Healthy life expectancy by area deprivation: magnitude and trends in England, 1994–1999

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This article examines the magnitude of inequalities in health by area deprivation using two composite indices of health expectancy, one based on a subjective assessment of general health status (healthy life expectancy) and the second on reported limiting longstanding illness (disability-free life expectancy). Trends in healthy life expectancy by deprivation for the period 1994–1999 were also examined.

Results show that males and females living in the most deprived wards spend twice as many years in poor health, both in absolute (years of life) and relative (proportion of life) terms, than those living in the least deprived wards. There was no change in the healthy life expectancy gap between the most and least deprived areas over the study period.

Introduction

The enduring association of inequalities in health with measures of socio-economic status is well established. Since the early 1980s there have been a wealth of studies documenting the substantial relationship between socioeconomic status – whether measured by occupation, educational attainment or income – and a wide range of measures of mortality, morbidity, well-being and health care utilisation. What is less clear, however, is the combined impact of the differences in premature mortality with the lifelong experience of health and illness on social inequalities in health.

Recent shifts in public policy have led to increased interest in whole-life health experience, embracing not only longevity but also health-related quality of life.[1,2] Health expectancies provide summary measures of the lifelong experience of health, illness and death. They combine together into a single index estimates of years lived in states of full health and the average number of years a person may expect to remain alive (life expectancy). By their construction, health expectancies are independent of the age structure of the population and represent the average health expectation of a synthetic birth cohort experiencing current rates of mortality and morbidity over their lifetime. There are as many types of health expectancy indices as there are concepts and measures of health status (e.g. disease-free, disability-free and healthy life expectancy are examples of measures of three conceptual models of health – bio-medical, functional and social). In recent years, international agencies including REVES, Eurostat and the World Health Organisation have made concerted efforts to promote a common understanding of concepts and methods and develop a harmonised measure of healthy life expectancy for cross-country comparisons.[3,4]

The importance of health expectancies as a population health monitoring tool in the UK is reflected in the literature, with most studies either examining trends at the national level or looking at sub-regional comparisons.[5,6,7] Relatively few studies have focused on analyses by socioeconomic group[8,9] or by ethnicity,[10] mainly because such factors are either not recorded at all (e.g. ethnic group) or not reliably recorded (e.g. social position) on mortality databases, making direct comparisons between social groups prone to bias. In the absence of routine mortality-census data linkage, social inequalities in health can be addressed either by using longitudinal data (e.g. the ONS Longitudinal Study); or, as in this study, by using relative deprivation at small area level as a surrogate measure of social inequality.

The use of small area deprivation indices as an indicator of socio-economic conditions has a long history in research in the UK.[11,12,13] Numerous studies since the mid-1980s have demonstrated the universal disadvantage in health of populations in the most deprived areas of the country. MacIntyre *et al* argue that small area analysis may be a more powerful predictor of health than individual socioeconomic status since it captures both the compositional (individual characteristics) and contextual (physical and social environment) effects on health of the area of residence.[14] The evidence of an area effect on health over and above the effect of individual deprivation remains contested, with some studies showing little or no effect[15] and others a significant effect.[16] Because population homogeneity and geographical size of area are inversely correlated, more fine-grained small area analysis is thought to provide a more precise measurement of the underlying distribution of health inequality.

The choice of aggregates of wards as the units for analysis in this study was therefore dictated equally by considerations of data availability and methodological validity. The main aim of the analysis presented here is to estimate the magnitude of inequalities in health expectancy with increasing relative area deprivation. Two measures of health have been used. First, a global measure of self-assessed general health to calculate healthy life expectancy; and second, a global measure of functional limitation to calculate disability-free life expectancy. The latter is a self-reported measure of overall functional limitation with no differentiation by level of severity.

Finally, this study also explores for the first time differences between areas of high and low deprivation in respect of short-term (1994 – 1999) trends in healthy life expectancy.

Methods

Area deprivation

Deprivation scores were calculated for all 8,595 electoral wards in England as at the 1991 Census, using the index of deprivation developed by Carstairs *et al*.[13] The index is an unweighted combination of four indicators of material deprivation – namely, the proportions of people in households headed by a person in a semi-skilled or unskilled manual occupation (Social Class IV or V); economically active men seeking work; persons with no car; and persons living in overcrowded accommodation. The main advantage of using the Carstairs index is that it is a population-based rather than a household-based measure (e.g. Townsend index), and therefore more appropriate for a study of population health inequalities. A deprivation score based on 1991 ward boundaries was used in order to facilitate matching to the available ward-level mortality and population data for the period 1994–1999. Because wards vary enormously in population size (mean: 5,475; minimum: 78; maximum: 31,612), with larger populations in the most deprived wards, they have been grouped by *population* deciles in ascending order of deprivation (Table 1).

Health status measures

The measures of health status used for calculating health expectancies in this study have been derived from the annual Health Survey for England (HSE) series. The HSE is a continuous survey of the general (non-institutional) population of England, with an annual sample size of about 4,000 children (aged 2–15) and 16,000 adults (16 and over). In the 1999 HSE, the sample size of the general population was halved to accommodate a 'boost' sample of minority ethnic groups. In this study, we have used data from the general population sample only. Over the six years 1994–1999, the aggregated sample size was 100,686 of whom 47 per cent were male. The response rate to the HSE varied between 76 per cent and 78 per cent over the period of the study.

