Life expectancy in England: variations and trends by gender, health authority, and level of deprivation

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Abstract

***Study objectives*—To investigate variations and trends in life expectancy in English district health authorities in relation to gender and Jarman deprivation level.**

***Design*—Mortality data for English health authorities from 1984-94, compiled by the Office for National Statistics, were assessed conventionally and using life table techniques.**

***Setting*—District health authorities in England.**

***Main outcome measures*—Life expectancies in the 105 DHAs in relation to rank, to gender, and to deprivation category based on the census based Jarman score.**

***Conclusions*—Differences in life expectancy had widened over the decade and prosperous areas with greatest longevity had seen the largest gains. In most deprived areas improvements in life expectancy were negligible. The greatest gender differences in life expectancy were also seen in deprived areas.**

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The *Health of the Nation* white paper noted that effective strategies to improve health need to be sensitive to variations in health.[1] In a recent report on health variations, the Chief Medical Officer's Working Group concluded that action to tackle these is central to the achievement of the Government's *Health of the Nation* strategy.[2] It went on to specify actions that the Department of Health and the NHS can take to tackle the socioeconomic, regional, gender, and ethnic variations in health which prevail in the UK. Recommendations included the need for further research, including work on population groups at risk of poor health.

We examine the effects of regional variations in mortality on longevity. Mortality differences are conventionally assessed in terms of epidemiological measures such as standardised mortality rates/ratios that offer comparisons against a national average but give no tangible indication of their impact on longevity. Life table techniques convert mortality rates into life expectancy, a readily comprehensible summary index of mortality experience. Life expectancy data are available nationally,[3] for regional health authorities,[4 5] and for "clusters" of homogeneous areas[5] but have not hitherto been examined for health authorities.

Using mortality data for the decade 1984-94, we examined variations and trends in life expectancy at birth in relation to gender in district health authorities (DHAs) in England, using recent (1995) DHA boundaries. Life expectancy was also computed for "families" of DHAs grouped on the basis of 1991 census-based Jarman deprivation scores.[6 7] Gender differences and trends in life expectancy over the decade 1984-94 were also examined by DHA and level of deprivation. The findings depict regional, socioeconomic, and gender inequalities in mortality in terms of a yardstick everyone can comprehend—how long men and women live.

Methods

The analysis is based on mortality data for England for the individual years 1984-94 compiled by the Office for National Statistics (ONS), and ONS final mid-year population estimates for the years 1984-94. Abridged life tables were constructed by sex using the method described by Elandt-Johnson and Johnson.[8] The age groups used were <1, 1-4, 5-9, ..., 80-84, 85+. Life expectancy at birth was computed for the three year period 1992-94 (three year averages were used to smooth out annual fluctuations at local level). It was also computed for 1984-86 to examine the absolute change in values between the start and end periods of the decade, and area rankings in the two periods. The SD and coefficient of variation were computed for the two periods to examine whether or not regional differences had altered. Trends in life expectancy were calculated using the methodology for computing mortality trends in the Public Health Common Data Set, produced annually by the Department of Health.[7] Estimates of the average annual percent change were calculated using the logarithm of the annual life expectancies, on the basis of the formula $100(e^b-1)$ where b is the coefficient of the slope of the resultant regression line. A goodness of fit test showed strong evidence for a linear relationship ($p<0.01$ in all but 5 DHAs, and p value <0.05 in the remaining 5 DHAs).

Life expectancies in 1992-94 in the 105 DHAs in England (boundaries as of April 1995) are presented by sex in rank order from highest to lowest. Values and ranks for 1984-86 are also given, along with the average annual percentage change in life expectancy during 1984-94. In the maps and graphs similar scales

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and/or intervals are used for males and females to facilitate comparison by gender.

DHAs were also grouped into seven categories on the basis of their Jarman deprivation scores, which are derived from a number of 1991 census based demographic and socioeconomic variables.[6 7] The basis for the grouping, and the DHAs in each group, are shown in table 1. Life expectancy data for the deprivation categories are presented in the same format as described above for DHAs. Life expectancies and Jarman scores for the individual DHAs were correlated to measure the association between deprivation and longevity. Gender differences and trends in life expectancy between 1984-94 were examined by deprivation level.

Results

LIFE EXPECTANCY AND TRENDS IN DHAS

In 1992-94 life expectancy at birth in England was 74.1 years for men and 79.5 years for women (table 2). With the exception of males in Solihull (West Midlands), the DHAs with the highest life expectancies were in the south, east, or west of England. Life expectancy in both 1984-86 and 1992-94 was lowest in Manchester in both sexes. Given the mortality rates prevailing in 1992-94, men and women in Manchester die 4.2 years and 2.8 years earlier respectively than the national averages. The contrast is greater when compared with DHAs where life expectancy is highest: men and women in DHAs with the highest life expectancy live on average 6.7 years and 4.7 years longer respectively than men and women in Manchester. Other DHAs with low life expectancies at the start and end of the decade include Liverpool, Sunderland, South of Tyne, and St Helens and Knowsley. The north-south gradient in life expectancy is clearly apparent in figure 1. Exceptions to this geographical divide are the inner London DHAs of South East London, East London and the City, and Camden and Islington, where male life expectancies are among the lowest in the country.

If geographical differentials in mortality had narrowed over the decade, trends in life expectancy (fig 2) could be expected to show a gradient in the opposite direction to that in figure 1—that is, greater change in areas with low life expectancy. Such a gradient is not universally apparent, and in many DHAs low life expectancy at the start of the decade was followed by little improvement.

These regional contrasts can be seen clearly in table 2. The annual increase in life expectancy in England over the decade was 0.35% in males and 0.25% in females. In Manchester life expectancy increased by only 0.10% in males (the lowest increase nationally) and by 0.22% in females. This was significantly lower than the corresponding figures, for instance, for Eastern Surrey (0.45% and 0.33%). Liverpool and parts of inner London (South East London, East London and the City, Camden and Islington) similarly experienced much less improvement, particularly in men, than some DHAs with the highest life expectancies.

