

Effect of labour market conditions on reporting of limiting long term illness and permanent sickness in England and Wales

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Abstract

Study objective—To identify any bias in the reporting of limiting long term illness and permanent sickness due to labour market conditions, and show the absence of the effect in mortality rates.

Design—A geographically based study using data from the 1991 census. Standardised ratios for mortality and long term illness in people aged 0–64 years and permanent sickness in people of working age were compared with Carstairs deprivation scores in multilevel models which separated the effects operating at three geographical scales: census wards, travel to work areas, and standard regions. Holding ward and regional effects constant, variations between travel to work areas were compared with long term unemployment rates.

Setting—Altogether 8690 wards and 262 travel to work areas in England and Wales.

Main results—Variations in mortality, limiting long term illness, and permanent sickness were related to Carstairs deprivation scores and standard region. With these relationships controlled, limiting long term illness and permanent sickness were significantly related to long term unemployment levels in travel to work areas, but mortality was not affected. Self reported morbidity was more sensitive to variations in long term unemployment rates in conditions of high social deprivation than in affluent populations.

Conclusions—Limiting long term illness and permanent sickness measures may reflect a tendency for higher positive response in difficult labour market conditions. For average social deprivation conditions, standardised limiting long term illness for people aged 0–64 years was 20% higher in travel to work areas where employment prospects were relatively poor compared with areas with relatively good employment prospects. This casts doubt on the use of limiting long term illness as an indicator of objective health care needs for resource allocation purposes at national level.

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standardised mortality ratio (SMR),¹ and SMRs were accepted as indicators of health needs in resource allocation formulas. With the publication of the 1991 census, an alternative measure, the prevalence of limiting long term illness, became available. Based on the census question, "Does the person have any long-term illness, health problem or handicap which limits his/her daily activities or the work he/she can do? Include problems which are due to old age," this new information offered the prospect of a measure of health needs that includes conditions which are not life-threatening but which nonetheless place demands on health services. Within a short period, limiting long term illness was recommended as a key needs indicator for resource allocation purposes,² and has been adopted as such by the Department of Health. Yet in one respect the superiority of limiting long term illness over mortality ratios as a needs indicator is questionable. While death is objectively defined, limiting long term illness is a self reported measure and may reflect both "real" health status and other effects, such as differences in the way health is perceived and reported. The relative contribution of such effects to limiting long term illness prevalence rates is therefore of interest, and here we examine the potential influence of labour market conditions on the likelihood of reporting long term illness.

The existing evidence of labour market influences on self reported morbidity comes largely from studies of permanent sickness or disability. Data on permanent sickness have been collected in successive UK censuses as a reason given for being unable to work. In the 1991 census the relevant question was: "Which of these things was the person doing last week?" with a range of possible responses including "was unable to work because of long term sickness or disability". Although permanent sickness was one of the few morbidity measures available at the local scale prior to the 1991 census, its use as a measure of general health status has been limited. Only people excluded from employment are covered by the census category, so children, most elderly people, and many women are excluded, and there is doubt whether the conditions which prevent attendance at work are representative of the total morbidity in any population.³ In addition, there is concern about the self reported nature of the measure. Several studies have shown that registered rates of sickness and disability among people of working age rise in periods of high unemployment,⁴⁻⁷ which

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Until 1991, the best single measure of the comparative health status of local populations within the UK was widely recognised as the

is ascribed to a tendency for those with difficulty finding work, or those encouraged to retire early, to assess themselves as "permanently sick" or "disabled" without necessarily any deterioration in their physical condition. Recently, for example, the riddle of falling local unemployment rates in UK coalmining areas from 1981–94 (a period of massive job losses) has been explained by dramatic reductions in economic activity among men in those areas, corresponding to an increase in those who described themselves as "permanently sick".⁷ Since people eligible for sickness benefit are better off than those who are unemployed, there is a financial advantage in adopting the sick role.^{6–8}