The electoral ward of residence of informants in the survey was assigned using a look-up table matching postcode of residence to 1991 Census ward geography (79 cases could not be allocated). As shown in Table 1, the distribution of the sample was evenly spread across the ward deprivation deciles, and there is no evidence of a systematic response bias by deprivation.

Table 1 **Summary statistics by ward deprivation deciles**

England

	Wards	Population (1991)*		Deaths (1994–1999)†		Survey data (1994–1999)**		Deprivation score††
Deprivation decile	Number	Persons (000's)	Population (%)	All deaths	Deaths (%)	Base	Base (%)	Mean score
1 Least deprived	1,257	4,705	10.0	283,966	9.1	9,995	9.9	-3.72
2	1,209	4,699	10.0	294,595	9.4	10,767	10.7	-2.72
3	1,072	4,710	10.0	311,627	10.0	10,903	10.8	-1.98
4	959	4,706	10.0	323,231	10.3	10,309	10.2	-1.26
5	905	4,706	10.0	326,719	10.4	9,527	9.5	-0.43
6	772	4,708	10.0	328,968	10.5	9,685	9.6	0.56
7	707	4,704	10.0	322,689	10.3	10,213	10.1	1.74
8	617	4,702	10.0	326,167	10.4	9,940	9.9	3.15
9	578	4,703	10.0	313,224	10.0	9,308	9.2	5.02
10 Most deprived	519	4,713	10.0	297,048	9.5	10,039	10.0	9.07
England	8,595	47,055	100.0	3,128,234	100.0	100,686	100.0	0.00

* Source: 1991 Census, England
† Source: Author's analysis of ONS mortality data, England, 1994–1999
** Source: Health Survey for England, 1994–1999
†† Carstairs index of deprivation (Carstairs *et al* 1991)

Self-assessed general health was measured in the HSE using a 5-point scale recommended by the World Health Organisation for national health interview surveys which ranges from 'very good', 'good', 'fair', 'bad' and 'very bad' health.[17] The question on activity limitation is a follow-up question which asks respondents who report having a longstanding illness, disability or infirmity whether the condition/s limited their activity in any way. While the general health question was asked in all years of the HSE, the question on limiting longstanding illness was asked from 1996 onwards.

Previous articles in the *Health Statistics Quarterly* have used data from the General Household Survey (GHS) to estimate prevalence rates of good health. In this study, data from the HSE has been used for two reasons: first, geographically referenced individual-level survey records were made available for this study (the author was then an employee of the survey contracting organisation, the *National Centre for Social Research*); and second, the HSE uses the internationally recognised 5-point scale to record self-assessed general heath, whereas the GHS uses a 3-point scale (good/fairly good/not good). Besides improving the international comparability of the results of this study, the 5-point scale has also been found to be a more sensitive measure of the underlying variation in health between areas.[18]

Life expectancy

Data on all-cause mortality by sex and 5-year age bands (0–4, 5–9 ... 80 and over) and corresponding population estimates[19] for each ward in England were obtained for the years 1994–1999 and then aggregated up by deprivation deciles (Table 1). Standard abridged life table methods were used to calculate the life expectancy at birth and for each 5-year age band to age 80 and over, by sex, averaged over the periods 1994–1999 and 1996–1999 (corresponding to periods over which the two health status measures were available in the HSE).

Health expectancies

The response scale on each health status measure was dichotomised into 'good' and 'not-good' (sub-optimal) health. Age-specific prevalences of good health were used to partition out the expected number of years lived in each age interval (${}_nL_x$) in the life tables into years with and without good health using Sullivan's method.[20] The cumulative sums of years in good health were used to calculate two measures of health expectancy at birth for each deprivation decile: a) healthy life expectancy (HLE) based on self-assessed 'very good' or 'good' health, and b) disability-free life expectancy (DFLE), defined as life-years with no limiting longstanding illness. Separate figures were calculated for males and females. As children under two years old were not included in the survey, prevalence rates of good health for 2- to 4-year-olds were used for the 0–4 age band. The health status of infants (aged 0–1) reported in the HSE from 2001 onwards were the same as or slightly better than for children aged 2–4.[21] Hence the impact of the approximation used for infant health in this study on health expectancies at birth is likely to be marginally underestimated. All sample estimates were weighted by HSE selection probability weights.

Standard errors and confidence intervals at the 95 per cent level for HLE and DFLE measures were estimated using the method described by Jagger.[22] For health expectancy at birth, the principal source of error (and hence the width of the confidence intervals) is associated with the survey prevalence estimates and driven essentially by the size of the total sample. When the population on which the mortality rates are based is very large compared to the survey sample size, it has been shown that the error associated with the life expectancy component of health expectancies is negligible and can be ignored.[22]

Trend analysis

The trend was analysed for HLE only as data were available for all six years as compared with four years for DFLE. Furthermore, as children were not interviewed in 1994, the trends at age 15 were examined. Because of the problem of small sample sizes in each year to allow analysis by deprivation decile and sex, estimates for each year have been calculated for all persons rather than separately by sex.