The high-low difference in life expectancy between DHAs increased over the decade. In 1984-86 the difference between the highest and lowest ranking DHAs was 5.2 years for males and 4.3 years for females; by 1992-94 the difference had widened by 1.5 years (29%) in males to 6.7 years, and by half a year (9%) in females to 4.7 years. Furthermore, the spread of the DHA values around the national average has not decreased over the decade. The SD for males was 1.24 years in 1984-86 and 1.34 years in 1992-94, and for females it was 1.05 and 1.10 years respectively, representing an increasing coefficient of variation from 1.72% to 1.81% in males and from 1.36% to 1.39% in females (although some of this could be due to random variation).

KEY POINTS

- Life expectancy in health authorities in England varies by 6.7 years in males and 4.7 years in females.
- These differences have widened over the past decade.
- Deprivation (Jarman scores) is correlated with both levels and trends in life expectancy.
- Prosperous areas with the greatest longevity have seen the largest gains in life expectancy.
- Despite having the shortest life spans in the 1980s, most deprived areas (inner London, Manchester, and Liverpool) have experienced negligible improvements.
- Deprived areas have the greatest gender differences in life expectancy.

LIFE EXPECTANCY AND TRENDS BY LEVEL OF DEPRIVATION

Life expectancy by sex in DHAs grouped according to the level of deprivation is shown in table 3 and figure 3. Although there is considerable overlap in the life expectancy of DHA outliers in the different deprivation categories, the negative association between deprivation and life expectancy at DHA level is evident in a correlation coefficient of −0.77 for men and a somewhat weaker association of −0.56 for women. In 1992-94 life expectancy in the most affluent areas exceeded that in the most deprived areas, which include inner London, by 4.0 years in males and 2.4 years in females. These differences had increased over those prevailing in the mid-1980s (2.8 years and 1.6 years respectively). Despite having the highest life expectancy in the mid-1980s, the most affluent areas experienced significantly greater gains in life expectancy over the decade (0.38% in males and 0.28% in females) than the most deprived areas where life expectancy was lowest (0.18% and 0.17% respectively).

The percentage change between 1984-86 and 1992-94 in deaths occurring up to specific ages in a cohort of 100 000 births was analysed by level of deprivation. In both sexes and all age groups there was a consistent negative association between the rate of mortality decline and the level of deprivation. This effect was particularly marked for the most deprived areas, where

Table 1 Jarman score based area classification using the distribution of district health authority scores (mean 0.00, (SD 17.37))

Group	District health authority			
Deprivation level 1 (scores < −SD (ie < −17.37)	D09	Huntingdon	M04	Worcester
	E05	North West Hertfordshire	M20	Solihull
	E18	East and North Hertfordshire	M26	North Worcestershire
	G12	Bromley	M27	South Staffordshire
	H20	Western Surrey	M28	Warwickshire
	H21	Eastern Surrey	N18	South Cheshire
	J25	North and Mid Hampshire	P22	South Lancashire
	K24	Buckinghamshire		
Deprivation level 2 (scores between −1.0 and −0.5 of the SD)	B21	North Yorkshire	J30	Wiltshire and Bath
	C01	North Derbyshire	K13	Berkshire
	C14	North Nottinghamshire	K33	Northamptonshire
	C15	Lincolnshire	K41	Oxfordshire
	D01	Cambridge	L40	Gloucestershire
	D13	East Norfolk	L51	Somerset
	E06	South West Hertfordshire	M02	Herefordshire
	F31	North Essex	M05	Shropshire
	F32	South Essex	M18	Dudley
	G23	West Kent	P16	Stockport
	H19	Kingston and Richmond		
Deprivation level 3 (scores between −0.5 and 0.0 of the SD)	A11	Northumberland	J10	Dorset
	A34	North Cumbria	J21	Portsmouth and SE Hampshire
	C02	Southern Derbyshire	J22	Southampton and SW Hampshire
	C03	Leicestershire	L10	Bristol
	D05	North West Anglia	L21	Cornwall and Isles of Scilly
	D12	Suffolk	L35	Exeter and North Devon
	D14	Bedfordshire	M07	North Staffordshire
	E07	Barnet	N17	North Cheshire
	E09	Hillingdon	N43	Sefton
	H09	Croydon	P28	Morecambe Bay
	H22	West Sussex		
Deprivation level 4 (scores between 0.0 and 0.5 of the SD)	A30	North Durham	G21	East Sussex
	A31	South Durham	G22	East Kent
	B11	East Riding	J41	Isle of Wight
	B16	Grimsby and Scunthorpe	L36	Plymouth and Torbay
	B71	Wakefield	M21	Walsall
	C08	Nottingham	N31	St Helens and Knowsley
	C09	Barnsley	N51	Wirral
	C10	Doncaster	P20	North West Lancashire
	C11	Rotherham	P23	Wigan and Bolton
	E19	Brent and Harrow	P24	Bury and Rochdale
	F33	Barking and Havering		
Deprivation level 5 (scores between 0.5 and 1.0 of the SD)	A16	Sunderland	G24	Bexley and Greenwich
	A32	Tees	H17	Merton, Sutton and Wandsworth
	A33	South of Tyne	M17	Coventry
	B51	West Yorkshire	M22	Wolverhampton
	B61	Leeds	P21	East Lancashire
	C12	Sheffield	P25	West Pennine
	F34	Redbridge and Waltham Forest	P27	Salford and Trafford
Deprivation level 6 (scores between 1.0 and 1.96 of the SD)	A35	Newcastle and North Tyneside	F36	New River
	B31	Bradford	M19	Sandwell
	E20	Ealing, Hammersmith and Hounslow	M25	South Birmingham
	E21	Kensington, Chelsea and Westminster	M29	North Birmingham
Deprivation level 7 (scores significantly greater than the mean at 5% level (ie >= 1.96 SD)	F35	East London and the City	N21	Liverpool
	F37	Camden and Islington	P26	Manchester
	G26	South East London		

by the age of 40 men had lost all improvements in survival over the decade. Mortality changes within selected age groups in a cohort of 100 000 births were also analysed and showed that mortality in men aged 30-39 increased nationally and in all area groupings, with an increase of over 20% in the most deprived areas. Deprived areas also saw a significant increase in mortality among men aged 20-29. In most deprived areas, mortality increased also in women aged 10-19 and 20-29.

