Mortality and migration in Britain, first results from the British Household Panel Survey

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Abstract

This study investigates the extent to which current geographical variations in mortality are influenced by patterns of migration since birth. It is based on a longitudinal study of migrants which consists of a representative sample of 10264 British residents born after 1890 and enumerated as part of the British Household Panel Study in 1991. Between 1991 and 1996, 527 of the study members died and these deaths were analysed by area of residence at birth and in 1991 at both the regional and local district geographical scales. These were compared with findings from the Office for National Statistics Longitudinal Study.

The British Household Panel Survey sample replicates the results of work conducted on the Longitudinal Study which finds that geographical variations in age–sex standardised mortality ratios at the regional scale cannot be attributed to selective migration. However, for the British Household Panel Survey sample, the major geographical variations at district level could be attributed to selective migration.

Geographical variations in mortality are not well understood. Restrictions on what it is possible to analyse in the Office for National Statistics Longitudinal Study may have resulted in the underestimation of the importance of local lifetime selective migration in producing the contemporary map of mortality variation across Britain. The British Household Panel Survey is a small, recent, but very flexible study, which can be used to investigate the effects of lifetime migration on mortality patterns for all of Britain. This first report of its results on mortality shows that it produces findings which accord with the much larger Longitudinal Study, but which can be taken further to show that selective migration over the whole life-course at the local level does appear to have significantly altered the geographical pattern of mortality seen in Britain today. © 1999 Elsevier Science Ltd. All rights reserved.

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Introduction

Geographical inequalities in mortality within Britain are amongst the highest in Europe and have been growing in recent years (Britton, 1990; Phillimore et al., 1994; Staines and Cartright, 1994; Congdon, 1995; Dorling, 1997; Kunst, 1997). Mortality ratios are generally higher in the North of England and in Scotland and are highest within cities (Bentham, 1986; Howe, 1986; Britton, 1990; Watt et al., 1994; Dorling, 1997; Shaw et al., 1998). Many researchers have attempted to explain these inequalities in terms of factors such as the geographical distribution of people in different social classes and experiencing differing levels of material deprivation, geographical differences in beha-

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viour across Britain, differences in the propensity of damaging life-course events such as unemployment and differences in the physical environment (Blaxter, 1990; Jones and Goldblatt, 1990; Phillimore and Morris, 1991; Phillimore and Reading, 1992; MacIntyre et al., 1993; Phillimore, 1993; Curtis, 1995; Ben-Shlomo et al., 1996; Davey Smith et al., 1997; Davey Smith et al., 1998). Importantly, Law and Morris (1998) have recently suggested that a large proportion of district level variations in mortality can be attributed to differences in smoking. Ecological analyses such as these ignore the mechanism which we report on in this paper and so their results and the results of similar studies, could be seriously affected by the findings we report here.

One possible contributory factor to the existing and widening geographical inequalities in mortality in Britain, which has been largely dismissed in the existing literature, is migration. It is possible that some of the inequalities between areas seen today are the results of different groups of migrants carrying different mortality risks with them when they move to different parts of the country. This is not to suggest genetic explanations, rather that differences in the work environments, educational opportunities and material living conditions experienced through the life-course in different places are manifest through mortality statistics only at the usual place of residence at death.

Studies have shown that factors such as age, ethnicity, housing tenure, socio-economic position and education level affect the extent to which people migrate (OPCS, 1980; Hoinville, 1983; Boyle et al., 1998) and the distance they migrate (Fox and Goldblatt, 1982; Britton, 1990) with those with higher educational levels and those with higher socio-economic status tending to migrate further, more often, for different reasons and to different areas than those in lower social classes or educational level. In addition, stage in the life course and life events such as separation and divorce are linked to propensity to, reasons for and distance of, migration (Buck et al., 1994). For most of this century, the net effect of migration in Britain has been of movement out of cities and towards the South (Dorling and Atkins, 1995; Champion, 1996). Much of this migration tends to be by the economically active and in particular by those in professional social classes (I and II) (Dorling and Woodward, 1996; Champion and Ford, 1998). The factors which affect the extent of migration are also those which affect mortality rates (Fox and Goldblatt, 1982; Blane et al., 1993; Morris et al., 1994; Davey Smith, 1996).

