Inequalities in disability-free life expectancy by area deprivation: England, 2001–04 and 2005–08

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Abstract

Background

The reduction of health inequalities is a long-standing public health priority. Accurate and timely measurement of the magnitude of health inequalities over time is complex, often relying on data available from a decennial census to conduct detailed analyses of social and geographical inequalities. While inequalities in mortality rates and life expectancy are well-established, the scale of inequality in health expectancies has been reported to be even greater. This study examines changes in inequality in disability-free life expectancy (DFLE) over time between Lower Super Output Areas (LSOAs) in England, grouped into quintiles of an area-based measure of relative deprivation.

Methods

Life expectancy (LE) and DFLE for males and females at birth and at age 65 were estimated using a combination of survey, mortality and population data; survey data provided an estimate of the prevalence of limiting long-standing illness or disability (LLSI) used in the DFLE metric. An estimate of the inequality in DFLE between area-based quintiles of relative deprivation (using the Index of Multiple Deprivation 2007) in the periods 2001–04 and 2005–08 enabled the measurement of change in equality over time between advantaged and disadvantaged areas.

Results

The prevalence of LLSI among males and females rose incrementally with increasing levels of deprivation in both periods. Males and females in the most deprived areas were more than 1.5 times more likely to report LLSI compared to those in the least deprived areas. There were also large inequalities in LE and DFLE in a similar pattern to LLSI. The extent of inequality in DFLE between the most and least deprived quintiles was approximately twice that of LE. Although LE and DFLE generally increased over time, this improvement varied across quintiles, causing the gap between the most and least deprived quintiles to increase. In comparison with more advantaged areas, people experiencing the greatest deprivation spent the greatest proportion of their lives with a limiting illness or disability, and this proportion increased over time.

Conclusions

Males and females at birth and at age 65 in the less deprived areas could expect longer, healthier lives than their counterparts in more deprived areas in both 2001–04 and 2005–08. This analysis suggests that the inequality in DFLE between deprived and affluent area clusters has increased during the first decade of the 21st century.

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Introduction

Health expectancies (HEs) provide estimates of life spent in various states of health. As such, they add an extra, more qualitative, dimension to life expectancy (LE) figures and are used in the assessment of need for health and social care, the impact of policies designed to reduce health inequalities, the likely proportion of the working age population fit for work at a given age, and the fairness of increases in the state pension age.

Of particular importance is the extent of inequality in health these measures convey. The reduction in health inequalities remains an important public health concern, and the Strategic Review of Health Inequalities in England post-2010 (Marmot, 2010), estimated that 2.8 million person-years free of limiting illness or disability could be gained if everyone in England experienced the same rates of death and limiting illness as the fifth of the population living in the most advantaged group of small areas. The report concluded that such a gain would bring clear economic as well as social benefits, in terms of improved productivity, lower welfare payments and healthcare costs, and increases in revenue (Marmot, 2010). It also highlighted the substantial differences in the LE and disability-free life expectancy (DFLE) of people based on the income deprivation level of their neighbourhoods; those in the poorest neighbourhoods will, on average, die seven years earlier than those in the richest, while the average difference in DFLE between these areas is 17 years (Marmot, 2010).

A number of studies (Olatunde *et al.*, 2010; Smith *et al.*, 2010a; White and Edgar, 2010; ONS, 2006) comparing small population groupings based on social class and lower level geographies have shown that the inequalities in HEs at sub-national levels are much more pronounced than those between the constituent countries of the UK. However, these analyses require survey data sources that have sufficiently large sample sizes to allow computation of robust HE metrics for sub-national populations. While the decennial census of population has been used extensively in estimating HEs for different sub-national population groupings, the infrequent nature of the census means that these analyses can only be updated every 10 years. More frequent investigations using survey sources that align closely with the census-based measures of health status can provide more timely information on the direction of health inequalities during the inter-censal years.

This report aims to address the relative shortage of information on inequalities in sub-national health expectancies during the inter-censal years by comparing the DFLE in Lower Super Output Area (LSOA) geographies, grouped into quintiles of relative deprivation in two time periods during the first decade of the 21st century.

Background

DFLE divides expected years of life into those spent with and without a limiting long-standing illness or disability.

Although the relationship between DFLE and measures of material advantage is well established, measuring and monitoring these inequalities in sub-national populations is complex and often restricted by the availability of sufficiently detailed and timely information from survey data sources.