GENDER DIFFERENCES AND TRENDS IN LIFE EXPECTANCY

Female life expectancy in England in 1992-94 exceeded male life expectancy by 5.4 years (table 2), however, regional differences are apparent in this respect also (fig 4). The gender differential in 1992-94 was smaller in DHAs with relatively high life expectancy, such as Cambridge (4.6 years) and Western Surrey (4.7), and greater in DHAs with relatively low life expectancy, such as Camden and Islington (7.0), Manchester (6.8), South East London (6.7), East London and the City (6.4), and Liverpool (6.1). Gender differences ranged from 5.0 years in the most affluent areas to 6.6 years in the most deprived areas (table 3). The strong positive association between deprivation and gender differences in life expectancy at DHA level is apparent in figure 4, and is reflected in a correlation coefficient of 0.8.

Furthermore, there was an association between deprivation and trends in gender differences in life expectancy. In England overall, the female-male difference in life expectancy narrowed somewhat from 5.83 years in 1984-86 to 5.38 years in 1992-94, a decline of

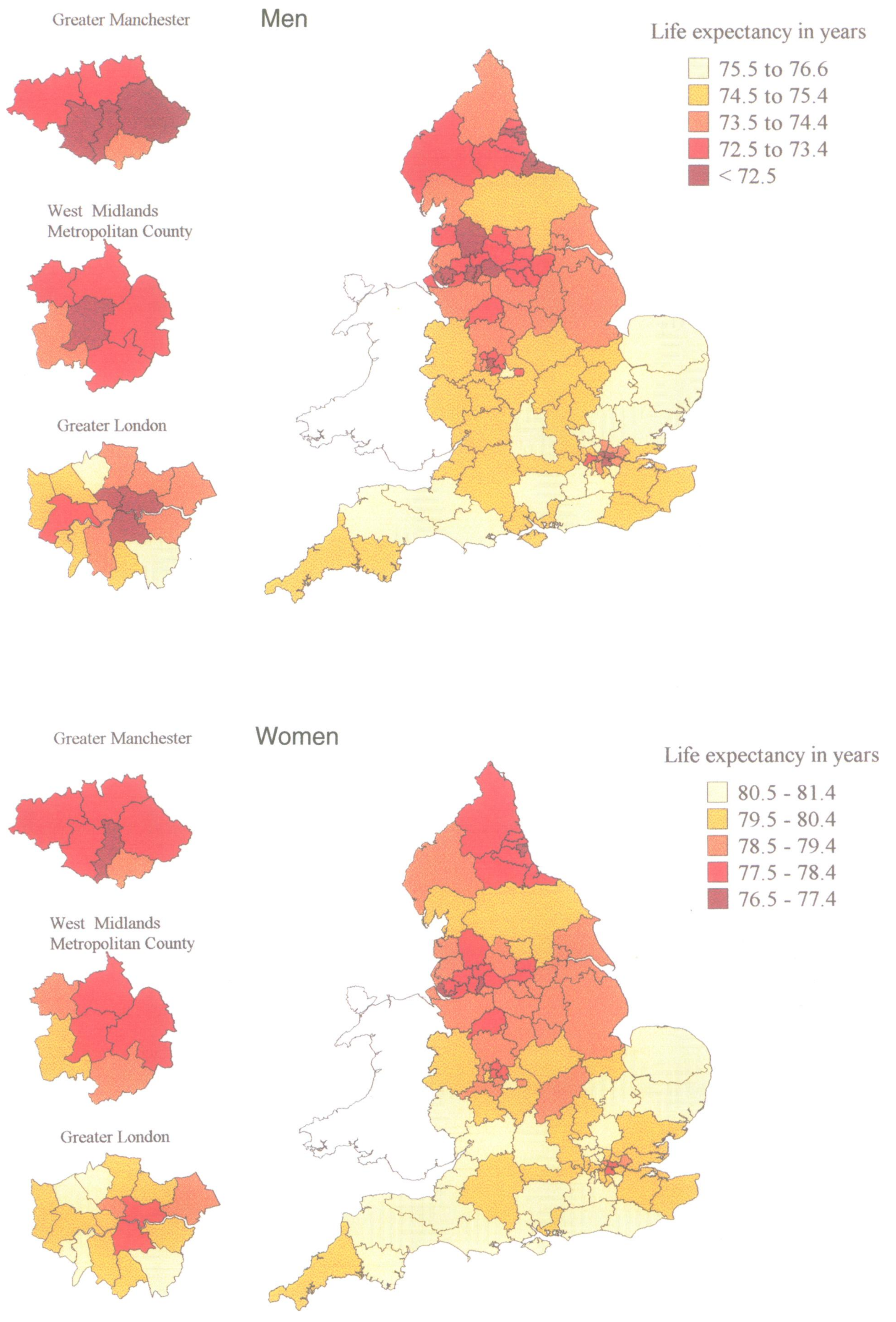

Figure 1 *Life expectancy (in years) among men and women in English district health authorities, 1992-94.*