The Office for National Statistics Longitudinal Study has been used to dismiss claims that selective migration has been in operation (Strachan et al., 1995). We believe that this conclusion may be prema-ture and that it is difficult to show the impact of selective migration given both the limitations of the data held within the Longitudinal Study and the restrictions that have been placed upon analysing it (to preserve anonymity within the national censuses). Here we report results which both replicate previous Longitudinal Study results at the broad regional level, but which also show that, by altering the geographical scale of the analysis, very different conclusions about the importance of selective migration are reached. As outlined above, movers between districts tend to have different characteristics and life chances than movers between regions and the majority of migratory moves are also between local areas rather than between regions (Champion et al., 1996). Therefore a district-level analysis will include a greater proportion and range of migrants thus giving us a better picture of migration and mortality.

Recently Wiggins et al. (1998) have reported the findings of a multilevel analysis of geographic variations in limiting long-term illness (LLTI) at the district level using the Longitudinal Study. They found effects of individual characteristics (education, social class, ethnicity), as well as social and geographical trajectories in the period 1971–1991, but also an additional effect of area type on likelihood of reporting a LLTI in 1991. However, over and above these influences some areas were observed to have higher ('coalfields' and 'ports and industry' areas) or lower ('most prosperous' areas) LLTI than expected given their socio-economic characteristics. In this study, the social and geographical trajectories were measured using three summary indicators: social class mobility, intercensal migration (either within or between county districts) and whether the individual had ever lived in the southeast region (which is thought to provide an 'escalator effect' for individual occupational history). These were included in the model as individual characteristics. It is possible, however, that the rates of LLTI that were not explained by the model were related to the degree and nature of migration in or out of the areas. It is also possible that some of what was explained was, in fact, due to migration rather than with the associations found. This, we believe, is a common error made in many analyses.

A final example is the seminal work of Phillimore and Morris (1991) which showed that although the two towns of Middlesborough and Sunderland were 'equally socially deprived' they have very different premature mortality rates. However, more than twice as many people (net) were migrating out of Middlesborough than Sunderland prior to the study. The authors of that study dismissed this difference in a mere sentence, although they did acknowledge it to be 'striking'. It could well be much more than that, as we explain below.

Table 1
Standardised mortality ratios (number of deaths) for ischaemic heart disease and stroke by area of enumeration in 1939 and area of residence in 1971[a]

	By area of residence in 1939			By area of residence in 1971		
	observed deaths	expected deaths	SMR	observed deaths	expected deaths	SMR
Greater London	4242	4954	85.6	3444	4087	84.3
East Anglia	931	991	93.9	983	1037	94.8
South west	2219	2359	94.1	2507	2661	94.2
Rest of south east	3992	4286	93.1	4806	5120	93.9
Total low mortality areas	11384	12591	90.4	11740	12906	91.0
West Midlands (county)	1658	1634	101.5	1499	1503	99.7
West Midlands (remainder)	1194	1178	101.4	1216	1216	100.0
East Midlands	2166	2149	100.8	2158	2129	101.4
Yorkshire and Humberside (rem.)	900	846	106.4	909	874	104.0
Merseyside and Greater Manchester	2812	2620	107.3	2698	2468	109.3
Wales	1891	1645	115.0	1875	1626	115.3
North west	1418	1234	115.0	1494	1288	116.0
South and West Yorkshire	2434	2154	113.0	2318	2035	113.9
North (remainder)	1168	979	119.3	1058	863	122.6
Tyne and Wear and Cleveland	1095	913	119.9	1155	990	116.7
Total high mortality areas	16736	15351	109.0	16380	14993	109.3
England and Wales	28120	27943		28120	27900	

[a] Based on Tables 2 and 3 published in Strachan et al. (1995), combining non-migrants and migrants by area of enumeration in each year and deaths in the 1971–1988 period. Standardised mortality ratios are relative to the whole of the Longitudinal Study population. Observed total for England and Wales does not equal exactly expected total because of rounding.

Our starting point in reclaiming the importance of migration is a 1995 paper on 'Mortality from cardiovascular disease amongst interregional migrants in England and Wales' by Strachan et al. (1995). Among its findings, one of the 'key messages' of this research was that: ''…the geographical pattern of mortality from cardiovascular disease cannot be attributed to selective migration''. Table 1 is derived from Tables 2 and 3 of that paper and shows how, at the level of the broad regional geographical aggregates used in that study, migration between 1939 and 1971 made little difference to the geography of mortality from cardiovascular diseases.

