

# Exploring the impact of selective migration on the deprivation-mortality gap within Greater Glasgow

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**Exploring the impact of selective migration on the deprivation-mortality gap within Greater Glasgow.**

**A report for the Glasgow Centre for Population Health.**

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## Executive summary

- The mortality gap between the least and most deprived areas in Greater Glasgow has widened recently.
- Greater Glasgow's most deprived areas have seen a concurrent dramatic loss of population, so the widening mortality gap could be due to migration of healthier and wealthier individuals away from these areas rather than a relative worsening of health per se.
- We tested this hypothesis using data from the Scottish Longitudinal Study that links a 5.3% sample of the 1991 and 2001 Scottish censuses to each other and to mortality and other administrative records.
- We found, amongst those aged 15 to 64 in 1991, that the most deprived areas saw high losses of population by 2001 (mainly to other areas in Greater Glasgow) amongst both high and low socio-economic groups and amongst those with and without a limiting illness in 1991.
- This meant that net migration did not greatly change the composition of the areas' population according to characteristics examined, although there was some variation by measure used. For example, those with a limiting illness became slightly more concentrated in deprived areas.
- The study confirmed the widening mortality gap in 2001-06 compared to 1991-96 and found that migration may have played a small role in this widening. However, even when accounting for migration, the mortality gap had still widened.
- Although it is important to investigate the potential role of migration in the widening mortality gap, this study suggests that in the case of Greater Glasgow selective migration between deprivation quintiles is not the sole or most important explanation for the widening mortality gap.

## Introduction

Glasgow is recognised as one of the least healthy cities in Europe. Problems of health, poverty and destitution were recognised as early as the 19th Century<sup>1,2</sup> with the contribution of migration also recognised: the early 19th Century saw a big influx of Irish migrants (by 1831 constituting almost 18% of the population) who, being largely unskilled, increased both the relative poverty and the mortality rates of the city<sup>3</sup>.

More recently, in 2006, male life expectancy at birth was less than 70 years, the lowest in Britain and almost ten years less than the local authority with the highest<sup>4</sup>. For women, life expectancy at birth was also the lowest in the UK. It has held these unenviable positions for at least 15 years<sup>5</sup>. While the high levels of deprivation within Greater Glasgow will play an important part in these trends, in comparison to similarly deprived areas in Scotland, Glasgow's deprived areas have an even worse health record<sup>6</sup>.

Within Glasgow, and its surrounding areas (Greater Glasgow), there is a wide variation in mortality rates by deprivation and the gap between the most and least deprived has widened in recent years. For example, while affluent areas have seen life expectancy rise since 1981, in line with national trends, the most deprived areas within Greater Glasgow region have seen very small average improvements (for women) and a slight decline (for men) in life expectancy meaning that the gap has risen between the best- and worst-off<sup>7</sup>. The differences in mortality within Greater Glasgow are particularly apparent for premature mortality.

One possible explanation for these widening mortality trends within Greater Glasgow, which has been relatively ignored to date, is selective migration. There is growing evidence that selective migration, whereby there is a net movement of the economically better-off and healthier residents away from the relatively more deprived areas, and the residualisation of unhealthy people in more deprived areas, can have a significant impact on the spatial distribution of ill-health<sup>8-12</sup>. This is often accompanied by a net decline in the numbers of people living in the least desirable places. One study has indicated that selective migration may have been responsible for about 50% of the increase in socioeconomic gradients in mortality in England and Wales during the 1990s<sup>13</sup> and Cox *et al.*<sup>14</sup> have shown that differential migratory patterns lead to the residualisation of unhealthy individuals in deprived areas, thereby exaggerating the relationship between diabetes prevalence and material deprivation in Scotland.

Within the Greater Glasgow area there have been dramatic shifts in population in recent years with a rapid decline in the numbers of people living in the most deprived areas and slight growth in more affluent areas. In the most deprived quintiles within Glasgow the population has declined from 203,677 in 1981 to 150,821 in 1991 and then to 120,240 in 2001<sup>7</sup>.

Understanding the impact of such population movement on widening health inequalities within Glasgow is important because the widening gap may represent a residualisation of the worst off in the most deprived areas rather than (relative) worsening health in these areas. This is important to ascertain as the impact of interventions to improve the health of Glasgow residents may be masked by this selective movement of population, which will not be detected by repeat cross-sectional studies. Using longitudinal census data available in the Scottish Longitudinal Study (SLS) the main aim of this project is to ascertain the degree to

which selective migration has led to a widening of inequalities in mortality within Greater Glasgow.

### *Research questions*

1. Is selective internal migration (within Scotland) responsible for widening socio-economic differences within Greater Glasgow?
2. Have the increasing socio-economic differences within Greater Glasgow's population been due primarily to a net gain of more deprived individuals or to a net loss of more affluent residents?
3. Is there a difference in the mortality experience of those people who migrate from and to the most deprived areas within Greater Glasgow compared to those who remain?
4. To what extent does selective internal migration contribute to widening inequalities assessed by area deprivation within Greater Glasgow?

### **Methods**

#### *Areas*

The boundaries of Greater Glasgow in this study were defined using those Consistent Areas Through Time (CATTs)<sup>15</sup> that equate to the area served by NHS Greater Glasgow and Clyde. CATTs are small areas in Scotland that were designed to retain consistent boundaries over time. This makes them ideal for longitudinal analysis as they avoid difficulties introduced by boundary changes. CATTs vary in (population) size (in 2001 mean population of 503, range 50 to 18,510) but 99% had a population of less than 4,000 in 2001.

In total there were 2,476 CATTs in Greater Glasgow. In sensitivity analysis we replicated our analysis for a broader area of West of Scotland (4,310 CATTs) that incorporated 11 local authority areas. Results were not greatly affected by this alternative definition so are not presented here.

An area based deprivation measure, the Carstairs score, was constructed for every CATT in Greater Glasgow. The Carstairs score is based on the distribution of the following census characteristics in the area: living in no car access households, living in overcrowded households, working age male unemployment and living in low social class headed households. Greater Glasgow specific Carstairs scores were constructed for both the 1991 and 2001 censuses<sup>a</sup>. CATTs in Greater Glasgow were then divided by Carstairs score into quintiles for analysis. In the analysis 1 is the least deprived quintile and 5 the most deprived quintile. As we were interested in population loss over time, the quintiles were not population weighted.

#### *Individual data*

Data on the characteristics of residents of Greater Glasgow came from the Scottish Longitudinal Study (SLS)<sup>16</sup>. This is based on a 5.3% sample of the Scottish population linking people through time from the 1991 to 2001 censuses and also linking them to vital events (such as mortality records). The SLS is based on the Office for National Statistics (England and Wales) Longitudinal Study. Our analysis was limited to those appearing in both the 1991 and 2001 censuses who were aged 15 to 64 in 1991. Students in the 1991 census were enumerated at their home address; however in 2001 they were enumerated at their term time address so we

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<sup>a</sup> Thanks to Zhiqiang Feng for deriving the Carstairs Scores.

used 15 as the minimum age in 1991 to avoid student moves in 2001 (when the minimum age would be 25, an age when most people will have completed their higher education studies). Moreover, we excluded anyone living in communal accommodation in either 1991 or 2001 to avoid the results being influenced by the presence of large communal institutions in particular areas of Greater Glasgow. In total there were 31,695 people in Greater Glasgow meeting these criteria in 1991.

This is not an entirely closed sample as other people who appeared in both censuses but living elsewhere in Scotland could enter the analysis if they had moved to Greater Glasgow in the 2001 census. Additionally people could have left Greater Glasgow in the 2001 census to live elsewhere in Scotland.

### *Analysis*

To study the changes in the distribution of people by baseline socio-economic and health characteristics we used four variables measured in the 1991 census. We chose to focus on housing tenure (coded as social rented versus private rented and owner occupier), and household car access (coded as no access versus access): both variables are measured at the household level and so are readily available for all respondents. We also used highest education qualification (based on whether or not someone had a higher education qualification in the 1991 census) as this is usually gained in early life and may be less influenced by present circumstances. Analysis of the highest qualification variable was limited to those aged 25 and over in 1991 in order to only include those who had completed their education; in addition there were some missing values for this variable (4.1% missing) which were excluded from the analysis. Finally, we used whether or not the person reported a longstanding limiting illness in 1991 as a measure of baseline health status.