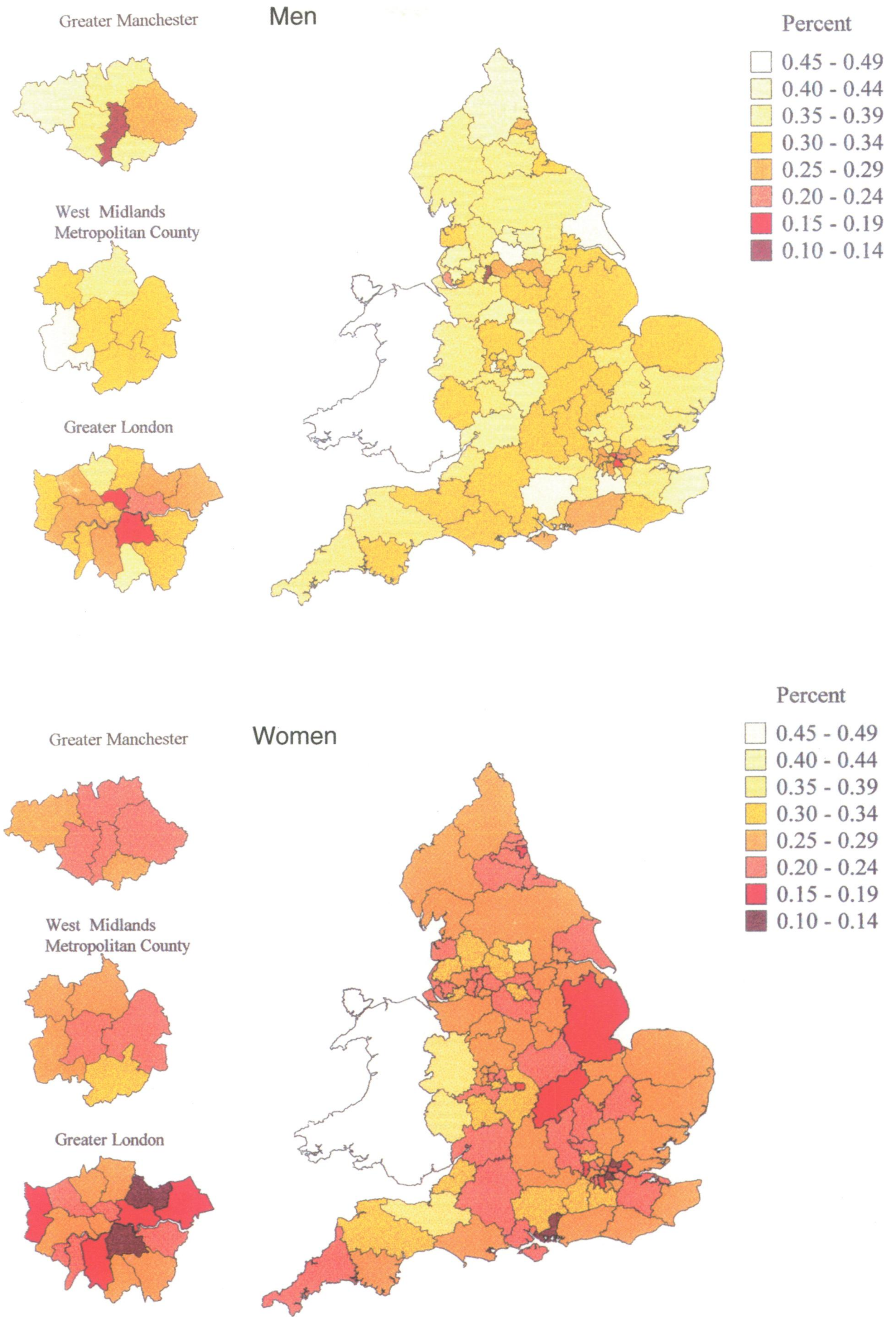

Figure 2 Percentage increase in life expectancy among men and women in English district health authorities between 1984-86 and 1992-94.

Table 2 Life expectancy at birth in relation to gender in 1984-86 and 1992-94: English district health authorities ranked highest to lowest on the 1992-94 values