Recognition that levels of self assessed permanent sickness or disability are partly determined by labour market conditions raises the question of the extent to which the declaration of limiting long term illness in the 1991 census was also affected, particularly as raised rates of limiting long term illness are noticeable among men aged 55 to 69, close to retirement age.⁹ There was, of course, some correspondence between positive replies to the long term illness and the permanent sickness questions in the census, and an automatic edit used by OPCS ensured that the number of people whose economic position was "permanently sick" agreed with the corresponding count of persons with long term illness.¹⁰ Nevertheless, 45% of men and 30% of women aged between 16 and 59 with limiting long term illness were economically active and therefore ineligible for the permanent sickness category.⁹

The methodological problem is to separate a suspected bias in self reporting of illness in conditions of high unemployment from the "objective" effects of unemployment on physical health.⁸ There is accumulating evidence that unemployment is a direct cause of ill health.^{11,12} Unemployment is also a component of a broader "social deprivation" syndrome which is known to be related to objective health indicators such as mortality rates,¹ and unemployment is included in all the major indices of social deprivation.^{13–15} Limiting long term illness is even more strongly related to indicators of social deprivation than is mortality,¹⁶ and it seems reasonable to interpret at least part of that relationship as a real health effect rather than an artefact of reporting biases.

The objective and subjective effects of unemployment on limiting long term illness are likely to operate at different geographical scales. Census small area statistics for electoral wards

represent average local conditions, where differences in social deprivation measures (including local unemployment rates) might be expected to be reflected in real mortality and morbidity variations. But electoral wards (containing about 5000 population on average) are much too small to be representative of the labour markets in which people seek and travel to work. Travel to work areas typically focus on an urban centre and include the surrounding hinterland, an area which usually includes many wards. Wards within a travel to work area typically show large variations in social deprivation, but they all experience similar labour market conditions. The level of long term unemployment within a travel to work area is an indication of the relative ease or difficulty in getting a job, which is believed to affect the self-assessment of permanent sickness. An investigation of the relative contribution of ward social deprivation values and travel to work area long term unemployment rates in predicting variations in recorded illness levels therefore promises to include both objective and subjective effects if they exist. While self reported permanent sickness or disability is expected to be prone to subjective biases of reporting in conditions of poor employment prospects, and limiting long term illness may be, mortality cannot be affected in the same way. A comparison between mortality, limiting long term illness and permanent sickness rates under varying conditions of employment prospects is therefore of additional interest. Since it has been shown that both mortality and morbidity vary by geographical region independently of social deprivation,^{16,17} the comparison must take account of geographical region as a possible confounding factor.

Method

Data on the usually resident population and the number of people reporting limiting long term illness and permanent sickness were collected by age group, sex, and electoral ward for all residents in households and communal establishments in England and Wales from the local base statistics of the 1991 census, accessed through the University of Manchester Computing Centre.¹⁸ For each ward, standardised illness ratios (SIRs) were calculated for males and females aged under 65 years by indirect standardisation using age specific rates of limiting long term illness for England and Wales. Standardised permanent sickness ratios (SPSRs) were similarly calculated by ward for males aged 16–64 years and for females aged 16–59 years. All cause mortality statistics for 1990–92 broken down by age, sex, and ward were obtained through the University of Manchester Computing Centre,¹⁹ and standardised mortality ratios (SMRs) were calculated for males and females aged under 65 years by ward. Mortality data for 164 wards with suppressed census information because of very small populations were treated in the same way as the census information, by importing into adjacent wards. Wards which had boundary changes during the period 1990–92 were excluded from

KEY POINTS

- Self reported rates of limiting long term illness and permanent sickness are affected by local labour market conditions.
- Mortality rates are not affected in the same way.
- Distortion by labour market factors means that limiting long term illness rates may not be a reliable indicator of health needs

