RESEARCH REPORT

Increasing inequalities in premature mortality in Great Britain

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Study objective: To describe inequalities in all cause premature mortality between and within regions of Great Britain and how these inequalities have changed between 1979 and 1998.

Design: Retrospective study using routine population and death data aggregated into five year age and sex groups for each of 20 years.

Setting: All 459 local authority districts (England and Wales) and local government districts (Scotland).

Participants: Estimated population and registered deaths aged 0–64.

Main outcome measures: Indirectly standardised mortality ratios for all cause mortality; percentages of deaths that would be avoided if there were no inequalities between and within regions.

Results: The decrease in premature mortality of 36% seen in Great Britain ranged from 42% in Wales to 33% in Scotland and 31% in London. Differences between regions led to excess mortality of about 25% in Scotland, the North East, and the North West. In London excess mortality increased from 14% to 19%. Inequalities within regions increased in most parts of Great Britain, the exceptions being Wales, London, and the South West. The largest increase was seen in Scotland where the percentage of excess deaths increased from 23% to 33%.

Conclusions: A decrease in premature mortality in Great Britain was seen in all regions, although less pronounced in London, but the gap between regions remained. Inequalities between districts within regions vary from one region to another and have increased in nearly every part of Great Britain.

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Mortality rates in Great Britain have fallen in recent years among men and women.¹ While this is true for most age groups, there is evidence that mortality rates may have increased for young men.² Moreover, there have been increases in life expectancy in all social classes³ with corresponding decreases in mortality rates.⁴ However, the comparison of the relative mortality differentials between unskilled manual workers and professionals has shown inequalities in mortality by social class not just to exist but also to have increased.⁵

Geographical inequalities in health and mortality are known to exist in Great Britain, with Scotland, Wales, and Northern Ireland having higher mortality than England and regions in the north of England having higher mortality than the south.⁶ Although the gap between regions with high and low mortality rates appears unchanged between 1950 and 1990,⁷ the variation between regional mortality rates has been increasing in the younger age groups.⁸ Substantial variation between mortality rates in local authorities within the regions is linked to socioeconomic indicators of area deprivation,⁷ type of area (based on summary characteristics),⁶ or both.⁹ Moreover, the geographical patterns of mortality vary by age and cause.¹⁰

There has been less work considering changes in mortality rates—and consequent inequalities in mortality—over time. Such studies are frequently at regional rather than local level.¹¹ This is not always the case; some studies compare rates at one time period with those at another. A comparison of the highest and lowest mortality rates for local authorities suggested that by the 1990s such differentials were greatest in Scotland and North West England for all age groups and additionally in London for 15–44 year olds,⁶ although comparing extremes may not provide a robust measure. However, such a finding for Scotland is lent weight by an investigation of relative inequalities in mortality suggesting the social class gradient had increased more rapidly between

1951 and 1981 in Scotland than in England and Wales.¹² Furthermore, mortality differentials between populations living in the most and least socioeconomically deprived areas increased between 1981 and 1991 in Scotland¹³ and the north of England.¹⁴ A comparison of the mortality of the 10% of the population living in areas with the highest and lowest mortality rates indicated an increasing differential from the 1950s to the 1990s,¹⁵ in absolute and relative terms.¹⁶

Geographical inequalities in mortality have increased internationally at differing levels of aggregation. In the 20 years from 1978 life expectancy increased by five years in high income countries but remained unchanged in low and middle income countries.¹⁷ In the Netherlands there was some increase in regional inequalities in total mortality for men and women between 1972 and 1982.¹⁸ Between the early 1980s and the early 1990s inequalities have also increased between local administrative districts in Budapest,¹⁹ electoral wards in Barcelona,²⁰ and small areas in an anonymous “large Swedish city”.²¹ Similarly, regional inequalities in mortality increased in Manitoba between the late 1980s and early 1990s.²² The picture from Australia seems mixed; while inequalities have increased between local government areas in Sydney²³ (between 1972 and 1992) and New South Wales²⁴ (1972 to 1987), at a national level increasing inequalities were limited to males aged 0–24 between 1986 and 1996, with other ages and females showing no change or decreasing inequalities.²⁵

This paper describes the contribution to the mortality rate of inequalities between regions and inequalities within regions, and illustrates how these inequalities have changed using annual data from 1979 to 1998.

