Life expectancy and disability-free life expectancy estimates for Middle Super Output Areas; England, 1999–2003

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Abstract

Background

In recent years, there has been increasing demand for health indicators at small area level to support monitoring and planning. This study investigates the use of a small area geography, Middle Layer Super Output Areas (MSOAs) for the estimation and comparison of disability-free life expectancy (DFLE) in England.

Methods

Using death registrations from 1999 to 2003 and data on limiting long-term illness from the Census 2001, life expectancy and DFLE are estimated for English MSOAs and Government Office Regions. Figures are presented for quintiles based on MSOA DFLE values, and quintiles of relative deprivation using the Index of Multiple Deprivation 2004. Health inequalities are assessed at regional level and between quintile extremes for both measures.

Results

The distribution of DFLE across MSOAs was characterised by a north-south geographical divide: the highest DFLE at birth for males was in Kensington and Chelsea 016 (73.9 years) and lowest was in Manchester 013 (44.1 years). For females the highest value was in Kensington and Chelsea 012 (74.4 years) and the lowest in Liverpool 039 (48.2 years). Over 40 per cent of MSOAs in the South East, but only about 3 per cent of those in the North East, were in the quintile with the highest DFLE values at birth. Conversely, the equivalent proportions in the quintile with the lowest values were approximately 4 per cent and 50 per cent respectively.

At birth, males in the most affluent areas could expect to spend an additional 12.6 years without a disability compared to those in the most deprived areas. For females this inequality was 10.9 years. At age 65 inequalities persisted but the differences were narrower.

Conclusions

This is the first use of MSOAs in estimating DFLE, and the results highlight the substantial inequalities between quintile groupings based on DFLE values as well as between the least and most deprived MSOAs in England. These findings provide useful health outcomes information to planners at the local level, for benchmarking purposes and to assist in resource allocation through the identification of differences in relative need between local populations.

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Introduction

Health expectancies (HEs) combine mortality and health-related data to produce measures of life spent in various states of health. The Office for National Statistics (ONS) reports two such measures: healthy life expectancy (HLE) and disability-free life expectancy (DFLE) for the UK and its four constituent countries; these measures are important indicators of national health status over time. While differences in HEs between the constituent countries are evident, comparisons at this geographical scale conceal more sizeable differences at finer spatial scales, such as between local authorities, and electoral wards within these authorities.

Reducing inequalities in health is a public health priority; however, there is limited information relating to health expectancies at sub-national levels during inter-censal periods. As the demand for sub-national health metrics, such as HEs, is increasing to assist in the assessment of need, the planning and provision of services, and policy impact monitoring, this limitation represents a significant gap in the available knowledge base.

The most recent analyses reporting sub-national HEs compared electoral wards and local authorities using Census 2001 data (Rasulo *et al.* 2007; ONS report, 2007; ONS report, 2006). However, electoral ward analyses proved particularly problematic due to the substantial variation among wards in population size; for very small wards, this prevents the calculation of meaningful health expectancy estimates.

This report aims to support health-related planning at the small area level by estimating DFLE for Middle Super Output Areas (MSOAs). An advantage of these areas for statistical purposes is their relative homogeneity in population size.

Background

Period life expectancy (LE) is a measure of the expected length of life, based on current mortality rates within a population. By extension, HEs partition LE into years spent in favourable and unfavourable health states. DFLE, which is reported here, divides expected years of life into periods spent with and without disability. This measure reflects the duration of disability before death, and as such better indicates the health status of a population than measures of longevity alone (Rasulo *et al.* 2007).

While national estimates of HEs provide a snapshot of the morbidity experience of a whole population, they do not reveal the heterogeneity of experience within it. As such, favourable averages for large populations may be disproportionately influenced by extremes of health experience within smaller geographical groupings. For example, in the period 2000–2002 (centred on 2001), a four year difference between the highest (61.7 years in England) and lowest (57.7 years in Wales) average DFLE figures at birth for males at national level hides the much greater difference evident at Government Office Region (GOR) level at 7.6 years (ONS, 2006). Similarly, in the period 1999–2003 (centred on 2001) the DFLE differential at electoral ward level was 31 years (ONS, 2007). These contrasts clearly indicate the disparity present at lower level geographies and provide more relevant metrics to support needs assessment, priority setting and monitoring performance of policies targeted at local populations.

Electoral wards (referred to as electoral divisions in Wales) are the building blocks of administrative geography in the UK. Wards have been used extensively in health analysis but there are a number of limitations to their use. While electoral ward level analyses of LE and HE provide additional insight into the scale of health inequalities within larger sub-national areas and nationally, comparison between these geographical areas is problematic due to large variations in population size: for example, ward populations in 2001 ranged from only 995 to 35,767, with a mean of 5,952. In addition, it is difficult to draw comparisons between wards over time as their boundaries are unstable. For example, there were over 3,000 ward boundary changes in England and Wales between 1991 and 2001.

Introduced in England, Northern Ireland and Wales at the Census 2001, Output Areas (OAs) are the smallest geography of the Census 2001. Built from clusters of adjacent postcodes, they were designed to have similar population sizes, have stable boundaries and be socially homogeneous (based on housing tenure and dwelling type). OAs are aggregated into Lower Layer Super Output Areas (LSOAs) with an average population of 1,500 and a minimum population size of 1,000, and Middle Layer Super Output Areas (MSOAs) with an average population of 7,200 people and a range of 5,001 to 15, 326 people.

This article reports DFLE for MSOAs in England based on 2001 Census data. It includes DFLE at birth for individual MSOAs, as well as quintiles of MSOAs based on DFLE values, with 95 per cent confidence intervals for males and females. Individual MSOAs are referred to by the name of the local authority in which they fall, followed by a three digit number. Estimates at birth and at age 65 are also provided for quintile groupings based on a measure of relative area deprivation, the Index of Multiple Deprivation (IMD) 2004. The geographical and deprivation related patterns in health inequalities are described.

Methods

Data Sources

This study uses the Census 2001 for prevalence of limiting long-term illness, and death registration data over the period 1999 to 2003 (centred on 2001). Five years of mortality and population data were pooled in order to achieve the minimum sample size required for the calculation of meaningful LE estimates. Using three years of aggregated data to calculate LE at this small area level, as is practice for national estimates, is likely to result in overestimated LE and wider confidence intervals than desired, because the likelihood of having age bands with no deaths increases as population size decreases.

Measurement of area deprivation

Area deprivation was measured using the Indices of Multiple Deprivation 2004 (IMD 2004) which combines information on seven distinct domains, such as income and employment (Communities and Local Government, 2004). Each domain consists of a number of indicators which relate primarily to data from the Census 2001. The domains were constructed to reflect the different dimensions in which deprivation can be experienced and each can be used alone in analyses relating to the type of deprivation they describe. For the overall index the domains are weighted to reflect their relative importance (see Box 1), then combined to produce an overall deprivation measure. Each English

LSOA was assigned domain-specific and overall IMD scores. For this analysis, the IMD score for each MSOA was derived by taking the mean of the scores for the group of LSOAs making up that particular MSOA. These scores were used to rank and then group MSOAs into quintiles of relative deprivation for further analysis.

Box 1 Index of Multiple Deprivation 2004

Domain	Weight
Income deprivation	22.5%
Employment deprivation and disability	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 (2004)

Calculation of life expectancy

Standard abridged life table methods were used to calculate LE (Chiang, 1968). The tables were constructed for individual MSOAs and for each area deprivation quintile using data on all-cause mortality by sex and five-year age bands (0–4, 5–9….85 and over) over the period 1999 to 2003, and the corresponding MSOA level population according to the Census 2001. The population data from the Census 2001 was multiplied by five to derive the number of person-years consistent with the number of years covered by death registrations.

The 95 per cent confidence interval (CI) for each area was calculated using the revised Chiang method (Chiang II), allowing the calculation of the variance of the mortality rates for those age bands with no deaths registered in the analysis period. This method is the approved standard for ONS outputs of life expectancy at sub-national level (Toson and Baker, 2003).

Calculation of disability-free life expectancy

DFLE was calculated using the Sullivan method (Jagger, 1999). For each MSOA and area deprivation quintile, the prevalence of self-reported absence of disability by sex and for each five-year age band was calculated from the responses to the limiting long-term illness question at the Census in 2001 (See Box 2). The prevalence rates were multiplied by the corresponding person-years lived during a given age interval to calculate the total person-years lived in that age interval without disability. DFLE at a particular age interval was then calculated by adding up the persons-years lived without disability from that age interval to the final interval, divided by the number of people surviving to the age interval from the size of a synthetic cohort assumed at birth.

