Redditch, Telford, Shrewsbury, Bridgenorth and Rugby are clearly identifiable from their surrounding areas. Stone-on-Trent and the authorities in the Black Country are dominated by MSOAs or electoral wards with low life expectancies. Sandwell is particularly notable as being very homogenous with very few areas having a male life expectancy higher than the regional average.

The remaining authorities in Birmingham, Staffordshire, Coventry and Telford and Wrekin have a more balance distribution of life expectancies. In Birmingham the electoral wards show a north/south divide with the city with the northern wards around Sutton Coldfield having higher life expectancies than the rest of Birmingham. The greater detail provided by the MSOAs in Birmingham however identify a second pocket of high life expectancies in the south west of the city around the Edgbaston, Harborne, Sellyoak and Bourneville areas.

Figure 7.11 and Figure 7.12 present the corresponding female life expectancy maps by electoral ward and MSOA respectively. The broad picture is similar to that for males with a concentration of low life expectancies in the urban centres of Birmingham, the Black Country, Coventry and Stoke-on-Trent. However within the more rural counties the areas with lower life expectancies are more evenly spread and not as concentrated within the county towns as are those for males.

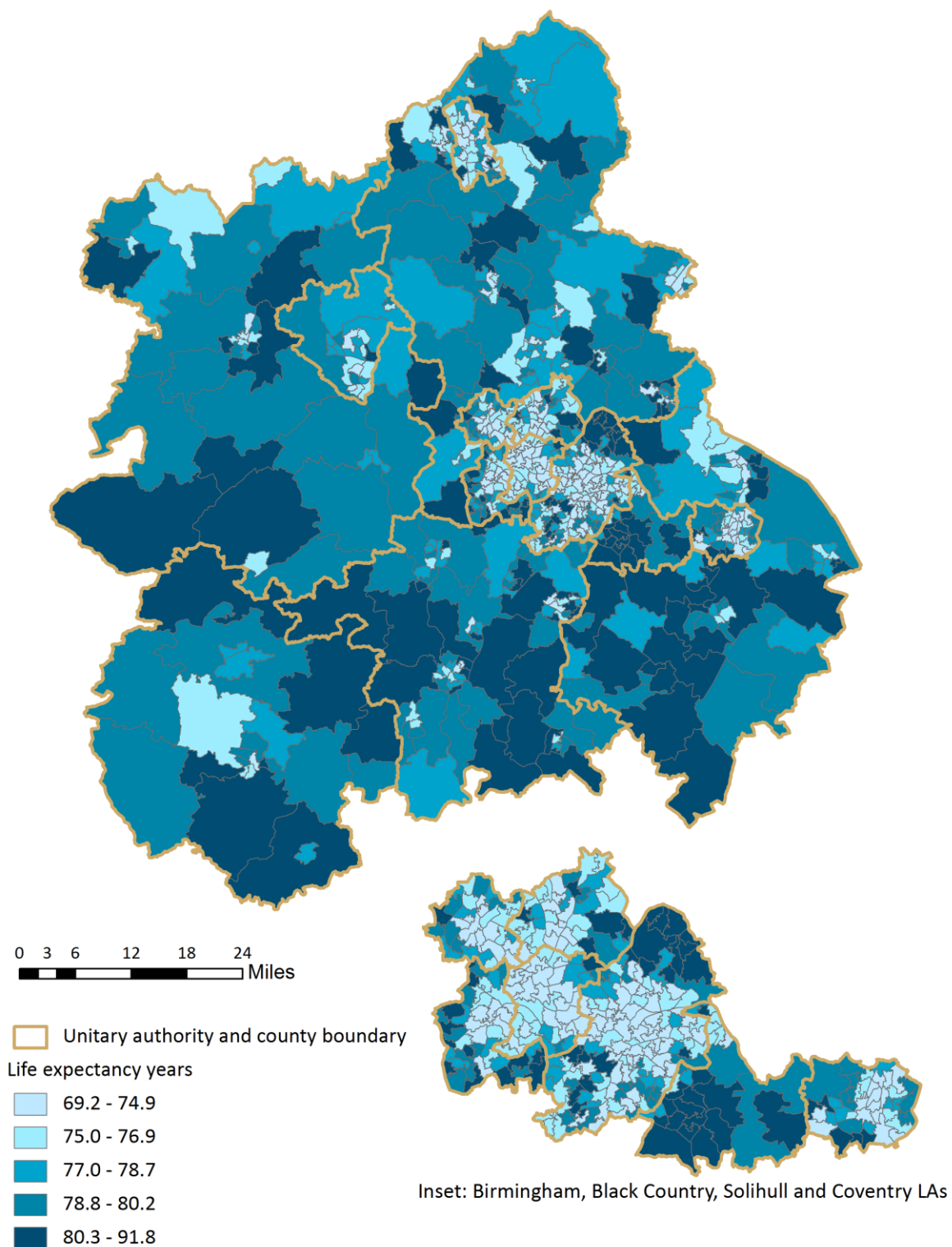
Figure 7.9: Male life expectancy at birth by electoral ward, West Midlands 2006-10



Source:
Health profiles - local health,
Department of Health / Network of Public Health Observatories

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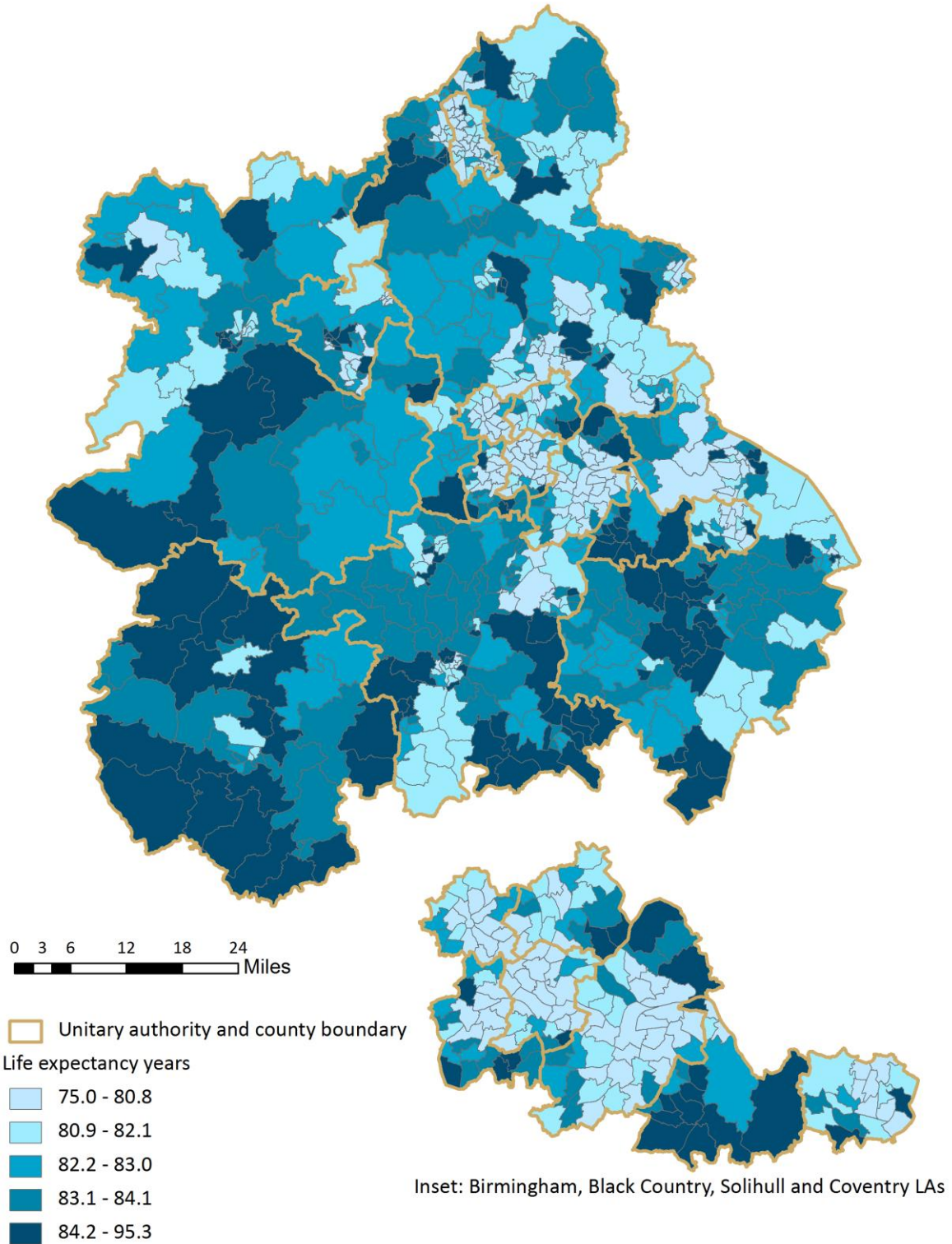
Figure 7.10: Male life expectancy at birth by MSOA, West Midlands 2006-10



Source:
Health profiles – local health,
Department of Health / Network of Public Health Observatories