Abbreviations: SMR, standardised mortality rate; LGR, local government reorganisation

METHODS

Deaths from all causes by five year age groups and sex for local authorities in England and Wales on an annual basis were obtained from the Vital Statistics Tables of the Office for National Statistics (ONS) from 1979 to 1998; mid-year population estimates (also from the ONS) were used to provide denominator populations. A comparable dataset was assembled for Scotland from death records and population estimates from the General Register Office for Scotland. Analysis was restricted to deaths among the population aged less than 65; a summary of these data is provided in table 1. An increase of 4.1% in the population aged less than 65 was accompanied by a 32.8% decline in the number of deaths, meaning that by 1998 there were about 12 fewer deaths per 10 000 population than in 1979. The largest decreases were seen in the older age groups.

The data refer to populations living in local authority districts (England and Wales) or local government districts (Scotland). These are the basic units of the analysis and, although far from homogenous in terms of their populations, they reflect substantial differences in terms of their compositions.²⁶ In 1979 there were 459 such districts. These districts are clustered within the nine regions of England plus Scotland and Wales; however, the intermediate level of county in England and Wales and Health Board in Scotland is also considered. London is considered to be a single county (as well as being a region); it was broken down into five pseudo-counties based on the Nomenclature of Units for Territorial Statistics (NUTS3) areas.²⁷ (As the counties of England and Wales are NUTS3 areas, this creates a standard unit.) These will enable us to determine whether regional variations arise due to the clustering of districts of similar mortality within counties; there were a total of 73 counties in 1979.

The data contain a number of hierarchies. Repeated measures (the number of deaths) were available for each of 20 years in each district. As some districts always tend to have mortality rates that are higher or lower than average, the observations on each district are clearly correlated (just as they would be if repeated measures were made on an individual). Moreover, the districts are nested within counties and the counties within regions. Mortality rates for all of the districts within the same county are likely to be correlated, as are those for all counties within a particular region. Multilevel modelling^{28 29} was used to take account of these hierarchies and allow for persistently high (or low) mortality rates in some regions (in contrast with random fluctuations from one year to another). This enabled the partitioning of the variation between districts to that part attributable to each of the district, county and region levels. The multilevel Poisson regression model applied used as an offset the expected number of deaths in each year in each

district (based on the 1998 age and sex specific mortality rates for Great Britain) and was therefore equivalent to modelling indirectly standardised rates.³⁰ The software used was MLwiN³¹; further details of the methodology can be found elsewhere.³² Variance components were estimated from the model with the levels of year (observation), district, county and region; however, as there were only 11 regions these were treated as fixed effects as compared with random effects in the models reported (that is, a dummy variable was included for each region).

A trend was fitted to allow for changes over time. The SMRs reported in this paper are those estimated from this trend; using the data for all years in this way has the advantage over the observed SMR for a single year of smoothing out random fluctuations around the trend. The variation between districts within each region is summarised by a standard deviation. As a Poisson multilevel model has been fitted these standard deviations are on the same scale as the log rate ratio. The trend was found to vary significantly between districts, counties, and regions; this meant that the standard deviations changed over time. If the standard deviation is unchanged it implies that the relative dispersion of districts is unchanged (and, with falling mortality rates, this will imply a reduction in the absolute variation).

Local government reorganisation (LGR) between 1995 and 1998 created new unitary authorities; old districts were merged and split as part of this process.²⁷ The death records used in Scotland included both pre-LGR and post-LGR areas of residence; however, the aggregated mortality data in England and Wales were provided using boundaries in existence that year. The impact of these changes, shown in table 1, was a reduction in the number of districts from 459 in 1979 to 432 in 1998. As the trends in the mortality rates in individual areas—and the variance between areas—are of interest, a multiple membership model³³ was used to take account of the geographical changes. In essence, this entails modelling the relative risk of mortality associated with each of the new areas through the weighted sum of the risks for the pre-LGR areas. The weights used were according to the populations in the pre-LGR and post-LGR areas.

RESULTS

Between 1979 and 1998 the mortality rate (standardised to the European standard population) for Great Britain fell from 348 to 219 per 100 000 population aged 0–64 (table 2). Over this time the standard error of the district mortality rates—presented as a measure of variation—decreased from 59 to 48. Although the standard error decreased in absolute terms, the fact that this decrease was smaller than that seen for the mortality rate implies that relative inequalities increased. Also shown in table 2 are the mortality rates and standard errors for each region.