Results

Overall, about four in five (79 per cent) respondents reported having good health and a similar proportion (78 per cent) reported not having

Table 2 **Age-standardised rates for all-cause mortality, self-assessed poor health and limiting longstanding illness, by deprivation decile and sex, 1994–1999**

England

	Males			Females			Persons		
Deprivation decile	Mortality rate (per 000)	Poor health* (1994–1999) %	Limiting longstanding illness (1996–99) %	Mortality rate (per 000)	Poor health* (1994–1999) %	Limiting longstanding illness (1996–99) %	Mortality rate (per 000)	Poor health* (1994–1999) %	Limiting longstanding illness (1996–99) %
1 Least deprived	8.8	13	17	10.5	15	19	9.9	14	18
2	9.1	14	17	10.3	17	21	10.0	15	19
3	9.3	15	18	10.3	18	20	10.2	16	19
4	9.6	17	19	10.6	19	22	10.5	18	20
5	9.9	19	19	10.6	22	23	10.6	21	21
6	10.4	21	21	10.9	24	25	11.0	22	23
7	10.7	23	22	11.0	25	25	11.3	24	23
8	11.4	24	24	11.4	26	26	11.8	25	25
9	11.8	27	25	11.5	28	27	12.1	27	26
10 Most deprived	12.7	30	29	11.9	33	29	12.7	32	29
Ratio (10/1)	1.4	2.4	1.7	1.1	2.3	1.5	1.3	2.3	1.6
95% CI of ratio	(1.43–1.45)	(2.2–2.6)	(1.6–1.9)	(1.13–1.14)	(2.1–2.4)	(1.4–1.7)	(1.28–1.29)	(2.2–2.4)	(1.5–1.7)
England	10.4	20	21	10.9	23	24	11.0	21	22

* Poor health is defined as those who rated their health as 'fair', 'bad' or 'very bad'.

a limiting longstanding illness. The prevalence of limiting longstanding illness increased more rapidly with age than reported poor health for both sexes.

There was a stepped increase in age-standardised rates of mortality, poor health and limiting longstanding illness with increasing deprivation (Table 2). The rate ratio between the most deprived and the least deprived decile was smaller for mortality (persons: 1.3) than for either of the two morbidity measures (2.3 for poor health and 1.6 for limiting longstanding illness). This pattern was similar for males and females. The separate analysis of mortality and morbidity measures tells us the scale of health inequalities for each, but does not tell us whether their combined effect amplifies or reduces health inequalities.

Life expectancy at birth

Life expectancy (LE) at birth declined steadily with increasing deprivation in a similar, but inverse, pattern to that for mortality rates (Table 3). On average, females live 5 years longer than males (80.0 *vs*. 75.0, respectively). LE for females is higher than for males in all deprivation groups and the gender gap increases uniformly with increasing levels of deprivation from 4 years in the least deprived wards to 7 years in the most deprived wards. The deprivation gradient in LE is therefore steeper for males than females (Figures 1 and 2).

Healthy life expectancy at birth

Over their lifetime, on average males in England spend 59.1 years in good health and 15.9 years in poor health and females 61.4 and 18.6 years (Table 3). Hence, although women live longer than men, they also spend more years in sub-optimal health. This has two consequences: first, the absolute difference between males and females in LE (5.0 birth years) at birth is more than halved for HLE (2.3 years); and second, the proportion of life spent in poor health for both sexes is similar: males 21 per cent, females 23 per cent (Table 5). In other words, although females can expect to live longer, they spend approximately the same proportion of their lives in poor health as males.

Figures 1 and 2 show LE at birth for each deprivation group, subdivided into the number of years in good health ('healthy') and years in poor health ('not healthy') for males and females separately. Males living in the most deprived wards spend 22.0 years in poor health compared to 11.2 years in the least deprived wards. This differential translates into approximately 2 in 7 years of life being spent in poor health in the most deprived wards and 1 in 7 years in the least deprived wards. The equivalent figures for females are 26.3 years and 12.7 years, or 2 in 6 years and 1 in 6 years, respectively. Hence, males and females living in the most deprived wards not only have a shorter life-span on average, they also spend about twice the number of years and twice the *proportion* of life in sub-optimal health (Table 5) compared with residents in the least deprived wards.

Disability-free life expectancy at birth

At birth, national estimates for DFLE were 58.4 years for males and 60.4 years for females, or about one year less than for HLE for both males and females (Table 3). For both sexes, the overarching deprivation-related gradient in DFLE was markedly similar to that for HLE (Figures 3 and 4), but the gap between wards at the extreme ends of the deprivation distribution is narrower (Table 5). This is because males and females in the most deprived wards spend a similar number of years in poor health (males: 22 years, females: 26 years) and with a disability (21 and 24 years). In the least deprived wards, however, males and females have more years of life with a disability (14 and 17 years) than in poor health (11 and 13 years).

Table 3 **Life expectancy (LE), healthy life expectancy (HLE), disability-free life expectancy (DFLE) at birth, by deprivation decile and sex, 1994–1999**

