Deprivation and self-reported health: are there ‘Scottish effects’ in England and Wales?

David K. Whynes
School of Economics, University of Nottingham, Nottingham NG7 2RD, UK
Address correspondence to David K. Whynes, E-mail: david.whynes@nottingham.ac.uk

ABSTRACT

Background Although the association between poor health and deprivation is well-founded, a ‘Scottish effect’ has been observed, whereby the level of health appears even poorer than Scotland's higher level of deprivation should warrant. We consider whether ‘Scottish effects’ also occur within the regions of England and Wales.

Method Using ward-level data from the national census, we regress healthy life expectancies relative to total life expectancies on Carstairs deprivation scores, households’ average disposable incomes, geo-spatial characteristics and regional dummy variables.

Results Higher incomes and lower Carstairs scores are each associated with longer proportions of lives expected to be spent in good health or without long-standing illness. Relative to the London region, the coefficients on the regional dummies are uniformly negative and mostly significant.

Conclusions There exist differences in relative health expectancies between the regions of England and Wales, which are not fully explained by the differences in socio-economic circumstances. Conventional deprivation measures tend to understate the poorer health performances of the more deprived regions (Wales and the north of England), and the understatement increases with deprivation. The exception to the rule is London, where health expectancies are superior to those which deprivation leads us to expect.

Keywords carstairs score, deprivation, healthy life expectancy, self-reported health

Introduction

The evidence supporting the proposition that, in more deprived populations, the prevalence of good health is lower and life expectancy is shorter, is now ‘overwhelming’.1 In the UK in the late 1970s, the Department of Health’s Working Group on Inequalities in Health utilized the wealth of data which had been collected routinely by the Office of Population, Censuses and Surveys to identify the existence of a health gradient by occupational class.2 Non-manual professionals evidently enjoyed superior mortality and morbidity rates compared with those of unskilled, manual workers. In the years following, alternatives to occupational class as a measure of relative affluence were developed. Several different ways of combining data taken from the 1981 census and associated surveys were used to describe deprivation within the populations of small, geographically defined, areas. Each method combined variables to generate a summary score reflecting the socio-economic status of a locality relative to that of others.3 Using such measures, analysis of 2001 census results identified a north–south gradient in both life expectancy4 and self-reported health,5 with deprivation explaining much of the geographical variation.

Although the association between deprivation and poor health appears robust in general terms, certain puzzles remain. In particular, Scotland was the focus of one of the path-breaking studies of 1980s, with Carstairs and Morris devising a deprivation index which demonstrated that deprivation was considerably ‘more severe’ in Scotland than it was in England and Wales.6 Such differential deprivation was advanced initially as the root cause of Scotland’s higher mortality rate. Evidence from later censuses and surveys, however, demonstrated that the Scots experienced levels of health poorer than those of inhabitants of England and Wales, even after accounting for differences in socio-economic circumstances.7,8 In the light of conventional wisdom, whereby health is driven by deprivation, such
findings appear paradoxical. There seems to be a ‘Scottish effect’, whereby a proportion of inter-regional differences in health remain unexplained by differences in deprivation, and the existence of the effect has become enshrined in Scotland’s policy rhetoric.9

A recent study which confirmed the decreasing influence of differences in deprivation on Scotland’s excess mortality between 1981 and 200110 ended with the speculation that it was unlikely that the ‘Scottish effect’ was confined to Scotland: ‘The north of England and Wales may well show similar findings’ (p. 203). The present paper takes its cue from this speculation and seeks to determine whether or not there exist health differences unexplained by deprivation between regions within England and Wales.

Methods

Regional health effects, if they exist, can be detected by regression analysis, using data compiled at the sub-regional or small area level. If we regress small area data for a health variable onto one or more measures of deprivation and include a dummy variable for membership of each region, significant coefficients associated with the dummies will demonstrate a regional effect independent of deprivation. Within the most recent decennial census (2001), the basic geo-political micro-unit is the ward. There are ~8800 wards in England and Wales, with an average size of ~6000 persons. At the opposite extreme, the highest level of geopolitical aggregation beneath national boundaries is the 10 Government Office Regions (GORs), for example, the East Midlands, Wales and London.