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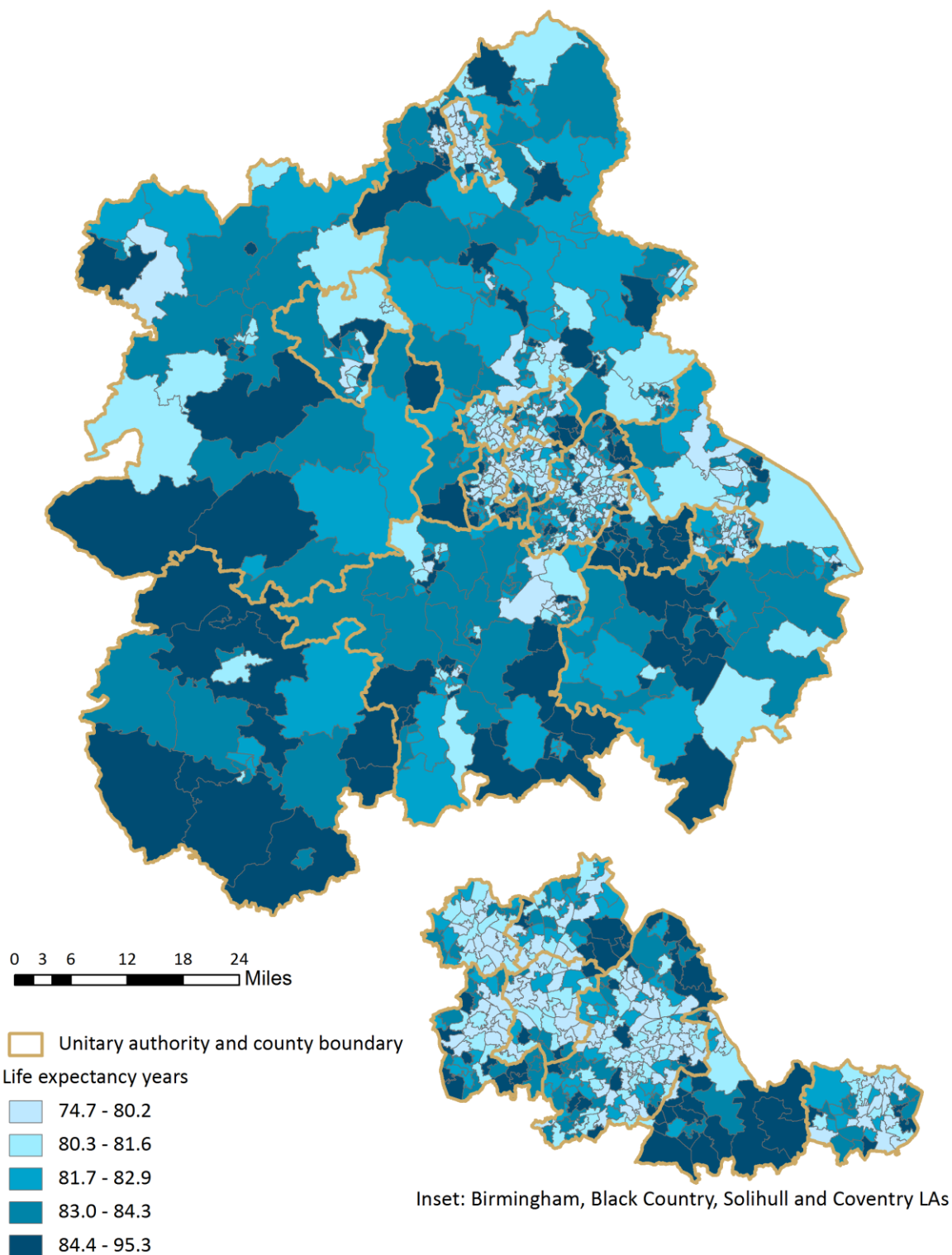
Figure 7.11: Female life expectancy at birth by electoral ward, West Midlands 2006-10



Source:
Health profiles - local health,
Department of Health / Network of Public Health Observatories

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Figure 7.12: Female life expectancy at birth by MSOA, West Midlands 2006-10



Source:
Health profiles – local health,
Department of Health / Network of Public Health Observatories

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Table 7.3 presents the 15 highest and lowest MSOA life expectancies in the West Midlands for both males and females. The range in male life expectancies is 22.6 years from Peter's Hill in Dudley at 91.8 years to Highgate Sparkbrook in Birmingham at 69.2 years. Birmingham local authority clearly has a very wide variation in life expectancies within its boundaries having three MSOAs in the highest 15 and eight in the lowest 15. The range in female life expectancies is 20.6 years from Lyppard Grange in Worcestershire at 95.3 years to Middleport and Burslem in Stoke-on-Trent at 74.7 years.

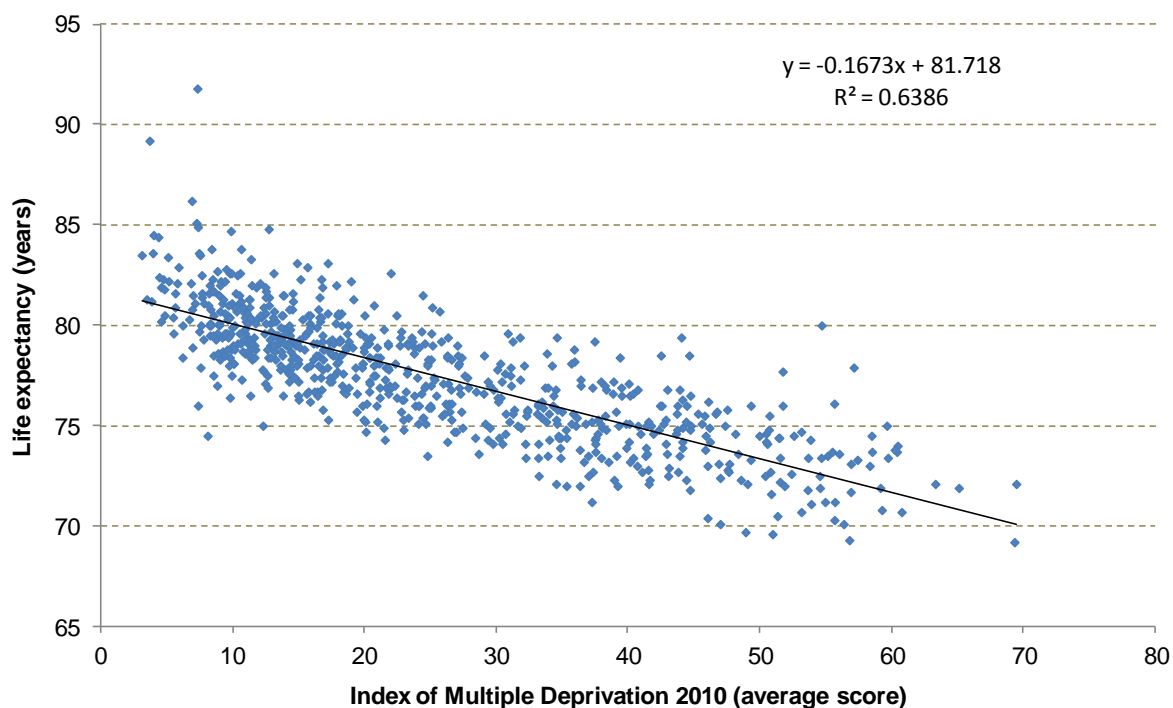
Table 7.3: 15 Highest and lowest life expectancies by MSOA by gender, West Midlands 2006-10