Males		Ranks in 1984-86	Life expectancy 1984-86	Life expectancy 1992-94	% annual increase	Females		Ranks in 1984-86	Life expectancy 1984-86	Life expectancy 1992-94	% annual increase
O00	England		72.1	74.1	0.35	O00	England		77.9	79.5	0.25
D01	Cambridge	1	74.4	76.6	0.37	G12	Bromley	2	79.6	81.4	0.28
H20	Western Surrey	2	74.2	76.4	0.37	J10	Dorset	3	79.5	81.4	0.26
H21	Eastern Surrey	15	73.4	76.2	0.45	D01	Cambridge	1	79.7	81.1	0.24
E07	Barnet	5	73.9	76.0	0.36	H20	Western Surrey	23	78.9	81.1	0.33
M20	Solihull	16	73.4	76.0	0.40	L35	Exeter and North Devon	17	79.0	81.0	0.30
E05	North West Hertfordshire	20	73.4	75.9	0.43	L51	Somerset	34	78.6	80.9	0.38
K41	Oxfordshire	3	74.0	75.9	0.32	H22	West Sussex	7	79.3	80.9	0.25
J10	Dorset	4	73.9	75.9	0.32	K41	Oxfordshire	8	79.2	80.9	0.27
G12	Bromley	6	73.8	75.7	0.30	E07	Barnet	13	79.1	80.9	0.26
D12	Suffolk	17	73.4	75.7	0.37	H19	Kingston and Richmond	4	79.4	80.8	0.23
J25	North and Mid Hampshire	27	73.1	75.7	0.45	J25	North and Mid-Hampshire	26	78.8	80.8	0.30
L35	Exeter and North Devon	12	73.5	75.7	0.35	H21	Eastern Surrey	27	78.8	80.8	0.33
E06	South West Hertfordshire	13	73.5	75.7	0.36	J22	Southampton & SW Hants*	6	79.3	80.8	0.23
F31	North Essex	11	73.5	75.6	0.35	J41	Isle of Wight	14	79.1	80.8	0.23
E18	East and North Hertfordshire	8	73.6	75.6	0.36	E19	Brent and Harrow	5	79.3	80.7	0.20
L51	Somerset	10	73.5	75.6	0.32	D13	East Norfolk	19	79.0	80.7	0.27
H22	West Sussex	7	73.8	75.5	0.29	D12	Suffolk	16	79.0	80.6	0.25
D13	East Norfolk	18	73.4	75.5	0.31	M20	Solihull	9	79.2	80.6	0.21
K24	Buckinghamshire	14	73.5	75.4	0.33	E18	East and North Hertfordshire	20	78.9	80.6	0.26
L40	Gloucestershire	33	72.9	75.4	0.41	M02	Herefordshire	40	78.3	80.6	0.35
H19	Kingston and Richmond	22	73.3	75.4	0.33	G21	East Sussex	25	78.9	80.6	0.27
M02	Herefordshire	9	73.5	75.3	0.30	E06	South West Hertfordshire	33	78.6	80.6	0.30
J22	Southampton & SW Hants*	25	73.2	75.3	0.33	L36	Plymouth and Torbay	24	78.9	80.6	0.25
K13	Berkshire	26	73.1	75.3	0.35	E05	North West Hertfordshire	12	79.1	80.6	0.23
L10	Bristol	29	73.0	75.2	0.35	L40	Gloucestershire	15	79.0	80.5	0.23
J30	Wiltshire and Bath	21	73.3	75.2	0.30	L10	Bristol	32	78.6	80.5	0.30
E09	Hillingdon	23	73.2	75.1	0.32	D09	Huntingdon	31	78.6	80.5	0.28
E19	Brent and Harrow	19	73.4	75.1	0.27	F31	North Essex	21	78.9	80.4	0.25
M04	Worcester	30	73.0	75.0	0.36	E21	Ken, Chelsea & Westmin¶	29	78.7	80.4	0.28
L21	Cornwall and Isles of Scilly	37	72.8	75.0	0.37	J30	Wiltshire and Bath	28	78.7	80.3	0.24
D09	Huntingdon	24	73.2	75.0	0.33	L21	Cornwall and Isles of Scilly	30	78.6	80.3	0.24
B21	North Yorkshire	38	72.6	74.9	0.38	K13	Berkshire	41	78.3	80.1	0.28
H09	Croydon	50	72.3	74.9	0.41	E09	Hillingdon	10	79.2	80.1	0.15
G21	East Sussex	28	73.0	74.9	0.30	M04	Worcester	48	78.2	80.1	0.30
G23	West Kent	45	72.4	74.8	0.39	F32	South Essex	42	78.3	80.1	0.27
L36	Plymouth and Torbay	32	72.9	74.8	0.30	G22	East Kent	47	78.2	80.1	0.29
G22	East Kent	49	72.4	74.7	0.41	B21	North Yorkshire	37	78.4	80.1	0.26
C03	Leicestershire	35	72.8	74.7	0.32	K24	Buckinghamshire	22	78.9	80.1	0.20
D05	North West Anglia	41	72.6	74.6	0.36	F34	Redbridge & Walth Forest‡	11	79.2	80.0	0.13
K33	Northamptonshire	39	72.6	74.6	0.32	C03	Leicestershire	38	78.4	79.9	0.24
F32	South Essex	34	72.8	74.6	0.32	F36	New River	43	78.3	79.9	0.26
M28	Warwickshire	54	72.1	74.6	0.43	J21	Portsmouth & SE Hants†	18	79.0	79.9	0.14
D14	Bedfordshire	43	72.5	74.6	0.33	M05	Shropshire	62	77.6	79.8	0.35
J21	Portsmouth & SE Hants†	40	72.6	74.6	0.33	D05	North West Anglia	49	78.1	79.8	0.28
J41	Isle of Wight	31	72.9	74.5	0.25	H09	Croydon	54	77.8	79.8	0.29
M05	Shropshire	48	72.4	74.5	0.36	G24	Bexley and Greenwich	36	78.4	79.8	0.20
M26	North Worcestershire	53	72.2	74.5	0.39	D14	Bedfordshire	44	78.2	79.8	0.21
N18	South Cheshire	52	72.2	74.4	0.37	M18	Dudley	56	77.7	79.7	0.27
F34	Redbridge & Walth Forest‡	36	72.8	74.3	0.25	E20	Ealing, H'smith & Houns**	52	78.0	79.7	0.26
C15	Lincolnshire	47	72.4	74.3	0.34	G23	West Kent	39	78.4	79.6	0.20
F36	New River	42	72.5	74.3	0.30	H17	Merton, Sutton & Wands§	35	78.5	79.6	0.18
G24	Bexley and Greenwich	46	72.4	74.3	0.33	P28	Morecambe Bay	58	77.7	79.5	0.28
B11	East Riding	67	71.5	74.2	0.47	B61	Leeds	74	77.2	79.5	0.35
M27	South Staffordshire	56	72.0	74.2	0.34	M28	Warwickshire	65	77.5	79.5	0.31
M18	Dudley	64	71.5	74.2	0.46	N18	South Cheshire	61	77.6	79.4	0.28
P16	Stockport	57	71.9	74.2	0.38	F33	Barking and Havering	46	78.2	79.4	0.19
F33	Barking and Havering	51	72.3	74.2	0.29	C12	Sheffield	70	77.3	79.4	0.30
P28	Morecambe Bay	60	71.8	74.0	0.37	C15	Lincolnshire	45	78.2	79.4	0.19
H17	Merton, Sutton & Wands§	44	72.5	74.0	0.28	B11	East Riding	50	78.0	79.3	0.24
C14	North Nottinghamshire	58	71.9	74.0	0.34	M27	South Staffordshire	67	77.4	79.3	0.29
P22	South Lancashire	63	71.6	73.9	0.43	C08	Nottingham	63	77.6	79.3	0.27
C01	North Derbyshire	55	72.1	73.9	0.30	C02	Southern Derbyshire	66	77.5	79.3	0.26
C02	Southern Derbyshire	66	71.5	73.9	0.42	P16	Stockport	60	77.7	79.2	0.26
B61	Leeds	72	71.2	73.9	0.44	M26	North Worcestershire	53	77.9	79.2	0.21
C08	Nottingham	59	71.8	73.6	0.32	M22	Wolverhampton	72	77.2	79.2	0.28
B16	Grimsby and Scunthorpe	65	71.5	73.5	0.32	K33	Northamptonshire	51	78.0	79.1	0.15
N43	Sefton	71	71.2	73.5	0.38	C14	North Nottinghamshire	69	77.3	79.1	0.29
A11	Northumberland	69	71.3	73.5	0.41	B16	Grimsby and Scunthorpe	78	77.1	79.0	0.28
E21	Ken, Chelsea & Westmin¶	68	71.3	73.5	0.34	M25	South Birmingham	81	77.0	79.0	0.32
N51	Wirral	70	71.2	73.4	0.36	N51	Wirral	71	77.3	78.9	0.20
A34	North Cumbria	74	71.0	73.3	0.38	C01	North Derbyshire	68	77.4	78.9	0.21
C12	Sheffield	62	71.7	73.3	0.30	F37	Camden and Islington	57	77.7	78.8	0.20
B51	West Yorkshire	86	70.7	73.2	0.45	N43	Sefton	64	77.6	78.8	0.22
E20	Ealing, H'smith & Houns**	61	71.7	73.2	0.25	P22	South Lancashire	82	76.9	78.8	0.32