For example, a recent study showed a gap of up to 12.6 years in DFLE between the least and the most deprived fifth of Middle Super Output Areas (MSOAs) in England (Olatunde *et al.*, 2010). However, analysis at this fine grained level is currently restricted to data derived from the decennial Census 2001, and thus has limited application in monitoring health inequalities during the inter-censal period.

In another recent study (Smith *et al.*, 2010a) we demonstrated the potential of the General Household Survey/General Lifestyle module of the Integrated Household Survey (GLF) to provide a reliable inter-censal measure of DFLE for LSOA geographies, grouped into quintiles of relative deprivation based on the Index of Multiple Deprivation 2004 (IMD, 2004).

In this study we update this approach, using the more recent IMD (2007) and compare two four-year time periods, 2001–04 and 2005–08, to assess any change in the inequality in LE and DFLE that may have occurred during the first decade of the 21st century.

Methods

The prevalence of self-reported limiting long-standing illness or disability among males and females resident in private households in England was compared across LSOA quintiles of relative deprivation and over time. Data were aggregated over two four-year periods (2001–04 and 2005–08) in order to achieve sufficiently large sample sizes to enable meaningful statistical comparison. Prevalence data were combined with mortality and mid-year population estimates (MYPE) over the same periods to calculate estimates of LE and DFLE at birth and at age 65 for males and females in each deprivation quintile. Slope and Relative indices of inequality (SII and RII respectively) were used to assess the absolute and relative inequality in DFLE between the least and most deprived quintiles. These indicators measure the total impact of inequality in DFLE, by taking into account the inequalities in intervening quintiles of relative deprivation.

Boxes 1, 2, 3, 4 and 5 provide brief descriptions of the measure of deprivation, survey data and methods used in this analysis.

Box 1 Area deprivation

The Index of Multiple Deprivation 2007 (IMD, 2007) 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. The 32,482 LSOAs in England can be ranked according to their IMD 2007 scores and grouped for subsequent analyses. Such groupings represent a continuum of relative deprivation but are likely to have a significant degree of heterogeneity, such that (for example) those at the bottom of group 1 could be more closely related to those at the top of group 2 than those at the top of group 1.

The IMD has been criticised as conceptually problematic when used in health-related studies as it includes health as one of its domains of 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 biases 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 has little or no effect in biasing the relationship between health and deprivation, particularly with regard to general health, limiting chronic illness and/or mortality as outcome measures (Adams and White, 2006; Gartner *et al.*, 2008).

Box 2 Survey data

The sources of survey data used in this analysis were the General Household Survey (GHS) 2001–04 and the General Lifestyle Survey/Module (GLF) 2005–08. In essence the GHS and GLF represent a single data source; however in 2005 the survey changed from a cross-sectional to a rotating-panel longitudinal design becoming the General Household Survey Longitudinal (GHS (L)). The name of the survey was subsequently changed to the GLF in 2008 when it became a component of the Integrated Household Survey (IHS). For consistency, the survey data source is referred to as GLF throughout this article. In 2006 the survey weighting was revised to account for potential attrition or non-response bias in subsequent panels of repeat respondents. Investigation has shown that this weighting adequately compensates for bias in self-reported limiting long-standing illness or disability (Smith *et al.*, 2010b). The GLF has been identified as a suitable data source to monitor health inequalities between census years (Smith *et al.*, 2010a).

Each survey data record was mapped to an LSOA level geographical boundary using a postcode identifier look-up table, and assigned to the relevant quintile of the IMD 2007 based on the overall deprivation score for that area. These were aggregated over two four-year periods, 2001–04 and 2005–08 to provide a sufficiently large sample for calculating DFLE estimates for each quintile of relative deprivation by age and sex. The distribution of survey data across deprivation quintiles was not even, ranging between 17 and 23 per cent across the two time periods (see table 1).

Table 1 **Number and distribution of respondents to the GLF: by area deprivation quintile, 2001–04 and 2005–08**

England		Number, Percentages		
Deprivation quintile	2001–04		2005–08	
	Persons	Per cent	Persons	Per cent
Males				
1 – least deprived	7,586	21.4	8,561	23.3
2	7,155	20.2	8,494	23.1
3	7,199	20.3	6,615	18.0
4	6,643	18.8	6,848	18.7
5 – Most deprived	6,827	19.3	6,180	16.8
Total	35,410	..	36,698	..
Females				
1 – least deprived	7,862	20.8	9,127	22.6
2	7,539	19.9	9,239	22.9
3	7,825	20.7	7,330	18.2
4	7,152	18.9	7,575	18.6
5 – Most deprived	7,465	19.7	7,061	17.5
Total	37,843	..	40,332	..