	Males				Females			
Highest	E02002027	Dudley	Peter's Hill	91.8	E02006741	Worcestershire	Lyppard Grange	95.3
	E02002107	Solihull	Monkspath	89.2	E02002027	Dudley	Peter's Hill	92.5
	E02006741	Worcestershire	Lyppard Grange	86.2	E02002934	Telford and Wrekin	Apley Castle & Leegomery	90.1
	E02001841	Birmingham	Wylde Green	85.1	E02006201	Staffordshire	Baswich & Brocton	89.9
	E02006148	Staffordshire	Longden & Chorley	84.9	E02002106	Solihull	Knowle	88.7
	E02001905	Birmingham	Edgbaston & University	84.8	E02002141	Walsall	Streetly West	88.4
	E02006736	Worcestershire	Blackpole Warndon & Trotshill	84.7	E02002103	Solihull	Bills Wood	88.4
	E02002108	Solihull	Dorridge	84.5	E02002099	Solihull	Solihull Central	88.4
	E02002137	Walsall	Streetly Central	84.4	E02002109	Solihull	Blythe Parishes	88.2
	E02006766	Worcestershire	Bredon & Eckington	83.8	E02001829	Birmingham	Roughley Moor Hall	87.9
	E02001832	Birmingham	Rectory Park & Barracks	83.8	E02006520	Warwickshire	Park Hill	87.8
	E02006145	Staffordshire	Barton, Tatenhill & Rangemore	83.6	E02001876	Birmingham	Newtown & Eastside	87.8
	E02002104	Solihull	Hillfield	83.6	E02001975	Coventry	Hipswell Highway & Ansty Road	87.7
	E02006201	Staffordshire	Baswich & Brocton	83.5	E02006766	Worcestershire	Bredon & Eckington	87.4
	E02001998	Coventry	Green Lane	83.5	E02006499	Warwickshire	Eastlands	87.4
Lowest	E02002068	Sandwell	Cape Hill	71.2	E02002143	Walsall	Palfrey	77.5
	E02001918	Birmingham	Moseley Village	71.2	E02002173	Wolverhampton	Blakenhall Central	77.4
	E02002965	Stoke-on-Trent	City, Festival Park & Etruria	71.1	E02002147	Walsall	Moxley & Darlaston West	77.4
	E02001866	Birmingham	Lozells	70.8	E02006127	Staffordshire	Hawks Green	77.3
	E02002062	Sandwell	West Bromwich East	70.7	E02002062	Sandwell	West Bromwich East	77.3
	E02001869	Birmingham	Holborn	70.7	E02002984	Stoke-on-Trent	Trentham East & Ley	77.1
	E02002959	Stoke-on-Trent	Middleport & Burslem	70.5	E02002172	Wolverhampton	Blakenhall East	77.1
	E02001876	Birmingham	Newtown & Eastside	70.4	E02002152	Wolverhampton	Bushbury Hill & Wood Hayes	77.0
	E02001867	Birmingham	Victoria Holte	70.3	E02002051	Sandwell	Ocker Hill	77.0
	E02002070	Sandwell	Uplands	70.1	E02006163	Staffordshire	Bradwell & Beasley	76.9
	E02001947	Birmingham	Druids Heath	70.1	E02001996	Coventry	Willenhall	76.9
	E02002139	Walsall	Walsall Central	69.7	E02002127	Walsall	Goscote/ Ryecroft/ Coalpool	76.5
	E02006735	Worcestershire	Gorse Hill North	69.6	E02001889	Birmingham	Little Bromwich South	76.5
	E02001894	Birmingham	Lee Bank Digbeth	69.3	E02002082	Solihull	Smith's Wood North	76.4
	E02001897	Birmingham	Highgate Sparkbrook	69.2	E02002959	Stoke-on-Trent	Middleport & Burslem	74.7

Source: Health Profiles - Local Profiles, Network of Public Health Observatories.

The relationship between male life expectancy and deprivation at a small area level is presented in Figure 7.13 using MSOAs as the unit for analysis. As at the local authority district level there is a strong negative correlation between male life expectancy and deprivation – the higher the MSOAs deprivation score, the lower its male life expectancy. The strength of the relationship is similar to that seen for the local authority districts (Pearson R coeff = -0.80, $p < 0.001$) and its gradient is slightly steeper. For females the strength of the correlation is not as great (Pearson R coeff = -0.61, $p < 0.001$) and the gradient less steep than for males. This reflects the less polarised distribution seen in the rural areas in the maps.

Figure 7.13: Male life expectancy vs. IMD 2010 by MSA, West Midlands 2008-10



Source: Health profiles – local health, Network of Public Health Observatories; Indices of Deprivation 2010, Department for Communities and Local Government.

7.9 Are variations in life expectancy in small areas meaningful?

An important issue when describing the variation in life expectancy in small areas is the robustness of the life expectancy estimates, i.e. are the life expectancies calculated from the observed mortality rates a true reflection of the underlying mortality risks. As the populations under consideration become smaller the number of deaths observed become fewer and the relative effect of chance on the number of deaths becomes greater. There is a danger that we are merely mapping random variations, or statistical noise, rather than true differences in risk. The uncertainty in a life expectancy estimate is quantified by its 95% confidence interval – this is a range of values which has a 95% probability of including the true underlying life expectancy. For the MSOAs in the West Midlands the width of the confidence interval around the life expectancy estimate is on average ± 2.2 years for both males and females. This confidence interval can be used to assess whether a MSA's life expectancy is statistically significantly different from that of the regional average. If the confidence interval does not overlap the regional figure we can say that the difference is unlikely (less than 1 chance in 20) to have occurred by chance.

Figure 7.14 and Figure 7.15 map the statistical significance of the MSA life expectancies for males and females respectively. For male life expectancy approximately one half of the MSOAs have values

that are statistically significantly different from the regional MSOA average. These are split evenly between those that have higher life expectancies and those that have lower. For females life expectancy the proportion of MSOAs which differ significantly from the average is lower at around 38%. Again the split between high and low life expectancies is more or less even.

For both males and females the significantly low life expectancies are concentrated in the urban MSOAs and the significantly high ones in the suburban and rural MSOAs.

These figures demonstrate that using 5 years of mortality data at the MSOA level gives a reasonable ability to differentiate true variations in the life expectancy over and above that caused by chance.

7.10 Measuring inequalities in small area life expectancy

In the November 2012 update to the Public Health Outcome Framework three indicators were specified for with the purpose of measuring inequalities in the overarching life expectancy at birth indicator.⁴

These are:

Indicator 0.2i: Slope index of inequality (SII) in life expectancy at birth based on national deprivation deciles of Lower Super Output Areas (LSOAs) within England [National level].

Indicator 0.2ii: Number of upper tier local authorities for which the local SII in life expectancy (as defined in 0.2.iii) has decreased [National level].

Indicator 0.2iii: SII in life expectancy at birth within each English upper tier local authority, based on local deprivation deciles of LSOAs [LA level].

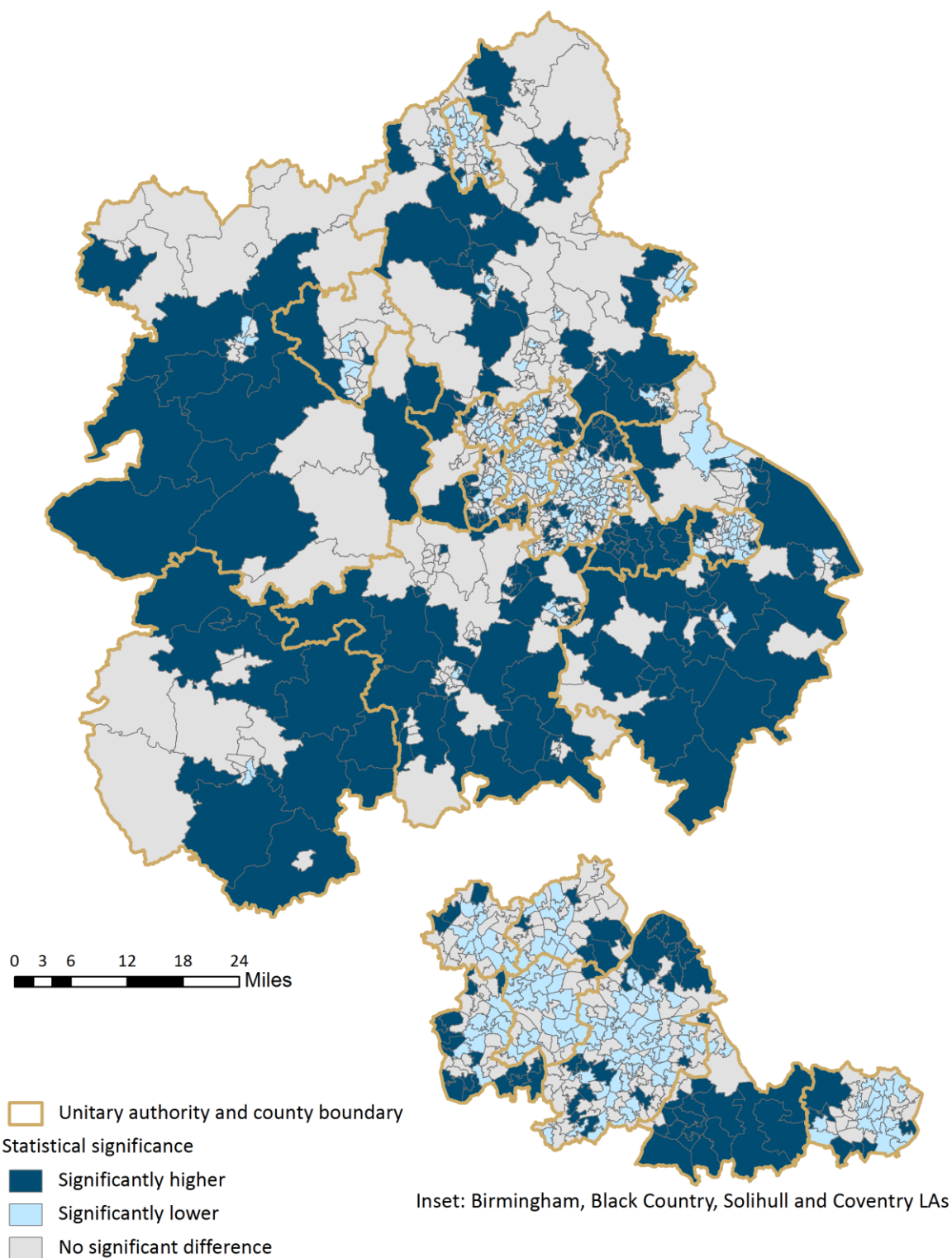
The SII was developed in 2004 by Low and Low as a method for summarising the absolute health gap across different deprivation status groups.¹⁴ The method was recommended by APHO for use in a life expectancy at birth inequalities indicator at the Primary Care Trust level within the World Class Commissioning Assurance Framework.¹⁵ The PHOF indicator applies the same method at the upper-tier local authority level (indicators 0.2ii and 0.2iii) and national level (indicator 0.2i).