* Southampton and South West Hampshire.
† Portsmouth and South East Hampshire.
‡ Redbridge and Waltham Forest.
§ Merton, Sutton and Wandsworth.
¶ Kensington, Chelsea and Westminster.
** Ealing, Hammersmith and Hounslow.

Table 2 continued

Males		Ranks in 1984-86	Life expectancy 1984-86	Life expectancy 1992-94	% annual increase	Females		Ranks in 1984-86	Life expectancy 1984-86	Life expectancy 1992-94	% annual increase
C10	Doncaster	75	71.0	73.2	0.38	A34	North Cumbria	80	77.0	78.8	0.29
M21	Walsall	81	70.8	73.1	0.36	M17	Coventry	59	77.7	78.7	0.17
C11	Rotherham	73	71.2	73.1	0.29	P20	North West Lancashire	77	77.2	78.7	0.24
B31	Bradford	96	70.3	72.9	0.43	C11	Rotherham	76	77.2	78.6	0.23
B71	Wakefield	87	70.6	72.9	0.42	C10	Doncaster	79	77.1	78.5	0.25
M17	Coventry	78	70.9	72.9	0.34	B51	West Yorkshire	97	76.3	78.5	0.33
A31	South Durham	91	70.5	72.9	0.39	B31	Bradford	96	76.3	78.5	0.33
P23	Wigan and Bolton	100	70.2	72.8	0.44	G26	South East London	55	77.7	78.4	0.11
N17	North Cheshire	77	71.0	72.8	0.32	M07	North Staffordshire	87	76.5	78.4	0.29
M07	North Staffordshire	92	70.4	72.8	0.41	A11	Northumberland	89	76.5	78.3	0.28
P20	NW Lancashire	83	70.7	72.7	0.30	M29	North Birmingham	83	76.8	78.3	0.24
C09	Barnsley	76	71.0	72.7	0.29	M19	Sandwell	73	77.2	78.3	0.20
M29	North Birmingham	89	70.6	72.6	0.34	A31	South Durham	86	76.7	78.1	0.23
M25	South Birmingham	82	70.8	72.6	0.32	M21	Walsall	91	76.4	78.1	0.28
M22	Wolverhampton	79	70.9	72.6	0.30	C09	Barnsley	88	76.5	78.1	0.23
A35	Newcastle and North Tyneside	84	70.7	72.6	0.29	A35	Newcastle and North Tyneside	84	76.8	78.1	0.20
A30	North Durham	93	70.4	72.6	0.36	F35	East London and the City	75	77.2	78.1	0.17
P24	Bury and Rochdale	90	70.5	72.5	0.35	N17	North Cheshire	98	76.2	78.0	0.30
P21	East Lancashire	94	70.4	72.4	0.38	B71	Wakefield	94	76.3	78.0	0.26
P27	Salford and Trafford	95	70.3	72.4	0.36	P27	Salford and Trafford	85	76.7	78.0	0.20
N31	St Helens and Knowsley	102	70.0	72.4	0.41	P24	Bury and Rochdale	95	76.3	77.9	0.22
A32	Tees	99	70.3	72.2	0.34	A30	North Durham	93	76.4	77.8	0.20
A16	Sunderland	97	70.3	72.1	0.32	P23	Wigan and Bolton	100	76.2	77.8	0.28
P25	West Pennine	88	70.6	72.1	0.27	P21	East Lancashire	104	75.9	77.8	0.33
M19	Sandwell	101	70.2	72.0	0.31	A33	South of Tyne	90	76.5	77.8	0.22
A33	South of Tyne	103	70.0	71.9	0.34	A32	Tees	92	76.4	77.8	0.23
F37	Camden and Islington	80	70.9	71.8	0.16	P25	West Pennine	99	76.2	77.7	0.24
G26	South East London	85	70.7	71.7	0.18	N31	St Helens and Knowsley	102	76.1	77.6	0.24
F35	East London and the City	98	70.3	71.7	0.23	A16	Sunderland	101	76.2	77.4	0.17
N21	Liverpool	104	69.8	71.2	0.24	N21	Liverpool	103	76.0	77.3	0.21
P26	Manchester	105	69.2	69.9	0.10	P26	Manchester	105	75.4	76.7	0.22

Table 3 Life expectancy at birth in relation to gender in 1984-86 and 1992-94: English district health authorities grouped by level of deprivation, listed in order of increasing deprivation

Level of deprivation	Males: Rank in 1984-86	Males: Life expectancy 1984-86	Males: Life expectancy 1992-94	Males: % annual increase	Females: Rank in 1984-86	Females: Life expectancy 1984-86	Females: Life expectancy 1992-94	Females: % annual increase	Female-male difference in life expectancy (y) 1984-86	Female-male difference in life expectancy (y) 1992-94
England		72.1	74.1	0.35		77.9	79.5	0.25	5.8	5.4
Deprivation level 1	1	73.0	75.2	0.38	2	78.4	80.2	0.28	5.4	4.9
Deprivation level 2	2	72.9	75.0	0.35	1	78.5	80.1	0.25	5.5	5.1
Deprivation level 3	3	72.6	74.8	0.36	3	78.4	80.0	0.25	5.8	5.3
Deprivation level 4	4	71.6	73.7	0.35	4	77.6	79.1	0.24	6.0	5.5
Deprivation level 5	5	71.1	73.0	0.34	6	77.1	78.7	0.25	6.0	5.6
Deprivation level 6	6	71.0	72.9	0.32	5	77.3	78.9	0.26	6.3	6.0
Deprivation level 7	7	70.2	71.2	0.18	7	76.8	77.8	0.17	6.7	6.6

Note: definition of deprivation levels is given in table 1.