Estimates of LE and DFLE at birth and at age 65 were also calculated at the person level.

Box 2 Census 2001 question on Limiting Long-term Illness:
Do you have any long-term illness, health problem or disability which limits your daily activities or the work you can do? Include problems which are due to old age: Yes/No

Mortality rates and the prevalence of disability were calculated using the Census 2001 population as a proxy for annual mid-year population estimates (MYPE) since the latter are not available at MSOA level for all the years included in the deaths registrations.

MSOAs were ranked according to DFLE values (highest to lowest) and non-overlapping 95 per cent confidence intervals were used to judge significant differences between them.

Distribution of DFLE at birth and of MSOAs within IMD Quintiles

To assess the geographical distribution of DFLE at birth, MSOAs were ranked according to descending DFLE values and divided into five distinct groupings (quintiles), such that the fifth of MSOAs with the highest DFLE were in quintile 1 while those with the lowest were placed in quintile 5. For each quintile, the proportion of MSOAs within regions was examined. Similarly, the distribution of MSOAs within regions was examined for each area deprivation quintile.

Measures of inequality in DFLE

England

Two approaches were used to assess health inequalities across England. First, for each DFLE quintile described above, the median LE and DFLE values were calculated. Then the gap in DFLE and DFLE relative to LE between quintile extremes was used to assess the inequality in DFLE and in the proportion of life spent without disability respectively. The second approach provides a measure of deprivation-related health inequality by comparing DFLEs at birth and at age 65 in the least deprived and most deprived fifths of MSOAs.

Comparisons were drawn between quintile extremes using the median DFLE instead of the mean, since outliers have a biasing effect on the latter, that is they disproportionately ‘inflate’ or ‘deflate’ group means and standard deviations. In addition, the median is more representative of the ‘average’ LE and DFLE values since the distribution of LE and DFLE within these quintiles is not symmetrical.

Within Government Office Regions

MSOAs were grouped by GOR membership. The median DFLE for each GOR was calculated and the gap between the highest and lowest values was used to assess the level of inequality in DFLE present at regional level. As with DFLE quintiles, the distribution of DFLE within GORs is also skewed and median values provide a more accurate reflection of the ‘average’ for each region.

Additionally, a comparison of the highest and lowest DFLE values within regions may be distorted by the fact that extreme values are influenced by local factors such as the proportion of an MSOA population living in communal establishments. This influence is likely to affect southern GORs more as they have a higher proportion of people aged 65 and over living in communal establishments compared to the north (author’s analysis). To overcome this, the gap between the 5th and 95th percentile DFLE, which contains 90 per cent of MSOAs in each GOR, was used to assess the regional variation in DFLE. The median absolute deviation was also used to examine the degree of within-region variability. This method provides a more robust measure of dispersion compared to the standard deviation because it is more resilient to the effect of outliers.

Issues in the calculation of small area estimates of LE and DFLE

There are two major challenges in producing LE at small area level. First, due to the level of detail of mortality data required to calculate LE, it is very likely that some age bands in some areas will have no deaths. The contribution of these age bands to the variance in mortality is zero and this leads to increases in standard errors and the width of 95 per cent CIs. This is particularly problematic at birth since every age band contributes to the standard error (SE) of LE at birth, which reduces the precision of these estimates and therefore the reliable detection of significant differences between areas.

Toson and Baker (2003), however, showed that SEs for populations of 5,000 and above are not adversely affected by having age bands with no deaths. This population threshold was set by ONS as the standard below which sub-national LE estimates will not be calculated. In contrast to wards, all MSOAs meet this population threshold at the person level, but not for sex-specific populations. For the calculation of LE at birth for each sex therefore, multiplying the 2001 MSOA person-years by five to match the period covered by death registrations provides sex-specific population counts exceeding this threshold. However, from age 65 onwards, the sex-specific population in the majority of MSOAs do not meet the threshold. As such, LE and DFLE at age 65 for individual areas as well as for quintiles of DFLE are not reported in this article.

Second, LE estimates for small areas are likely to lack stability due to random variation in the number of deaths. To minimise the effect of this variation, five years of mortality data (that is 1999–2003) were pooled to ensure a sufficient number of death events. However, since the population count was taken at a single point in time, multiplying each age band five-fold can result in some having deaths but a zero population count.

Methodological adjustments to LE calculations

Not all MSOAs had the full complement of information needed to compute estimates of LE. In MSOAs where there were no deaths or population in the final age band (that is 85 years and over), the calculation of variance was not possible. To overcome this, the equivalent sex-specific mortality rate in the particular GOR within which these MSOAs are located was inserted into the calculation. Also, where there were deaths but no population or the number of deaths exceeds the population, the number of deaths was assumed to be correct. A population figure was then calculated for the age band in question by dividing the number of deaths in the MSOA by the corresponding GOR death rate. These adjustments were made for males in Tower Hamlets 021, Plymouth 018, St. Edmundsbury 005, and for both sexes and at the person level in Blyth Valley 006.

These adjustments were not applied in three MSOAs for two reasons. First, for males in Basingstoke and Deane 021 and South Oxfordshire 009, there were neither deaths nor populations in the final age band and a decision was taken not to simply impute the GOR specific rate (an assumption would also have to be made for disability status if GOR death rates are imputed). Second, since the person-years lived in the final age band is calculated by dividing the number of survivors in the age band by the corresponding mortality rate, this could not be calculated for Cannock Chase 010 as there were no survivors from age band 80–84 to 85 and over. As previously described, the total person-years lived at a particular age interval, used in calculating DFLE, is dependent on the contribution of person-years lived without disability from that age interval to the final. Thus, in these three MSOAs where person-years were missing in the final age band, DFLE could not be calculated for all age intervals. However, to allow the calculations to proceed in other age bands, the final age bands in these MSOAs were assumed to contribute zero person-years to the total number of person-years lived without disability.

Issues with implausible life expectancy estimates

Visual examination of LE estimates at birth for males and females suggested implausible values in some areas and were treated as potential outliers. These outliers were identified using a box plot which suggested that at birth, LE values below 62.2 for males and above 92.7 years for females were extreme outliers. Although reported in this article, female LE at birth and consequently DFLE in the following MSOAs are treated as outliers: Swindon 018, Gloucester 010, and St. Edmundsbury 005. For males, LE and DFLE at birth in Manchester 009 and Leicester 024 areas are treated as outliers.

On further investigation, outliers above the box plot threshold were found to arise from implausibly low mortality rates in final age bands. Consequently, excessively high numbers of person-years were generated in these age bands and also contributed to the total person-years lived in the younger age bands, thereby overestimating LE at birth. In contrast, outlying areas below the threshold had implausibly high mortality rates in final age bands, fewer person-years than would be expected in their final age bands; the latter resulting in underestimated LE estimates at birth.

Adjustments to the DFLE calculation

Similarly to LE, the calculation of DFLE was not possible where everyone in an age band had limiting long-term illness (LLTI) i.e. the disability-free prevalence rate equals zero or, where no one had a LLTI, i.e. disability-free rate equals 1. Since there is no justification for imputing GOR prevalence rates in these cases, disability-free rates were set at 0.01 and 0.99 respectively. For an example of this practice, please refer to the HE wards report in the following link:
http://www.ons.gov.uk/ons/taxonomy/index.html?nscl=Subnational+Health+Expectancies

A similar approach to that taken in the life tables described above was also used to allow the DFLE calculations to proceed in Basingstoke and Deane 021, South Oxfordshire 009 and Cannock Chase 010.

Results

The detailed DFLE estimates for MSOAs in England (1999-2003) are available on the Office for National Statistics website.

The estimates for males and females can be found here: Males and Females table and for all persons here: All Persons table

DFLE (with associated 95 per cent confidence intervals) and accompanying LE estimates are reported for males and females at birth and at the person level at birth and at age 65. To aid interpretation, these estimates are presented along with contextual variables such as the proportion of the population in each MSOA aged 65 and over living in medical and care establishments and IMD 2004 quintiles of relative deprivation.

Distribution of MSOAs within quintiles based on DFLE values

For both sexes there was a clear north-south geographical divide in the distribution of MSOAs across DFLE quintiles: those with the highest DFLE values were predominantly located in the South East, East of England and South West; those with the lowest values were mainly located in the North East, North West, and Yorkshire and The Humber. Figures 1 and 2 show the DFLE and IMD quintile distribution of English MSOAs.