To analyse the impact of selective migration on the characteristics of individuals resident in each Carstairs quintile in 2001 compared to the baseline in 1991, we used information on people's area of residence in both periods. This enabled us to compare those living in each deprivation quintile in 1991 and 2001, and the moves made 1991 to 2001 between quintiles. To summarise the *distribution of characteristics* and how this was changed by migration we calculated the index of dissimilarity at each time point<sup>17</sup>. This is a measure of the extent to which people in an area (in this case Greater Glasgow) are segregated within sub-areas (in this case deprivation quintiles) by some characteristic (for example having a limiting illness or not). It is a proportion, with 0 being no segregation and 1 being total segregation and can be interpreted as the fraction of individuals with or without the characteristic that would need to move to achieve no segregation. For example, if people with and without a limiting illness in Greater Glasgow were randomly distributed across deprivation quintiles then the index would be 0: no segregation; however, if all those with a limiting illness and none of those without a limiting illness lived in the most deprived quintile then the value would be 1: total segregation.

As a form of sensitivity analysis we defined a move between deprivation quintiles in three different ways. First, we used **deprivation measured in 1991**, so that a move between 1991 and 2001 occurred when: a person had a different address in 2001 compared to 1991; the move was to a different CATT; and this CATT was in a different 1991 deprivation quintile. Second, we defined a move as above (a change of address to a new CATT in a different quintile) but based the analysis on **deprivation measured in 2001**. Third, we defined a move based on a change of quintile using **both 1991 and 2001 deprivation** measures. We refer to this as "1991 to 2001 deprivation". In this case the person did not necessarily have to change address and CATT, as their "move" could either be caused by a change of address

or their CATT of residence changing quintile. This definition of a move has been previously used in other studies of selective migration<sup>12</sup>. Box 1 presents a summary of these three definitions. In fact, the results of the analysis were not greatly changed by the definition used and so in the main report we focus on the results for deprivation quintiles defined in 2001 (2001 deprivation), making mention of results for 1991 deprivation and 1991 to 2001 deprivation. Full graphs and tables using all definitions of deprivation are shown in the appendix.

To examine the mortality gradient we calculated European age and sex standardised death rates for people living in each deprivation quintile for deaths post 1991 census to the end of 1996 (for all those aged 25 to 74 in 1991) and deaths post 2001 census to the end of 2006 (for our sample of individuals aged 15 to 64 in 1991 who had aged to 25 to 74 in 2001). Censoring due to migration from Scotland during follow up was accounted for in the mortality analysis. To assess the changes in the mortality gradient across the quintiles we calculated the relative index of inequality using a method appropriate to the study of rates<sup>18</sup>. The relative index of inequality takes account of differences in population size and thus allows us to compare the deprivation gradient in mortality after net migration has changed population sizes. The higher the value of this measure, the larger the mortality gradient.

**Box 1. Three definitions for moving deprivation quintile 1991 to 2001.**

**1991 deprivation** – a move is defined as a change of quintile in 2001 from 1991 with quintiles defined by 1991 deprivation. To move quintile a person would have had to change address.

**2001 deprivation** – a move is defined as a change of quintile in 2001 from 1991 with quintiles defined by 2001 deprivation. To move quintile a person would have had to change address.

**1991 to 2001 deprivation** – a move is defined as a change of quintile in 2001 from 1991 with quintiles defined by 1991 deprivation (for 1991) and 2001 deprivation (for 2001). To move to a different quintile a person could have changed address or could have remained at the same address but their area could have changed quintile.

## Results

### *Migration patterns*

Between 1991 and 2001 Greater Glasgow experienced an overall decrease in population of -3.2% due to internal migration within Scotland. This was because 8.2% of the 1991 population left Greater Glasgow while those entering in the 2001 census represented only 5% of the 1991 population. It experienced net loss in all age and social groups considered here (Table 1). However, because the net losses were reasonably consistent across the different sub-groups, the distribution of the population in Greater Glasgow by 1991 characteristics changed very little between 1991 and 2001.

**Table 1. Net migration rates and population composition (based on 1991 characteristics) for Greater Glasgow 1991 to 2001 (Source: Scottish Longitudinal Study)**

	% net migration	1991 %	2001 %
Total Population	-3.2	100 (n = 31,695)	100 (n= 30,679)
Age -15-24	-0.9	19.3	19.8
25-34	-5.1	25.4	24.9
35-44	-2.7	21.5	21.6
44-54	-3.4	18.2	18.2
55-64	-3.6	15.6	15.5
Limiting illness - No	-3.2	89.0	89.0
Yes	-3.3	11.0	11.0
Tenure – owned/private	-3.6	61.4	61.1
social rented	-2.5	38.6	38.9
Car access – Yes	-3.1	62.4	62.5
No	-3.4	37.6	37.5
*Education 1991 - higher	-5.5	17.4	17.1
lower	-3.4	82.6	82.9

Education in 1991 is for ages 25 to 64 only, the overall loss for this group is -3.8%.

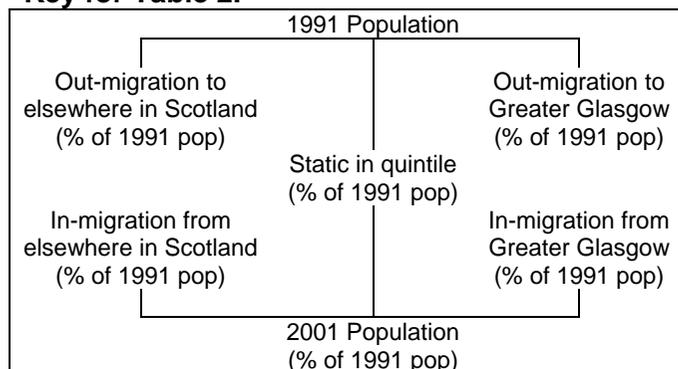
However, this overall picture masks greater variation in population loss by deprivation quintile as illustrated in Table 2. Table 2 shows that for deprivation quintiles based on 2001 deprivation there was a gradient for out-migration from the lowest rate in quintile 1 (25.3%) to the highest rate in quintile 5 (43%). It should be noted, though, that out-migration to elsewhere in Scotland was actually highest in the least deprived quintile, so this overall out-migration gradient (from 25.3 to 43%) was driven by variations in migration to other deprivation quintiles within Greater Glasgow. In general people were most likely to move to an adjacent quintile on the deprivation scale with moves between the most and least deprived quintiles being rare.

Overall, the in-migration rate was highest for quintile 2 (41.2%) and lowest for quintile 5 (16.1%). Quintile 5 had the lowest in-migration rates from both outside and inside Greater Glasgow. The high out-migration and low in-migration to and from quintile 5 meant a 26.9% decline in its population from 1991 to 2001, this is compared to a

5.7% decrease for quintile 4, a 1% decline for quintile 3 and positive increases for quintiles 2 and 1.

Tables A1 and A2 in the appendix present the results for deprivation defined by “1991 deprivation” and for “1991 to 2001 deprivation”. The pattern of results did not change although rates of migration were higher when using “1991 to 2001 deprivation” as the deprivation quintile could change not only on the basis of a change of address, but also if the area’s associated deprivation quintile changed between the two censuses.

**Key for Table 2.**



**Table 2. Changes in population composition 1991 to 2001 for 2001 deprivation. (Source: Scottish Longitudinal Study)**

Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
7855	7116	6048	5417	5259
-858 (-10.9)	-670 (-9.4)	-466 (-7.7)	-317 (-5.9)	-300 (-5.7)
-1133 (-14.4)	-1843 (-25.9)	-1929 (-31.9)	-1831 (-33.8)	-1962 (-37.3)
5864 (74.7)	4603 (64.7)	3653 (60.4)	3269 (60.3)	2997 (57)
524 (6.7)	473 (6.6)	296 (4.9)	195 (3.6)	107 (2)
1819 (23.2)	2459 (34.6)	2036 (33.7)	1643 (30.3)	741 (14.1)
8207 (104.5)	7535 (105.9)	5985 (99)	5107 (94.3)	3845 (73.1)

Notes: The top row of the table is population in 1991 and this is followed by out-migration (on the left those exiting Greater Glasgow and on the right those exiting to another quintile within Greater Glasgow). The next row gives the number static in that quintile, with the row after that giving entries to Greater Glasgow in 2001 (again on the left entries are from outwith Greater Glasgow and on the right from within). The bottom row gives the 2001 population. Percentages based on the 1991 population are given in brackets.

### *Redistribution of people 1991 to 2001 by their 1991 characteristics.*

In this section we focus on research questions 1 and 2. We explore the extent to which the redistribution of people through selective migration may play a role in concentrating those with a limiting illness and poor socio-economic circumstances in 1991 in the most deprived quintiles.