0.45 years (table 3). Affluent areas showed a greater narrowing of this differential than deprived areas: −0.48 years in the most affluent areas, with practically no change in the most deprived areas (−0.06 years).

Discussion

There have been major changes in ONS systems of processing mortality data, which came into effect from 1993 and affect cause of death coding. The all cause mortality data used here are unaffected, except for the change from numbers of registrations annually to numbers of occurrences. ONS expects this change to have little effect on annual totals.[9]

Life expectancy conveys the impact of mortality more readily than rates/ratios. It should, however, be noted that life table methodology is based on death rates prevailing in a particular period, comprising the mortality experience of many successive birth cohorts. Hence life expectancy is a "period" measure, describing how long a person would live if the mortality rates of a particular period prevailed for an entire generation. In this paper we have measured life expectancy based on mortality levels in the decade up to 1994; since it is realistic to expect mortality to continue to fall in the future, those born now are likely to live longer than predicted by this approach.

The findings presented here quantify the effects on longevity of regional differences in mortality in England. For instance, given the local mortality rates in the early 1990s, a male baby in Cambridge can expect to live almost 7 years longer than his counterpart in Manchester, the difference for a female baby being almost 4.5 years. Furthermore, regional differences have widened over the past decade. The lowest ranking areas in this analysis have

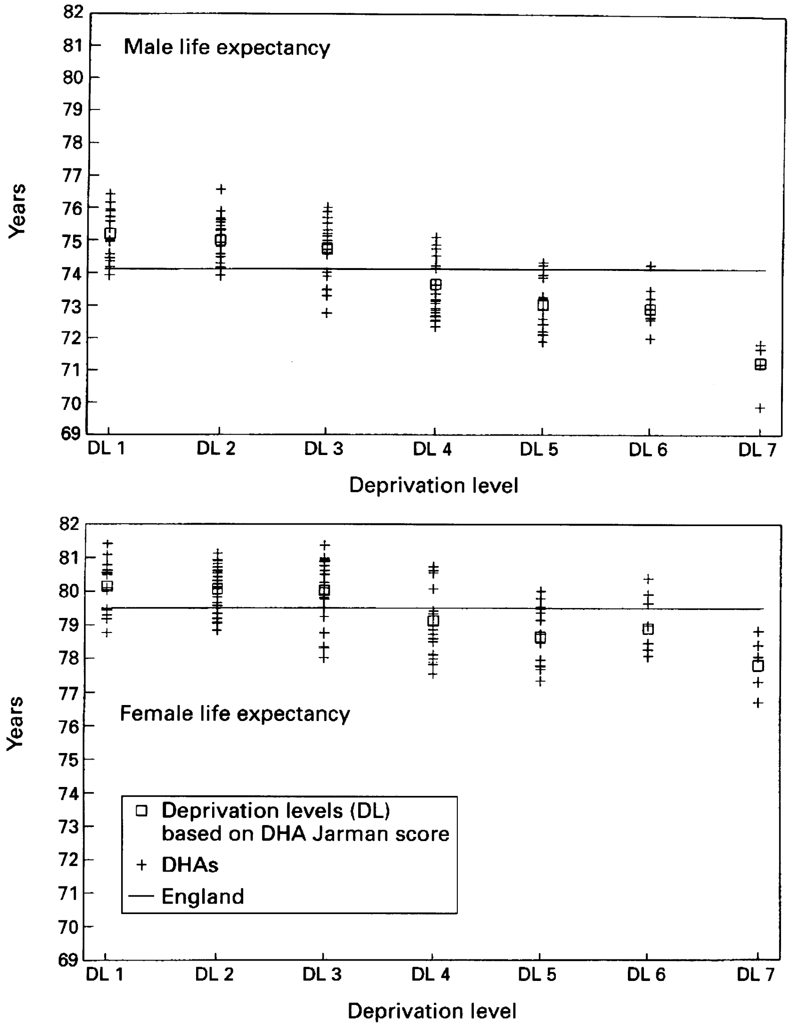

Figure 3 Male and female life expectancy at birth in district health authorities in England, 1992-94. Note: DL 1 <−SD (ie <−17.37); DL 2, between −1 and −0.5 of the SD; DL 3, between -0.5 and 0 of the SD; DL 4, between 0 and 0.5 of the SD; DL 5, between 0.5 and 1 of the SD; DL 6, between 1 and 1.96 of the SD; DL 7, significantly greater than the mean at the 5% level.

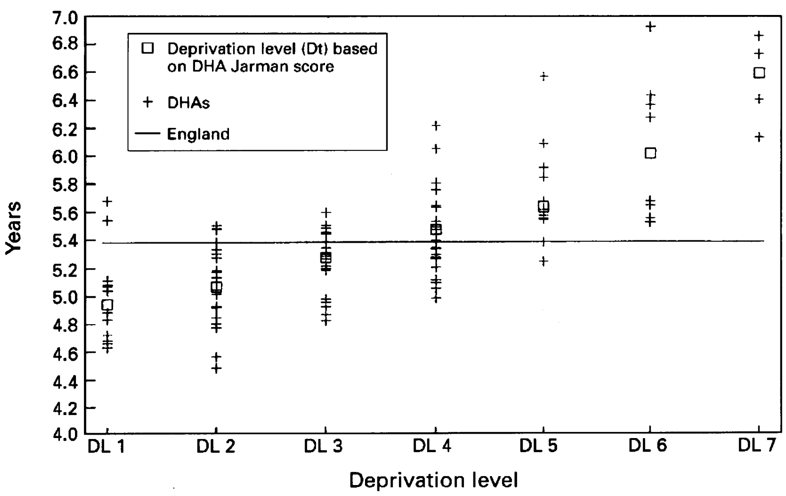

Figure 4 Female-male differences in life expectancy among English district health authorities, 1992-94. Note: deprivation levels are defined in the same way as in figure 3.

life expectancies in 1992-94 equivalent to those of England and Wales two decades ago.[3]

Using Jarman scores[6 7] as a measure of deprivation, we found a correlation coefficient between deprivation and life expectancy of −0.77 for men and −0.56 for women. Although other measures of deprivation are also available,[10 11] Jarman scores were used here because they are available for the 1995 DHA boundaries. Any method combining several variables into a single index has its limitations. However, correlation coefficients obtained by Eames *et al* between mortality and different deprivation indices do not vary greatly,[12] and are similar to our results.