DFLE for males at birth show that 42 per cent of MSOAs in the South East, 32 per cent in the East of England and 22 per cent in the South West were placed in the quintile with the highest values (quintile 1); but only 3 per cent in the North East and 7 per cent in the North West were in this quintile. In contrast, while 54 per cent of MSOAs in the North East, 38 per cent in the North West and 30 per cent in Yorkshire and the Humber were placed in the quintile with the lowest values (quintile 5), only 4 per cent in both the East of England and the South East, and 7 per cent in the South West were in this quintile. Similar results were observed for females (see table 1).

Figure 1 **Middle Layer Super Output Areas in England by DFLE at birth for males, 1999 to 2003 and the Index of Multiple Deprivation, 2004**

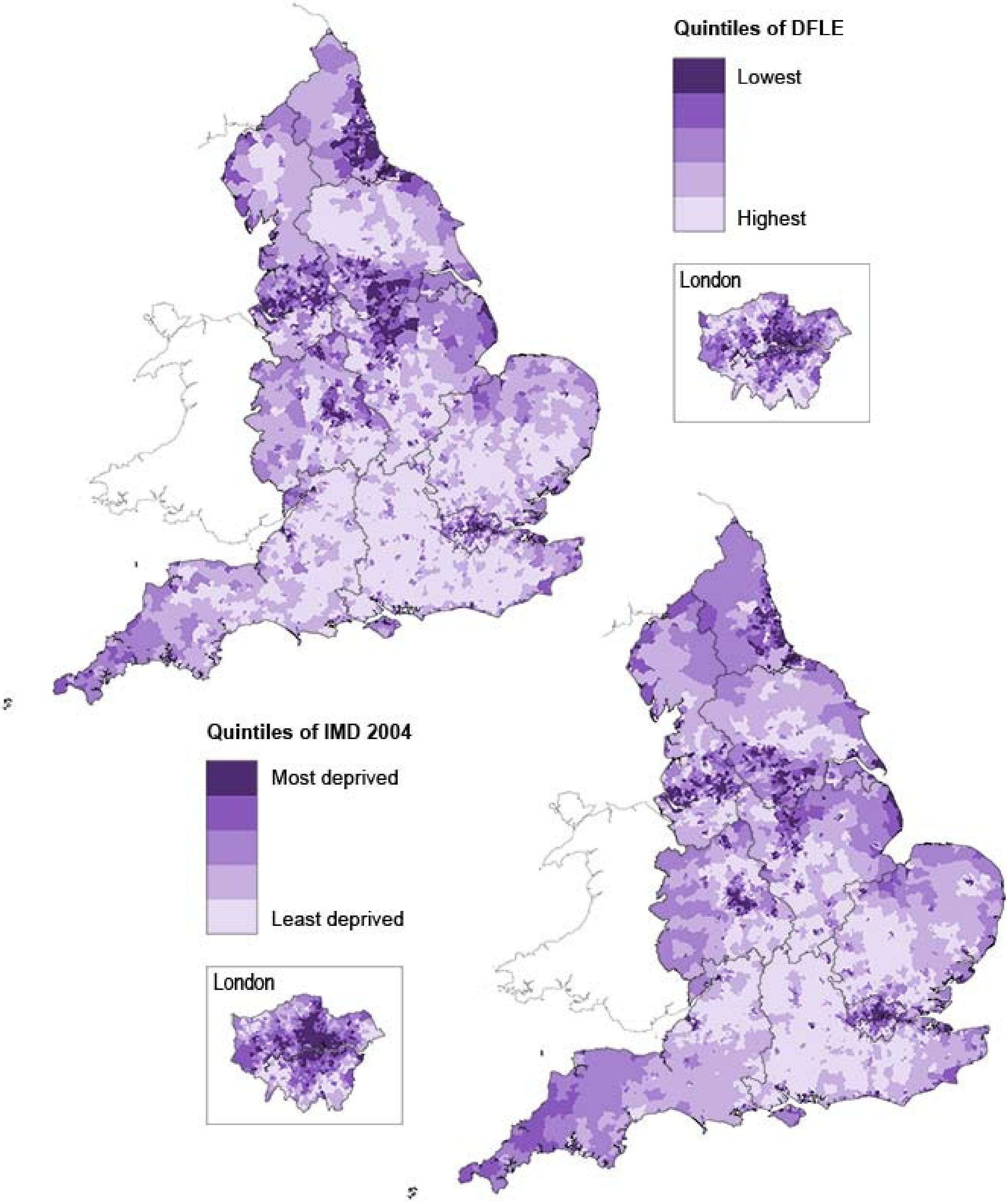


Figure 2 **Middle Layer Super Output Areas in England by DFLE at birth for females, 1999 to 2003 and the Index of Multiple Deprivation, 2004**

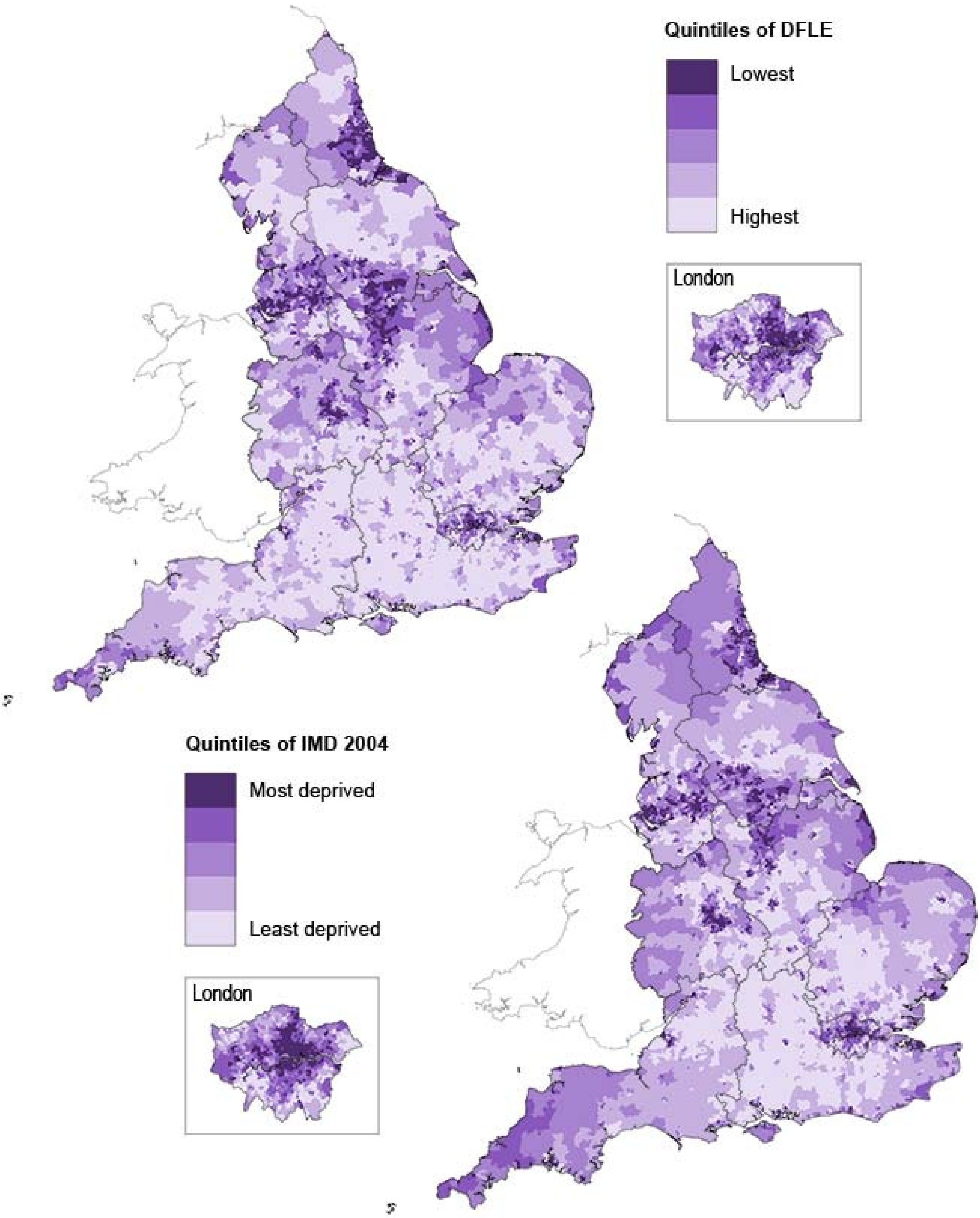


Table 1 Distribution of MSOAs by DFLE quintiles and Government Office Region, males and females at birth, 1999–2003