England

	LE (1994–1999)	HLE (1994–1999)		DFLE (1996–1999)	
At birth Deprivation decile	Years	Years	95% confidence interval	Years	95% confidence interval
Males					
1 Least deprived	77.4	66.2	(65.4 – 67.0)	63.1	(62.0 – 64.2)
2	76.9	65.0	(64.3 – 65.8)	62.4	(61.3 – 63.4)
3	76.6	63.9	(63.1 – 64.7)	61.4	(60.4 – 62.4)
4	76.0	62.2	(61.4 – 63.1)	60.9	(59.8 – 62.0)
5	75.6	59.7	(58.9 – 60.6)	59.9	(58.8 – 61.0)
6	75.0	58.4	(57.5 – 59.3)	58.1	(57.0 – 59.2)
7	74.4	56.3	(55.4 – 57.2)	57.0	(56.0 – 58.1)
8	73.4	55.3	(54.4 – 56.2)	55.4	(54.2 – 56.5)
9	72.8	52.4	(51.5 – 53.4)	54.0	(52.9 – 55.2)
10 Most deprived	71.4	49.4	(48.4 – 50.3)	50.7	(49.5 – 51.8)
Difference (Least – Most)	5.9	16.9	(15.7 – 18.1)	12.4	(10.9 – 14.0)
England	75.0	59.1	(58.8 – 59.3)	58.4	(58.1 – 58.8)
Females					
1 Least deprived	81.2	68.5	(67.7 – 69.2)	64.6	(63.5 – 65.7)
2	81.1	66.9	(66.1 – 67.7)	63.3	(62.2 – 64.4)
3	81.0	65.7	(64.9 – 66.5)	64.2	(63.1 – 65.2)
4	80.7	64.7	(63.9 – 65.5)	62.1	(61.0 – 63.2)
5	80.5	62.3	(61.4 – 63.2)	61.3	(60.2 – 62.4)
6	80.1	59.9	(59.0 – 60.8)	58.8	(57.6 – 60.0)
7	79.7	58.7	(57.8 – 59.6)	59.2	(58.1 – 60.3)
8	79.1	58.0	(57.1 – 58.9)	57.8	(56.6 – 58.9)
9	78.9	56.0	(55.1 – 57.0)	56.6	(55.4 – 57.8)
10 Most deprived	78.0	51.7	(50.7 – 52.6)	54.6	(53.4 – 55.8)
Difference (Least – Most)	3.2	16.8	(15.5 – 18.0)	9.9	(8.3 – 11.6)
England	80.0	61.4	(61.1 – 61.7)	60.4	(60 – 60.7)

Figure 1 **Males: LE and HLE at birth by deprivation deciles, 1994–1999**

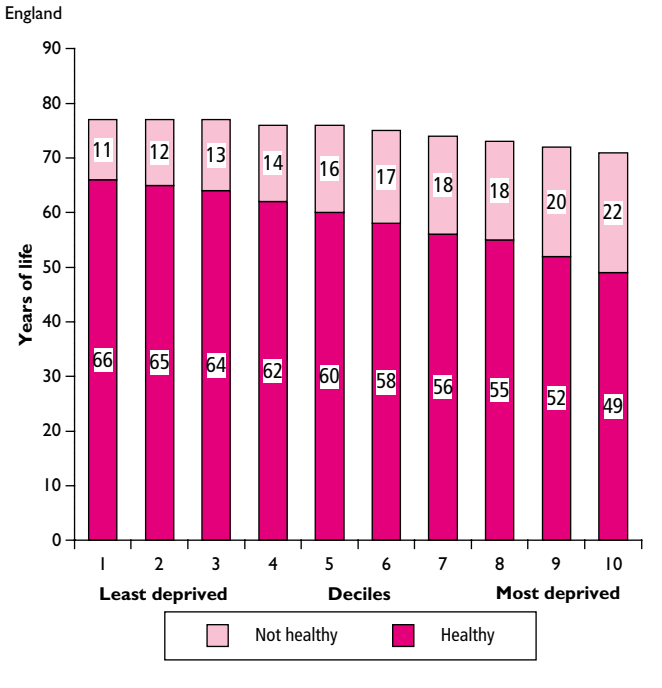


Figure 2 **Females: LE and HLE at birth by deprivation deciles, 1994–1999**

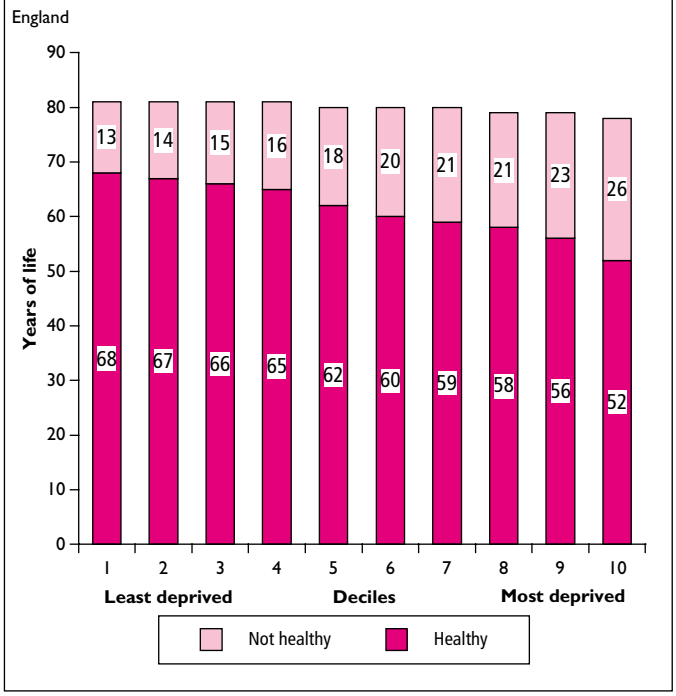


Table 4 **Life expectancy (LE), healthy life expectancy (HLE), disability-free life expectancy (DFLE) at age 65, by deprivation decile and sex, 1994–1999**