The SMR in 1979 for the whole of Great Britain was 157 (based on 1998 mortality rates); the 19 years therefore saw a 36.4% reduction in age and sex standardised mortality rates. This reduction was not uniform across regions; figure 1 shows yearly SMRs based on national mortality rates in 1998. The reduction in SMR was most marked in Wales—from an above average 165 in 1979 to a below average 96 in 1998, a decrease of 41.9%. The decrease in mortality was relatively slower in Scotland (from 191 to 128, a reduction of 33.1%) and London (150 to 103, 31.4%).

Figure 1 describes the differences between regions; however, this is only part of the picture. There are also considerable disparities in mortality between districts within the same region. Table 3 shows the districts with the highest and lowest SMRs in 1979 and 1998 in each region. The SMRs given in this table are predicted SMRs, based on long term trends in each district and therefore not subject to year on

Table 1 Summary statistics for premature mortality in Great Britain, 1979–1998		
	1979	1998
Population <65	46547810	48452162
Deaths <65	155628	104640
Deaths per 10000 population		
men <40	10.8	8.3
40–64	105.7	60.4
women <40	6.8	4.6
40–64	61.2	38.0
Regions	11	11
Counties	73	73
Districts	459	432

Table 2 Directly standardised mortality rates per 100000 population aged 0–64, together with the standard error of the district mortality rates, 1979 and 1998, for all regions and for Great Britain

Region	1979		1998	
	Mortality per 100000 aged 0–64	Standard error of district mortality rates	Mortality per 100000 aged 0–64	Standard error of district mortality rates
Scotland	422	67	279	60
North East	402	33	254	31
North West	394	44	250	44
London	335	52	226	42
York and Humber	363	42	226	40
West Midlands	354	44	219	31
Wales	363	40	210	24
East Midlands	333	32	208	34
South East	295	34	186	44
South West	304	39	186	27
East of England	290	31	185	31
Great Britain	348	59	219	48

year fluctuations. In every region there has been a greater reduction in mortality in districts with the lowest mortality rates than among those with the highest rates. The reductions in low mortality areas range from 77% in Scotland (from 137 to 77) to 47% in London; in high mortality areas they range from 37% in Wales to just 5% in Scotland. In general it has not been the same districts that have had the highest or lowest rates in both 1979 and 1998. Also shown in table 3 are the standard deviations for districts within each region; these have increased for all regions by between 16% (Wales) and 90% (East Midlands). These increases suggest a pattern of increasing relative inequalities in all regions.

A variance components model was used to quantify the relative importance of differences between and within regions. The variation between regions accounted for 44% of the total variation in addition to random year on year fluctuations in district mortality rates. There was little

variation (17%) between counties within regions, with the remainder (39%) arising because of differences between districts within counties.

Although a total of 56% of the variation in district mortality rates was attributable to differences within regions, this figure varied from one region to another. The relative importance of between regional variation and within regional variation for each region can be quantified in terms of the proportion of mortality that could be avoided if either of these sources of variation were to be eliminated and the other remained unchanged. Firstly, we consider reducing the average mortality rate in each region to that of the East of England—the region with the lowest SMR for most years in figure 1. The relative pattern of inequalities within regions is assumed to be unchanged so that, for example, the relative risk of mortality in Glasgow City remains 2.82 times that in Eastwood in 1998 (as given in table 3). Figure 2 shows the proportion of deaths that would be eliminated in each region

Figure 1 SMR for country and region, 1979–1998 (SMR for GB 1998 = 100). sco, Scotland; ne, North East; nw, North West; lon, London; y and h, York and Humber; wm, West Midlands; wal, Wales; em, East Midlands; se, South East; sw, South West; eas, East of England.