The SII for a local authority is calculated by grouping the LSOAs within it into deciles based on the LSOAs' IMD scores. These deciles are locally allocated, i.e. they are calculated from just the LSOAs in the authority, and are not based on regional or national deciles. For each decile the overall life expectancy for the aggregated LSOAs is calculated using the most recent five years of data available. The life expectancies are plotted against the population weighted deprivation deciles and a regression line fitted. The slope of this line is used to quantify the absolute difference in life expectancy between the extreme ends of the authority's deprivation scale.

Table 7.4 presents SII for male and female life expectancy at birth for the upper-tier local tier local authorities in the West Midlands, published by the Network of Public Health Observatories.¹⁶ For males, the absolute inequality in life expectancy between the most and least deprived within an authority ranges from 4.8 years in Herefordshire to 11.7 years in Coventry. Birmingham, Walsall and Solihull all have ranges over 10 years in width. The observation for Solihull is particularly noteworthy as this authority has the highest male life expectancy in the region in 2008-10. It shows that even within areas that are relatively healthy as a whole there may be hidden inequalities.

The index values for female life expectancy are generally smaller than those for males, ranging from 2.8 years in Telford and Wrekin to 10.3 years in Solihull. This Solihull figure is an outlier, the next largest female SII being 7.9 years in Coventry. These observations mirrors those made above where the gradient of the relationship between the MSOA life expectancies and deprivation was less steep for females than for males.

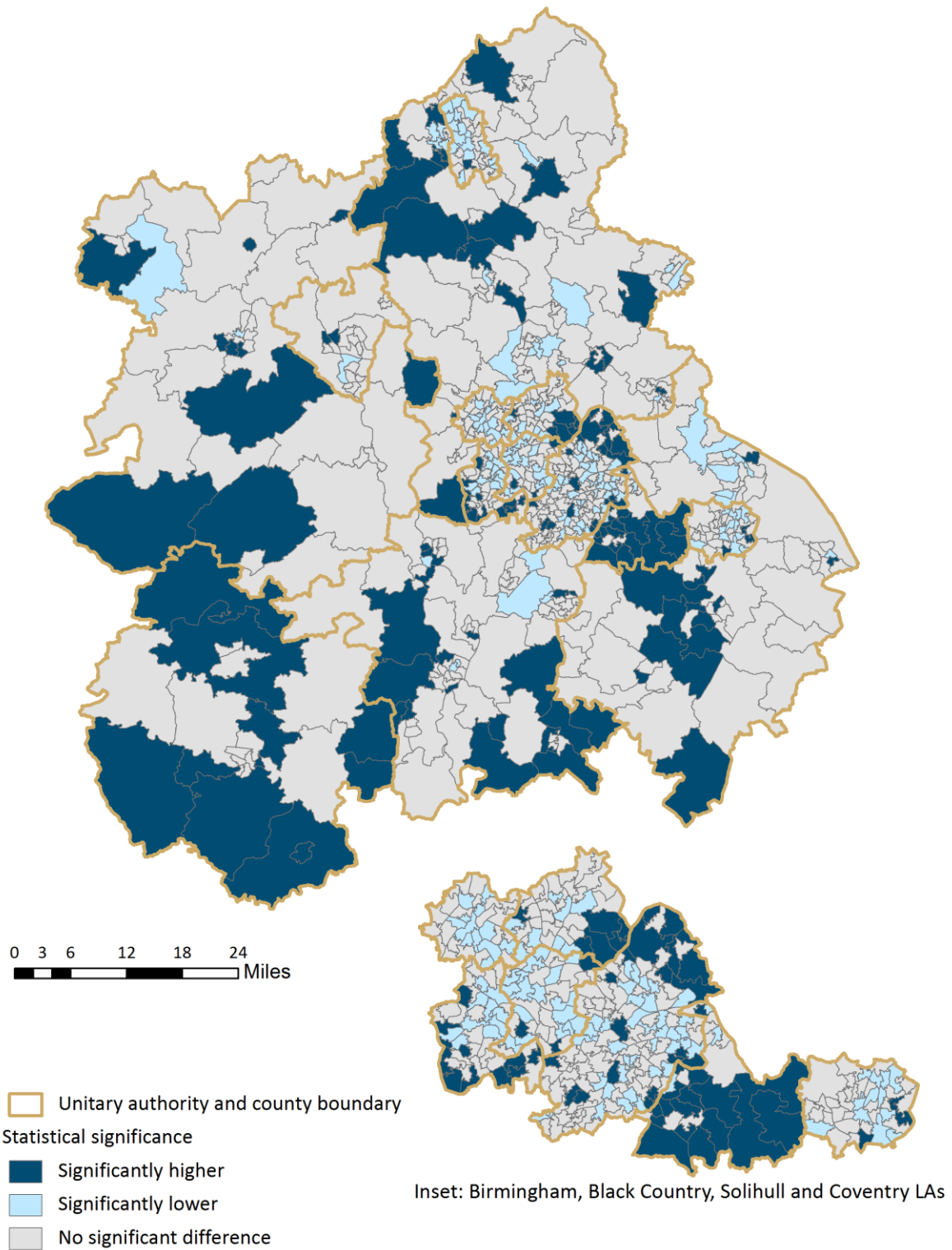
Figure 7.14: Statistically significant male life expectancy at birth by MSOA, West Midlands 2006-10



Source:
Health profiles – local health,
Department of Health / Network of Public Health Observatories

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Figure 7.15: Statistically significant female life expectancy at birth by MSOA, West Midlands 2006-10



Source:
Health profiles – local health,
Department of Health / Network of Public Health Observatories

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Produced by WMCSU, University of Birmingham.

Table 7.4: Slope Index of Inequality for life expectancy at birth by upper-tier local authority and gender, West Midlands 2006-10

ONS Area code	LA Name	Males			Females		
		SII	95% confidence limits		SII	95% confidence limits	
			Lower	Upper		Lower	Upper
E06000019	Herefordshire, County of UA	4.8	1.1	8.4	4.1	1.0	7.2
E06000051	Shropshire UA	6.7	4.2	9.1	4.3	2.8	5.8
E06000021	Stoke-on-Trent UA	8.2	5.7	10.7	4.7	1.0	8.5
E06000020	Telford and Wrekin UA	7.0	4.3	9.6	2.8	-1.3	6.8
E10000028	Staffordshire	8.0	6.9	9.1	6.2	4.0	8.5
E10000031	Warwickshire	8.3	6.0	10.6	7.6	5.2	9.9
E10000034	Worcestershire	7.8	5.6	10.0	5.4	4.0	6.8
E08000025	Birmingham	10.8	9.2	12.5	5.9	4.3	7.5
E08000026	Coventry	11.7	9.8	13.7	7.9	5.1	10.8
E08000027	Dudley	9.9	8.7	11.0	5.7	3.4	8.1
E08000028	Sandwell	9.6	7.5	11.8	6.4	4.3	8.6
E08000029	Solihull	10.8	8.3	13.2	10.3	7.7	12.8
E08000030	Walsall	10.8	8.9	12.6	6.9	3.2	10.5
E08000031	Wolverhampton	9.7	7.4	11.9	5.8	2.8	8.8

Source: Health Inequality Indicators, Network of Public Health Observatories.

The Public Health Observatories also publish SII data for local authority districts and life expectancy values for each deprivation decile within each local authority district.¹⁶

The PHOF does not specify exactly how improvements in the SII indicators will be assessed. It can be seen from Table 7.4 that the confidence intervals for the SII scores can be quite wide, even with five years data. It will be difficult to judge whether any increases or decreases in the scores are actually significant, especially if comparing scores for overlapping rolling time periods.

7.11 Life expectancy by electoral ward in Warwickshire

This section describes a more focussed look at the variation in life expectancy at small areas within a particular upper-tier local authority – in this case the county of Warwickshire.

At a county level, all cause mortality SMRs in Warwickshire, both for all ages, at 97.8 and for those aged under 75 at 92.3, are statistically significantly lower than the England index value of 100.⁹

Similarly, life expectancy at birth at 78.8 years for males and 82.6 years for females are both statistically significantly better than the England figures of 78.3 years and 82.3 years respectively.⁹

To contrast with the MSOA analyses presented above for the West Midlands as a whole, the unit of analysis used here within Warwickshire is the electoral ward. There are 105 electoral wards within Warwickshire. In comparison there are 66 MSOAs and 339 LSOAs.

At ward level, life expectancy at birth shows considerably more variation than it does at local authority level. For example, male life expectancy at birth 2006-10, ranges from a low of 72.0 years in Abbey ward in Nuneaton up to a high of 82.7 years in Cubbington, Radford and Stoneleigh wards – a variation of 10.7 years as opposed to 2.8 years at local authority level in Warwickshire (Figure 7.16, Table 7.5).