In 2007, the Office of National Statistics (ONS) published healthy and disability-free life expectancy (DFLE) data by ward for England and Wales.11,12 The data set combines life expectancy estimates obtained from 1999 to 2003 mortality data with responses to two health-related variables included in the 2001 census. These are, first, the individual’s assessment of his or her general health over the preceding year (rated as ‘good’, ‘fairly good’ or ‘not good’). Healthy life expectancy (HLE) at birth is the expected number of years a newborn would survive and remain in good or fairly good general health if she/he experienced the ward’s age and sex-specific mortality and health rates, as at 2001, throughout his or her life. Second, individuals indicated in their census responses whether or not they were currently suffering from a limiting long-standing illness (LLSI), namely, ‘any long-term illness, health problem or disability which limits your daily activities or the work you can do’, including old age. DFLE at birth is the expected number of years without LLSI, again assuming individuals experience the ward’s mortality and health rates over time.

The ONS also produces 2001 Carstairs deprivation scores for each ward. Carstairs scores are an un-weighted sum of four census variables: male unemployment, the proportion of households that are over-crowded, the proportion not owning a car and the proportion headed by a semi-skilled or unskilled manual worker. Prior to addition, each variable is standardized and centred around zero to avoid the influence of extreme values for any one variable.13 Higher Carstairs scores indicate greater deprivation.

It would be feasible to regress directly HLE or DFLE on Carstairs-assessed deprivation to test our hypothesis, although certain modifications to such an approach seem appropriate. To begin with, there is evidence that census-based indicators are incomplete descriptions of deprivation and material well-being. First, household income has been shown to predict self-reported health. Although it is closely associated with deprivation, income appears to exert an independent effect.14,15 We therefore include as independent variables ONS estimates of ward-level average disposable income per household for 2001–2.16 Second, there is evidence that the impact of deprivation on health differs between rural and urban settings.17,18 To allow for this, we include dummy independent variables reflecting each ward’s morphology and context, as defined by the contemporary rural and urban classification.19 Morphology refers to the physical form of the ward, classified as ‘urban’, ‘small town and fringe’ or ‘village, hamlet and dispersed’. Context refers to the spatial density of households within each ward and is categorized as ‘sparse’ or ‘less sparse’.

HLE and DFLE are composites and are each determined both by a subjective and by an objective factor, namely, self-reported health and overall life expectancy. In view of the effect of ageing on health per se, the former is likely to be affected by the latter. We therefore specify two dependent variables: the proportion of the average lifespan in which individuals can expect to live in good or fairly good general health and the proportion of the lifespan in which they can expect to be free from LLSI. These are simply HLE and DFLE expressed as percentages of life expectancy independent of health status. In the regression models, life expectancy itself becomes an independent predictor of both dependent variables.

Results

In terms of the number of wards, the smallest GORs are the North East (465 wards) and Yorkshire/Humberside (496 wards), whereas the largest are the South East (1497
wards) and the East of England (1117 wards). The variation in number reflects the physical size and the density of the populations of those regions. As small numbers of persons resident within a ward make life expectancy and income estimations especially unreliable, such data have not been produced for some 900 wards, namely, those with populations of less than around 1000 persons. Our final data set therefore comprised 7723 ward-level observations for males and 7882 for females.

Table 1 displays the mean values of all relevant variables by GOR. As is evident, the highest mean Carstairs scores (highest deprivation) are recorded for London and the North East, whereas the lowest are for the East and the South East. London is the most urbanized GOR, with all but two of its 625 wards classified as urban spaces. The East and the South West have the smallest proportions of urban wards. Wales is, by far, the most sparsely populated GOR, followed by the North East. No ward in London or the South East is sparsely populated. Average weekly disposable income is lowest in Wales and the North East and highest in London and the South East. Average life expectancies in the North East, the North West and Wales are at least 2 years shorter than life expectancies in the East, the South East and the South West.