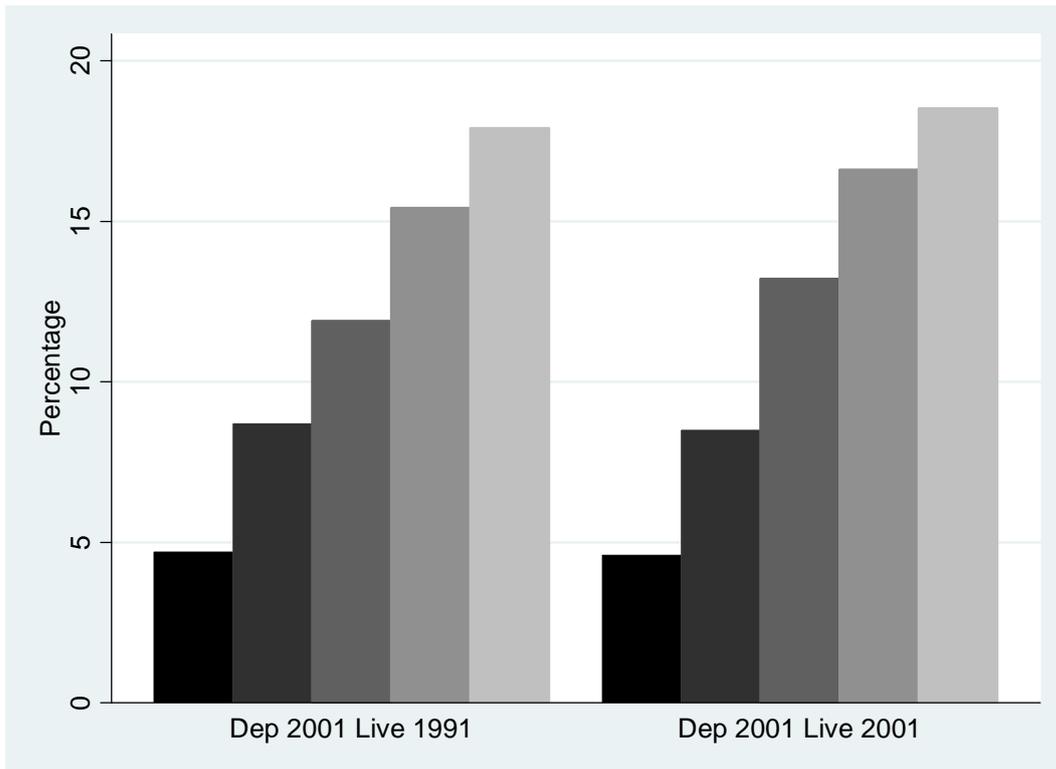
#### Limiting illness

Figure 1 shows the percentage in each 2001 deprivation quintile reporting a limiting illness in 1991 by residence in 1991 and 2001. Deprivation in 2001 means that the deprivation quintiles were based on the area's 2001 Carstairs score. Residence in 1991 is the quintile where people were living in 1991 with residence in 2001 being the quintile where people were living in 2001.

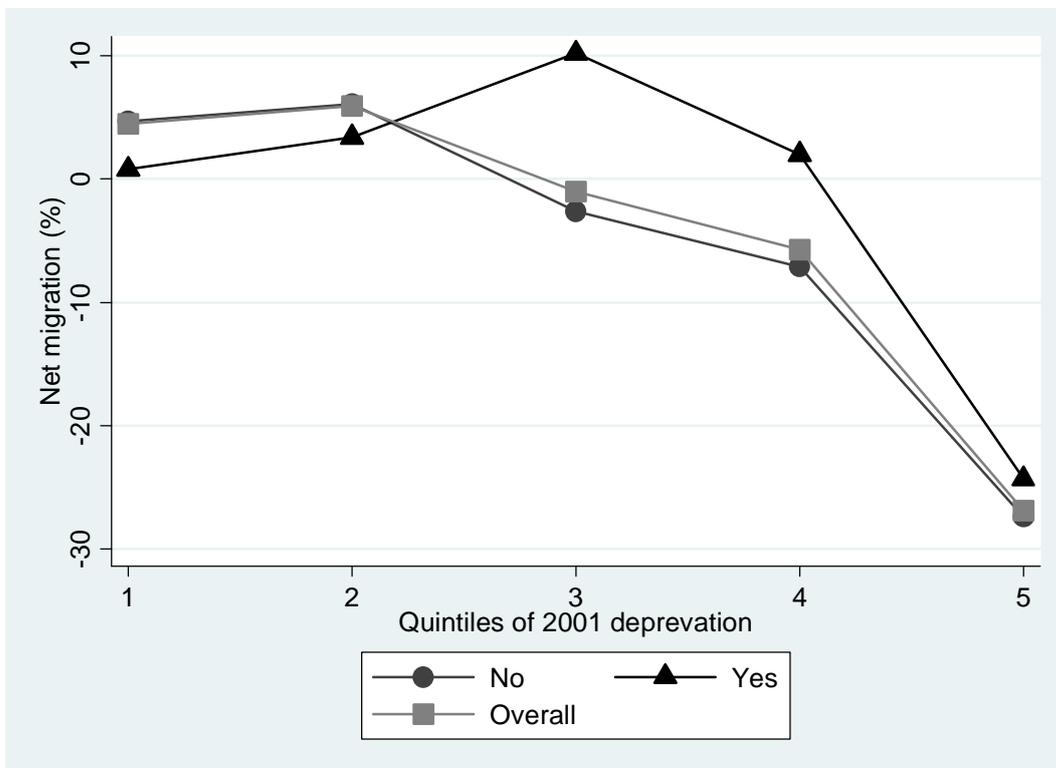
The baseline is residence measured in 1991. Here, as expected we see a deprivation gradient in limiting illness. When we retain the 2001 deprivation quintiles but move people to their 2001 residence, there were small increases in the percentage of people who had reported a limiting illness in quintiles 3 to 5. For example, in the most deprived quintile the rate of limiting illness reported in 1991 was 17.9% for 1991 residence but increased to 18.5% for 2001 residence. In quintiles 1 and 2 there was little change in the percentage of people who had reported a limiting illness from 1991 to 2001 residence.

Why these changes have occurred is illustrated in Figure 2, which shows that for 2001 deprivation there were large net losses of people who had and had not reported a limiting illness from the most deprived quintile although net loss was slightly less for those with a limiting illness. In quintiles 3 and 4 there were net gains of those who had reported a limiting illness and a net loss in those who had not reported a limiting illness. In quintiles 1 and 2 there were small net gains in those who had reported a limiting illness but slightly larger net gains in those who had not reported a limiting illness. How do these changes affect the segregation of people with and without a limiting illness by residence in 1991 and 2001? Segregation (that is, in relation to the distribution of the population with/without a limiting illness across the deprivation quintiles) increased very slightly from 1991 to 2001, as there was a small rise in the index of dissimilarity from 0.21 in 1991 to 0.24 in 2001 (for no segregation the index of dissimilarity would be 0 and for complete segregation it would be 1).

The pattern of results was not greatly changed when basing deprivation on 1991 quintiles or 1991 to 2001 quintiles (see Figures A1 and A2). For 1991 deprivation, segregation remained the same at 0.22 when segregation was assessed by where people were living in 1991 and 2001. For 1991 to 2001 deprivation, segregation increased slightly from 0.22 in 1991 to 0.24 in 2001.