England

At age 65 Deprivation decile	LE (1994–1999)	HLE (1994–1999)		DFLE (1996–1999)	
	Years	Years	95% confidence interval	Years	95% confidence interval
Males					
1 Least deprived	16.2	11.0	(10.5 – 11.6)	9.5	(8.8 – 10.3)
2	16.0	10.7	(10.2 – 11.2)	10.0	(9.3 – 10.7)
3	15.9	10.4	(9.9 – 10.9)	9.7	(9.0 – 10.4)
4	15.6	9.6	(9.0 – 10.1)	9.4	(8.7 – 10.1)
5	15.5	8.7	(8.1 – 9.3)	8.7	(8.0 – 9.5)
6	15.2	8.4	(7.8 – 8.9)	8.0	(7.2 – 8.8)
7	15.0	7.8	(7.2 – 8.4)	7.9	(7.2 – 8.6)
8	14.5	7.8	(7.2 – 8.3)	7.6	(6.9 – 8.3)
9	14.4	6.9	(6.3 – 7.4)	6.6	(5.8 – 7.3)
10 Most deprived	13.9	6.3	(5.7 – 6.9)	6.8	(6.1 – 7.6)
Difference (Least – Most)	2.3	4.7	(3.9 – 5.5)	2.7	(1.7 – 3.8)
England	15.2	8.8	(8.6 – 9.0)	8.5	(8.3 – 8.7)
Females					
1 Least deprived	19.1	12.5	(11.9 – 13.1)	11.0	(10.2 – 11.8)
2	19.3	12.5	(11.9 – 13.0)	10.7	(9.9 – 11.4)
3	19.3	11.2	(10.6 – 11.7)	10.7	(10.0 – 11.5)
4	19.1	11.6	(11.0 – 12.2)	10.5	(9.7 – 11.3)
5	19.1	10.7	(10.1 – 11.3)	10.2	(9.5 – 11.0)
6	18.8	9.8	(9.2 – 10.4)	9.0	(8.2 – 9.8)
7	18.7	9.7	(9.1 – 10.3)	9.3	(8.5 – 10)
8	18.4	9.5	(8.9 – 10.1)	9.1	(8.3 – 9.8)
9	18.3	8.7	(8.1 – 9.3)	7.9	(7.2 – 8.7)
10 Most deprived	18.0	7.8	(7.1 – 8.4)	8.0	(7.2 – 8.8)
Difference (Least – Most)	1.0	4.8	(3.9 – 5.6)	3.0	(1.8 – 4.1)
England	18.8	10.4	(10.3 – 10.6)	9.7	(9.4 – 9.9)

Table 5 **Proportion of life in poor health and with a disability in the least deprived and most deprived ward deciles, by sex, 1994–1999**

England

	At birth			At age 65		
	LE (years)	% LE in poor health	% LE with disability	LE (years)	% LE in poor health	% LE with disability
Males						
Least Deprived (1)	77.4	14	18	16.2	32	41
Most Deprived (10)	71.4	31	29	13.9	55	51
Ratio (10/1)		2.1	1.6		1.7	1.2
England	75.0	21	22	15.2	42	44
Females						
Least Deprived (1)	81.2	16	20	19.1	34	42
Most Deprived (10)	78.0	34	30	18.0	57	56
Ratio (10/1)		2.2	1.5		1.7	1.3
England	80.0	23	25	18.8	44	48

Health expectancies at age 65

By age 65, differences by deprivation levels greatly reduce, but persist. The gap in LE between the most and least deprived wards narrows to 1.0 years for women and 2.3 years for men (Table 4). The relative ratios of life spent in poor health (1.7) or with a disability (1.3) between the most and the least deprived wards are smaller than comparative ratios at birth (approximately 2.1 and 1.6, respectively) (Table 5). Again, because residents in the least deprived wards spend more years on average with disability than in poor health, the inequality gradient in DFLE is less steep than for HLE.

Difference between sexes

Life expectancy at birth for females was higher than for males in all deprivation deciles. In the most deprived wards the sex difference in LE was 6.6 years (i.e. 78.0 *vs*. 71.4) and gradually fell to 3.8 years (81.2 *vs*. 77.4) for the least deprived wards (Table 3). In contrast, the corresponding sex differences in HLE were 2.3 years for both the most and least deprived wards and, 3.9 years and 1.5 years for DFLE, respectively. Health expectancies therefore tend to reduce the inequalities in health between males and females.

Trends in LE and HLE at age 15

There is an upward trend in LE at age 15 over the six years of this study for all deprivation deciles (Table 6, Figure 5). However, the increase in LE for the most deprived decile is greater than for the other deciles. For the least deprived wards the difference between LE at age 15 over the period was 0.36 years (*95 per cent confidence interval 0.22, 0.50*) and 0.68 years (*0.52,0.85*) for the most deprived wards. Thus, between 1994 and 1999, LE at age 15 in the most deprived wards increased more than in the least deprived wards, a finding that was significant at the 95 per cent level. This has the effect of narrowing the gap in LE between the extreme deciles of deprivation (Figure 5).

With respect to HLE, there was no consistent pattern in trends across deciles. As Figure 5 shows, there were no significant changes in the national HLE estimates or the estimates for either the least or most deprived deciles over the study period.