Table 1 Multilevel model estimates: males

	Standardised mortality ratio	Standardised illness ratio	Standardised permanent sickness ratio
Fixed coefficients:			
Intercept	4.482	4.512	4.416
Slope	0.448 (52.2)	0.525 (75.1)	0.762 (76.8)
Random effects variance:			
(3) Between regions			
Intercept	0.003 (2.0)	0.016 (2.1)	0.061 (2.1)
(2) Between TTWAs			
Intercept	0.002 (4.2)	0.013 (9.9)	0.036 (9.9)
Slope	0.001 (1.2)	0.005 (5.4)	0.007 (4.0)
Covariance	0.000 (0.7)	0.004 (4.5)	0.001 (0.3)
(1) Between wards			
Intercept	0.112 (56.0)	0.028 (55.4)	0.082 (58.7)
Slope	0.027 (5.5)	0.006 (4.5)	0.035 (10.8)
Covariance	-0.046 (21.3)	-0.011 (20.3)	-0.048 (28.1)

Ratios of estimates to SEs are in brackets.

Table 2 Multilevel model estimates: females

	Standardised mortality ratio	Standardised illness ratio	Standardised permanent sickness ratio
Fixed coefficients:			
Intercept	4.495	4.483	4.328
Slope	0.348 (37.0)	0.500 (73.1)	0.806 (64.6)
Random effects variance:			
(3) Between regions			
Intercept	0.004 (2.0)	0.009 (2.0)	0.044 (2.0)
(2) Between TTWAs			
Intercept	0.002 (3.2)	0.012 (9.9)	0.045 (9.7)
Slope		0.005 (5.2)	0.011 (3.8)
Covariance		0.004 (5.2)	-0.002 (0.6)
(1) Between wards			
Intercept	0.170 (65.1)	0.028 (53.8)	0.129 (57.0)
Slope		0.006 (4.7)	0.068 (11.6)
Covariance		-0.010 (19.0)	-0.078 (27.8)

Ratios of estimates to SEs are in brackets.

the study. The number of wards included was 8690.

The Carstairs index was selected as the measure of social deprivation at ward level since this index has been shown to perform well relative to alternative indices in explaining the variation of a range of health measures.^{13,20} Ward data required for calculation of the Carstairs index were taken from the local base statistics of the 1991 census. The index was computed by ward as the sum of four standardised variables: the proportion of persons in overcrowded households, the proportion of persons in households with no car, the proportion of persons in households with household head in social class 4 or 5 and the male unemployment rate.

The latest available definitions of local labour markets in England and Wales were the 262 travel to work areas based on returns of the 1981 census published in 1984.²¹ Long term unemployment figures were obtained from the national on-line manpower information system (NOMIS) at the University of Durham. The number of males who had been claiming unemployment benefit for at least 52 weeks in April 1991 was extracted and expressed as a percentage of the number of males in the workforce for each travel to work area. Long term unemployment claimant rates were higher and more variable for males than females and the male claimant rate was chosen as it was believed to reflect local labour market variations more closely than the female rate.

To take account of changes in ward boundaries between 1981 and 1991, each 1991 ward was matched with a travel to work area by overlaying digitised boundaries of 1991 wards on digitised travel to work area boundaries

using a geographic information system.²² In cases where 1991 wards overlapped travel to work area boundaries, the travel to work area containing the majority of the ward was identified. Finally, the standard region containing each travel to work area (or the majority of its wards in cases of overlap) was recorded, allowing the data to be organised in a nested hierarchy of three geographical levels: wards within travel to work areas within regions.

Multilevel modelling was applied to separate the effects operating on mortality and morbidity measures at different geographical scales. Multilevel models are able to distinguish relationships at several scales simultaneously and offer more conservative Bayes estimates of parameters than conventional ordinary least squares regression.^{23,24} The computer program *MLN*, developed at the Institute of Education, University of London, was used. The models fitted were of the form:

$$Y_{ijk} = a + bX_{ijk} + (u_k + v_kX_{ijk} + r_{jk} + s_{jk}X_{ijk} + e_{ijk} + f_{ijk}X_{ijk}) \quad (\text{equation 1})$$

Wards were defined as level 1, travel to work areas as level 2 and standard regions as level 3 (subscripts i , j and k respectively). The response variable (Y_{ijk}) was the natural logarithm of the health outcome measure (SMRs, SIRs and SPsRs for males and females). The explanatory variable (X_{ijk}) was the natural logarithm of the Carstairs score. Logarithms were taken to produce a model with proportional rather than incremental relationships,¹⁶ and the transformation had the additional advantage of reducing skewness and giving better fits. For the Carstairs index a constant was added before logging to remove negative scores and the logged values were then centred on their mean. The fixed parameters of the model were the intercept constant a and the slope b . Random effects (in parenthesis in equation 1) were distinguished at regional, travel to work area and ward levels. At each level a random variable associated with the intercept (u_k , r_{jk} and e_{ijk}) and a random variable associated with the slope (v_k , s_{jk} and f_{ijk}) were included, and the covariance of these terms was also estimated.