Although, for females, overall life expectancy is greater than for males there is still a considerable difference across the county, ranging from 78.4 years in Abbey ward in Nuneaton to 87.8 years in Park Hill ward in Kenilworth (Figure 7.17).

Table 7.5: Life expectancy at birth by county district and gender, Warwickshire 2006-10

County District	Males	Females
North Warwickshire	77.9	81.7
Nuneaton & Bedworth	77.1	81.3
Rugby	79.0	82.4
Stratford	79.9	83.1
Warwick	79.8	83.9
Warwickshire County	78.8	82.6

Source: Health Profiles – Local Health, Network of Public Health Observatories.

A look at the statistical significance of the electoral ward level life expectancy data, against the county average, paints a largely similar picture of the county. For example, the 4 wards with the lowest male life expectancy are all in Nuneaton and Bedworth Borough (marked in red in Figure 7.18) and have life expectancies that are statistically significantly lower than the county average of 78.8 years at birth. Eight of the nine wards with statistically higher male life expectancies than the county average, have expectancies that are in the highest banding (marked in green in Figure 7.18). For females, the picture is broadly similar to that for males (Figure 7.19).

Figure 7.16: Male life expectancy at birth by electoral ward, Warwickshire 2006-10

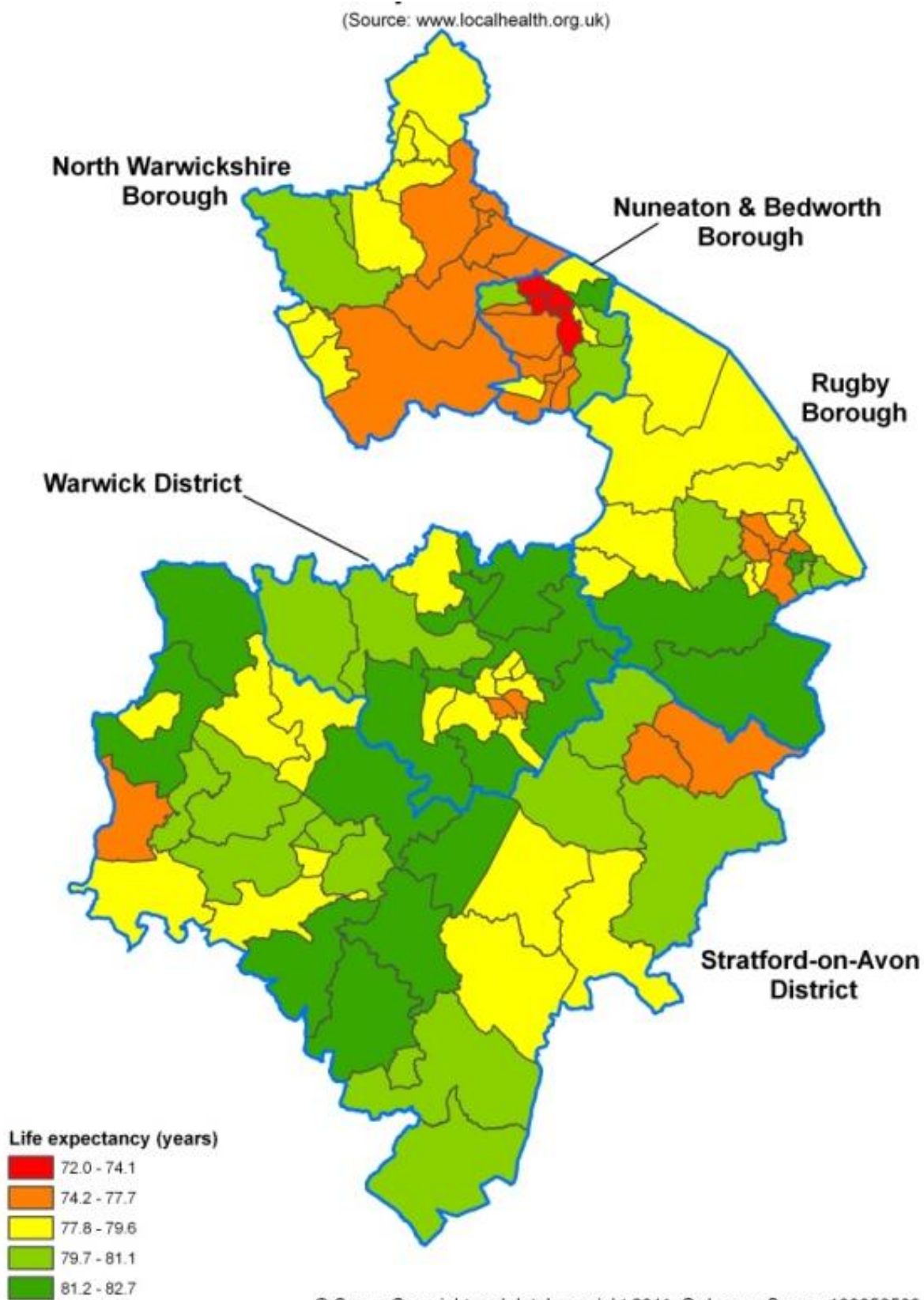
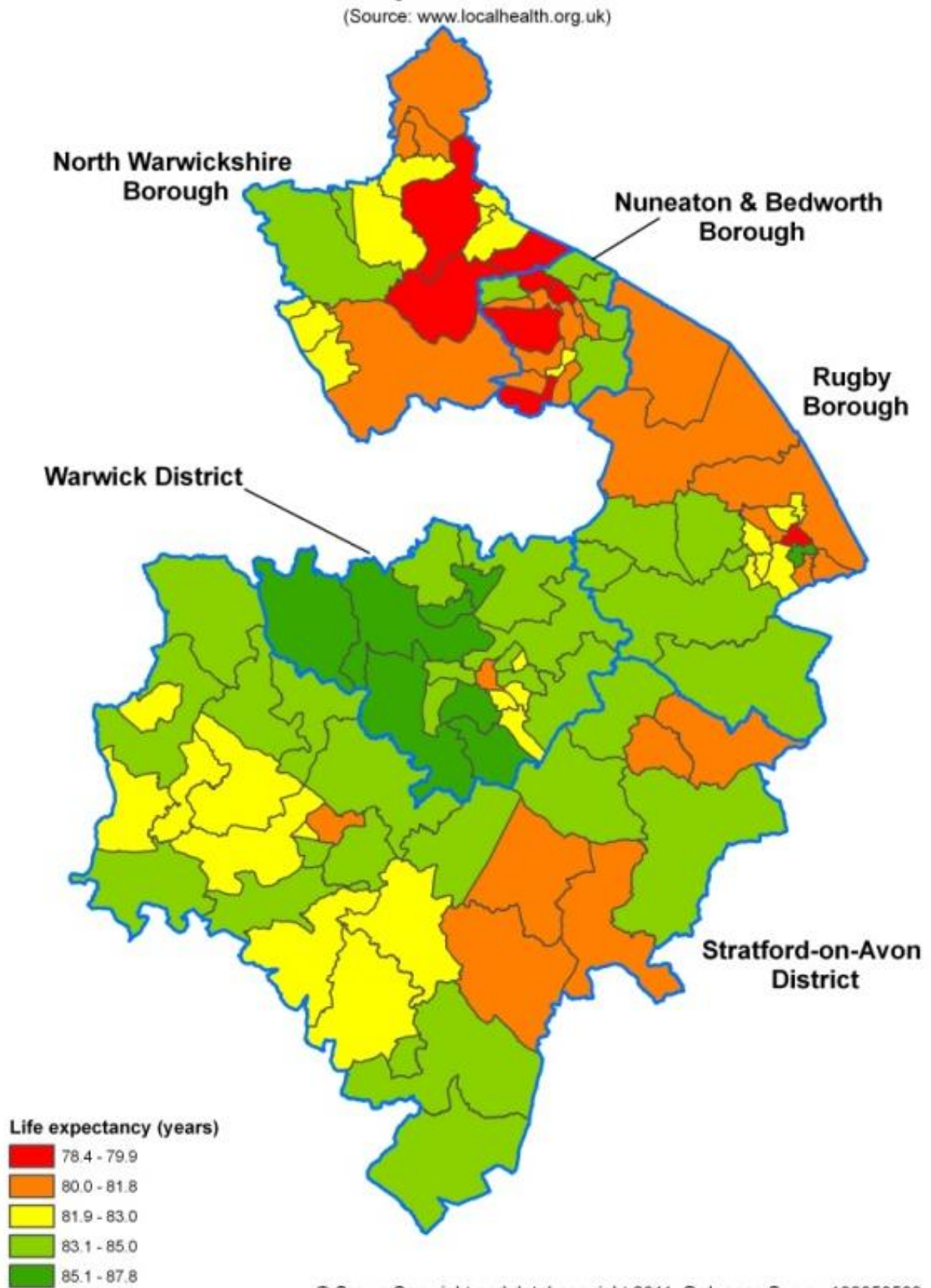
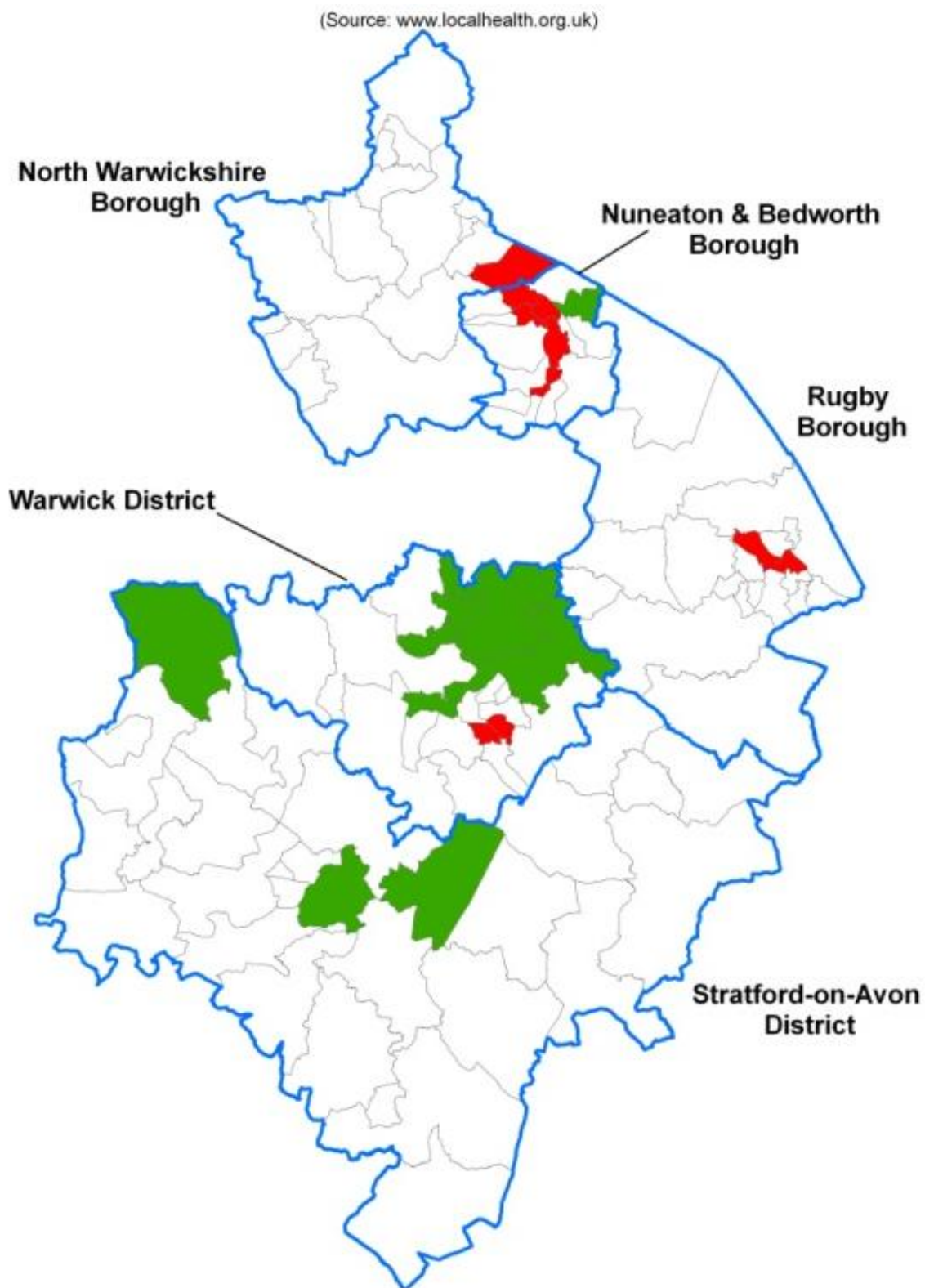