Table 1 shows that if the three regions with rela-

Table 2
British Household Panel Survey standardised mortality ratios of regions adjusting for the effect of migration between regions ($n = 7870$, using a representative sample of the population of England and Wales, all ages, men and women)[a]

	With migration			Without migration		
	observed deaths	expected deaths	SMR	observed deaths	expected deaths	SMR
Low mortality regions	181	189	95.8	168	176	95.5
High mortality regions	238	230	103.5	251	243	103.3
Total	419	419	100	419	419	100

[a] Standardised mortality ratios (SMR) are relative to the whole of the British Household Panel Survey population not including those born or those living in Scotland at the time of the survey. High and low mortality regions are the same as those used in table 1.

Table 3
British Household Panel Survey standardised mortality ratios of regions adjusting for the effect of migration between regions (total $n = 10264$, a representative sample of the population of Britain in 1991, all ages, men and women)[a]

	With migration			Without migration		
	observed deaths	expected deaths	SMR	observed deaths	expected deaths	SMR
Low mortality regions	210	223	94.2	194	207	93.7
High mortality regions	317	304	104.3	333	320	104.1
Total	527	527	100	527	527	100

[a] Standardised mortality ratios (SMR) are relative to the whole of the British Household Panel Survey population. High and low mortality regions are the same as those used in Table 1 with the addition of Scotland in the high mortality regions.

tively low mortality ratios for cardiovascular disease (East Anglia, the southeast and the southwest) are separated from the rest of England and Wales then none of the geographical divide between these two halves of Britain can be accounted for by selective migration. The mortality ratio of the high mortality areas was 109 by area of residence in 1971 and had all migrants been 'sent home' to what had been their place of residence in 1939, before they died, that mortality ratio would have remained unaltered. However, four limitations of the above study need to be considered: the study excludes Scotland, the study excludes many causes of death, the study only looks at migration between regions and the study only considers migration between 1939 and 1971.

New BHPS research findings

The Economic and Social Research Council established a new cohort study in 1991 under the auspices of the Research Centre for Micro-social Change at the University of Essex (Buck et al., 1994). This study is the British Household Panel Survey which at its first wave of data collection included 10264 people aged 16 and over. Questions on current place of residence as well as place of birth were included in the questionnaire. The sample was representative of the population of Britain and has been followed up in each subsequent year. Between 1991 and 1996, 527 study members died. When the British Household Panel Survey data is released for research the individual anonymised records are made available and sample of anonymised records district of birth and residence is recorded. Sample of anonymised records districts are individual 1991 local authority districts or amalgamations of districts so that no area has a population of less than 120,000 (Marsh and Teague, 1992). This data can therefore be used both to replicate longitudinal study analyses and to expand upon them. The British Household Panel Survey has a number of limitations for epidemiological research: cause of death is not cur-

rently recorded and the sample size is small when compared to the Longitudinal Study. However, the advantages of the British Household Panel Survey are that it does include Scotland, it is conducted annually and its respondents are asked a large number of pertinent questions every year. These include their income, medical symptoms, smoking and other health related behaviours as well as questions on many other subjects. Here we are simply using the survey to consider the impact of migration on the geography of mortality in Britain. In this analysis, migrants are defined as those people whose place of birth differed from their place of residence in 1991. These people could have migrated at any point after birth and could also have made multiple moves. Non-migrants are defined here, by necessity, as those whose place of residence in 1991 (district or region, depending on the analysis) was the same as their place of birth. This group will therefore include some migrants who moved back to their place of birth and migrants that moved shorter distances (for example, between wards).

Because the sample size of the British Household Panel Survey is small and because no epidemiological studies have been based on this resource to date, it is necessary to first confirm that it replicates existing research findings. To do this we divide the country into the same regional areas of high and low mortality as used by Strachan et al. (1995). We then calculate age–sex standardised mortality ratios by place of residence in 1991 and by place of residence at birth (which, for a small number of respondents, goes back as far as the 1890s). The results are presented in Table 2 showing a remarkable degree of similarity with Strachan et al.'s findings, particularly as we are now considering all causes of death, migration since birth rather than since 1939 and given that we are considering deaths in a later time period (1991–1996). The table confirms that selective migration has had no impact on the regional geography of mortality in England and Wales when measured in this way.