All of the above variables were entered into ordinary least squares regression models. Morphology was accommodated by dummy variables for ‘town’ and ‘village’ only, ‘urban’ being excluded to prevent over-identification. For the same reason, the GOR London dummy was excluded. Separate models were estimated for males and females, given the existence of sizeable differences in longevity by sex.

The regression results appear in Table 2, from which several points emerge. First, the models explain, at worst, three-quarters of the variation, and virtually all the coefficients are statistically significant. Second, the signs for the income and Carstairs coefficients are as would be expected, given previous research findings. Higher average incomes are associated with longer proportions of lives expected to be spent in good health or without LLSI. A higher Carstairs score predicts a relatively shorter period. In each of the two regression formulations, the marginal health expectancy gain for reduced deprivation is higher for women, whereas the marginal gain from increasing income is higher for men. Third, living in a sparsely populated area significantly increases the proportion of time spent in better health, as does town- or village-dwelling for women. Again, this result is consistent with previous findings. 20 Fourth, for women, living longer increases the proportion of time spent in poorer health, although by less than the absolute increase in life expectancies. The effect for men is smaller or even reversed, possibly owing to their shorter life expectancies.
Table 2 Regression models

| Dependant: proportion of expected life spent in good or fairly good health (%) | | | | Dependant: proportion of expected life without limiting long-standing illness (%) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Male | Female | | Male | Female | | | | | | |
| β | SE | P value | β | SE | P value | β | SE | P value | β | SE | P value |
| Constant | 87.52 | 0.62 | 0.00 | 95.73 | 0.57 | 0.00 | 83.14 | 0.92 | 0.00 | 98.72 | 0.75 | 0.00 |
| Life expectancy (years) | 0.03 | 0.01 | 0.00 | −0.08 | 0.01 | 0.00 | −0.08 | 0.01 | 0.00 | −0.27 | 0.01 | 0.00 |
| Net weekly income, £’00 | 0.44 | 0.00 | 0.00 | 0.25 | 0.00 | 0.00 | 1.20 | 0.00 | 0.00 | 0.82 | 0.00 | 0.00 |
| Carstairs score | −0.54 | 0.01 | 0.00 | −0.62 | 0.01 | 0.00 | −0.64 | 0.01 | 0.00 | −0.75 | 0.01 | 0.00 |
| Context (sparse = 1) | 1.16 | 0.09 | 0.00 | 1.53 | 0.09 | 0.00 | 1.55 | 0.14 | 0.00 | 2.02 | 0.13 | 0.00 |
| Morphology (town = 1) | 0.00 | 0.05 | 0.97 | 0.16 | 0.05 | 0.00 | −0.02 | 0.07 | 0.72 | 0.18 | 0.06 | 0.00 |
| Morphology (village = 1) | −0.11 | 0.05 | 0.02 | 0.20 | 0.05 | 0.00 | −0.35 | 0.07 | 0.00 | 0.18 | 0.07 | 0.01 |
| GOR (North East) | −1.92 | 0.10 | 0.00 | −1.79 | 0.11 | 0.00 | −3.17 | 0.15 | 0.00 | −2.48 | 0.14 | 0.00 |
| GOR (North West) | −1.56 | 0.09 | 0.00 | −1.90 | 0.09 | 0.00 | −2.11 | 0.13 | 0.00 | −2.31 | 0.12 | 0.00 |
| GOR (Yorkshire/Humberside = 1) | −1.19 | 0.09 | 0.00 | −1.32 | 0.10 | 0.00 | −1.75 | 0.14 | 0.00 | −1.57 | 0.13 | 0.00 |
| GOR (East Midlands = 1) | −0.53 | 0.10 | 0.00 | −0.90 | 0.10 | 0.00 | −0.74 | 0.14 | 0.00 | −1.19 | 0.13 | 0.00 |
| GOR (West Midlands = 1) | −0.53 | 0.09 | 0.00 | −1.01 | 0.10 | 0.00 | −0.50 | 0.14 | 0.00 | −1.20 | 0.13 | 0.00 |
| GOR (East) | −0.24 | 0.08 | 0.00 | −0.38 | 0.08 | 0.00 | −0.63 | 0.12 | 0.00 | −0.91 | 0.11 | 0.00 |
| GOR (South East) | −0.03 | 0.07 | 0.65 | −0.03 | 0.08 | 0.72 | −0.42 | 0.11 | 0.00 | −0.40 | 0.10 | 0.00 |
| GOR (South West) | −0.22 | 0.10 | 0.02 | −0.31 | 0.10 | 0.00 | −0.22 | 0.14 | 0.13 | −0.31 | 0.13 | 0.02 |
| GOR (Wales = 1) | −3.21 | 0.10 | 0.00 | −3.59 | 0.11 | 0.00 | −4.48 | 0.15 | 0.00 | −4.52 | 0.14 | 0.00 |
| Adjusted $R^2$ | | 0.80 | | | | 0.78 | | | | 0.76 | | 0.77 |