Figure 7.17: Female life expectancy at birth by electoral ward, Warwickshire 2006-10



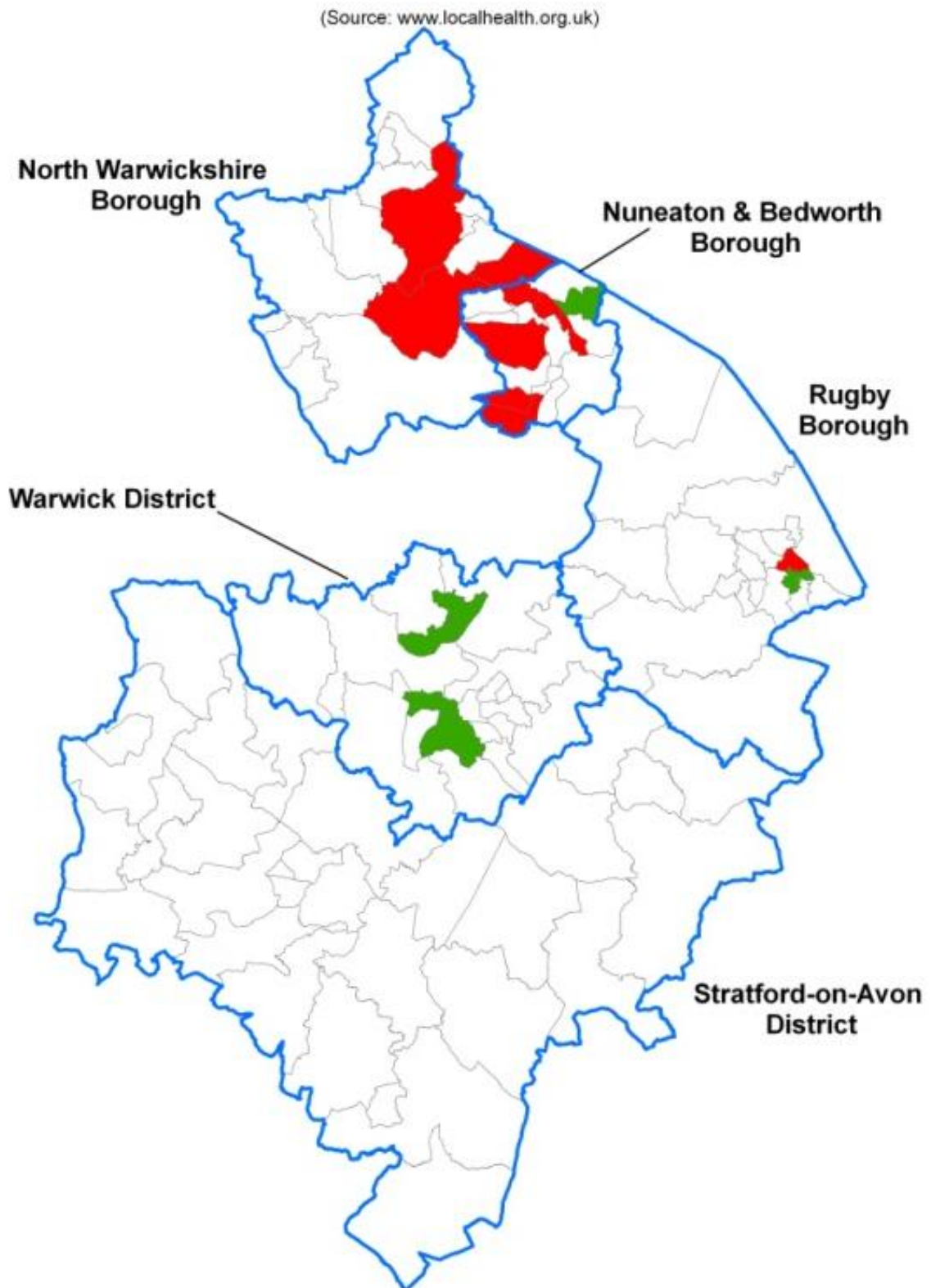
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Figure 7.18: Statistical significance of male life expectancy by electoral ward, Warwickshire 2006-10