Figure 3 **Males: LE and DFLE at birth by deprivation deciles, 1996–1999**

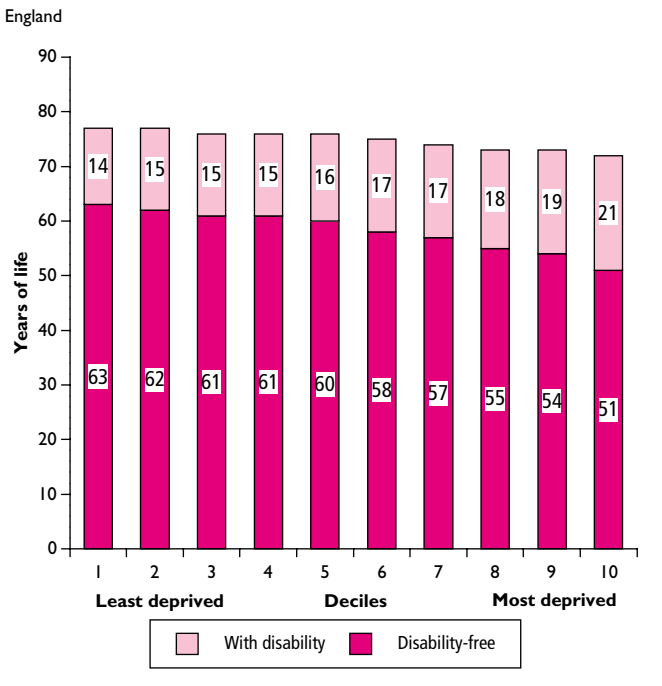


Figure 4 **Females: LE and DFLE at birth by deprivation deciles, 1996–1999**

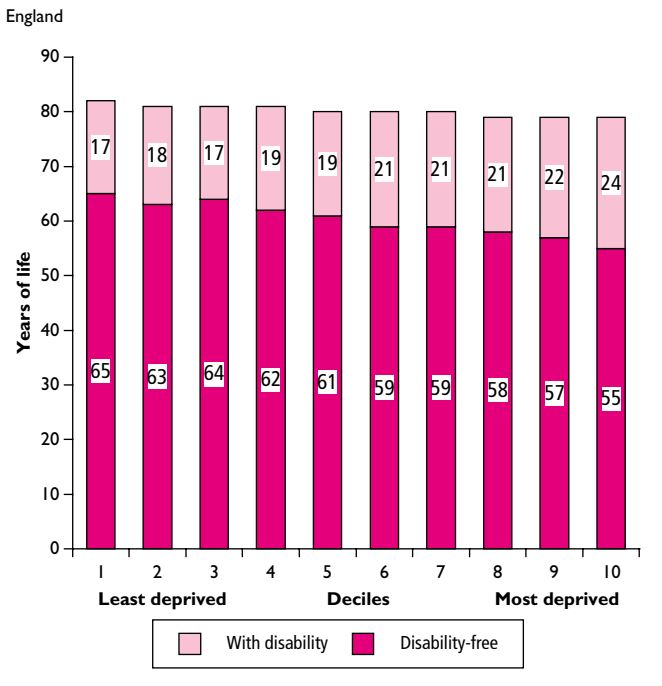


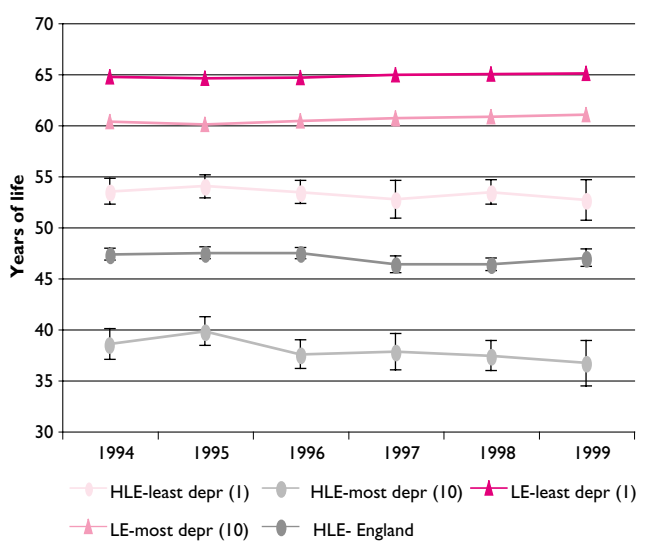
Table 6 **Trends in life expectancy (LE), healthy life expectancy (HLE) at age 15 for all persons, by deprivation decile, 1994–1999**