England | Percentages

	GOR	Quintile 1 (Highest)	Quintile 2	Quintile 3	Quintile 4	Quintile 5 (Lowest)
Males at birth	East Midlands	16.6	21.7	20.1	22.1	19.4
	East of England	32.2	29.7	22.8	11.7	3.5
	London	18.0	17.1	19.3	26.3	19.2
	North East	3.2	8.8	12.0	22.5	53.5
	North West	6.6	12.8	17.7	24.5	38.4
	South East	42.0	22.4	18.4	13.2	3.9
	South West	21.7	29.8	25.3	16.4	6.8
	West Midlands	12.0	19.6	18.2	23.9	26.3
	Yorkshire and The Humber	10.4	14.3	23.9	21.0	30.4
Females at birth	East Midlands	13.1	21.0	23.1	22.2	20.5
	East of England	29.6	30.3	23.9	13.2	3.0
	London	16.7	16.5	20.4	25.3	21.1
	North East	3.5	9.1	13.5	23.7	50.3
	North West	7.2	12.3	17.6	23.6	39.4
	South East	43.7	22.2	17.8	12.8	3.5
	South West	26.8	30.2	24.2	14.0	4.9
	West Midlands	10.2	20.1	17.1	25.0	27.5
	Yorkshire and The Humber	11.2	15.1	21.5	23.2	29.0

DFLE at birth in the highest and lowest ranked MSOAs

For the purpose of the following analyses, the highest and lowest ranked areas only refer to the top and bottom ten areas respectively. The rankings exclude areas with outlying LE estimates.

For males DFLE at birth was highest in Kensington and Chelsea 016 (73.9 years). This figure is 29.8 years higher than in Manchester 013, the MSOA with the lowest DFLE at birth (44.1 years). For females DFLE at birth was highest in Kensington and Chelsea 012 (74.4 years) and lowest in Liverpool 039 (48.2 years), a gap of 26.2 years.

Among the highest ranked areas, not all differences between the highest ranked and the other MSOAs within this grouping were significant. For example, while DFLE at birth for males in Kensington and Chelsea 016 was significantly higher than those in Guildford 016, Kensington and Chelsea 012, Bromley 021, Kensington and Chelsea 010, St Albans 005, Guildford 011, Basingstoke and Deane 021 it was not significantly different from those in South Bucks 002, and Westminster 019. Similar results were found among the lowest ranked areas and for females (Tables 2 and 3).

Table 2 Life expectancy and disability-free life expectancy in the highest and lowest ranked MSOAs: by DFLE, males at birth, 1999–2003

England Years/Percentages

	MSOA	GOR	LE	DFLE	Lower 95% confidence interval	Upper 95% confidence interval
Highest ranked	Kensington and Chelsea 016	London	89.3	73.9	*73.0*	*74.8*
	South Bucks 002	South East	82.8	72.7	*72.0*	*73.4*
	Westminster 019	London	83.1	72.6	*71.5*	*73.8*
	Guildford 016	South East	83.3	72.3	*72.1*	*72.4*
	Kensington and Chelsea 012	London	82.5	72.1	*72.0*	*72.1*
	Bromley 021	London	83.0	71.9	*71.0*	*72.8*
	Kensington and Chelsea 010	London	82.9	71.7	*71.2*	*72.2*
	Guildford 011	South East	81.2	71.6	*71.5*	*71.7*
	St Albans 005	East of England	83.2	71.6	*70.9*	*72.3*
	Basingstoke and Deane 021	South East	77.9	71.2	*71.1*	*71.3*
Lowest ranked	Easington 003	North East	71.2	46.7	*46.2*	*47.2*
	Barnsley 014	Yorkshire and The Humber	72.5	46.6	*46.2*	*47.1*
	Blackpool 007	North West	67.6	46.6	*45.8*	*47.3*
	Bolton 016	North West	65.9	46.5	*45.5*	*47.5*
	Easington 006	North East	72.1	45.7	*45.3*	*46.1*
	Liverpool 023	North West	66.6	45.6	*44.6*	*46.6*
	Liverpool 024	North West	67.1	45.6	*44.6*	*46.6*
	Wirral 011	North West	66.7	45.3	*44.8*	*45.8*
	Wirral 016	North West	66.7	44.4	*43.7*	*45.1*
	Manchester 013	North West	62.5	44.1	*43.2*	*45.0*

Table 3 Life expectancy and disability-free life expectancy in the highest and lowest ranked MSOAs: by DFLE, females at birth, 1999–2003

England Years/Percentages

	MSOA	GOR	LE	DFLE	Lower 95% confidence interval	Upper 95% confidence interval
Highest ranked	Kensington and Chelsea 012	London	87.1	74.4	*73.7*	*75.0*
	Richmond upon Thames 007	London	87.1	73.8	*73.8*	*73.9*
	Wycombe 020	South East	88.5	73.8	*73.1*	*74.5*
	Kensington and Chelsea 008	London	86.4	73.8	*73.7*	*73.9*
	St Albans 005	East of England	89.0	73.7	*73.6*	*73.8*
	Leeds 001	Yorkshire and The Humber	88.6	73.6	*73.5*	*73.7*
	Kensington and Chelsea 016	London	91.3	73.5	*73.0*	*74.1*
	Waverley 016	South East	86.4	73.4	*73.3*	*73.5*
	Kensington and Chelsea 018	London	87.9	73.2	*73.1*	*73.3*
	Guildford 018	South East	85.5	73.2	*73.0*	*73.4*
Lowest ranked	Manchester 010	North West	72.5	50.8	*50.2*	*51.4*
	Wigan 010	North West	73.8	50.7	*50.3*	*51.2*
	Manchester 013	North West	72.4	50.7	*49.9*	*51.6*
	Liverpool 022	North West	73.1	50.7	*49.8*	*51.5*
	Bolton 016	North West	75.9	50.7	*50.1*	*51.2*
	Liverpool 044	North West	74.1	50.5	*49.9*	*51.2*
	Liverpool 037	North West	73.5	50.5	*50.2*	*50.7*
	Easington 006	North East	76.8	49.9	*49.6*	*50.3*
	Liverpool 024	North West	72.4	49.6	*49.0*	*50.2*
	Liverpool 039	North West	72.5	48.2	*48.0*	*48.3*

Relative DFLE at birth in the highest and lowest ranked MSOAs

As with absolute DFLE, the proportion of life spent without disability was also characterised by a north to south polarity; MSOAs with the highest DFLE relative to LE were predominantly located in the southern GORs and those with the lowest in the north (see tables 4 and 5).

For males relative DFLE at birth was highest in Basingstoke and Deane 021 (91.5 per cent) and lowest in Easington 006 (63.3 per cent). For females at birth, it was highest in Richmond upon Thames 009 (87.5 per cent) and lowest in Easington 006 (65.0 per cent).

Among those areas ranked with the highest absolute DFLE at birth, not all were ranked highest in relative DFLE. In fact for males, only Basingstoke and Deane 021 was ranked highest in both absolute and relative terms. A similar picture occurs for the lowest ranked areas: only Barnsley 018, Easington 006 and Wirral 011 were ranked in the lowest grouping in both absolute and relative DFLE. Thus, areas observed to have much higher or lower absolute DFLE are not always indicative of longer or shorter proportions of life without disability.

For females at birth, none of the highest ranked areas by DFLE were similarly ranked in proportional terms. Among the lowest ranked areas according to absolute DFLE, only Liverpool 039, Bolton 016 and Easington 006 were also ranked lowest in relative terms.