The coefficients on the regional dummies are uniformly negative and, in all but three cases, significant. The models indicate that, for example, the proportion of life expected to be spent without an LLSI for males in Wales is 4.48 percentage points less than that for males in London, and 2.37 percentage points less than that for males in North West England, after allowing for differences in deprivation, income and geo-spatial characteristics. Similarly, the proportion of lifetime spent in good or fairly good health for females in the East of England is 1.41 percentage points higher than that for females in the North East.

At the GOR level, the coefficients of correlation between the four sets of region-specific intercepts (Table 2) and the regions’ mean disposable incomes (Table 1) vary between 0.68 and 0.75. The correlation coefficients between intercepts and mean Carstairs scores for the GORs vary between −0.28 and −0.38, if London is included, or −0.69 and −0.76, if London is excluded. In general, therefore, relative healthy life expectancies are poorer than those predicted by income, deprivation and geo-spatial characteristics when GOR income is low and when GOR deprivation is high. The latter is especially true if London’s deprivation is ignored.

As noted earlier, a proportion of wards was excluded from the analysis owing to the lack of health expectancies and income data. A comparison between the Carstairs scores, morphology and context data of the wards included in, and those excluded from, the analysis indicates selection bias in the sample. A far higher proportion of excluded wards was lower, indicating lower deprivation in London, for which no data were missing, the least proportion excluded was 4.5 and 5.5% for the South East and the North East, respectively. The disproportionate portion excluded was 15.9, P = 0.01). The average Carstairs score of the excluded wards was lower, indicating lower deprivation in comparison with the main sample (−1.7 versus 0.2, t = 15.9, P < 0.01). By GOR, the highest proportion of wards excluded from the analysis was 30.5 and 17.7% for Wales and the South West, respectively. Other than London, for which no data were missing, the least proportion excluded was 4.5 and 5.5% for the South East and the North East, respectively. The disproportionate exclusion of more sparsely populated, village wards with lower deprivation was repeated in all individual GORs with two exceptions: excluded and included wards did not differ significantly in terms of context for the East of England and the East Midlands.
Discussion

Main findings
Our results confirm that deprivation, household income and spatial characteristics, as measured at the census ward level, are all significant influences on health-related life expectancies in England and Wales. More importantly, however, there evidently exist differences in relative health expectancies between the regions of England and Wales which are not fully explained by differences in socio-economic circumstances. As with the case of Scotland vis-à-vis England and Wales, conventional deprivation measures tend to understate the poorer health performances of the more deprived regions. Thus, relative health expectancies in Wales and in the north of England are lower than those predicted from their higher levels of deprivation. The exception to the rule is London, and the ‘London effect’ is the reverse of the ‘Scottish effect’. Although they are by no means as high as those in other regions of southern England, the relative health expectancies of Londoners are significantly superior to those which their average deprivation status would lead us to expect.

What is already known
Bivariate analyses of recent UK data support the association between deprivation and self-reported health expectancies. A sample based on combined health survey and census data demonstrated, for the late 1990s, that those living in the most deprived wards spent twice as many years in poor health than those in the least deprived wards. Using the same health expectancy data as used in our analysis, another study grouped wards into 20 deprivation categories, in terms of increasing Carstairs scores. It showed that people in the most deprived wards had shorter life expectancies and lived more years in poor health in comparison with those in the least deprived wards.