England

At age 15, all persons Deprivation decile	Year						Difference
	1994	1995	1996	1997	1998	1999	1999–1994
LE							
1 Least deprived	64.6	64.5	64.6	64.9	64.9	65.0	0.4
2	64.4	64.3	64.3	64.7	64.8	64.9	0.5
3	64.2	64.2	64.3	64.3	64.5	64.6	0.4
4	63.9	63.6	63.8	64.0	64.2	64.2	0.3
5	63.6	63.5	63.5	63.8	63.8	63.9	0.4
6	63.2	62.8	63.1	63.2	63.4	63.6	0.4
7	62.6	62.5	62.6	62.8	62.9	63.0	0.4
8	61.8	61.8	61.9	62.1	62.1	62.3	0.4
9	61.3	61.3	61.4	61.7	61.7	62.0	0.7
10 Most deprived	60.3	60.0	60.4	60.6	60.8	60.9	0.7
Difference (Least – Most)	4.4	4.5	4.2	4.3	4.2	4.0	
England	63.0	62.9	63.0	63.2	63.4	63.5	0.5
HLE							
1 Least deprived	53.4	54.0	53.4	52.7	53.4	52.6	-0.8
2	52.4	52.5	52.7	52.8	51.1	51.9	-0.5
3	51.4	52.1	51.6	50.7	49.4	52.5	1.0
4	50.6	49.4	51.9	47.7	49.1	49.7	-0.8
5	46.8	47.3	47.6	46.5	48.4	48.9	2.1
6	46.3	46.4	45.5	45.0	46.1	46.0	-0.2
7	44.8	43.8	46.1	44.0	44.1	43.7	-1.2
8	44.4	43.3	44.3	43.7	41.9	43.8	-0.6
9	42.1	42.0	42.2	40.2	40.4	41.4	-0.7
10 Most deprived	38.5	39.8	37.5	37.8	37.3	36.6	-1.9
Difference (Least – Most)	14.9	14.2	15.9	14.9	16.0	16.0	
England	47.1	47.1	47.3	46.1	46.1	46.7	-0.4
95% CIs (HLE)							
Least deprived (1)	(52.2 – 54.7)	(52.8 – 55.1)	(52.3 – 54.5)	(50.9 – 54.5)	(52.2 – 54.6)	(50.6 – 54.6)	
2	(51.1 – 53.7)	(51.3 – 53.8)	(51.6 – 53.8)	(51.1 – 54.4)	(49.8 – 52.3)	(50.2 – 53.6)	
3	(50.2 – 52.6)	(51.0 – 53.3)	(50.3 – 52.8)	(49.0 – 52.5)	(48.2 – 50.6)	(50.9 – 54.1)	
4	(49.3 – 51.8)	(48.2 – 50.6)	(50.6 – 53.1)	(46.1 – 49.4)	(47.8 – 50.4)	(47.9 – 51.5)	
5	(45.4 – 48.2)	(45.9 – 48.7)	(46.3 – 48.9)	(44.7 – 48.3)	(47.1 – 49.8)	(47.0 – 50.8)	
6	(45.0 – 47.6)	(45.1 – 47.7)	(44.2 – 46.9)	(43.0 – 47.0)	(44.6 – 47.5)	(44.1 – 48.0)	
7	(43.5 – 46.2)	(42.5 – 45.1)	(44.7 – 47.5)	(42.2 – 45.9)	(42.7 – 45.4)	(41.7 – 45.6)	
8	(43.0 – 45.7)	(41.9 – 44.7)	(43.0 – 45.7)	(41.7 – 45.8)	(40.7 – 43.2)	(41.7 – 45.8)	
9	(40.6 – 43.6)	(40.6 – 43.5)	(40.9 – 43.5)	(38.3 – 42.2)	(38.8 – 42.1)	(39.6 – 43.3)	
Most deprived (10)	(37.0 – 40.0)	(38.3 – 41.2)	(36.1 – 38.9)	(36.0 – 39.6)	(35.9 – 38.8)	(34.4 – 38.9)	

Figure 5 **Trends in LE and HLE at age 15 in England, all persons: most deprived (10) *vs* least deprived (1) deciles, 1994–1999**

England



Discussion

The study has shown a large difference in life expectancy between the most and least deprived tenths of the population of 5.9 years for males and 3.2 years for females. These differences are considerably wider than those reported by Raleigh *et al*. of 4.0 years for males and 2.4 for females between the most and least deprived health authorities in England (1992–1994).[23] This discrepancy is mainly because of the averaging effect on estimates calculated for more heterogeneous populations such as health authorities with populations ten times larger than wards. Deprivation groups defined at small area level pick out pockets of relative deprivation and affluence more precisely, and thereby provide a better discriminator of the underlying distribution of health expectancy by relative deprivation. Hence, differences by ward deprivation categories, even when aggregated up to include a large percentage of the population as in this study, are likely to be larger than for groups of health authorities.

Both the absolute (number of years) and relative (proportion of life) HLE measures show that residents in the most deprived areas spend on average about twice as many years in poor health as those in the least deprived areas. The rate ratio between the two extremes of the deprivation scale in HLE (males 2.1, females, 2.2, Table 5) is closer to the age-adjusted poor health prevalence rate ratio (2.3 for persons, Table 2) than to the smaller mortality rate ratio (1.3, Table 2). HLE therefore amplifies the inequalities gap in conventional mortality-only measures to a level similar to that observed for morbidity prevalence measures.

A previous study, using the identical question on limiting longstanding illness to estimate DFLE but a different survey source, reported national levels of DFLE at birth for males (58.9 years) and females (61.2) in Great Britain similar to those found in this study.[7] Our estimates for DFLE show that the gap between the least deprived and most deprived groups is narrower than for HLE, but remains higher than for LE. This is because expected years with a disability at birth are higher than expected years in poor health in the least deprived decile (by 3 years for males and 4 years for females), and lower than expected years in poor health in the most deprived decile (by 1 year for males and 3 years for females).

The expansion in years with disability for the least deprived areas, relative to years in self-assessed poor health, and the converse in deprived areas, suggests differences in reporting behaviour between the two groups. Self-reported health is influenced by illness-behaviour, norms and expectations of health[24] which vary between population groups - with age, gender and socioeconomic status – as well as over time.[25,26] More cognitive testing of instruments and research on survey measurement error is needed to explore issues of differential response bias. However, such differences would explain some, but not all of the observed gradient in health expectancies.