Table 4 Highest and lowest ranked areas by proportion of life spent without disability, males at birth, 1999–2003

England | Years/ Percentages

	MSOA	GOR	LE	DFLE	DFLE as a proportion of LE (%)
Highest ranked areas	Basingstoke and Deane 021	South East	77.9	71.2	*91.5*
	Elmbridge 016	South East	77.9	70.1	*90.0*
	Surrey Heath 005	South East	79.0	70.5	*89.3*
	Elmbridge 011	South East	78.1	69.5	*89.0*
	Woking 002	South East	78.5	69.8	*89.0*
	Basingstoke and Deane 003	South East	77.7	69.0	*88.9*
	Mid Sussex 004	South East	78.3	69.6	*88.8*
	Three Rivers 004	East of England	78.9	70.1	*88.8*
	Elmbridge 005	South East	77.5	68.7	*88.7*
	Richmond upon Thames 008	London	73.6	65.2	*88.6*
Lowest ranked areas	Barnsley 018	Yorkshire and The Humber	71.2	47.9	*67.2*
	Wirral 016	North West	66.7	44.4	*66.6*
	Barnsley 022	Yorkshire and The Humber	72.9	48.5	*66.6*
	Easington 012	North East	73.3	48.7	*66.5*
	Easington 008	North East	73.1	48.0	*65.7*
	Easington 003	North East	71.2	46.7	*65.6*
	Knowsley 010	North West	73.5	48.1	*65.5*
	Easington 007	North East	73.7	47.5	*64.5*
	Barnsley 014	Yorkshire and The Humber	72.5	46.6	*64.3*
	Easington 006	North East	72.1	45.7	*63.3*

Table 5 Highest and lowest ranked areas by proportion of life spent without disability, females at birth, 1999–2003

England Years/ Percentages

	MSOA	GOR	LE	DFLE	DFLE as a proportion of LE (%)
Highest ranked areas	Richmond upon Thames 009	London	79.8	69.8	*87.5*
	Reigate and Banstead 007	South East	78.2	68.4	*87.4*
	Cherwell 012	South East	83.3	72.7	*87.3*
	Wycombe 007	South East	80.5	70.3	*87.3*
	Elmbridge 016	South East	83.8	73.1	*87.2*
	Windsor and Maidenhead 017	South East	78.8	68.7	*87.2*
	West Berkshire 015	South East	78.0	67.9	*87.1*
	Elmbridge 002	South East	82.3	71.7	*87.1*
	Wokingham 016	South East	79.2	69.0	*87.1*
	Elmbridge 018	South East	83.1	72.3	*86.9*
Lowest ranked areas	Bolton 016	North West	75.9	50.7	*66.7*
	Stoke-on-Trent 017	West Midlands	79.5	52.8	*66.5*
	Liverpool 039	North West	72.5	48.2	*66.4*
	Easington 008	North East	77.3	51.3	*66.4*
	Birmingham 039	West Midlands	82.9	55.0	*66.3*
	Barnsley 014	Yorkshire and The Humber	78.4	51.9	*66.2*
	Knowsley 010	North West	80.3	52.7	*65.6*
	Newham 033	London	85.6	55.9	*65.3*
	Easington 007	North East	79.2	51.6	*65.2*
	Easington 006	North East	76.8	49.9	*65.0*

DFLE at birth for Government Office Regions

For both sexes, the median DFLE at birth was highest in the South East and lowest in the North East: for males at birth, those in the South East could expect to live without disability for an additional 8.3 years compared with those in the North East; for females, this inequality was 7.1 years.

The proportion of life spent without a disability was also highest in the southern GORs of the South East, South West and East and lowest in the northern GORs. Males in the South East could expect to spend 84.1 per cent of their life without disability compared with only 76.1 per cent in the North East. For females, the comparable proportions were 82.4 and 75.9 per cent for these GORs.

For males, the DFLE values for the 5th and the 95th DFLE percentiles showed both of these to be lowest in the North West, North East and Yorkshire and the Humber and highest in the East of England, South East and South West (table 6). Between GORs, the 5th percentile ranged from 49.5

years in the North West to 58.1 years in the East of England, a gap of 8.6 years; and 95th percentile ranged from 65.4 years in the North East to 69.5 in the South East, a gap of 4.1 years. Similar results were found among females (table 7).

Within regions, the range between the 5th and 95th percentile values showed that the gap in DFLE was wider among northern GORs compared to southern ones. For males, the widest gap was 16.8 years in the North West while the smallest was 10.6 years in the East of England; for females, the equivalent gaps were 15.3 years in the North West and 9.3 years in the East of England. The median absolute variation also showed that there were wider DFLE gaps within GORs in the north compared with those in the south. For males, the largest variation was in the North West and smallest in the East of England. For females, the largest variation was also in the North West but smallest in the South West (see tables 6 and 7). Thus the pattern of variation was such that the gap in DFLE between the MSOA with the highest and that with the lowest value was greater in GORs with low DFLE values compared to those with higher values.

Table 6 Median, median absolute deviation and range of DFLE for MSOAs by Government Office Region, males at birth, 1999–2003

England Years

GOR	Median	Median Absolute Deviation	5th Percentile	95th Percentile	Range between 5th and 95th percentile
East Midlands	61.9	3.24	52.8	67.3	14.5
East of England	64.7	2.03	58.1	68.7	10.6
London	61.6	3.34	54.5	68.5	14.0
North East	56.8	3.52	49.7	65.4	15.7
North West	59.2	3.86	49.5	66.4	16.8
South East	65.1	2.47	57.6	69.5	11.9
South West	63.7	2.11	56.6	68.1	11.6
West Midlands	60.9	3.57	53.1	67.0	13.9
Yorkshire and The Humber	60.6	3.43	51.7	67.0	15.3
England	62.3	3.32	52.8	68.2	15.5

Table 7 Median, median absolute deviation and range of DFLE for MSOAs by Government Office Region, females at birth, 1999–2003

England Years

GOR	Median	Median Absolute Deviation	5th Percentile	95th Percentile	Range between 5th and 95th percentile
East Midlands	64.5	2.63	56.8	69.1	12.3
East of England	66.5	1.85	61.1	70.4	9.3
London	63.9	3.04	57.6	69.9	12.3
North East	60.3	3.13	54.1	67.4	13.3
North West	61.8	3.46	53.3	68.6	15.3
South East	67.4	2.15	61.0	71.2	10.2
South West	66.3	1.78	60.4	70.0	9.7
West Midlands	63.3	3.17	55.6	69.0	13.3
Yorkshire and The Humber	63.4	3.11	55.2	69.1	13.9
England	64.7	2.97	56.3	70.0	13.8

Comparison with national figures

For males absolute DFLE at birth was lower in all northern GORs than the national average; substantially lower in the North West and North East (3.2 and 5.6 years respectively) but only 0.4 years lower in the East Midlands, 1.5 years in the West Midlands and 1.7 years in Yorkshire and the Humber. In contrast, with the exception of London, all southern GORs had a higher DFLE at birth than national figures; 2.4 years higher in the East of England, 2.7 years in the South East, 1.4 years in the South West. Similarly, compared with the national average, the proportion of life spent without disability was lower in all northern GORs and higher among those in the south. Results were similar for females (table 8).

Table 8 Proportion of life spent without disability: by Government Office Region and sex, 1999–2003

England | Years/ Percentages

	GOR	Median LE	Median DFLE	Lower 95% confidence interval	Upper 95% confidence interval	DFLE as a proportion of LE (%)
Males at birth	East Midlands	76.1	61.9	*61.5*	*62.3*	*81.4*
	East of England	77.3	64.7	*64.3*	*64.9*	*83.7*
	London	75.6	61.6	*61.1*	*62.0*	*81.4*
	North East	74.6	56.8	*56.2*	*57.5*	*76.1*
	North West	74.7	59.2	*58.5*	*59.5*	*79.2*
	South East	77.4	65.1	*64.9*	*65.4*	*84.1*
	South West	77.5	63.7	*63.4*	*63.9*	*82.2*
	West Midlands	75.5	60.9	*60.4*	*61.5*	*80.6*
	Yorkshire and The Humber	75.6	60.6	*60.1*	*61.2*	*80.2*
	England	76.3	62.3	*62.2*	*62.5*	*81.7*
Females at birth	East Midlands	80.7	64.5	*63.9*	*64.7*	*79.9*
	East of England	81.8	66.5	*66.3*	*66.8*	*81.3*
	London	80.9	63.9	*63.6*	*64.3*	*79.0*
	North East	79.4	60.3	*59.7*	*60.8*	*75.9*
	North West	79.7	61.8	*61.4*	*62.3*	*77.5*
	South East	81.7	67.4	*67.1*	*67.6*	*82.4*
	South West	81.9	66.3	*66.1*	*66.5*	*81.0*
	West Midlands	80.6	63.3	*62.7*	*63.7*	*78.6*
	Yorkshire and The Humber	80.6	63.4	*62.9*	*63.7*	*78.6*
	England	81.0	64.7	*64.6*	*64.9*	*79.9*

Quintile level analysis of DFLE at birth

For both sexes there were substantial inequalities in DFLE at birth between the highest and lowest quintiles of areas; however, the gap was significantly wider for males than for females. While males in the fifth of MSOAs with the highest DFLE at birth could expect to spend an additional 12.5 years free from disability than those in the bottom fifth, for females this inequality was only 11.2 years.

In each quintile females had a higher DFLE at birth than males; however, they also spent a higher proportion of life with a disability (table 9). In quintile 1, males at birth could expect to spend 84.9 per cent of their life without disability, compared with only 75.9 per cent in quintile 5. For females the equivalent proportions were 82.9 per cent compared with 74.3 per cent respectively.