**Figure 1. Percentage of each deprivation quintile (1 dark, 5 light) with a limiting illness in 1991 by deprivation measured (dep) in 2001 and residence (live) in 1991 or 2001 (Source: Scottish Longitudinal Study)**



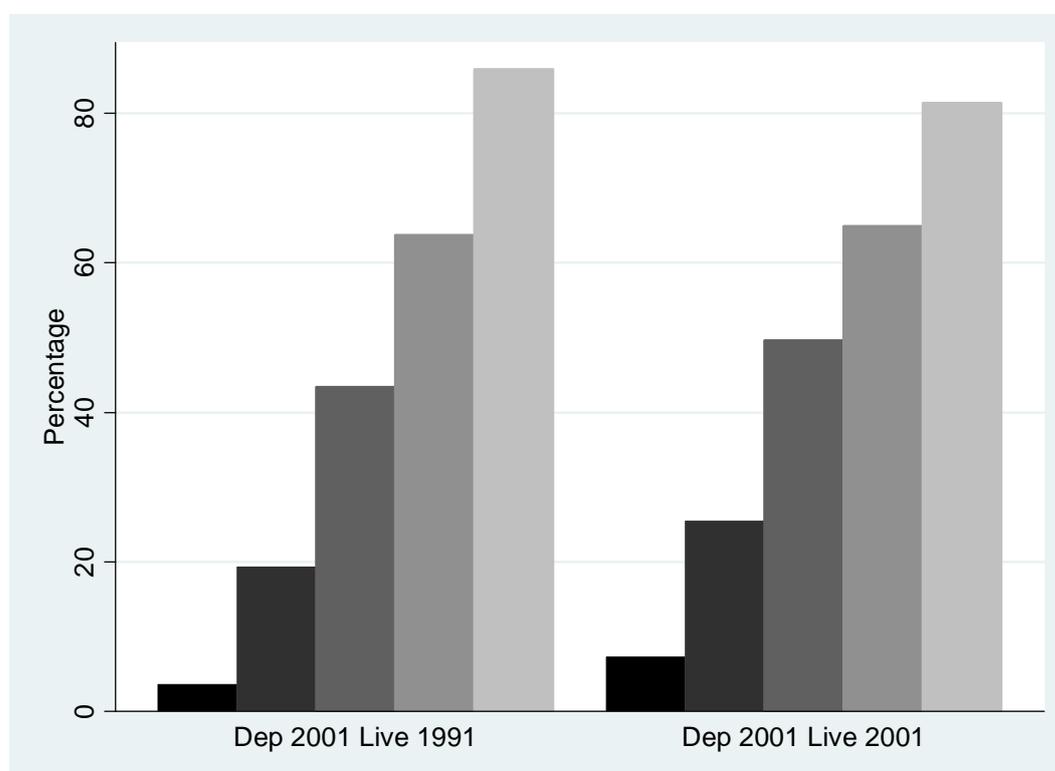
**Figure 2. Net migration of people from 1991 to 2001 with (yes) and without (no) a limiting illness in 1991 by deprivation quintile based on 2001 deprivation (Source: Scottish Longitudinal Study)**

## Tenure

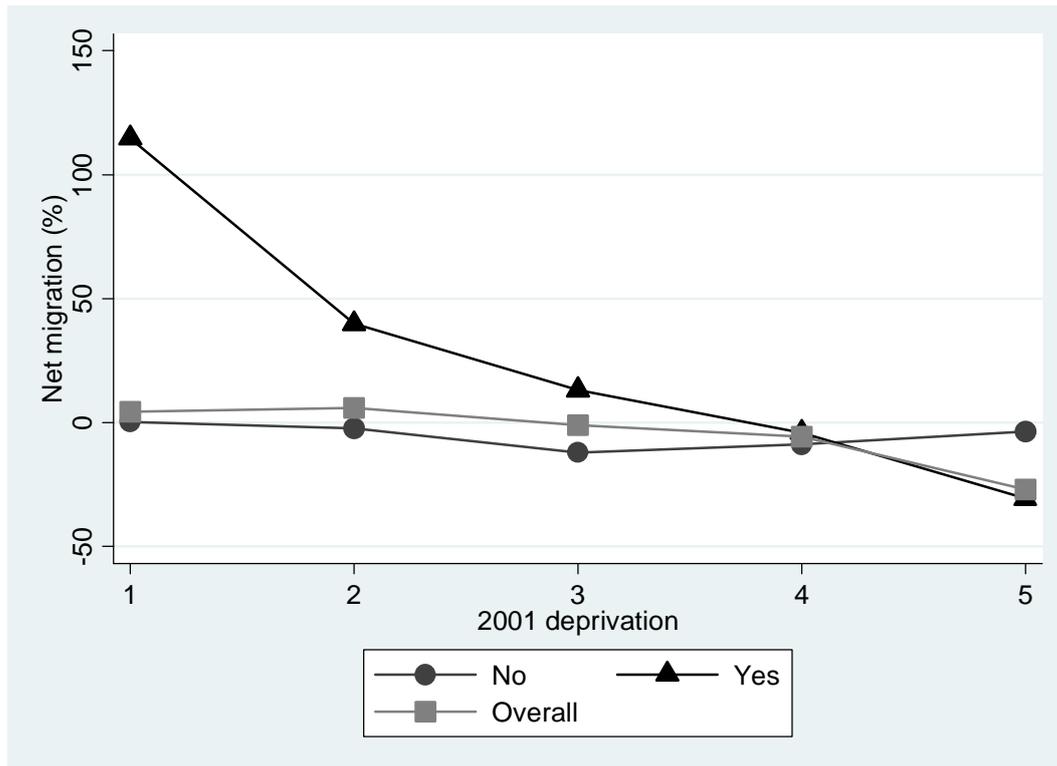
Next we assess the movement of people between 1991 and 2001 for those who lived in social rented housing in 1991. Figure 3 shows the steep gradient in social housing by 2001 deprivation and 1991 residence. Moving people to their 2001 residence but retaining the 2001 deprivation quintiles showed a decrease in the percentage of people from a social renting background in the most deprived quintile (85.9% in 1991 to 81.4% in 2001) and increases in the percentage in other quintiles although the changes were not large.

The net rates of migration between 1991 and 2001 are shown in Figure 4. It shows that there were large net losses of people from a social renting background from quintile 5 but a smaller net loss of those from a non social rented housing background. In quintiles 1 to 3 there were large net gains in those with a social renting background but it should be remembered that in absolute terms these changes are still small given the low level of social renters at baseline in these less deprived quintiles, particularly quintile 1 (where 3.5% of people were social renters in 1991, see Figure 3). In terms of segregation, there was a slight decrease in the level of segregation in 2001 compared to 1991. This was because the index of dissimilarity decreased from 0.55 for 1991 residence to 0.49 for 2001 residence.

The pattern of results was similar when using 1991 deprivation and 1991 to 2001 deprivation (see Figures A3 and A4). In both cases segregation fell slightly when redistributing people from their 1991 to 2001 residence (0.54 in 1991 to 0.47 in 2001 for 1991 deprivation and 0.54 in 1991 to 0.49 for 1991 to 2001 deprivation)



**Figure 3. Percentage of population who lived in social rented accommodation in 1991 in each deprivation quintile by deprivation measured (dep) in 2001 and residence (live) in 1991 or 2001 (Source: Scottish Longitudinal Study)**



**Figure 4. Net migration of people from 1991 to 2001 living in (yes) or not (no) social rented housing in 1991 by deprivation quintile based on 2001 deprivation (Source: Scottish Longitudinal Study)**

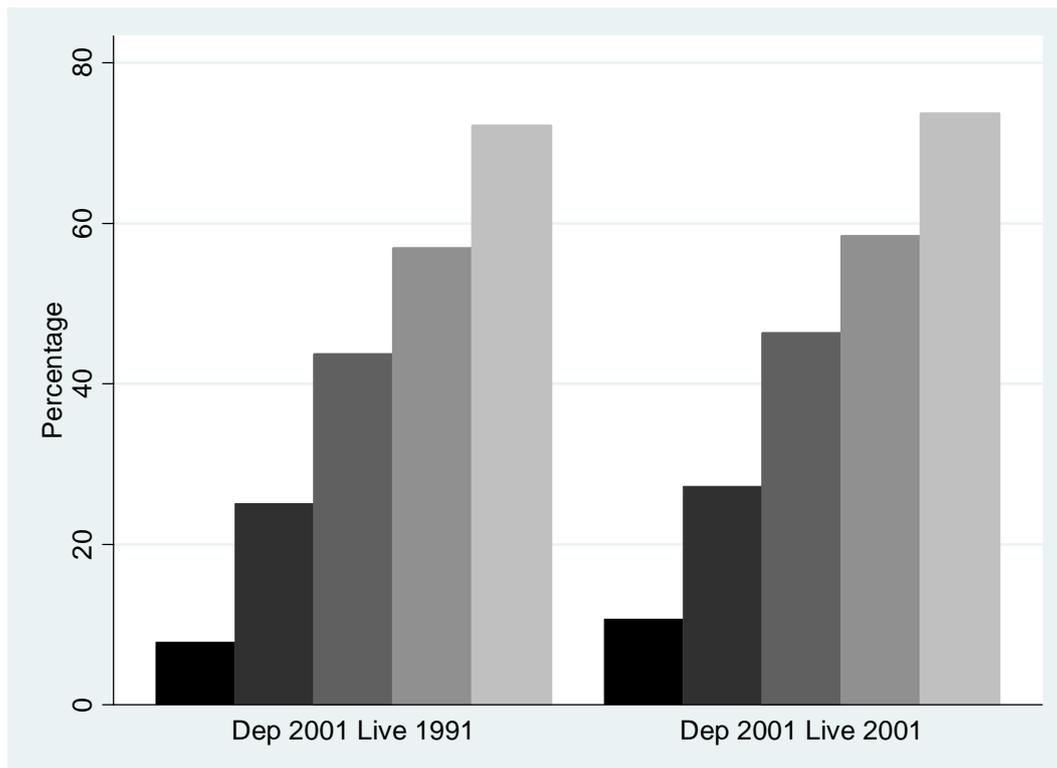
#### Car access

Figure 5 shows the gradient in those living in a household without access to a car in 1991. Based on 2001 deprivation, moving people to their 2001 residence showed a slight increase in the percentage of people in the most deprived quintile who had no car access in 1991 (72.1% in 1991 and 73.6% in 2001) because, as shown in Figure 6, there was a slightly greater net loss of people with car access from 1991 to 2001.