Predicted values of the health measures for travel to work areas were calculated from the fitted multilevel models, holding constant the random variations at ward and standard region levels. Predictions were made using three different social deprivation scores in equation (1): a low score (taken at the 5 percentile of Carstairs values, which was a score of -3.82), an average score (the median Carstairs value of -0.83), and a high deprivation score (7.05, corresponding to the 95 percentile of Carstairs scores). The predicted values were compared with male long term unemployment rates in travel to work areas. The analysis was done using standardised mortality, limiting long term illness and permanent sickness ratios for males and females in turn.

Results

With one exception, all the multilevel models converged successfully on parameter estimates. The exception was for female SMRs, which failed to produce estimates for all the possible

random effects simultaneously, but which did converge on parameter estimates for the fixed part of the equation and for random intercept terms at the three levels. Multilevel model estimates are given in tables 1 and 2, together with the ratios of the estimates to their standard errors. Using a pseudo z test, a ratio of more than two standard errors was taken to indicate statistical significance at the 0.05 level. The results for males (table 1) and females (table 2) were similar.

In the fixed part of the models the terms "intercept" and "slope" in the tables refer to a and b respectively in equation 1. The positive relationships between the health measures and the Carstairs deprivation score at ward level were all highly significant, and the slope increased from SMRs to SIRs to SPSRs. That is to say, permanent sickness was much more sensitive to changes in the ward deprivation score than mortality, with limiting long term illness in an intermediate position.

After taking the relationship with social deprivation into account, the coefficients in the random part of the models were estimates of the remaining variance in health measures occurring at ward, travel to work area and regional levels. All health measures had more random variance between wards than between travel to work areas or between regions, but mortality rates had more random variance between wards and less at the two higher levels than the morbidity measures. The largest component of random variance consisted of the positive and negative deviations of ward health measures above and below the predicted values (intercept variations between wards in tables 1 and 2). In addition, there was evidence of significant slope variations and of significant negative covariance between intercepts and slopes at ward level. These terms indicated that the data were heteroscedastic: wards with low Carstairs values (logged) tended to have more variable health measures (also logged) than wards with high Carstairs values.

In addition to the random variation between wards, all models identified significant variation between travel to work areas and between regions, justifying the use of a multilevel methodology. The random variations between regions were all marginally significant and showed consistent variations above and below the predicted health values from one standard region to another. The regional effect was weakest for mortality and strongest for permanent sickness. There were no significant random variations in slopes or significant covariance between slopes and intercepts at regional level for all health measures, so only the random intercept variance was estimated in the final models.

At the intermediate scale of travel to work areas there was evidence of significant random variations in intercepts, slopes and significant covariance, although two of these terms could not be estimated for female SMRs. The relationship between health and the Carstairs deprivation score had significantly different intercepts in different travel to work areas for all the health measures, although there was markedly less variation for mortality compared