DFLE at age 65 was not calculated for each quintile of DFLE values, since estimates were not calculated for individual areas at this age.

Table 9 Summary statistics of DFLE quintiles for MSOAs, 1999–2003: males and females at birth

England Years/ Percentages

	Quintiles of DFLE	Median LE	Median DFLE	Lower 95% confidence interval	Upper 95% confidence interval	DFLE as a proportion of LE (%)	Minimum DFLE	Maximum DFLE
Males at birth	Highest- 1	79.2	67.2	*67.1*	*67.3*	*84.9*	65.9	73.9
	2	77.6	64.7	*64.7*	*64.8*	*83.4*	63.5	65.9
	3	76.3	62.3	*62.3*	*62.4*	*81.7*	61.0	63.5
	4	74.6	59.3	*59.2*	*59.4*	*79.5*	57.3	61.0
	Lowest- 5	72.1	54.7	*54.5*	*54.8*	*75.9*	44.1	57.3
	Range between Quintiles 1 and 5	7.1	12.5	*12.4*	*12.7*	*9.0*	21.8	16.6
	England	76.3	62.3	*62.2*	*62.5*	*81.7*	44.1	73.9
Females at birth	Highest- 1	83.4	69.2	*69.1*	*69.2*	*82.9*	67.9	74.3
	2	82.0	66.9	*66.8*	*66.9*	*81.5*	65.8	67.9
	3	81.0	64.7	*64.7*	*64.8*	*79.9*	63.6	65.8
	4	79.8	62.1	*62.0*	*62.2*	*77.8*	60.3	63.6
	Lowest- 5	78.0	57.9	*57.8*	*58.1*	*74.3*	48.2	60.3
	Range between Quintiles 1 and 5	5.4	11.2	*11.0*	*11.4*	*8.6*	19.7	14.0
	England	81.0	64.7	*64.6*	*64.9*	*79.9*	48.2	74.3

Distribution of MSOAs within IMD 2004 quintiles

For both sexes there were clear regional differences in the distribution of MSOAs in the least and most deprived quintiles; 44.8 per cent of MSOAs in the South East, 32.5 per cent in the East of England and 19.4 per cent in the South West were members of the least deprived quintile. In contrast, only 4.7 per cent in the North East and 10.0 per cent in the North West were in this group. The regional pattern was reversed for the most deprived quintile: while 42.1 per cent of MSOAs in the North East, 33.4 per cent in the North West and 30.5 per cent in Yorkshire and the Humber were placed in this quintile, only 5.0 per cent in the East of England, 4.1 per cent in the South East and 6.6 per cent in the South West were in this group.

Table 10 Distribution of MSOAs by IMD 2004 quintiles and Government Office Regions, 1999–2003

England Percentages

GOR	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
East Midlands	21.7	19.8	20.7	20.7	17.2
East of England	32.5	28.9	20.6	13.0	5.0
London	9.9	14.4	19.0	28.9	27.8
North East	4.7	9.9	18.7	24.6	42.1
North West	10.0	16.1	18.8	21.8	33.4
South East	44.8	21.4	17.6	12.1	4.1
South West	19.4	29.6	24.5	19.9	6.6
West Midlands	12.5	20.8	19.9	20.5	26.3
Yorkshire and The Humber	9.8	16.0	21.9	21.8	30.5

DFLE at birth and at age 65 by area deprivation

Absolute DFLE

For both sexes there was an inverse relationship between relative deprivation and DFLE; as relative deprivation increased, the number of years lived without disability decreased. (See Figures 3 & 4).

The gap in DFLE at birth between quintile extremes was significantly greater for males than for females. While males at birth in the least deprived areas could expect to spend an additional 12.6 years without disability compared with those in the most deprived areas, the equivalent inequality for females was 10.9 years.

At age 65 inequality in DFLE was still present and differences by sex, though much narrower than at birth, were significant. Males in the least deprived areas could expect to spend an extra 4.0 years without disability compared with those in the most deprived areas; for females the equivalent gap was 3.8 years.

As described earlier, it was not possible to calculate DFLE at age 65 for quintiles based on DFLE values because DFLE was not estimated for individual MSOAs at this age. In contrast, DFLE at age 65 was calculated for each quintile of area deprivation as this was not dependent on individual DFLE values at this age.

Figure 3 **Life expectancy (LE) and disability-free life expectancy (DFLE) for males at birth by quintiles of relative deprivation: MSOAs in England, 1999–2003**

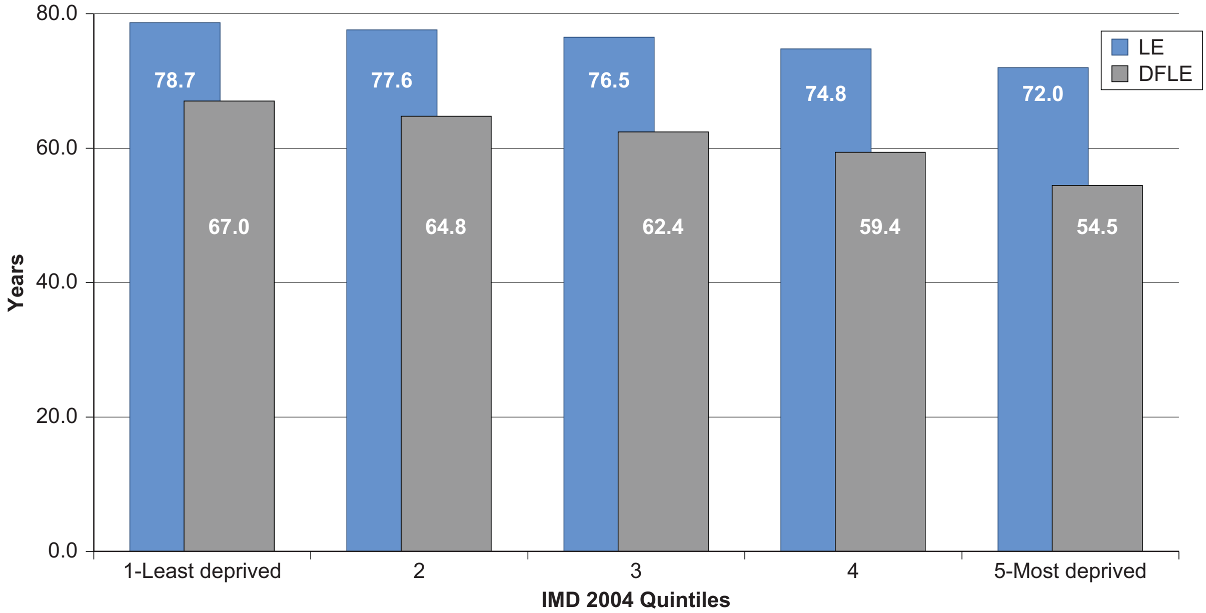
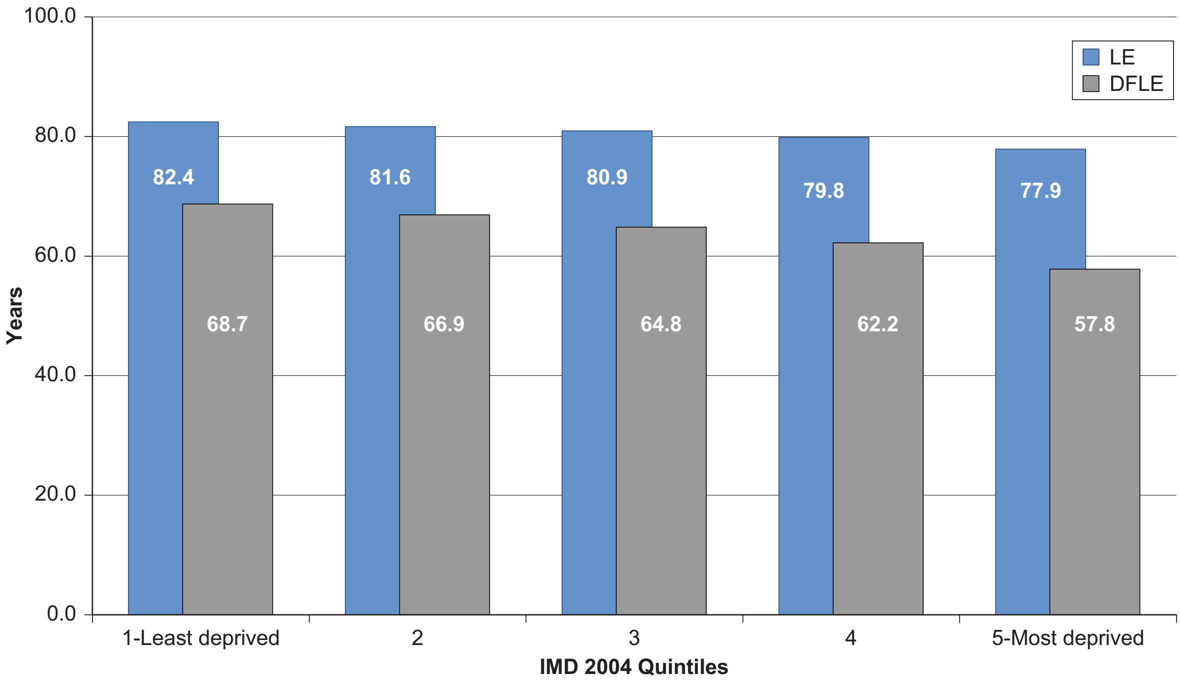