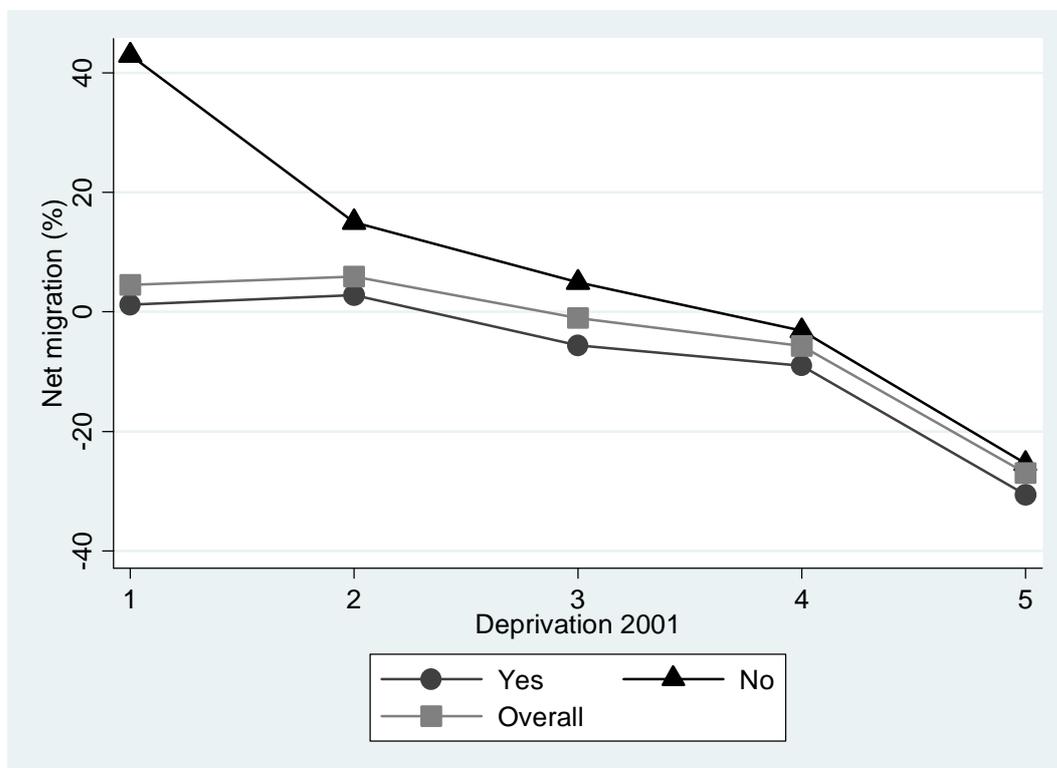
A similar pattern was observed for quintile 4. In quintile 3 there was also a slight increase in 2001 in the percentage of people from a no car access background (see Figure 5) because there was a net gain of people from a no car access background but a net loss of those from a car access background. In quintiles 1 and 2, there were small increases in the percentage of people from a no car access background as the net increases illustrated in Figure 6 were larger for those with no car access.

The impact of these changes on segregation was to decrease the level of segregation in 2001 compared to 1991. This was because the index of dissimilarity declined from 0.43 in 1991 to 0.41 in 2001.

Again the overall pattern of results was not changed greatly by using 1991 deprivation or 1991 to 2001 deprivation (see Figures A5 and A6.) In both cases segregation fell with the index of dissimilarity for 1991 deprivation decreasing from 0.44 to 0.41 and for 1991 to 2001 deprivation from 0.44 to 0.41.



**Figure 5. Percentage of population who had no car access in 1991 in each deprivation quintile by deprivation measured (dep) in 2001 and residence (live) in 1991 or 2001 (Source: Scottish Longitudinal Study)**



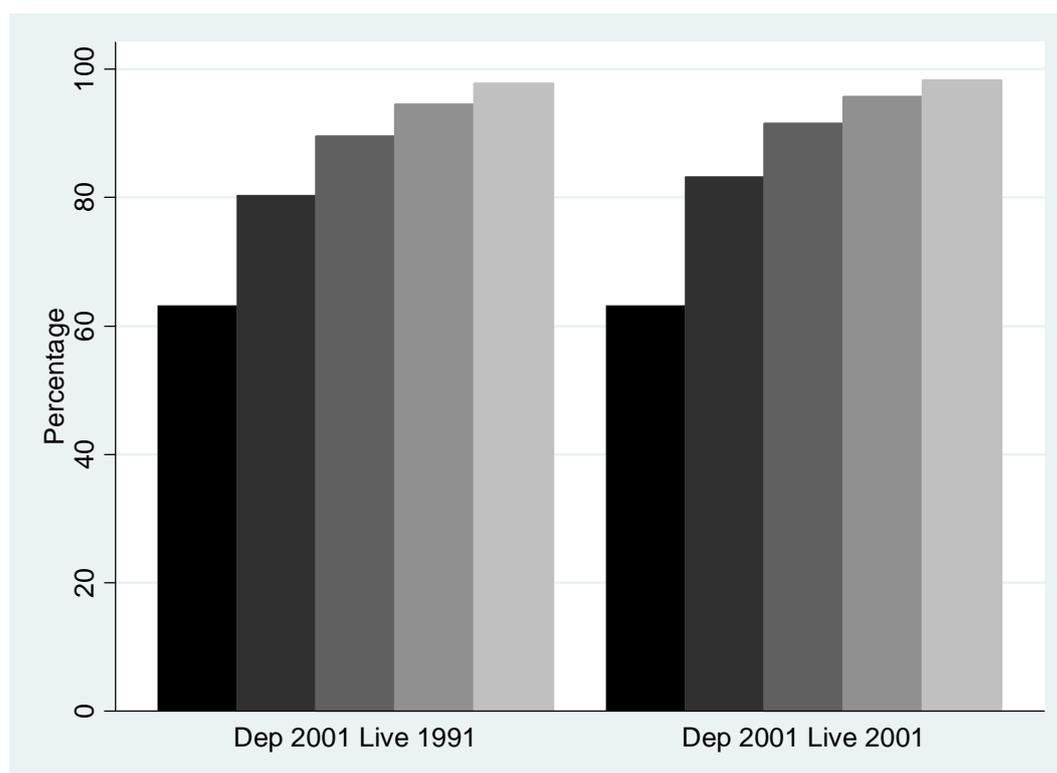
**Figure 6. Net migration of people from 1991 to 2001 with (yes) and without (no) car access in 1991 by deprivation quintile based on 2001 deprivation (Source: Scottish Longitudinal Study)**