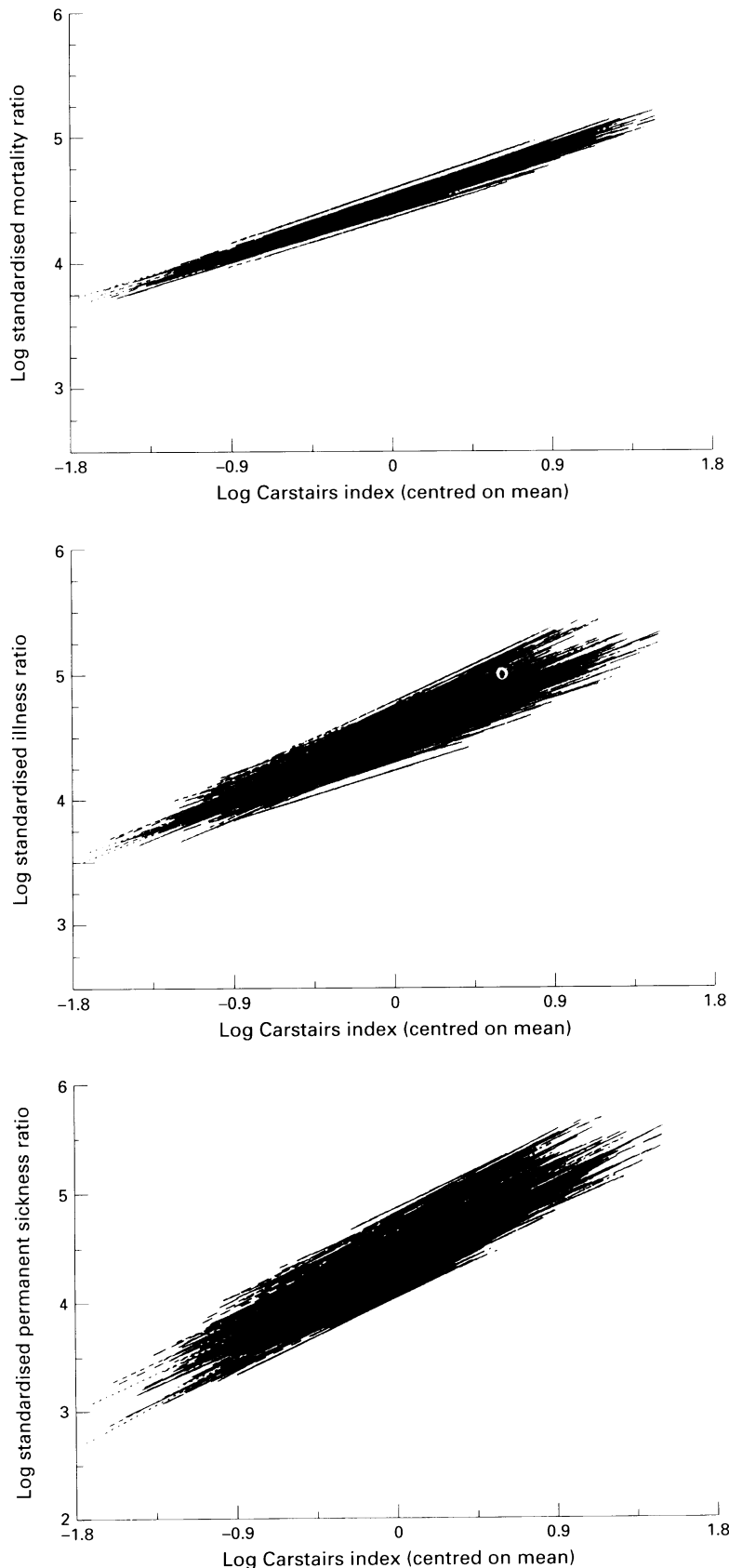


Figure 1 Estimated relationship between three health measures and Carstairs score for 262 travel to work areas. Male values.

Table 3 Mean predicted standardised mortality and morbidity ratios (95% confidence intervals) in travel to work areas at three levels of social deprivation, by long term male unemployment rate: males