Box 3 Limiting long-standing illness or disability?

The prevalence of a limiting long-standing illness or disability by sex and five-year age band was derived from responses to the following questions:

‘Do you have any long-standing illness, disability or infirmity – by long-standing I mean anything that has troubled you over a period of time or that is likely to affect you over a period of time?’

(1) Yes

(2) No

If ‘Yes’ the respondent is then asked;

Does this illness or disability (Do any of these illnesses or disabilities) limit your activities in any way?

(1) Yes

(2) No

In this analysis, people responding ‘Yes’ to both questions were identified as having a limiting long-standing illness or disability.

Box 4 Disability-free life expectancy (DFLE)

DFLE partitions LE into estimated periods of life with and without a limiting long-standing illness or disability. This measure is calculated using the Sullivan method which combines the prevalence of limiting long-standing illness or disability (see Box 3), with mortality data and mid-year population estimates (MYPE) (Sullivan, 1971; Jagger, 1996). For these analyses, all data were aggregated over the four-year periods 2001–04 and 2005–08. MYPEs were adjusted to match the private household population by subtracting numbers resident in communal establishments; however, the mortality data represents the entire population of England.

Box 5 Slope and Relative indices of inequality

To calculate the slope and relative index of inequality:

The quintiles were ordered by decreasing area deprivation, that is, from the most to the least deprived. The fraction of the total population in each quintile (f) was calculated. The cumulative frequency (c_i), that is the cumulative sum of the population in successively less deprived quintiles, was also obtained and the relative deprivation rank (x) for each quintile was calculated as:

$$x = c_{i-1} + (0.5 \times f)$$

The SII (slope of the regression line) was then estimated by regressing DFLE for each quintile against the relative deprivation rank (x), weighted by the population in each quintile.

The RII was calculated using the method described by Mackenbach and Kunst (1997). First, the predicted value of DFLE (y) for the least deprived areas, taking into account its relative deprivation rank, was estimated using a linear regression model. Then the SII was divided by the predicted DFLE value, (SII / y). The result obtained represents the ratio of the DFLE of the most deprived areas to that of the least deprived. This was then expressed as a rate ratio by adding 1 to it, giving the modified RII.

$$\text{Modified RII} = 1 + (SII / y)$$

Results

Prevalence of limiting long-standing illness or disability (LLSI), 2001–04 and 2005–08

LLSI increased with rising deprivation for both sexes in each time period (see table 2).

Table 2 Prevalence of limiting long-standing illness in England: by area deprivation quintile, 2001–04 and 2005–08

England		Percentages			
Deprivation quintile	2001–2004		2005–2008		
	Males	Females	Males	Females	
1 – least deprived	13.6	15.8	13.6	16.3	
2	16.2	18.5	15.4	16.9	
3	16.9	18.1	16.2	19.2	
4	19.4	20.7	17.1	20.3	
5 – Most deprived	22.7	24.1	23.0	24.2	
Ratio (5/1)	1.7 ¹	1.5 ¹	1.7 ¹	1.5 ¹	
95% CI of ratio	1.6–1.7	1.5–1.6	1.6–1.8	1.4–1.5	
England	17.7	19.4	16.8	19.2	

¹ Significant difference between males and females

In 2001–04 the prevalence of LLSI among males was 13.6 per cent in the least deprived areas. In contrast, LLSI affected 22.7 per cent of males in the most deprived areas. For females the equivalent figures were 15.8 and 24.1 per cent respectively. LLSI was therefore 1.7 times higher in males and 1.5 times higher in females in the most compared to the least deprived areas. LLSI among females was approximately 1–2 per cent higher than for males in each quintile in this period. This difference between the sexes was also evident at national level where the average prevalence of LLSI was 17.7 per cent for males and 19.4 per cent for females. Estimates for England fell between quintiles 3 and 4 for males and females in both time periods.

In 2005–08 the deprivation gradient in LLSI prevalence was similar to that observed in 2001–04 (Table 2). The prevalence of LLSI in males decreased between the two periods in quintiles 2 to 4. LLSI remained consistent in the least deprived areas and increased slightly in the most deprived. The most notable improvement was in quintile 4 where LLSI decreased by approximately 2.3 per cent. For females, there was no clear pattern in the prevalence of LLSI over time. While improvements were observed in quintiles 2 and 4, LLSI increased in quintiles 1, 3 and 5. The greatest reduction in LLSI was observed in quintile 2, where prevalence decreased by 1.6 per cent between the two periods, while the prevalence in quintile 3 worsened by 1.1 per cent. Changes in the remaining quintiles were less pronounced and less than 1 per cent over the period.