### Higher education (aged 25 to 64 only in 1991)

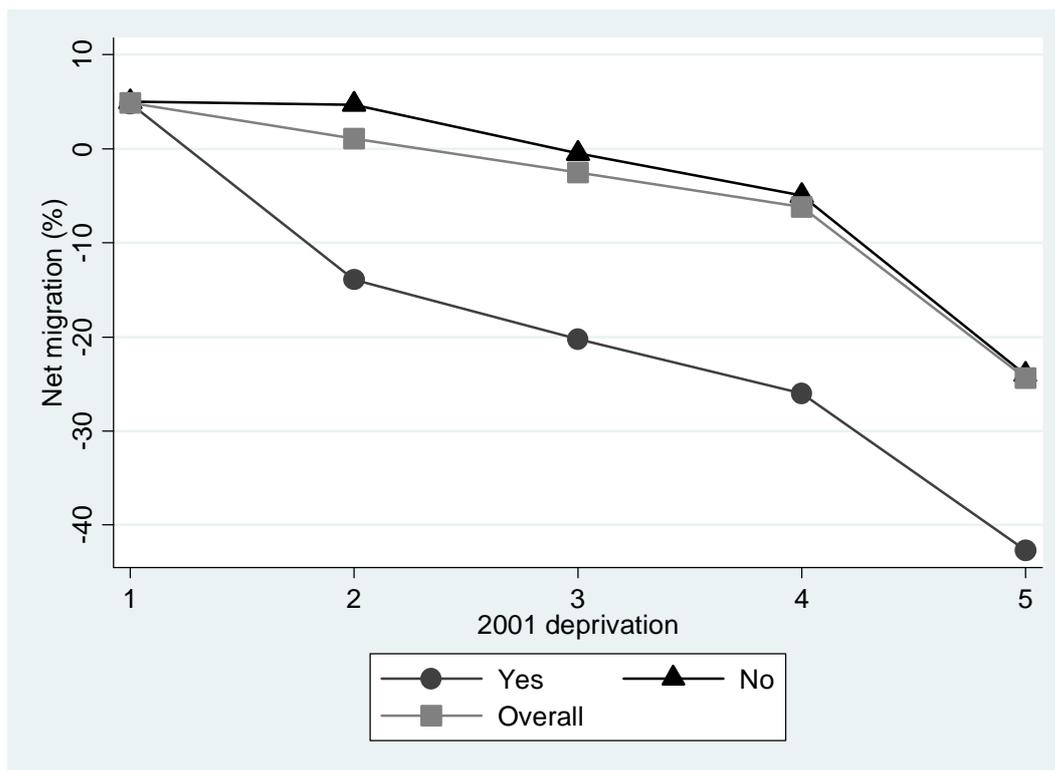
Figure 7 shows the gradient for not having a higher education qualification in 1991 by 2001 deprivation and 1991 residence. Moving people to their 2001 residence saw increases in the percentage of people reporting no higher education qualification in quintiles 2 to 5. In quintiles 3 to 5 this was due to higher net losses amongst those who had reported a higher education qualification, as shown in Figure 8. For quintile 2, there was a net gain of people who had not reported a higher education qualification and a net loss of people who had reported a higher education qualification. In quintile 1 the percentage of people who had reported no higher education did not change as there were small net gains in 2001 of people who had and had not reported a higher education qualification.

The level of segregation was little changed 1991 to 2001. This was because the index of dissimilarity increased very slightly from 0.39 in 1991 to 0.40 in 2001.

Again the pattern of results was similar when using 1991 deprivation and 1991 to 2001 deprivation (see Figures A7 and A8). The index of dissimilarity was the same for 1991 and 2001 residence for 1991 deprivation (0.38) and increased slightly for 1991 to 2001 deprivation (0.38 for 1991 residence and 0.40 for 2001 residence).



**Figure 7. Percentage of population with no higher education qualification in 1991 in each deprivation quintile by deprivation measured (dep) in 2001 and residence (live) in 1991 or 2001 (Source: Scottish Longitudinal Study)**



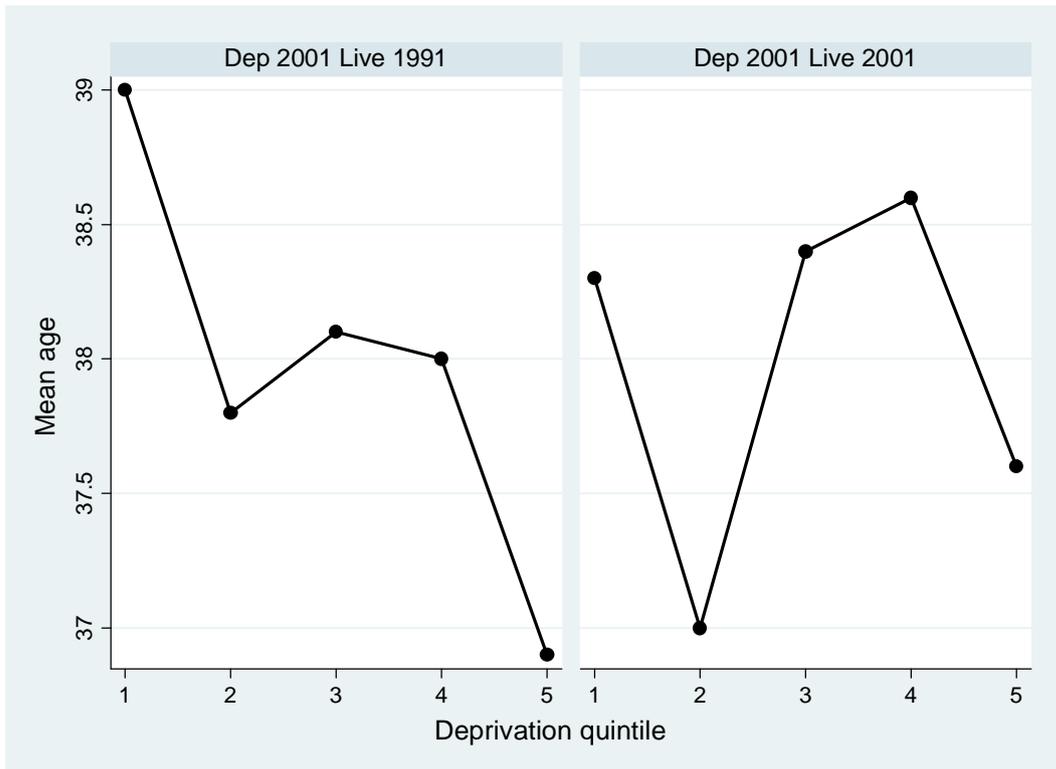
**Figure 8. Net migration of people from 1991 to 2001 with (yes) and without (no) a higher education qualification in 1991 by deprivation quintile based on 2001 deprivation (Source: Scottish Longitudinal Study)**

### Age

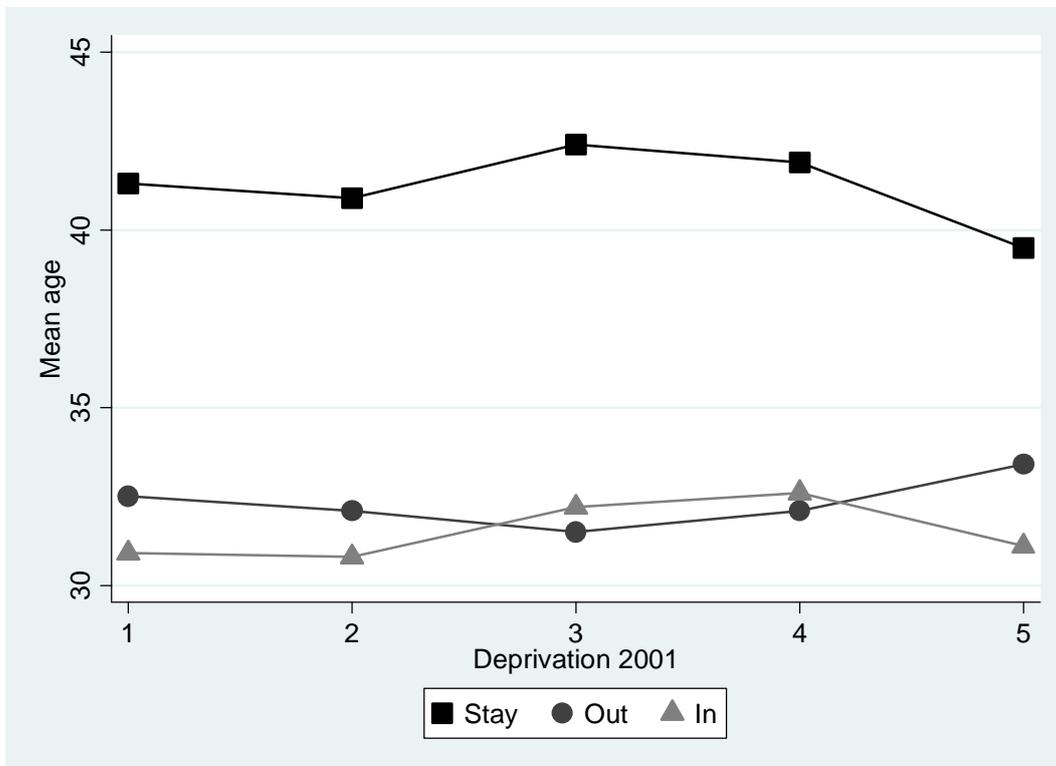
To complete this section we assess the impact of internal migration on the age distribution of the populations in each quintile. Figure 9 shows the mean age (based on 1991 age) in each quintile by 2001 deprivation and year of residence. Overall, there were small differences; in- and out-migration 1991 to 2001 led to, in 2001, a slight decrease in the mean age in quintiles 1 and 2 and slight increase in quintiles 4 and 5. Figure 10 illustrates that for migration 1991 to 2001, those static in each deprivation quintile were older than both in- and out-migrants who, in turn, were quite similar in their average age.