Figure 4 **Life expectancy (LE) and disability-free life expectancy (DFLE) for females at birth by quintiles of relative deprivation: MSOAs in England, 1999–2003**



Relative DFLE

In all deprivation quintiles at birth and at age 65, females spent a higher proportion of life with disability than males. In the least deprived areas, males at birth could expect to spend 85.2 per cent of their life without disability, compared with only 75.7 per cent in the most deprived areas. For females the equivalent proportions were 83.3 per cent compared with 74.2 per cent respectively. However, the advantage of men in relative DFLE at national level is modified by level of area deprivation; females in quintiles 1, 2 and 3 spend a larger proportion of their life free of disability than males in quintiles 4 and 5.

At age 65 the inequality in relative DFLE between the deprivation extremes was considerably wider than at birth: males in the least deprived areas could expect to spend 56.6 per cent of their remaining life without disability compared with only 41.0 per cent in the most deprived areas. For females the equivalent proportions were 53.0 per cent and 39.1 per cent respectively. (See Figures 5 & 6). The similar modifying effect of area based deprivation on the national pattern by sex observed at birth was also present at age 65.

Figure 5 **Proportion of life spent without disability for males by age and quintiles of relative deprivation: MSOAs in England, 1999–2003**

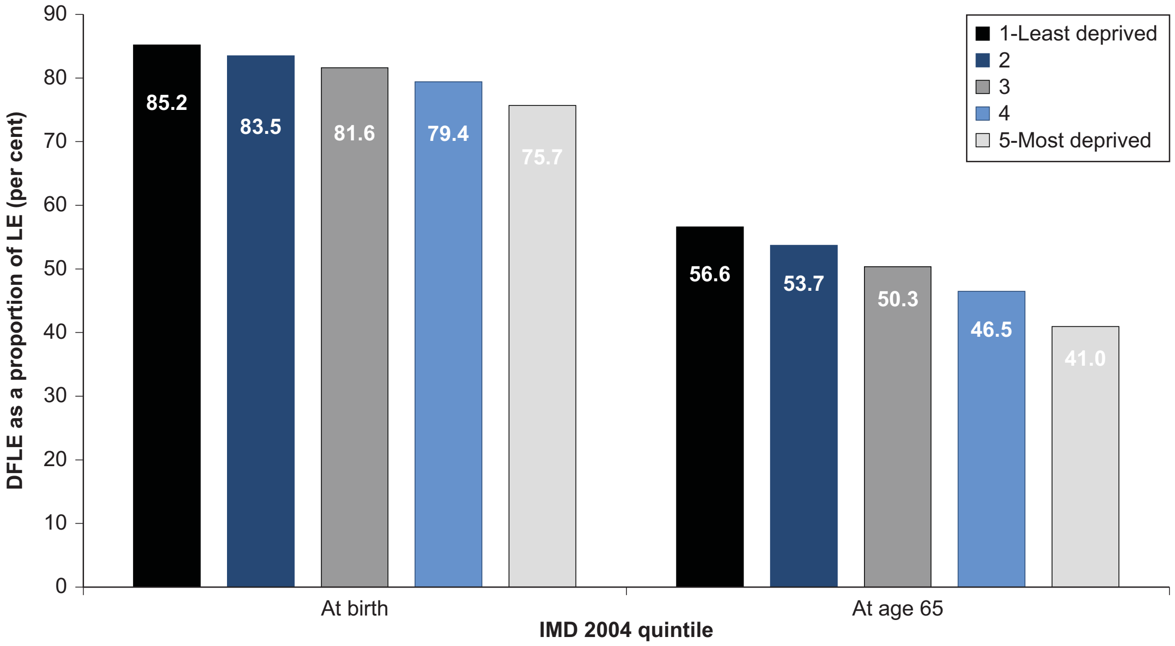
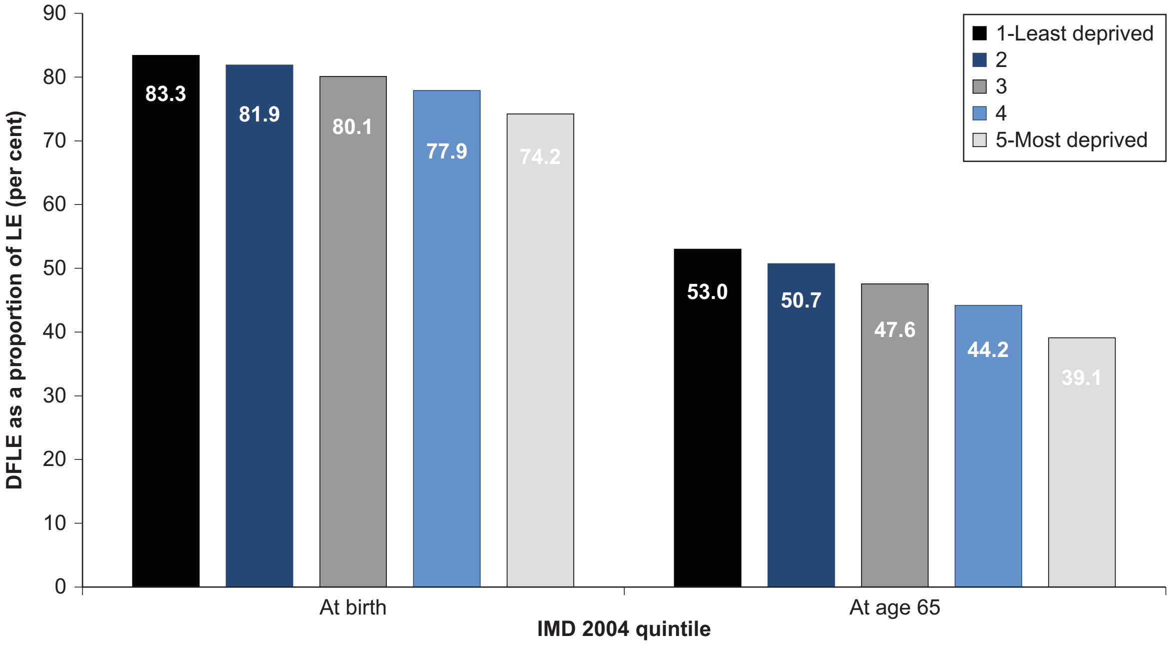


Figure 6 Proportion of life spent without disability for females by age and quintiles of relative deprivation: MSOAs in England, 1999–2003



The scale of inequality in DFLE varied across adjacent deprivation quintiles; the inequality in DFLE at birth and at age 65 between quintiles 4 and 5 for both sexes, was considerably wider than that between any other two adjacent quintiles. These gaps were also wider for males than for females (table 11).

Comparison with national figures

The absolute and relative DFLE at birth for males in England was considerably higher than that for those living in the most deprived areas: 61.7 years (81.2 per cent) compared with only 54.5 years (75.7 per cent) respectively. For females the equivalent figures were 64.2 years (79.7 per cent) compared with only 57.8 years (74.2 per cent) respectively.

In contrast, males and females in the least deprived areas had a higher DFLE at birth than the corresponding national estimates. At age 65 a similar pattern was observed (table 11).