The likelihood (rate ratio) of reporting an LLSI between the least and most deprived areas remained largely constant for males and females over time, and was higher for males than for females; 1.7 and 1.5 respectively.

For England as a whole there were improvements in LLSI prevalence rates for both sexes between 2001–04 and 2005–08, however this was more pronounced among males than females; LLSI reduced by 0.9 per cent and 0.2 per cent respectively.

Disability-free life expectancy

For each time point LE and DFLE fell with increasing deprivation for both sexes (see tables 3, 4, 5 and 6). Males and females at birth and at age 65, in the least deprived areas, could therefore, expect longer, healthier lives than their counterparts in more deprived areas in both 2001–04 and 2005–08.

Males at birth

Table 3 **LE and DFLE for males at birth: by area deprivation quintile, 2001–04 and 2005–08**

England		Years, Percentages						
Deprivation quintile	2001–04				2005–08			
	LE	DFLE	95 per cent CI	Proportion of life disability free (%)	LE	DFLE	95 per cent CI	Proportion of life disability free (%)
1 – Least deprived	79.7	67.9	67.2–68.5	85.2	81.0	69.3 ¹	68.7–69.9	85.5
2	78.3	65.0	64.4–65.7	83.0	79.7	66.6 ¹	66.0–67.2	83.5
3	77.1	63.5	62.9–64.2	82.4	78.4	65.1 ¹	64.4–65.7	83.0
4	75.1	59.6	58.9–60.3	79.3	76.3	62.1 ¹	61.4–62.8	81.4
5 – Most deprived	71.9	54.0	53.3–54.7	75.1	73.0	54.7	53.9–55.4	74.8
Range	7.8	13.8	12.9–14.8	:	8.0	14.6	13.7–15.6	:
Ratio	1.11	1.26	: :	:	1.11	1.27	: :	:
SII	9.4	16.5	: :	:	9.7	16.2	: :	:
RII	1.12	1.24	: :	:	1.12	1.23	: :	:

1 Significant difference in DFLE between 2001–04 and 2005–08

Differences between cells may not match due to rounding

In 2001–04 males in the least deprived areas could expect an additional 7.8 years of life compared with those in the most deprived areas; 79.7 and 71.9 years respectively. The difference between these areas in terms of DFLE was even more striking; those in the least deprived areas having 13.8 more years free from LLSI than their counterparts in the most deprived areas (67.9 and 54.0 years respectively). In relative terms, those in the least deprived areas had a DFLE 1.26 times higher than those in the most deprived. As shown in Table 3, the absolute difference in DFLE between quintile extremes, as measured by the SII, is greater than that measured by the range in DFLE between these areas. For males at birth in 2001–04, the gap in DFLE between the least and most deprived areas, as measured by the SII, was 16.5 years while the modified RII was 1.24.

When DFLE is assessed as a proportion of LE, those in the least deprived areas could expect to spend approximately 85 per cent of their lives free from LLSI, whereas those in the most deprived areas could expect to spend approximately three-quarters (75.1 per cent) of their lives without LLSI.

The gap in LE and DFLE between quintiles was most pronounced between the two most deprived groups of areas, that is quintiles 4 and 5, where the difference accounted for approximately 41 per cent of the total range in LE and DFLE.

Between 2001–04 and 2005–08 improvements were seen in LE and DFLE across all quintiles, but to varying extents. While the least and most deprived areas saw increases in LE of 1.4 and 1.1 years respectively, the corresponding increase in DFLE in the least deprived areas was more than twice that of the most deprived (1.4 and 0.6 years respectively). Thus, for the most deprived, the gain in LE was not matched by that of DFLE, leading to a slight decline (0.3 per cent) in the proportion of life spent without LLSI. In all other quintiles there were improvements of between 0.3 and 2.1 per cent in the proportion of life spent free from a disability, the greatest being in quintile 4. The range in LE between the least and the most deprived areas rose slightly from 7.8 years in 2001–04 to 8.0 years in 2005–08, while the corresponding range in DFLE increased from 13.8 to 14.6 years. The ratio between these areas increased slightly over the period from 1.26 to 1.27.