Unemployment rate (%)	No	Standardised mortality ratio	Standardised illness ratio	Standardised permanent sickness ratio
Low deprivation:				
0-0.99	72	100 (99, 100)	96 (94, 97)	89 (86, 91)
1-1.99	96	100 (100, 101)	100 (99, 102)	101 (98, 104)
2-2.99	46	100 (99, 101)	102 (100, 104)	106 (101, 111)
3-3.99	26	100 (100, 101)	105 (101, 109)	113 (104, 121)
4.00+	22	100 (99, 100)	107 (103, 111)	121 (113, 130)
Average deprivation:				
0-0.99	72	100 (99, 100)	94 (92, 95)	88 (86, 91)
1-1.99	96	100 (99, 101)	100 (98, 102)	101 (98, 104)
2-2.99	46	100 (99, 101)	104 (101, 107)	107 (102, 112)
3-3.99	26	101 (100, 102)	106 (101, 110)	111 (103, 119)
4.00+	22	100 (99, 101)	113 (108, 117)	124 (115, 132)
High deprivation:				
0-0.99	72	100 (99, 100)	91 (89, 93)	88 (85, 91)
1-1.99	96	100 (99, 101)	100 (98, 102)	101 (98, 104)
2-2.99	46	100 (99, 101)	106 (102, 110)	109 (103, 114)
3-3.99	26	101 (100, 103)	108 (102, 114)	109 (100, 118)
4.00+	22	100 (99, 102)	119 (113, 126)	127 (117, 136)

Table 4 Mean predicted standardised mortality and morbidity ratios (95% confidence intervals) in travel to work areas at three levels of social deprivation, by long term male unemployment rate: females

Unemployment rate (%)	No	Standardised mortality ratio	Standardised illness ratio	Standardised permanent sickness ratio
Low deprivation:				
0-0.99	72	100 (99, 100)	97 (96, 98)	90 (87, 93)
1-1.99	96	100 (100, 101)	100 (98, 101)	100 (97, 104)
2-2.99	46	100 (99, 100)	101 (99, 103)	104 (99, 110)
3-3.99	26	101 (100, 102)	105 (102, 109)	118 (108, 128)
4.00+	22	101 (100, 101)	107 (103, 112)	126 (114, 138)
Average deprivation:				
0-0.99	72	100 (99, 100)	95 (93, 97)	90 (87, 93)
1-1.99	96	100 (100, 101)	99 (98, 101)	100 (97, 104)
2-2.99	46	100 (99, 100)	102 (99, 105)	105 (99, 111)
3-3.99	26	101 (100, 102)	107 (103, 111)	114 (104, 123)
4.00+	22	101 (100, 101)	113 (107, 118)	126 (115, 138)
High deprivation:				
0-0.99	72	100 (99, 100)	93 (91, 95)	91 (87, 94)
1-1.99	96	100 (100, 101)	99 (97, 101)	101 (97, 104)
2-2.99	46	100 (99, 100)	105 (100, 109)	106 (100, 112)
3-3.99	26	101 (100, 102)	109 (103, 115)	109 (100, 119)
4.00+	22	101 (100, 101)	119 (111, 128)	127 (115, 140)

with the two self-reported measures. The slope of the relationship with the Carstairs score varied significantly between travel to work areas for SIRs and SPSRs, but not for male SMRs. In the case of long term illness there was also positive covariance between intercepts and slopes, so some travel to work areas had both high long term illness ratios and an apparently greater response of long term illness to social deprivation variations compared with other areas.

The travel to work area residuals for the three health measures in males are shown in figure 1. Each diagram shows, in effect, the individual regression lines of travel to work areas. The relationship between mortality and deprivation varied very little between travel to work areas, so most of the 262 regression lines are superimposed on each other. The residuals for limiting long term illness were much more variable, with a range of different lines of best fit for the travel to work areas. The variability between travel to work areas was even more marked for permanent sickness. It is clear from the diagrams that a given level of social deprivation was associated with a range of self assessed morbidity values in different travel to work areas, but a much narrower range of standardised mortality ratios. The diagrams for females were similar.

In tables 3 and 4 the 262 travel to work areas are divided into five groups according to their male long term unemployment rate (ranging from less than 1% to 4% and above). The mean values and confidence limits of multilevel model predictions of health values in travel to work areas, holding random variations at ward and regional levels constant, are given for each group. Thus, for the 72 travel to work areas with long term unemployment rates below 1%, the predicted SMR values had a mean of 100 with narrow confidence limits irrespective of whether a low, medium or high deprivation score was entered into the equation.