Table 3 Districts with the highest and lowest SMR in 1979 and 1998 by region and standard deviation (SD) of all districts

Region	Year	High		Low		District	County	District	County	SMR	SD
		County	District	District	County						
Scotland	1979	Greater Glasgow	Glasgow City	Glasgow City	Greater Glasgow	Bearsden & Milngavie				136.6	0.132
	1998	Greater Glasgow	Glasgow City	Glasgow City	Greater Glasgow	Eastwood				77.1	0.208
North East	1979	Cleveland	Middlesbrough CD	Middlesbrough CD	Northumberland	Alnwick CD				156.2	0.076
	1998	Cleveland	Middlesbrough UA	Middlesbrough UA	Northumberland	Alnwick DC				90.2	0.116
North West	1979	Greater Manchester	Manchester MD	Manchester MD	Cheshire	Macclesfield CD				140.4	0.090
	1998	Greater Manchester	Manchester MD	Manchester MD	Cumbria	South Lakeland DC				82.5	0.160
London	1979	Inner London—East	Tower Hamlets LB	Tower Hamlets LB	Outer London—W&NW	Harrow LB				121.8	0.146
	1998	Inner London—East	Lambeth LB	Lambeth LB	Outer London—W&NW	Richmond upon Thames				82.8	0.179
York & Humber	1979	West Yorkshire	Bradford MD	Bradford MD	Humberside	Borough of Beverley CD*				135.9	0.116
	1998	Humberside	Kingston upon Hull UA	Kingston upon Hull UA	North Yorkshire	Ryedale DC†				77.6	0.174
West Midlands	1979	Staffordshire	Stoke on Trent CD	Stoke on Trent CD	Shropshire	Bridgnorth CD				126.5	0.108
	1998	Staffordshire	Rhonddda CD	Rhonddda CD	Hereford & Worcester	Bromsgrove DC				76.5	0.144
Wales	1979	Mid-Glamorgan	Merthyr Tydfil UA	Merthyr Tydfil UA	Powys	Radnorshire CD				138.5	0.098
	1998	Mid-Glamorgan	Nottingham CD	Nottingham CD	Gwent	Monmouthshire UA‡				85.5	0.114
East Midlands	1979	Northamptonshire	Corby CD	Corby CD	Leicestershire	Blaby CD				127.9	0.082
	1998	Northamptonshire	Dartford CD	Dartford CD	Leicestershire	Oadby & Wigston DC				72.6	0.156
South East	1979	Berkshire	Slough UA	Slough UA	Buckinghamshire	Wycombe CD				106.7	0.100
	1998	Berkshire	Bristol CD	Bristol CD	Berkshire	Wokingham UA				67.3	0.149
South West	1979	Gloucestershire	Gloucester CD	Gloucester CD	Avon	Wansdyke CD				119.5	0.067
	1998	Gloucestershire	Thurrock CD	Thurrock CD	Dorset	East Dorset CD				68.7	0.097
East of England	1979	Essex	Luton UA	Luton UA	Essex	Rochford CD				114.7	0.072
	1998	Bedfordshire			Norfolk	South Norfolk CD				69.1	0.123

*Subsequently merged with East Yorkshire, Holderness and part of Boothferry to form East Riding of Yorkshire. †Formed from the split of Ryedale CD. ‡Formed from the merger of Stoke on Trent with part of Stafford. §Formed from the merger of Monmouth with part of Blaenau Gwent.

Figure 2 Percentage of deaths that would be avoided if differences between regions were eliminated. sco, Scotland; ne, North East; nw, North West; lon, London; y and h, York and Humber; wm, West Midlands; wal, Wales; em, East Midlands; se, South East; sw, South West; eas, East of England

in each year in this manner. The excess mortality is calculated as the proportional decrease in observed deaths that would result from having the same long term trend in the risk of mortality as the East of England. Yearly fluctuations in the observed deaths around the long term trend mean that the excess mortality in the East of England will not be exactly 0%. Although some regions such as Wales decreased differences with the East of England, most maintained relative differentials. Excess mortality was about 25% in Scotland, the North East and the North West. There was a

persistent increase in excess premature mortality in London, from 14% of all deaths under 65 in 1979 to 19% in 1998.