Taking into account the inequalities in intervening quintiles of relative deprivation, the SII and RII indicated a slight decrease in absolute and relative inequality in DFLE; falling from 16.5 years to 16.2 years and 1.24 to 1.23 respectively over the period.

In 2005–08 the difference in DFLE between quintiles 4 and 5, the two most deprived areas, accounted for slightly more than half (50.9 per cent; 7.4 years) of the total range between quintile extremes compared with 40.5 per cent (5.6 years) in 2001–04. The exceptional gain in DFLE in quintile 4 ensured that the inequality between them and those in the most affluent areas narrowed over time, from 8.3 to 7.2 years.

Males at age 65

Table 4 **LE and DFLE for males at age 65: by area deprivation quintile, 2001–04 and 2005–08**

England		Years, Percentages						
Deprivation quintile	2001–04				2005–08			
	LE	DFLE	95 per cent CI	Proportion of life disability free (%)	LE	DFLE	95 per cent CI	Proportion of life disability free (%)
1 – Least deprived	18.0	11.9	11.4–12.4	65.8	19.3	12.9 ¹	12.5–13.3	66.9
2	17.3	10.8	10.3–11.3	62.7	18.4	11.4	10.9–11.8	61.7
3	16.7	10.1 ²	9.7–10.6	60.8	17.8	11.2 ^{1,2}	10.8–11.7	63.1
4	15.7	8.9	8.5–9.4	56.9	16.7	9.6	9.2–10.1	57.7
5 – Most deprived	14.5	7.7	7.2–8.2	53.0	15.3	7.3	6.9–7.8	47.9
Range	3.5	4.2	3.5–4.9	:	4.0	5.6 ¹	4.9–6.2	:
Ratio	1.24	1.55	: :	:	1.26	1.76	: :	:
SII	4.2:	5.0	: :	:	4.6	6.0	: :	:
RII	1.23:	1.41	: :	:	1.24	1.46	: :	:

1 Significant difference in DFLE between 2001–04 and 2005–08

2 Not significantly lower than next less deprived quintile

Differences between cells may not match due to rounding

In 2001–04 men at age 65 living in the least deprived areas could expect to live a further 18.0 years, compared with only 14.5 years for those in the most deprived areas – a difference of 3.5 years. In the case of DFLE, men in the least deprived areas could expect to spend 11.9 years without LLSI compared with 7.7 years for those in the most deprived – a difference of 4.2 years. In relative terms DFLE was 1.55 times higher in the least compared to the most deprived areas. Again, much of the overall differences in LE and DFLE across the quintiles was accounted for by the gap between quintiles 4 and 5; which accounted for approximately 34 per cent; 1.2 years (LE) and 31 per cent; 3.5 years (DFLE) of the range between the extremes of deprivation. With respect to DFLE as a proportion of LE, men in the least deprived areas could expect to spend 65.8 per cent of their remaining life without LLSI, compared with 53.0 per cent for those in the most deprived areas.

As at birth, the SII (5.0 years) for men at age 65 was greater than the range (4.2 years), while the modified RII was 1.41.

In 2005–08 LE for men aged 65 increased in all areas compared to 2001–04. As at birth however, increases varied across quintiles. In the least deprived areas, LE rose by 1.3 years to 19.3 years whereas in the most deprived areas this increase was 0.8 years to 15.3 years. This variation resulted in a widening of the gap in LE between these areas from 3.5 years in 2001–04 to 4.0

years in 2005–08. DFLE also increased in all quintiles other than the most deprived compared to 2001–04. In the least deprived areas DFLE rose by 1.0 year to 12.9 years; by contrast, in the most deprived areas DFLE decreased by 0.3 years to 7.3 years, causing the range to increase significantly from 4.2 to 5.6 years over time. Consequently, the ratio of DFLE between the least and most deprived areas increased from 1.54 to 1.76. As in 2001–04, the greatest proportion of the range in both LE and DFLE was accounted for by the difference between quintiles 4 and 5; approximately 35 per cent (1.4 years) and 41 per cent (2.3 years) of the total respectively.

In terms of the proportion of life spent free from a disability at age 65, men in the least deprived areas could expect to spend 66.9 per cent of their lives disability-free, a 1.1 per cent increase on 2001–04 while men in the most deprived areas could expect to spend less than half (47.9 per cent) of their remaining life disability-free, a fall of 0.3 per cent.

The absolute difference in DFLE between the least and most deprived areas, as measured by the SII, was 6.0 years compared with 5.0 years in 2001–04. The modified RII also rose from 1.41 to 1.46.