Tables 3 and 4 show that there were only minor differences between the male and female results. As already noted, the predictions of SMRs in travel to work areas were unaffected by social deprivation variations at ward level. More important, the means of predicted SMRs in travel to work areas were 100 or 101 whatever the long term unemployment rate, with confidence limits all including 100. In contrast, the means of the predicted values of both long term illness and permanent sickness showed a gradient, with the lowest standardised ratios in travel to work areas with low long term unemployment rates and the highest in areas with high long term unemployment rates. The gradient was confirmed by the progression of 95% confidence limits and by highly significant analysis of variance tests. The gradient in means was greater for permanent sickness than for limiting long term illness. Both morbidity measures were more sensitive to changes in long term unemployment rates in conditions of high social deprivation than in the context of low social deprivation. At average social deprivation levels, the mean predicted standardised long term illness ratio for males increased from 94 to 113 over the range of unemployment categories, an increase of 20%. For areas with low and high social deprivation levels, the equivalent increases for male SIRs were 11% and 31% respectively. The increases in mean predicted standardised long term illness ratios with unemployment for females were marginally less: 10%, 19% and 28% respectively in conditions of low, average and high social deprivation.

Discussion

These results confirm the well known associations between the health status of populations in small areas, social deprivation and standard region. Comparison between the "objective" measure (mortality) and the two self reported measures shows a broadly similar pattern of relationships. Increases in the Carstairs social deprivation score between census wards were matched by proportional increases in all three health measures. Some regions had higher levels of health than others, independently of social deprivation.

The advantage of the multilevel modelling approach was an ability to detect any contextual variations in the relationship between limiting long term illness and social deprivation,²⁵ and such variations were identified between travel

to work areas. Its disadvantage is complexity, and the attendant possibility that the results might have been produced by other undetected relationships. For example, apparent effects at higher levels in a multilevel analysis could result from a mis-specification of lower level associations. The Carstairs index was used as the predictor of health variations in wards in this study because it incorporates several aspects of social deprivation and because it has been shown to be superior to alternative indices in explaining variations in health, so the risk of mis-specification was small. Furthermore, any mis-specification present would be anticipated to show in the SMR results as well as in the morbidity results, and there was no evidence of that.

The hypothesis investigated was that objective and subjective measures of health are subject to different influences. While both objective and self-assessed measures might be expected to respond to social deprivation variations at the census ward scale, there might be an additional effect of increased self reporting of limiting long term illness in difficult employment conditions. People seek jobs in local labour markets, which are much larger than census wards and are approximated by travel to work areas. This hypothesis was tested against two controls: by comparison with mortality, where no extra subjective effect is possible, and permanent sickness, where such an effect has been suggested in the literature. The results reported here are consistent. Adjusted mortality rates were not related to employment conditions in travel to work areas. Both self-assessed measures varied strongly between travel to work areas, and the variations reflected local employment conditions.

Since self reported health measures were shown to be more sensitive than SMRs to variations in social deprivation at the ward level, it is possible that the observed variations in travel to work areas were due to a general relationship with social conditions rather than a specific reaction to labour market conditions. This is a possible explanation of the results if our hypothesis is wrong, but it does not account for the absence of any trend in mortality ratios between travel to work areas. The study design took regional differences into account, so any supposed mechanism would operate at an intermediate geographical scale. It is not clear what such a mechanism might be.

An alternative explanation is that people living in places where it was difficult to get a job were more likely to declare themselves ill. If this interpretation is correct, the increased reporting of illness induced by lack of employment opportunities was much more pronounced in poor areas than in affluent areas. While for affluent populations the standardised ratios might have been inflated by up to 10% by adverse labour market conditions, an increase of up to 30% was detected in populations

with the highest deprivation scores. Women appeared to be almost as much affected as men.

One implication of these findings is that limiting long term illness should not be used uncritically as an indicator of objective health needs for resource allocation purposes at national level. Mortality rates have the comparative advantage of being unaffected by subjective biases connected with the relative ease or difficulty in getting employment, and so might be preferable. At the local scale of small areas within the same labour market, where mortality data are sparse, limiting long term illness still appears to be a reliable indicator of relative health needs.

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Conflicts of interest: none.

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