The British Household Panel Survey allows us to see if this is also the case if Scotland is included with the

Table 4
British Household Panel Survey standardised mortality ratios of sample of anonymised records districts adjusting for the effect of lifetime migration between districts (total $n = 7870$, a representative sample of the population of England and Wales in 1991, all ages, men and women)[a]

	High mortality districts	Low mortality districts	Total
Observed deaths with migration	193	226	419
Expected deaths with migration	184	235	419
Standardised mortality ratio with migration	104.9	96.2	100
Observed deaths without migration	259	163	419
Expected deaths without migration	256	160	419
Standardised mortality ratio without migration	98.8	101.9	100

[a] Standardised mortality ratio are relative to the British Household Panel Survey population, not including those born or those living in Scotland at the time of the survey. Table 4 shows that when the population of the British Household Panel Survey is returned to its district of birth, the previously high mortality districts have an overall low mortality rate and vice versa for the low mortality districts. This is because within the British Household Panel Survey, between 1991 and 1996, there were 21 deaths of migrants from low mortality districts to high mortality districts, 84 deaths of migrants from high mortality districts to low mortality districts, 21 expected deaths amongst migrants from low mortality districts to high mortality districts and 96 expected deaths amongst migrants from high mortality districts to low mortality districts: $193-21+84 = 256:184-21+96 = 259$. $226+21-84 = 163:235+21-96 = 160$.

high mortality areas. As can be seen from Table 3, the addition of Scotland makes little difference to the effect of migration on regional mortality rates. This might at first seem surprising, given work such as that of Harding and Maxwell (1998) which shows a much higher SMR for lifetime migrant men born in Scotland and living in England and Wales at time of death (129, or 132 when adjusted for social class (ages 20–64, 1991–93)). In Eurostat data, which is standardised to the England and Wales rates and for 1990, Scottish men have an SMR of 126 and women 123 (under 65). Our assumption is that the high mortality rate of migrants from Scotland is roughly equated out by the high rate of migrants to Scotland.

When considering the impact of migration upon the geography of mortality in Britain it is important to remember that the majority of migration occurs within regions, even over the course of a lifetime (Dorling, 1995a; Dorling and Woodward, 1996) and most people die within their region of birth (Dorling, 1995b). Fortunately the British Household Panel Survey records sample of anonymised record's district of both place of birth and of residence in 1991 (and subsequently) and so we can consider the effects of selective migration at this more local geographical scale. Within regions, is selective migration contributing to the geography of inequalities in mortality in Britain?

To answer this question we again divide the country

Table 5
British Household Panel Survey standardised mortality ratios of sample of anonymised records districts adjusting for the effect of lifetime migration between districts (total $n = 10264$, a representative sample of the population of Britain in 1991, all ages, men and women)[a]

	High mortality districts	Low mortality districts	Total
Observed deaths with migration	271	256	527
Expected deaths with migration	256	271	527
Standardised mortality ratio with migration	105.9	94.5	100
Observed deaths without migration	335	192	527
Expected deaths without migration	335	192	527
Standardised mortality ratio without migration	100	100	100

[a] Standardised mortality ratio are relative to the whole of the British Household Panel Survey population. Table 5 shows that when the population of the British Household Panel Survey including Scotland is returned to its district of birth, no geographical differences are found. This is because within the British Household Panel Survey, between 1991 and 1996, there were 23 deaths of migrants from low mortality districts to high mortality districts, 87 deaths of migrants from high mortality districts to low mortality districts, 24 expected deaths amongst migrants from low mortality districts to high mortality districts and 103 expected deaths amongst migrants from high mortality districts to low mortality districts: $271-23+87 = 256-24+103 = 335$ and $256+23-87 = 271+24-103 = 192$.

into areas of high and low mortality using the 1991 mortality ratios of sample of anonymised record's districts rather than regions. The results are shown in Table 4 and demonstrate how very different results can be produced when using the same data, but, when the geographical scale of the analysis has been altered.