Females at birth

Table 5 LE and DFLE for females at birth: by area deprivation quintile, 2001–04 and 2005–08

England				Years, Percentages				
Deprivation quintile	2001-04				2005-08			
	LE	DFLE	95 per cent CI	Proportion of life disability free (%)	LE	DFLE	95 per cent CI	Proportion of life disability free (%)
1 – Least deprived	83.0	69.2	68.5–69.8	83.3	84.2	70.3	69.7–70.9	83.5
2	82.1	67.0	66.3–67.7	81.6	83.1	68.5 ¹	67.9–69.1	82.4
3	81.3	66.2 ²	65.5–66.9	81.4	82.3	65.9	65.2–66.6	80.1
4	79.9	62.5	61.8–63.2	78.2	80.9	63.4	62.7–64.1	78.4
5 – Most deprived	77.8	57.6	56.9–58.4	74.1	78.6	57.9	57.1–58.6	73.6
Range	5.2	11.6	10.5–12.6	:	5.6	12.4	11.4–13.4	:
Ratio	1.07	1.20	: :	:	1.07	1.21	: :	:
SII	6.3	13.7	: :	:	6.7	14.6	: :	:
RII	1.08	1.20	: :	:	1.08	1.20	: :	:

1 Significant difference in DFLE between 2001–04 and 2005–08

2 Not significantly lower than next less deprived quintile

Differences between cells may not match due to rounding

In 2001–04 females at birth in the least deprived areas could expect 5.2 more years of life than those in the most deprived areas; 83.0 and 77.8 years LE respectively. In terms of DFLE, females at birth in the least deprived areas could expect 69.2 years of life without LLSI compared with 57.6 years in the most deprived areas. In absolute terms, the range in DFLE between the least and most deprived areas, 11.6 years, was more than twice that of LE and the ratio of DFLE between these areas was 1.20. Proportionally, those in the least deprived areas could expect to spend almost 17 per cent of their lives with LLSI, whereas those in the most deprived areas could expect to spend more than a quarter (25.9 per cent) of their lives with LLSI. As with males, the gap in LE and DFLE between quintiles for females was most pronounced between quintiles 4 and 5. The difference between these two most deprived quintiles accounted for 40.9 per cent (2.1 years) and 42.4 per cent (4.9 years) of the total range in LE and DFLE respectively.

The SII showed an absolute difference of 13.7 years between the DFLE of the least and most deprived areas while the modified RII was 1.20.

Compared to 2001–04, LE for females at birth rose in each quintile in 2005–08. Increases in LE were greatest in the least deprived areas (1.1 years) and lowest in the most deprived areas (0.8 years), causing the range in LE between these areas to increase from 5.2 years to 5.6 years. DFLE also increased in each quintile over the period, with the exception of quintile 3 where it fell slightly. The increase in DFLE for the least deprived areas (1.1 years) was more than three times that of the most deprived areas (0.3 years). Consequently, the range and ratio in DFLE between these areas increased from 11.6 years to 12.4 years and 1.20 to 1.21 respectively. Again, much of the range was accounted for by differences between quintiles 4 and 5, 40.6 per cent (5.5 years) of the overall difference.

In 2005–08 the SII in DFLE between quintiles extremes was greater than in 2001–04, 14.6 years, while the modified RII remained constant at 1.20.

Females at age 65

Table 6 **LE and DFLE for females at age 65: by area deprivation quintile, 2001–04 and 2005–08**

England

Years, Percentages

Deprivation quintile	2001–04				2005–08			
	LE	DFLE	95 per cent CI	Proportion of life disability free (%)	LE	DFLE	95 per cent CI	Proportion of life disability free (%)
1 – Least deprived	20.6	13.3	12.8–13.8	64.5	21.6	13.8	13.4–14.3	63.9
2	20.0	12.8 ¹	12.3–13.2	63.9	20.9	13.3 ¹	12.8–13.8	63.7
3	19.6	12.3 ¹	11.8–12.8	62.7	20.4	12.0	11.5–12.5	59.0
4	18.8	10.6	10.1–11.1	56.5	19.6	10.8	10.3–11.3	55.0
5 – Most deprived	17.8	9.3	8.8–9.8	52.3	18.4	9.4	8.9–9.9	51.2
Range	2.8	4.0	3.3–4.7	:	3.3	4.4	3.7–5.1	:
Ratio	1.16	1.43	: :	:	1.18	1.47	: :	:
SII	3.3	4.9	: :	:	3.7	5.5	: :	:
RII	1.16	1.36	: :	:	1.17	1.38	: :	:

¹ Not significantly lower than next less deprived quintile

Differences between cells may not match due to rounding

In 2001–04 women living in the least deprived areas could expect an additional 20.6 years of life at age 65, compared with 17.8 years for those in the most deprived – a difference of 2.8 years. In the same period the equivalent DFLE figures were 13.3 and 9.3 years respectively – a difference of 4.0 years – while the ratio was 1.43. Much of the differences between quintile extremes were again accounted for by the gap between quintiles 4 and 5; 37.0 per cent (1.0 year) and 33.2 per cent (1.3 years) of the overall difference in LE and DFLE respectively. In proportional terms, women in the least deprived areas could expect to spend 64.5 per cent of their remaining life without LLSI, compared with 52.3 per cent for those in the most deprived areas.

The SII in DFLE between the least and most deprived areas was 4.9 years and the modified RII was 1.35.

Compared with 2001–04, LE in 2005–08 was higher for women at age 65 in each quintile. Increases in LE for women aged 65 were greatest in the least deprived areas (1.0 years) and lowest in the most deprived areas (0.6 years). Consequently, the range in LE between these areas increased from 2.8 years in 2001–04 to 3.3 years in 2005–08. DFLE for women aged 65 also increased in all but quintile 3. The greatest increases in DFLE (0.5 years) were seen in deprivation quintiles 1 and 2, while the smallest (0.1 years) was in the most deprived quintile. The range in DFLE between the least and most deprived areas therefore increased from 4.0 years in 2001–04 to 4.4 years in 2005–08, and the ratio increased to 1.46. As in 2001–04, the range in LE and DFLE between quintile extremes was made up to a large extent by differences between quintiles 4 and 5,

approximately 37 per cent (1.2 years for LE and 1.4 years for DFLE) of the overall differences. The SII shows that the absolute difference in DFLE between the least and most deprived areas worsened over time; 4.9 to 5.5 years in 2005–08, while the modified RII increased to 1.38.

Across all quintiles, the proportion of life that women at age 65 could expect to spend without LLSI fell slightly in 2005–08 compared with 2001–04 (Table 6).

Differences in DFLE by sex

DFLE was generally significantly higher for females than for males. In 2001–04 there was a single instance where this was not the case; at birth in the least deprived quintile. In 2005–08 the number of area clusters in which differences by sex were no longer significant had increased; DFLE was not significantly different between males and females at birth in quintiles 1, 3 and 4.

Discussion

This report explores changes in health inequalities over time, between groupings of small areas based on differing levels of deprivation and provides further evidence of the effect relative deprivation has on life chances and functional health status. These results are consistent with a widening of health inequality between advantaged and disadvantaged populations during the first decade of the 21st century.

The prevalence of LLSI varied substantially between the least and most deprived areas for both males and females: those living in the most deprived areas in England were at least 1.5 times more likely to report an LLSI than their counterparts living in the least deprived areas in each period examined, demonstrating the strong relationship between local area deprivation and limiting illness.

Over time, a reduction in the prevalence of LLSI in males occurred in quintiles 2 to 4, demonstrating the scope for health improvement in populations with already lower rates of limiting illness, and the potential for substantial reductions in LLSI in deprived areas with higher baselines. For females the picture over time was less clear – those in the least deprived quintile experienced a slight rise in the prevalence of LLSI, while there was little change for those in the most deprived quintile.

LE and DFLE for males and females at birth and at age 65 in both 2001–04 and 2005–08 decreased with increasing levels of deprivation in a linear pattern.

In 2001–04 males at birth in the least deprived areas would, on average, live for an additional 7.8 years more than their counterparts in the most deprived areas. For females, this gap was narrower at 5.2 years. Over time, the inequality in LE increased for both sexes but the difference by sex narrowed. For DFLE however, the magnitude of inequality between the least and most deprived areas was much greater in each time period. At birth the total inequality in DFLE was more than twice as great as that of LE for females and almost twice as great for males.

Between the two time periods, inequalities in DFLE increased by more than half a year for males and females at birth. Strikingly, in the most deprived areas, males and females at birth could

expect to spend approximately a quarter or more of their lives with LLSI, compared with approximately 15 per cent for those in the least deprived areas.