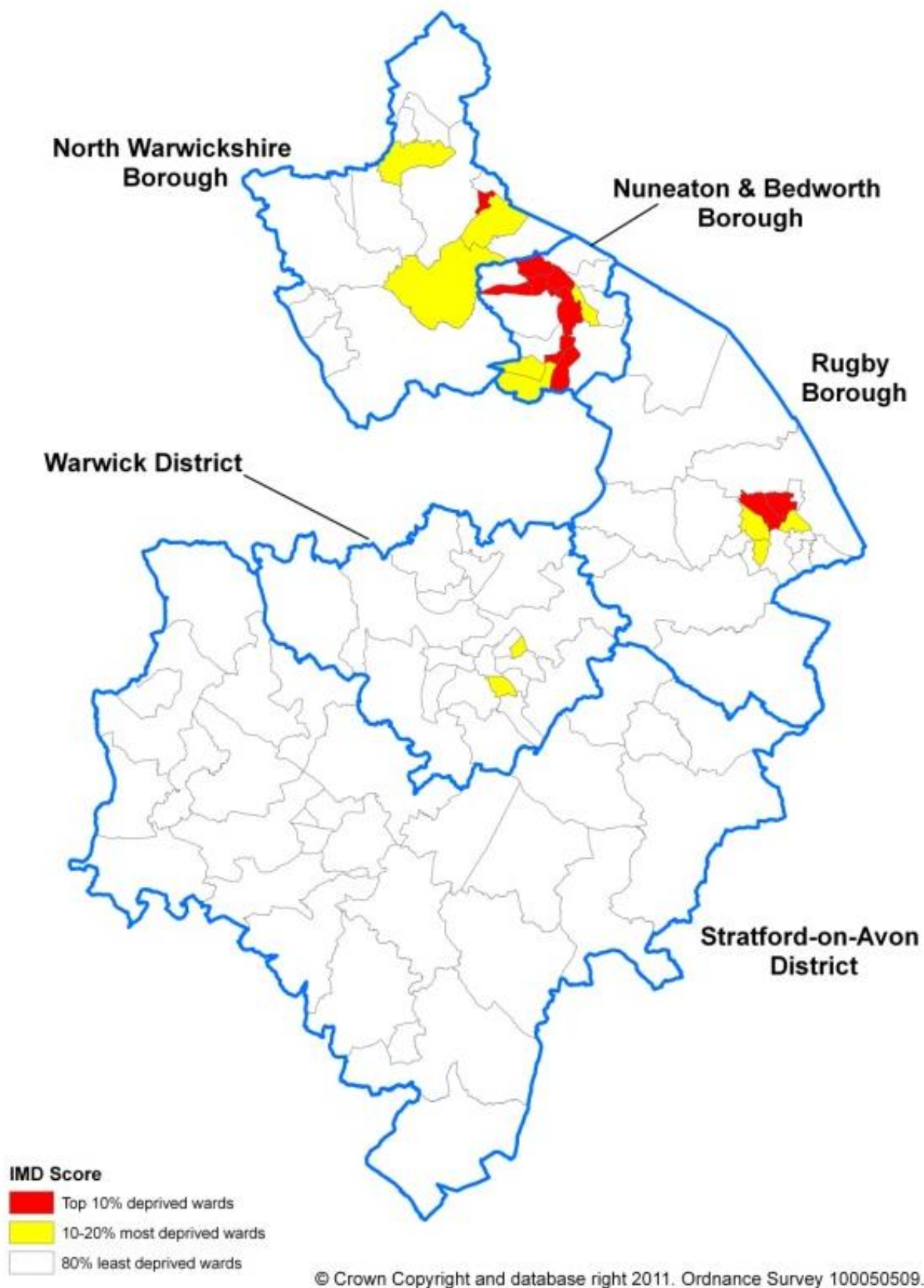
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Figure 7.19: Statistical significance of female life expectancy at birth by electoral ward, Warwickshire 2006-10



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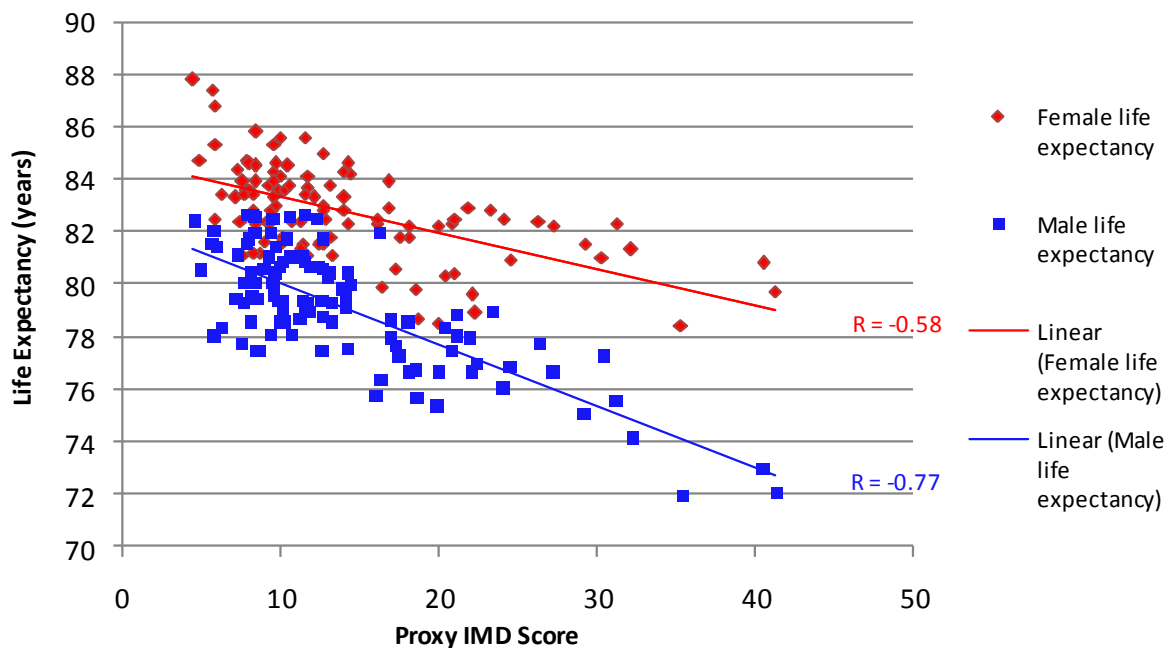
Figure 7.20: Most deprived electoral wards in Warwickshire based on proxy Index of Multiple Deprivation 2010 scores



The relationship between deprivation and life expectancy was considered by assessing the degree of correlation between the two variables. The Index of Multiple Deprivation (IMD) 2010 is recognised in England as a national measure of deprivation. IMD data is published at LSOA level, therefore to enable analysis to be made against the electoral ward level life expectancies, the LSOA IMD scores must be combined (using population-weighting) to give proxy electoral ward level deprivation scores. When these proxy IMD scores are mapped (Figure 7.20) it is clear that deprivation is greatest in the northern areas of the county, particularly in Nuneaton and Bedworth Borough. However, there are also more localised pockets of deprivation within Rugby Borough and Warwick District.

Male and female life expectancy can be charted and correlated against electoral ward level proxy IMD scores, as shown in Figure 7.21. For males, the Pearson correlation coefficient (R) value of -0.77 ($p < 0.001$) is indicative of a strong negative relationship between life expectancy and deprivation score, i.e. more deprived electoral wards have lower life expectancies. For females a similar negative relationship is seen but the correlation is not quite as strong (Pearson $R = -0.58$, $p < 0.001$). Comparison of the regression lines shows that the gradient of the male life expectancy relationship with deprivation is steeper than that of female life expectancy. These observations are consistent with those seen earlier at MSOA level across the whole of the West Midlands.

Figure 7.21: Life expectancy at birth vs. proxy IMD scores by electoral ward and gender, Warwickshire 2006-10



Source: Health Profiles – Local Profiles, Network of Public Health Observatories.

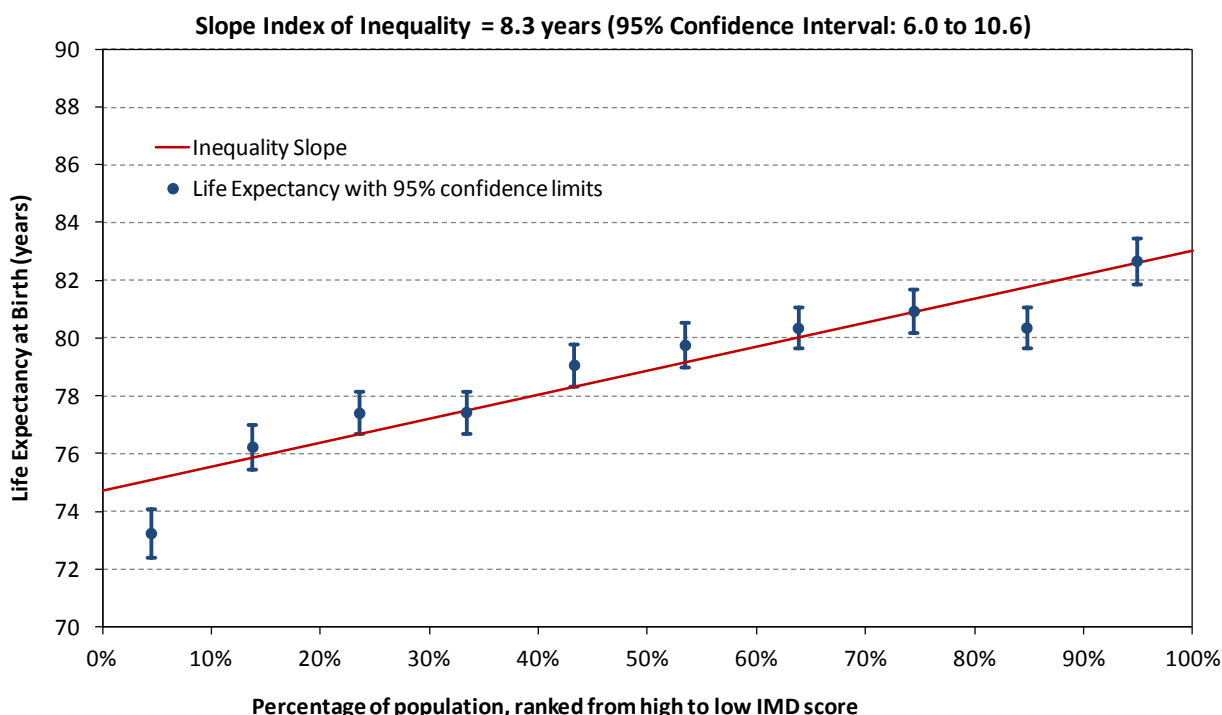
The SEPHO technical report on calculating small area life expectancy highlighted the potential effect that concentrations of nursing homes (which hold a particularly morbid population) in particular electoral wards might have.¹ With an ageing population in Warwickshire, this possibility of electoral ward level life expectancy being affected by care/nursing homes has been investigated. The number of beds, per home, varies from 2 to 254, hence the number of care/nursing establishments would not be an appropriate measure to quantify the possible effect, as it would take no account of the enormous variation in home sizes. Within the county, there are 195 homes with a total of nearly 4,500 beds

distributed across 69 of the 105 wards. Instead the number of nursing home beds in each ward has been used.