Returning migrants to their district of birth has resulted in a decrease in the SMR of the previously high mortality rate districts and an increase in the SMR of the previously low mortality rate districts such that the SMR of the previously high rate districts is actually lower than the SMR of the previously low rate districts.

The addition of those born or residing in Scotland (Table 5) presents a similar picture for Britain, showing that migration has had an effect on the mortality rates of districts in the case of the British Household Panel Survey sample, explaining all of the geographical variation in mortality at this scale.

The results at district level are remarkable and it is important to remember that, as yet, only 527 of the study population have died. However, the fact that all of the variation in mortality between areas of high and low mortality amongst this population can be accounted for by selective migration (or a process closely aligned with it) should encourage future researchers not to ignore migration as an explanation for why some local areas have higher age–sex standardised mortality ratios than others.

Discussion and conclusion

The majority of geographical inequalities in mortality are found at the local, not regional level (Phillimore et al., 1994). In Britain, between region mortality ratios vary by a few percentage points whereas between districts mortality ratios vary by as much as a factor of two; by electoral wards this factor can be as much as four (Phillimore and Morris, 1991; Phillimore and Reading, 1992; Phillimore, 1993). Hence the majority of geographical variation to be explained is at the local and not the regional level. The majority of migration is also between local areas rather than between regions and most interregional migrants migrate within the South rather than between the North and the South (Champion et al., 1996). Therefore, whereas migration might not be expected to explain regional inequalities, by the same token it would be surprising if it did not explain part of the growth in geographical inequalities between districts. It is remarkable that in the analysis reported here, migration appears to explain all of the geographical variation at sample of anonymised record's district level within Britain. However, this may to an extent reflect the importance of migration at the district level and

how migration is both part of the life-course and moves people with different chances due to their differing experiences of life to different places disproportionately.

This finding contributes to the debate over migration and health which is part of the wider debate over whether it is the characteristics of people or places that explains geographical inequalities in health (see for example, MacIntyre et al., 1993). In terms of migration, are these inequalities attributable to migrants with poorer health moving to particular areas and thus resulting in that area having worse health and therefore higher SMRs (and vice versa for migrants with good health)? Or is it that the area itself has certain characteristics that result in those living there, including those who have migrated there, having differing mortality rates? (For a fuller discussion of the extent to which migrants' mortality rates remain at the level of their place of origin or become similar to the rates of the place they migrate to see, for example, Balarajan and Bulusu, 1990; Harding and Balarajan, 1996). Alternatively, it may be that those migrants who are disadvantaged are both more likely to have poor health and more likely to be living in areas which adversely affect their health and to move to areas which adversely affect their health. In other words, the mortality rates of migrants are affected by disadvantage conferred by both place and individual circumstances throughout the life course. In addition, migration in itself has an effect on health and this varies according to the circumstances surrounding that migration including the place being migrated from and to (Hull, 1979; Buck et al., 1994). The low mortality areas of today were not always relatively prosperous places to be brought up in the 1930s.

The results seen may reflect the nature of the sample or the period of death (deaths in the early 1990s following high rates of migration in the 1980s) (Dorling and Atkins, 1995). The long period of follow-up (people's lifetimes) also means that a person may have moved just after birth, just before death, at any point in between and could have moved once or, more probably, numerous times, making it difficult to assess the relative contribution of people, place and migration. Unlike other studies (Marmot and Shipley, 1996; Davey Smith et al., 1998) the British Household Panel Survey is a random sample of all the people of Britain and so should produce far more reliable, replicable and representative results for this country as a whole than do studies of particular groups or places.

This study is just one example of the epidemiological analyses now possible using the British Household Panel Survey as a data source. The British Household Panel Survey includes more information about the individuals and households in its sample than any other comparable social survey and thereby opens up a

wealth of possibilities for future research. For instance, Law and Morris (1998) could use the British Household Panel Survey to test their hypothesis that differences in smoking account for geographical variations in mortality as the British Household Panel Survey records smoking history. It will also hopefully be possible, in future, to link those who have died in the British Household Panel Survey with their death certificates and thus to be able to consider the aetiology of various causes of death. However, it will be a few years before any such exercise is fully worthwhile and it will be in future years that the most valuable findings on mortality emerge from this survey.

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