Now we consider the effect of reducing the variation within regions. Figure 3 shows the proportion of deaths that would be eliminated in each region if all districts in that region had a mortality rate equivalent to the 10th centile of districts within that region. (It would be possible to choose any other centile, for example, the median or 50th centile. The choice of the 10th centile means that a fairly demanding target is being set.) The chosen centile is obtained from the

Figure 3 Percentage of deaths that would be avoided if differences within regions were eliminated. sco, Scotland; ne, North East; nw, North West; lon, London; y and h, York and Humber; wm, West Midlands; wal, Wales; em, East Midlands; se, South East; sw, South West; eas, East of England

Key points

- Mortality rates in Great Britain have decreased in all regions
- There are mortality differentials between regions of England and Scotland and Wales and between counties within these regions
- Differences in premature mortality between regions persisted between 1979 and 1998
- Differences between districts within regions have increased over the same time
- Inequalities between districts are greater in Scotland than in any other region

variance of all districts within the region. From figure 3 we can see that for most regions there was an increase in the proportion of excess deaths over the 20 years; the exceptions to this were a decline in Wales (from 14% in 1979 to 9% in 1998) and little change in London (18% to 19%) and the South West (11% to 13%). Not only did Scotland have a higher percentage of excess deaths than any other region, but this proportion increased substantially from 23% to 33%.

DISCUSSION

This paper has described changes over time in mortality rates and variation between districts in these rates. There has been no attempt to explain why this variation occurs; rather, the focus has been on the quantification of the variation in terms that are useful when considering inequalities in health. Many recent studies have focused on the relation between contextual (area) characteristics and health, with particular emphasis on social capital,³⁴ socioeconomic deprivation or socioeconomic status,^{35–38} and area level income inequality.^{39–43} Such factors would provide suitable starting points when trying to explain why these inequalities exist, and the contribution of any of these to inequalities could then be assessed.

The overall pattern of a reduction in SMRs is encouraging, although there must be questions as to why the reductions have varied across regions. It is possible that, at least in part, some of these differences could be explained by compositional differences in terms of factors associated with widening mortality differentials such as social class.³ This would not account for the much slower decline in mortality seen in London compared with other regions; by 1998 the relative risk of mortality in London was 15% higher than would have been the case had mortality rates in London declined in line with other regions. Possible causes include variation introduced through differing patterns of selective migration, either from abroad⁴⁴ or within Great Britain.⁴⁵ This slow decline led to an increase in the relative risk of mortality

Policy implications

- Reducing inequalities in health has become a health priority in the UK and in many other countries. Although inequalities between regions attract frequent comment, the fact that inequalities between districts may vary from one region to another receives less attention. Any future reduction in inequalities must come against a background of increasing inequalities between areas.

associated with living in London compared with the East of England, the region with the lowest mortality rates. Wales was the only region that closed the gap, with excess mortality falling from 19% to 12%. Inequalities between regions remained unchanged elsewhere.

The reduction in mortality rates was less pronounced in regions with high mortality in 1979; however, this effect was small and made little contribution to mortality differentials. But within regions the gaps between the districts with the lowest and the highest mortality rates increased. As in general it is not the same district that has a high or low mortality rate in a region in 1979 and 1998, the rate at which area mortality rates diverged will be greater than that implied by a simple comparison of the areas in table 3. This increasing polarisation as gaps have opened up between affluent and deprived or healthy and unhealthy areas has translated into increases in the proportion of excess deaths in most regions, with a particularly steep increase seen in Scotland.

Inequalities in health are undesirable and should be reduced when possible.⁴⁶ Many European countries now have specific programmes designed to reduce inequalities in health⁴⁷; it is in recognition of this that the Department of Health recently included the reduction of geographical differences in life expectancy as one of their inequality targets.⁴⁸ The department acknowledges the difficulty in reaching the target—a reduction by at least 10% of the gap in average life expectancy at birth between the 20% of health authorities (in England and Wales) with the lowest life expectancy and the population as a whole—given current trends. The increase in inequalities in mortality between areas is not unique to Great Britain but is an international problem. As the health of certain areas worsens relative to the rest of the country it is important to bear in mind that such inequalities should be tackled nationally and not just at the area or community level.^{49–50}

Mortality in Scotland is higher than in any region of England or Wales; about a quarter of premature deaths in Scotland would be avoided if Scotland had the same average mortality rate as the East of England. Research based on the early 1990s showed that only 60% of the difference between Scotland and England and Wales could be explained by deprivation—a finding termed the “Scottish effect”.⁵¹ However, a larger and increasing proportion of deaths would be avoided if inequalities between districts within Scotland were eliminated. The failure of current levels of health spending to reduce either source of inequality should be borne in mind in the face of recent calls to abolish⁵² or even maintain⁵³ subsidy through the Barnett formula.

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