A multivariate analysis using an approach similar to ours predicted standardized mortality rates and self-reported health rates for those aged under 65 years in wards grouped by geographical type, using deprivation measures, regional dummies and unemployment. Using data and categorizations from the early 1990s, the analysis confirmed the familiar negative deprivation/health association. It also showed that people living in rural wards had significantly better health, a result perhaps equivalent to the beneficial effect of sparseness evident from our own study. Although metropolitan wards exhibited ‘better than expected health’ on average, this effect was essentially the result of London’s health out-performing its socio-economic circumstances. A more recent study compared life expectancy differences between local authority areas in England. With ~350 authorities in the data set, the level of aggregation was higher than that used in our analysis. Deprivation was measured by the authorities’ Townsend scores, and a ‘socio-economic and demographic context’ dummy variable specific to each authority was included. Life expectancy was found to be associated with deprivation although, as with our study, deprivation tended to understate the poorer life expectancies of the more deprived regions. At the margin, male life expectancy was found to be more sensitive to deprivation than was female; in our analysis of relative health expectancy, however, the reverse is the case.

What this study adds
This study validates the speculation that the ‘Scottish effect’ in the UK is not confined to Scotland. In accordance with that speculation, health expectancies in Wales and in the north of England are lower than those predicted from deprivation, income and geo-spatial characteristics, and these are the regions where average deprivation itself tends to be higher. Health expectancies in London, however, are higher than those predicted.

While we have identified ‘Scottish effects’ elsewhere in the UK, we are no nearer than many other commentators to explain them, although the evident association between intercepts and deprivation re-affirms the importance of the latter in some guise. Demographic dynamics might offer an explanation, for it has been shown for Scotland that illness rates are lower in deprived areas whose populations are stable than they are in equivalent areas where populations are declining. For England and Wales, areas with higher proportionate levels of inward migration have lower standardized morbidity ratios. Alternatively, the significance of the regional dummies supports the existence of spatial autocorrelation, whereby observations that are geographically close are related to one another. It is conceivable, in other words, that it is not merely deprivation that influences health status, but the patterning of that deprivation. The effect of deprivation in poorer regions might represent an amplification engendered by the close proximity of many poor wards. In reverse, the better health reported in London might result from its close proximity to the least deprived regions of England.

Limitations
The exclusion of around 900 wards from the analysis inevitably means that Table 1 distorts real GOR means, especially for those GORs with many rural wards. Given that the excluded wards have lower levels of deprivation, the
Welsh averages in particular are almost certainly over-pessimistic. The extent of bias in the regression results consequent upon excluding these observations, if any, cannot be predicted satisfactorily.

The Carstairs score is a well-accepted measure of deprivation although it is essentially an artificial construct, as are all such measures. Its composition makes it prone to distortion. In comparison with other regions, for example, car use is far less common in London owing to shorter travel distances, local taxation and a comprehensive public transport network. Likewise, a higher density of occupation is both more usual and more acceptable in London. It is therefore possible that the Carstairs score over-states London's actual deprivation status, implying that the ‘London effect’ could be, in part at least, an artifact.

An increasing amount of socio-economic data is becoming routinely available and measures of deprivation considerably more comprehensive than the Carstairs score are being developed. The index of multiple deprivation (IMD) for small areas of England combines 38 indicators into seven individual dimensions of deprivation, such as income, employment, education and crime. Unlike the Carstairs score which relies on decennial census data, the IMD can be re-calculated more frequently. The incompatibility of the English and the Welsh IMDs makes the data unsuitable for addressing the specific research question being asked in this paper, although they are of potential value for future analysis within either of these countries alone. This said, it has been shown that the IMD and the Townsend score, which shares three of its four component variables with the Carstairs, map out essentially similar patterns of morbidity. Our conclusions using the Carstairs score, therefore, are not necessarily vulnerable to broader definitions of deprivation.

References