Correlation coefficients were calculated and analysed for life expectancy at birth against the number of care home beds by electoral ward for both males and females within the county. Surprisingly, there was virtually no correlation for either males or females. The Pearson correlation coefficient (R) value for males for the 69 wards with care homes was 0.00. For all 105 Warwickshire wards the value was -0.08. Coefficients for females are negative, but fractionally greater, at -0.08 and -0.16 respectively which again suggests there is very little correlation between the numbers of care home beds and electoral ward level life expectancy.

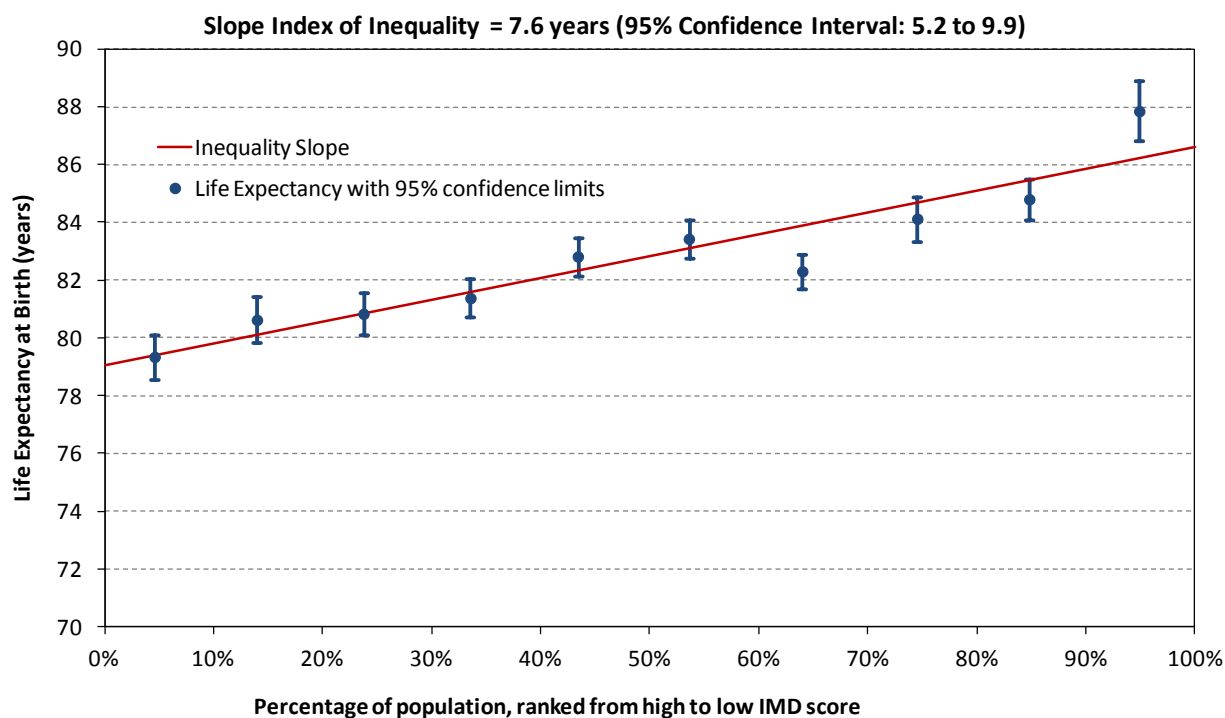
Figure 7.22 and Figure 7.23 show the SII for the county of Warwickshire for males and females respectively and Table 7.6 presents the life expectancy values for each of the LSOA based deprivation deciles within the county. These show that there is a range in the male life expectancy of 8.3 years between the least and most deprived parts of the Warwickshire population. For females the range is 7.6 years.

Figure 7.22: Male life expectancy at birth by deprivation decile showing the Slope Index of Inequality, Warwickshire 2006-10



Source: Health Inequality Indicators, Network of Public Health Observatories.

Figure 7.23: Female life expectancy at birth by deprivation decile showing the Slope Index of Inequality, Warwickshire 2006-10



Source: Health Inequality Indicators, Network of Public Health Observatories.

Table 7.6: Life expectancy by deprivation decile by gender, Warwickshire 2006-10

Deprivation decile	Males				Females			
	Life Expectancy	95% confidence limits		Population	Life Expectancy	95% confidence limits		Population
		Lower	Upper			Lower	Upper	
1	73.3	72.4	74.1	23,400	4.1	78.6	80.1	24,700
2	76.2	75.5	77.0	25,600	4.3	79.8	81.4	25,800
3	77.4	76.7	78.1	26,000	4.7	80.1	81.6	26,700
4	77.4	76.7	78.2	25,500	2.8	80.7	82.0	25,900
5	79.1	78.4	79.8	26,600	6.2	82.2	83.5	27,000
6	79.8	79.0	80.5	26,900	7.6	82.8	84.1	27,700
7	80.4	79.7	81.1	27,600	5.4	81.7	82.9	28,100
8	80.9	80.2	81.7	28,200	5.9	83.4	84.9	28,500
9	80.4	79.7	81.1	26,100	7.9	84.1	85.5	26,700
10	82.7	81.9	83.5	27,100	5.7	86.8	88.9	27,500

Sources: Death registration data and mid-year population estimates, ONS; Indices of Deprivation 2010, Department of Communities and Local Government. Analysis carried out by LHO and EMPHO.

Source: Health Inequality Indicators, Network of Public Health Observatories.

7.12 Summary points

- Life expectancy is a high profile outcome indicator that needs to be monitored by Health and Wellbeing boards, including the assessment of within local authority inequality.
- Life expectancy in the West Midlands is continuing to improve but has remained persistently below the national average for both men and women.
- There is a range of life expectancy between the highest and lowest local authority districts in the West Midlands of approximately 5 years for males and 4 years for females.
- It is possible to show significant variation in life expectancy at the electoral ward and MSOA level and between LSOA deprivation deciles within local authorities using 5-years of mortality data.
- At local authority, electoral ward and MSOA level there is a strong association between life expectancy and deprivation with people in more deprived areas living shorter lives. The association is stronger and the relationship steeper for males than for females.
- Wide inequalities in life expectancy exist within even those local authorities that have high life expectancies overall.
- Slope Index of Inequality values describing the inequality in life expectancy across the deprivation gradient within each upper-tier local authority range from 4.8 to 11.7 years for males and 2.8 to 10.3 years for females.
- Measuring the change in the SII over time in individual local authorities will be problematic as the confidence intervals are wide and long time periods are needed. Changes from one year to the next will be small and very difficult to detect in a robust way.

7.13 References

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7.14 Further information

In addition to the references and resources cited above the reader may find the following resources of use:

- The Neighbourhood Statistics web site provides an introduction and data files and look-up tables for small area geographies, classifications and conversions. Neighbourhood Statistics Geography. Available at: <http://www.neighbourhood.statistics.gov.uk/dissemination/Info.do?page=nessgeography/ness-geography.htm>
- Collated by the Public Health Observatories the Public Health Outcomes tool currently presents data for available indicators at England and upper tier local authority levels. Public Health England. *Public Health Outcomes Framework Data Tool* [online]. Available at: <http://www.phoutcomes.info/>
- The South East Public Health Observatory (SEPHO) life expectancy calculator enables users with death and population data for small areas to calculate life expectancy figures.

SEPHO. *Life expectancy calculator: LA and ward level* [online]. Available at:
<http://www.sepho.org.uk/ViewResource.aspx?id=8943>

- An APHO technical briefing assesses the types of small area data available to analysts and local policy makers and describes a range of analytical and presentational methods that may be used and some of the analytical issues that may be encountered.
Croft S, Heard H, Mills P. *Technical briefing 6: Using small area data in public health intelligence*. APHO, 2009. Available at: <http://www.apho.org.uk/resource/item.aspx?RID=74894>

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