In terms of net gains and losses by age groups, the most significant movements in each quintile were as follows. In quintile 1 there were large net gains (26%) in those aged 25 to 34 in 1991 (35 to 44 in 2001). In quintile 2 there were similar sized net gains in individuals aged 15 to 24 in 1991 (25 to 34 in 2001). In quintile 3 there were large net losses (slightly under 14%) for people aged 25 to 34 in 1991 but the highest net gains were amongst those aged 15 to 24 in 1991. In quintile 4 the largest net losses were amongst those aged 25 to 35 in 1991 (19%). In quintile 5 large net losses were observed in all age groups (20% or greater) but were largest in the youngest two age groups.

Generally the same pattern of results was seen for 1991 deprivation and 1991 to 2001 deprivation (see Figures A9 and A10.). However for 1991 to 2001 deprivation there was less difference in the average age between those remaining in the quintile and in- and out-migrants as these moves also include those who did not change address to another quintile but changed quintile because their area was reclassified.



**Figure 9. Mean age (based on 1991 age) of people resident in each deprivation quintile by deprivation (dep) in 2001 and residence (live) in 1991 and 2001 (Source: Scottish Longitudinal Study)**



**Figure 10. Mean age of those remaining (stay) and in- and out-migrants by deprivation quintile for deprivation measured in 2001 (Source: Scottish Longitudinal Study)**

## Summary

The impact of net migration on the redistribution of people - by their 1991 characteristics - in each deprivation quintile between 1991 and 2001 was small, and its impact on levels of segregation of the socio-economically worse off was limited (although results varied depending on the measure used).

For example, in terms of tenure and car access, the segregation of people from a social renting or no car access background actually decreased between 1991 and 2001, while for limiting illness and higher education there were slight increases in segregation.

It appears, therefore, that any deterioration in the socio-economic characteristics of the most deprived areas, and the relative widening of the gap in relation to the best off areas, cannot be solely attributed to the redistribution of people between 1991 and 2001.

For age, the overall picture is of in- and out-migrants being younger than the static population. Net changes were most significant in the youngest two age groups. The youngest tended to increase their numbers in quintiles 2 and 3. There were large net gains in quintile 1 but net losses from quintiles 3, 4 and 5 for those entering middle age in 2001 (35 to 44). Quintile 5 saw large net losses amongst all age groups.

### *The impact of internal migration on the mortality gradient*

In this section we address questions 3 and 4. Firstly, we address the question of whether there is a difference in the mortality experience of those people who migrate to and from the most deprived areas within Greater Glasgow compared to those who remain. For this section we focus on deaths post the 2001 census.

Using 2001 deprivation, Table 3 shows those remaining in the most deprived quintile had the highest age and sex adjusted mortality rate (1439 per 100,000). In turn, those migrating out of the quintile had a lower rate (1221) than those who had migrated in (1396). Overall, this meant that the mortality rate was slightly higher for those living in quintile 5 in 2001 (1414) than when the rate was recalculated for those living in the area in 1991 (1344).

The same pattern of results was seen when based on 1991 to 2001 deprivation (see Table A3). However, for 1991 deprivation the overall mortality rate was lower for 2001 (1307) residence compared to 1991 residence (1342) as in-migrants had a lower mortality rate (1068) than out-migrants (1374).

**Table 3. Age and sex adjusted mortality rate per 100,000 person years (95% CI) for 2001-06 for the most deprived quintile based on 2001 deprivation (Source: Scottish Longitudinal Study)**

	2001 deprivation
Stay	1439 (1262 to 1615)
Out (1991 only)	1221 (984 to 1457)
In (2001 only)	1396 (913 to 1879)
Stay plus out (1991)	1344 (1207 to 1482)
Stay plus in (2001)	1414 (1254 to 1575)

Next we address the extent to which internal migration contributed to the widening inequalities by deprivation observed within Greater Glasgow.

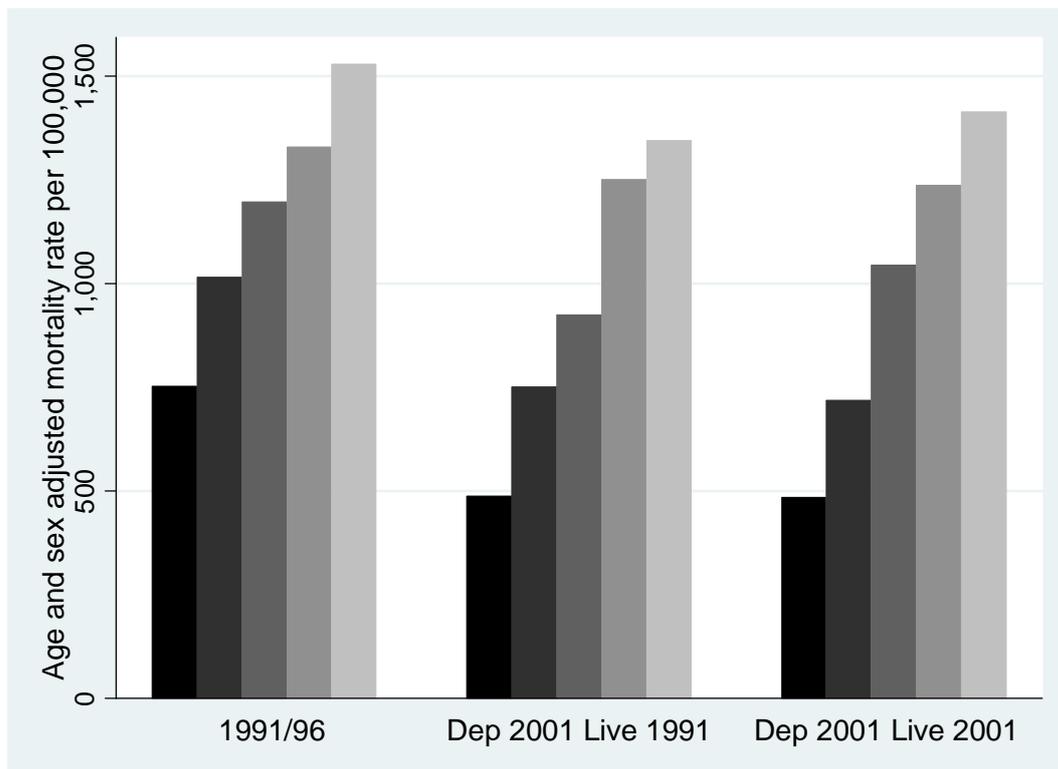
Figure 11 presents the mortality gradients for deaths 1991 to 1996 by deprivation in 1991 and compares it to the mortality gradient for deaths 2001 to 2006 by 2001 deprivation (based on 2001 and 1991 area of residence). Two issues are clear from this figure: first, that overall levels of mortality fell between 1991/96 and 2001/06 in every quintile; second, that the gradient across quintiles increased for 2001-2006 deaths (whether based on 2001 or 1991 area of residence) compared to 1991-1996.

To summarise the mortality gradient we used the relative index of inequality as shown in Figure 12. It shows that the mortality gradient, based on the relative index of inequality (RII – this is a summary measure of the gradient across all deprivation quintiles), for deaths 1991 to 1996 (first bar – RII = 2.4) was considerably lower than the mortality gradient for deaths 2001 to 2006 (last two bars - RII = 4.3 or 4.9). This confirms that the mortality gap had widened.