Our results are broadly consistent with findings from similar area-based analyses in Canada.[27,28,29] Wilkins and colleagues found that neighbourhoods in the poorest income quintile in Canada had lower LE and more years of life with activity limitation. Similarly, studies reporting on gender differences in health expectancies also show a sizeable reduction in the health gap between men and women after taking into account differences in sub-optimal health.[5]

Our finding of a narrowing in the gap in life expectancy between the most and least deprived ward deciles over the period merits further discussion. Conventional estimates of premature mortality rates, such as standardised mortality ratios (SMRs) for ages to 65 and 75, have shown a widening of the health inequalities gap between the most and least deprived areas until the early 1990s.[30] However, SMRs calculated using indirect standardisation techniques do not differentiate between deaths occurring at older and younger ages. On the other hand, deaths in the first year of life have the largest impact on average life expectancy with successively smaller weights attached to deaths at older ages. Hence, although the number of infant deaths is small, reductions in childhood mortality will have a larger effect on life expectancy than on SMRs. Whitehead and Drever present evidence to show that there has been a narrowing in the differential in infant mortality between lone mothers and couple parents in the early 1990s.[31] Evidence from the Longitudinal Study shows that while LE at birth for males in the lowest Social Class V increased by 2.9 years between 1992–1996 and 1997–1999, it increased by only 0.8 years for males in Social Class I (highest).[32] The equivalent figures for females show a smaller increase in Social Class V (0.1) and a *decline* in LE in Social Class I (-0.6) over the same period. While the reduction in the inequality gap in life expectancy is a new finding for England, similar trends have been observed for urban areas in Canada over the period 1971–1986.[27]

The possibility that our finding is an artefact of the data was also explored. Population estimates at ward level used in this study are likely to have become increasingly out-of-date in successive years after the census, introducing error in the estimation of the probabilities of death for deprivation groups. But as each decile group in this study includes at least 500 wards spread out across the country, it is likely that such errors would cancel each other out with a negligible overall effect on the LE estimates.

An important limitation of the study is that we have not adjusted for the health of the population in institutions. Residents in all types of communal establishments (including hostels, hotels, boarding schools, care homes etc.) constituted 1.35 per cent of the population in the 1991 Census with just under one per cent resident in healthcare institutions. The latter were mainly people aged 65 and over, constituting about five per cent of the total elderly population in 1991 and about four per cent in 2000.[33] Bebbington and Darton have estimated that the overall effect of institutional population adjustment for DFLE at birth was small, ranging between 0.1 and 0.4 years lower than the unadjusted estimates.[34]

Slightly more institutional places were located in the least deprived wards (11 per cent) than in most deprived areas (7 per cent) (author's calculation based on location of care homes in 1999), although poorer elderly people are more likely to enter care than more affluent older people.[35] The impact of the exclusion of the care home population on the difference in health expectancies between types of areas would depend upon the area of residence coding applied to residents. For example, if the care home is treated as the area of residence, relatively higher numbers of places in affluent areas would tend to lower HLE estimates for affluent areas and push up estimates for the more deprived areas thereby narrowing the health inequality gap. However, given the relatively small size of the institutional population, the slight skew in the distribution of places towards less deprived areas is unlikely to alter the main findings of this study.

It is important to note that the health expectancy for an area at a particular point in time reflects the mortality and ill-health experience of those living in the area at the time, rather than those born in the area. Hence, the selective migration of relatively healthy people from more to less deprived places (or vice versa for unhealthy people) over any time in the lifecourse, but particularly at older ages, would have the effect of overestimating the health inequality gradient. However, the available evidence suggests that migration does not have a substantial effect on the pattern of health differentials between localities.[34,18]

Lastly, wards have been classified into decile groups based on their deprivation score in 1991. We have assumed that the deprivation group membership of wards has remained unchanged over the period of our study.[36]

Conclusion

Compared with measures based on mortality alone, health expectancies amplified the inequality gap between residents in the most and least deprived areas, and the gradient was steeper for males than for females. The inequality in life expectancy between the sexes was reduced when years spent in sub-optimal health were taken into account. The gap between the extremes of the deprivation deciles narrowed between 1994–1999 for life expectancy, but not for healthy life expectancy.

As with all ecological studies, it should be borne in mind that the relationships observed at the group level do not necessarily apply at the individual level. Having said that, the strength of area level analysis is that it provides a convenient measure of the combined effect of individual characteristics and environmental conditions on health status. From a health policy perspective, healthy life expectancies at area level offer a way of monitoring inequalities in the total health experience of population groups; and potentially a mechanism to guide area-based allocation of health resources. However, to gain wider acceptability as a policy tool, more research is needed to assess the validity and sensitivity of self-reported health status measures across person, place and time.

Key findings

- Males and females living in the most deprived wards had lower life expectancy at birth and spend twice the number of years in poor health compared with those in the least deprived wards.
- Male healthy life expectancy at birth in the most deprived wards was 49.4 years and 66.2 years in the least deprived wards, a difference of 16.9 years. For females the figures were 51.7 and 68.5 years, respectively, a difference of 16.8 years.
- For both sexes, the gap in disability-free life expectancy between the most deprived and least deprived wards was slightly smaller than that for healthy life expectancy.
- There were no significant changes in trends in healthy life expectancy by deprivation over the period 1994–1999.

Acknowledgements

I am grateful to National Centre for Social Research for access to the geographically referenced Health Survey for England datasets and to Susan Purdon for statistical advice; to Nicky Best at the Small Area Health Statistics Unit, Imperial College London for providing ward-level population estimates; and to Bill Hageman and Paul Faulkner at the Department of Health (DH) for providing mortality data and the postcode to ward link files. Thanks specially to colleagues who commented on earlier drafts of the paper, and in particular Carol Jagger, John Fox, and David Blane. The analyses reported here were partly funded by DH. The views expressed are those of the author and not of the Department.

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