Table 11 Life expectancy and disability-free life expectancy: by area deprivation, males and females at birth, and at age 65, 1999–2003

England | Years/ Percentages

	IMD 2004 Quintile	LE	DFLE	Lower 95% confidence interval	Upper 95% confidence interval	DFLE as a proportion of LE (%)
Males at birth	1-Least deprived	78.7	67.0	*67.0*	*67.0*	*85.2*
	2	77.6	64.8	*64.8*	*64.8*	*83.5*
	3	76.5	62.4	*62.4*	*62.4*	*81.6*
	4	74.8	59.4	*59.4*	*59.4*	*79.4*
	5-Most deprived	72.0	54.5	*54.5*	*54.5*	*75.7*
	Range	6.7	12.6	*12.5*	*12.6*	*9.5*
	England	75.9	61.7	*61.7*	*61.7*	*81.2*
Males at age 65	1-Least deprived	17.4	9.8	*9.8*	*9.9*	*56.6*
	2	16.8	9.0	*9.0*	*9.1*	*53.7*
	3	16.2	8.2	*8.1*	*8.2*	*50.3*
	4	15.4	7.2	*7.1*	*7.2*	*46.5*
	5-Most deprived	14.3	5.9	*5.8*	*5.9*	*41.0*
	Range	3.0	4.0	*3.9*	*4.0*	*15.6*
	England	16.1	8.0	*8.0*	*8.1*	*50.1*
Females at birth	1-Least deprived	82.4	68.7	*68.7*	*68.7*	*83.3*
	2	81.6	66.9	*66.8*	*66.9*	*81.9*
	3	80.9	64.8	*64.8*	*64.8*	*80.1*
	4	79.8	62.2	*62.2*	*62.2*	*77.9*
	5-Most deprived	77.9	57.8	*57.8*	*57.8*	*74.2*
	Range	4.5	10.9	*10.8*	*10.9*	*9.1*
	England	80.5	64.2	*64.2*	*64.2*	*79.7*
Females at age 65	1-Least deprived	20.2	10.7	*10.7*	*10.7*	*53.0*
	2	19.7	10.0	*9.9*	*10.0*	*50.7*
	3	19.3	9.2	*9.1*	*9.2*	*47.6*
	4	18.7	8.3	*8.2*	*8.3*	*44.2*
	5-Most deprived	17.7	6.9	*6.9*	*7.0*	*39.1*
	Range	2.5	3.8	*3.7*	*3.8*	*13.9*
	England	19.1	9.0	*9.0*	*9.0*	*47.2*

Differences in the distribution of MSOAs across DFLE and IMD 2004 quintiles

The distribution of MSOAs within DFLE and IMD 2004 quintiles was such that those with the highest DFLE were not always placed in the least deprived areas, nor were those with the lowest all placed in the most deprived areas. Nevertheless, MSOAs placed in quintiles 1 and 5 by DFLE estimates predominantly occupied the same area deprivation quintile.

There was a clear difference by sex in the proportion of MSOAs equivalently placed on both quintile measures: for males, 74.0 per cent of MSOAs in DFLE quintile 1 were placed in the least deprived areas, while the equivalent proportion for females was only 69.3 per cent. The sex differences were much narrower for the most deprived areas in quintile 5: for males, while 83.6 per cent of MSOAs in DFLE quintile 5 were in the most deprived areas, the equivalent proportion for females was 81.9 per cent.

Discussion

This report measures DFLE at birth and at age 65 for males and females at the small area level. It has identified inequalities in both the number of years and proportion of life spent without disability between area groupings based on level of absolute DFLE and the IMD 2004 measure of area deprivation. It represents the first use of English MSOAs in estimating LE and DFLE by the ONS.

For both sexes there was a clear north-south divide in the regional density of MSOAs across quintiles of both DFLE and relative deprivation: MSOAs with the highest DFLE at birth were predominantly located in southern regions while those with the lowest had a greater density in the north; the most advantaged MSOAs were concentrated in southern regions and consequently had the highest DFLE at birth and at age 65

While the geographical variation in DFLE may in part be due to differences in the contextual characteristics of northern and southern MSOAs, it is likely to be influenced more by the underlying spatial differences in their socioeconomic composition. Several studies suggest that material disadvantage at an individual level accounts for most but not all spatial inequality in measures of health (Joshi *et al.* 2000; Woods *et al.* 2005). It is also widely accepted that the historical spatial variation in the employment structure in England, with a higher concentration of heavy industries (dominated by manual occupations) in the north, is partly responsible for area differences in health. People exposed to the hazards associated with these occupations as well as their families are more likely to experience material deprivation and less likely to adopt healthy lifestyle behaviours (Joshi *et al*. 2000). This article has not attempted to separate the relative contributions of contextual and individual level characteristics on observed geographical variations in DFLE.

The pattern of inequality found in this study is broadly consistent with previous research: DFLE at birth and at age 65 varied inversely with relative deprivation. The gap in DFLE at birth between the least and the most deprived areas was substantial and greater for males than for females. The gaps were still present at age 65; the magnitudes, however, were considerably smaller than at birth and the sex differences were much narrower.

In relative terms, females spent a higher proportion of life with disability than males across all deprivation quintiles. Compared to absolute DFLE, for both sexes the gap in relative DFLE between the least and the most deprived areas was wider at age 65 than at birth, and these gaps were greater for males than females. However, level of deprivation has an important modifying influence on the national pattern of relative DFLE by sex. The relative DFLE of women living in more affluent areas is higher than that of men living in more deprived areas.

For males the scale of inequality in DFLE at birth between quintile extremes was slightly greater for area deprivation than for DFLE. While males in the least deprived areas spent an additional 12.6 years without disability compared with those in the most deprived areas, the equivalent DFLE quintile gap was 12.5 years. For females the reverse was the case: the gap in DFLE at birth between quintile extremes was wider for DFLE than for area deprivation (11.2 compared with 10.9 years respectively). These differences are explained by the fact that males in DFLE quintiles 1 and 5 were more likely to occupy the same quintile of area deprivation than their female counterparts. For both sexes, over a quarter of MSOAs with the highest DFLE values were not in the most affluent areas, highlighting the fact that the measure of deprivation used leaves some of the variations in DFLE between areas unexplained and other latent factors outside the scope of the IMD 2004 are likely to contribute to these differences. Nevertheless, the concentration of disability in highly deprived areas confirms the importance of ecological deprivation in discriminating DFLE at the small area level.

While ward level analyses represent an alternative approach to estimating DFLE at small area level, wards are heterogeneous in terms of spatial scale and population size. The stability, accuracy and precision of measured health events between area comparisons and across the entire population of wards are therefore uncertain, reducing the scope for objective interpretation for policy purposes. For example, in a previous report (ONS Report, 2006), the sex-specific population counts in some wards were too small to allow calculation of DFLE at birth by sex even after temporal aggregation of five years of data. These limitations, however, were not encountered at MSOA level as the population count in each area was sufficiently large to compute DFLE at birth at the person level and by sex with temporal aggregation.

Another advantage of MSOA level analyses, as opposed to ward level, is the scope to track changes in health inequalities over time; MSOA boundaries were not designed for frequent change, hence ensuring spatial consistency and more meaningful comparison over time.

A further advantage of estimating HEs at MSOA level is the consistent level of precision in estimates compared with wards. The wide margins of error at ward level makes comparisons between individual areas difficult; for example, in the analyses covering the period 1999 to 2003, the average width of CI for ward DFLE at birth was 3.8 years for males and 3.6 years for females, while for individual areas the widest CIs were 25.2 years for males and 29.9 for females (ONS, 2007). The equivalent widths at MSOA level were much narrower: on average 1.1 years and 1.0 year for males and females respectively and at worst only 5.1 and 6.6 years for males and females for individual areas.

A possible source of bias in these analyses is the relative density of nursing and residential care homes across areas. For both sexes GORs in the south had a higher proportion of people aged 65 and over in these institutions, while the proportion of females was higher than males (author’s analysis). The inclusion of the institutional population is therefore likely to reduce DFLE more in the most affluent areas than the most deprived and act to narrow the gap in inequality between these areas. Nevertheless, in a previous study, Bebbington and Darton (1996) found that the overall effect of adjusting for the institutional population was small.

Conclusions

The estimation of health indices for small areas is important for resource allocation and for effective monitoring and planning purposes, since many services are implemented and delivered locally.

This report provides estimates of LE and DFLE at birth and at age 65 for individual MSOAs and measures of geographical and deprivation-related health inequalities in England for the period 1999–2003. For both sexes there are significant differences in DFLE at birth and at age 65 based on these two measures, while differences by sex were also present. We have illustrated the relative advantages of MSOAs over wards in estimating DFLE for small areas; their relative homogeneity in terms of population size and structure means that estimates are more precise and better inference between areas can be drawn. There is also scope for monitoring changes in health inequalities as MSOAs were designed to undergo minimal boundary changes over time.

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