We have shown that not only is life expectancy in English DHAs inversely associated with deprivation, but that the prosperous, longest lived populations have seen the greatest gains in life expectancy over the decade. In contrast, the most deprived DHAs (inner London, Manchester and Liverpool) experienced negligible improvements in longevity, despite having the lowest life spans in the mid-1980s. Inner London has shown the poorest gains, and male life expectancy in parts of the capital is among the lowest in the country. Another significant finding is that survival rates for young men aged 30-39 have deteriorated nationally, and in all area groupings, the decline being greatest in deprived areas, which also showed a significant fall in survival rates at 20-29. Mortality increased also in young women, but only in the very deprived areas.

From the data available, it is not possible to quantify the contribution of migration to life expectancy variations between DHAs. It is possible that the higher life expectancy of an area reflects in-migration of healthy people (and conversely), and that widening geographical differences reflect, at least in part, the effects of selective migration. While the health of migrants has important policy implications, such data would be available only on a sample basis. Furthermore, it does not detract from the value of an ecological investigation into local variations in health in order to identify the most disadvantaged areas.

The findings presented here are consistent with those noted by Charlton in his analysis of life expectancy for regional health authorities and the ONS area classification groups.[5] The latter is an area typology based on homogeneity across a range of demographic, housing, and socioeconomic variables. Charlton went on to show that the high mortality "Ports and industry" areas have the highest mortality from lung cancer, coronary heart disease, and stroke, and that people in inner London have the highest mortality from respiratory diseases and injury and poisoning.

There is mounting evidence about the association between socioeconomic inequalities and mortality differentials in England,[12-23] and that the degree of socioeconomic inequality within an area contributes an additional effect over and above that of the level of deprivation alone.[24-30] The analysis of Phillimore *et al* showed a widening of mortality differentials between affluent and deprived electoral wards in northern England between 1981 and 1991.[13] Eames *et al* have shown that premature mortality from all causes, coronary heart disease, and smoking-related diseases is associated with deprivation.[12] Sloggett and Joshi used longitudinal data to distinguish between the effects on mortality of deprivation at population and individual level.[23] They found that it is disadvantaged people that are at risk, irrespective of whether they live in deprived or affluent areas, and concluded that people not areas should be targeted by health interventions.

In contrast, Illsley and Le Grand concluded that age and sex specific regional trends in mortality between 1931 and 1987-89 suggest that behavioural risk factors and ethnicity, rather than deprivation, make the greatest contribution to the persistence of geographical differentials.[31] They noted that a convergence in regional differences in childhood mortality, the most vulnerable to the effects of poverty, contrasted with widening differences among the middle aged after 1961, which they attributed to differential changes in risk behaviour relating to coronary heart disease and lung cancer, with affluent groups responding most effectively to health promotion messages about behaviour induced diseases.

Although the major impact on life expectancy of regional differences in mortality is registered in middle aged adults, a significant difference in mortality continues to be apparent even at younger ages. This is reflected in the 1993 SMRs for ages 0-14 years of 72 in prosperous areas and 89 in growth areas, contrasting with 125 in manufacturing areas and 116 in inner London (England and Wales=100).[7] Thus, although the historical narrowing of mortality differentials regionally has been greatest at younger ages, the differences remain substantial even now.

However, Illsley and Le Grand's argument is consistent with our findings that regional differences in life expectancy are greater for males than for females, and that deprived areas not only have lower life expectancies but also greater gender differences. Deprived areas also showed the least narrowing of gender differences over the decade. It is not clear why deprivation should impact more on male than on female longevity. If the higher mortality of people in deprived areas reflects the cumulative effects of deprivation through childhood and later life,[30 32] it is not obvious why the effects should be greater for men than for women. Possible explanations are: selective migration to deprived areas of males in poor health; greater gender variation in deprived areas in the incidence of external causes of death such as accidents, suicide and violence; and finally, deprivation could be a stronger proxy for health risk behaviour in men than in women.

Rising mortality in young men irrespective of the area's socioeconomic status may reflect the increasing contribution of suicide and/or AIDS; the adverse effects on survival among young women in very deprived areas is less readily explained. Government population projections for England anticipated an AIDS related increase in young male mortality up to the mid-1990s; they also forecast an increase in young female mortality between 1994 and 1995.[33]

Areas with low life expectancy (particularly inner London) are also those with substantial ethnic minority populations. Infant mortality is significantly higher than the national average in infants of African-Caribbean and Pakistani born mothers, but not significantly different in infants of mothers born in India, Bangladesh or East Africa.[34] The 1991 census based analysis of mortality in England and Wales by country of birth shows raised SMRs at ages 20-69 for migrants from Africa and for South Asian men (but not women); Caribbean migrants had low SMRs.[35] The contribution of ethnicity to the regional differences in life expectancy noted here is difficult to ascertain but, since ethnicity is associated with deprivation, it is unlikely to have a strong independent effect.

The congruence between behavioural risk factors, the insults to physical and mental health imposed by deprivation, and ethnicity makes the issue of causation particularly complex. The *Variations In Health* report[2] concluded that differential lifetime exposure to health damaging or health promoting physical and social environments is the main explanation for variations in life expectancy, with health related social mobility, health damaging or health promoting behaviours, use of health services, and biological factors also contributing. In the next phase of this work we will explore shifts in age, gender and cause specific mortality to help identify the nature and sources of the variations noted in this paper.

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