At age 65 the inequalities in LE and DFLE persist. For LE, 3.5 years separated men in the least and most deprived areas in 2001–04 and this increased to 4.0 years in 2005–08. For women, the gap in LE between these areas also increased from 2.8 to 3.3 years. Inequality in DFLE at age 65 was again greater than that for LE and increased by more than a year for men and almost half a year for women over the period.

On the whole, there were significant differences in DFLE between adjacent quintiles, particularly at birth. By quintile, the greatest inequality in LE and DFLE lay between the most deprived and next most deprived quintiles. The difference in DFLE between these quintiles represented between a third and almost a half of the inequality between the least and most deprived areas. At birth, the inequality in DFLE between these quintiles increased for both males and females. Those in the most deprived areas appear to be becoming comparatively more disadvantaged over time. While males in quintile 4 closed the gap on less deprived areas, as a result of a sharper rise in DFLE compared to other areas, for females this gap widened slightly over time.

These findings demonstrate the importance of relative compared to absolute deprivation as a marker for health outcomes.

While simple measures of the absolute and relative difference in DFLE between quintile extremes, (such as the range and ratio) have the advantage of being simple to calculate and easy to interpret, they do not take into account the inequalities in intervening quintiles of relative deprivation. The slope and relative indices of inequality (SII and RII) were therefore used to explore the total impact of deprivation-related inequality on DFLE. These indices not only take into account the size of each deprivation group, but also their relative position in the 'deprivation hierarchy'. The results obtained can be interpreted as the difference in DFLE between the most and least deprived areas, estimated on the basis of the systematic relationship between DFLE and area deprivation for all deprivation quintiles.

In general, the magnitude of inequality in DFLE as demonstrated by the SII was greater than that measured by the range between quintile extremes. However, both measures had a similar pattern by sex with inequalities being greater for males than for females. Furthermore, with the exception of males at birth, the direction of inequality was found to be consistent for both measures: the gap between the least and most deprived fifth of the population in England increased in the latter period of the first decade of the 21st century. Males at birth were the only group to experience a slight narrowing of the inequality gap over the two periods.

The ratio and the relative index (RII) suggest that inequality at birth for both males and females has remained largely consistent over time. At age 65 however, these measures indicate that inequality has increased over the period, particularly for males. The ratio and relative index also suggest that deprivation has a greater impact on health inequality at older ages, as there is a much greater disparity in DFLE between quintiles at age 65 than at birth.

This study adds to the growing body of evidence that links increased deprivation with poorer health. Many recent studies illustrate the wide margins of health inequality that exist between small

areas experiencing differing degrees of deprivation (Bajekal, 2005; Rasulo *et al.*, 2007; Smith *et al.*, 2010a; Olatunde *et al.*, 2010).

The findings presented here provide, for the first time, an analysis of DFLE by IMD 2007 quintiles of deprivation. They are consistent with a widening of health inequality during the first decade of the 21st century, in absolute terms for males and females at birth and in both absolute and relative terms at age 65. Much of this apparent widening is due to disproportionate increases in LE, DFLE and in reductions in LLSI across quintiles of deprivation. The most deprived areas experienced the smallest increases in LE and DFLE compared to the other area groupings examined, causing them to fall further behind in 2005–08 compared to 2001–04. Particularly noteworthy are the improvements made by males in the penultimate deprivation quintile, demonstrating the scope for substantial improvements in the prevalence of LLSI in areas with high baselines and relatively high levels of deprivation.

Limitations of this approach

A limitation of this study is the exclusion of the communal establishment population. This population is not included in the GLF and was subtracted from MYPEs. However, the mortality data used in this study included this population. This may lead to a slight skew in the data, particularly if there is a large difference in the communal establishment population across quintiles of deprivation or if there has been a substantial change in this population between the time points examined. However, as with earlier studies (Smith *et al.*, 2010a; Bajekal, 2005), we consider it unlikely that the inclusion of communal establishment deaths would materially alter the main findings of this analysis.

Conclusions

This report adds further to the growing body of evidence linking deprivation with health outcomes, and illustrates the large differences that exist between advantaged and disadvantaged area groupings. In absolute terms, inequality in LE and DFLE between the least and most deprived areas increased between 2001–04 and 2005–08, mostly driven by the uneven increases in these metrics over time. Changes in relative inequality appear to be age-dependant, with those at age 65 experiencing greater inequality than those at birth.

The findings presented here provide evidence for policy responses aimed at mitigating health inequalities between advantaged and disadvantaged populations, and provide a benchmark for monitoring the relative health improvement of these populations during the next decade.

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