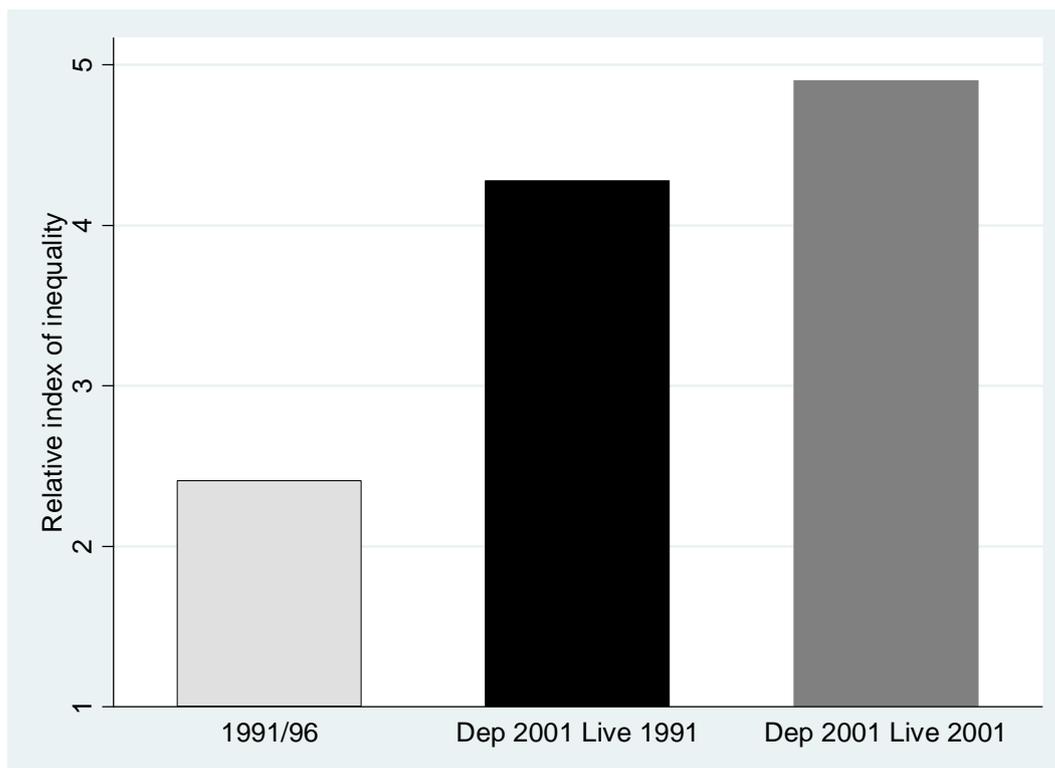
The extent to which this is due to internal migration is also shown in Figure 12. When 2001 deprivation was used to categorise people we find that there was a decrease in the relative risk of inequality when people were put back to their 1991 residence (RII

= 4.3) compared to their 2001 residence (4.9). So putting people back to their 1991 residence decreased the gradient slightly, this was due to a slightly higher gradient amongst in-migrants compared to out-migrants (Figure 13). It is notable that the gradient is much higher for those remaining in their quintile; this is due in part to mortality rates in the least deprived quintile being lowest amongst those remaining in the quintile and higher amongst both in- and out-migrants.

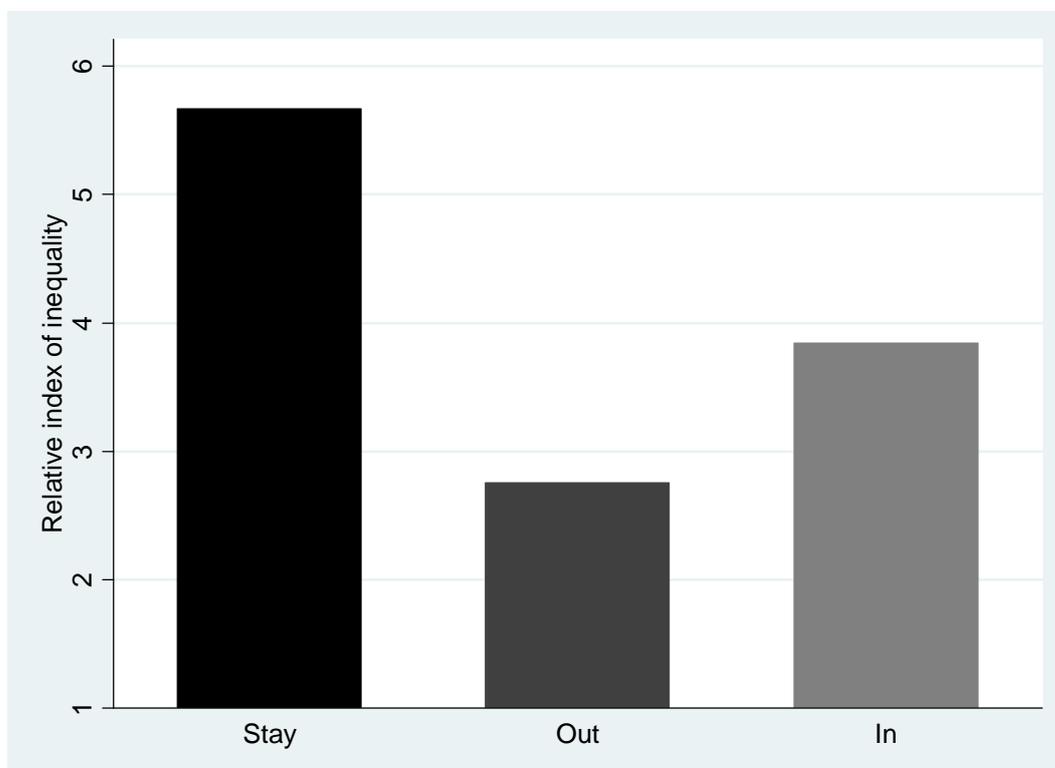
Figures A11 to A14 also present the mortality results for 1991 and 1991 to 2001 deprivation. The pattern of results was similar for 1991 to 2001 deprivation. However, for 1991 deprivation the 2001/06 gradient was slightly increased from 2001 (RII = 4.0) when people were put back to the 1991 area of residence (RII = 4.4). This was because, in this case, in-migrants had a smaller mortality gradient than out-migrants.



**Figure 11. Age and sex adjusted mortality 2001-2006 by deprivation (dep) in 2001 and residence (live) in 1991 and 2001 compared to 1991-1996 mortality for deprivation and residence in 1991 (Source: Scottish Longitudinal Study)**



**Figure 12. Relative index of inequality for age and sex adjusted mortality 2001-2006 by deprivation (dep) in 2001 and residence (live) in 1991 and 2001 compared to 1991-1996 mortality for deprivation and residence in 1991 (Source: Scottish Longitudinal Study)**



**Figure 13. Relative index of inequality for age and sex adjusted mortality 2001-2006 by 2001 deprivation for those remaining in the deprivation quintile (stay) and in- and out-migrants (Source: Scottish Longitudinal Study)**

## Conclusion

This study aimed to answer four questions, the first two of which related to the redistribution of baseline socio-economic characteristics by internal migration:

Question 1. Is selective internal migration (within Scotland) responsible for widening socio-economic differences within Greater Glasgow?

Question 2. Have the increasing socio-economic differences within Greater Glasgow's population been due primarily to a net gain of more deprived individuals or to a net loss of more affluent residents?

Our tentative conclusion to these questions is that internal migration is not responsible for any widening in socio-economic differences as net migration 1991 to 2001 did not lead to major redistributions of people in deprivation quintiles by their 1991 characteristics. The main net changes were in the most deprived quintiles where similar net losses were generally seen among both the socio-economically advantaged and disadvantaged. So, in general net migration was not highly selective on the characteristics observed and did not lead to large changes in the distribution of people by their baseline characteristics. Of course, the results varied slightly by socio-economic measure with segregation increasing slightly for limiting illness and higher education.

Our findings equate with other recent Scottish research on the impact of net migration on the redistribution of people by their characteristics. Using the 2001 census and one year migration, it has been found that net migration rates by education were broadly similar in each deprivation decile. Although slightly higher concentrations of people with low education were found in every decile, because of emigration from Scotland of higher educated individuals, the impact of these changes on segregation between different areas was minimal. The authors conclude that the impact of net migration on increasing segregation was very small and much less than previous literature had suggested<sup>19</sup>.

It is important to recognise that internal (within Scotland) migration is only one process that will affect population composition over time. Emigration, immigration and the distribution of births and deaths will also play an important role in population change over time and these aspects could be considered in future research.

Our third and fourth questions were:

Question 3. Is there a difference in the mortality experience of those people who migrate from and to the most deprived areas within Glasgow compared to those who remain?

Question 4. To what extent does selective internal migration contribute to widening inequalities assessed by area deprivation within Greater Glasgow?

Generally in- and out-migrants to the most deprived quintile had slightly lower mortality rates (2001-06) than those who remained in the quintile. When areas were categorised by 2001 deprivation (or 1991 to 2001 deprivation), out-migrants had lower mortality than in-migrants, the impact being to slightly increase the mortality rate in 2001 compared to what it would have been if we put people back to their 1991 residence but also to reduce the rate compared to what it would have been if we had assessed it for those who stayed in the quintile only.

We saw a similar pattern when comparing the overall mortality gradient in 2001-06 by 2001 deprivation (and 1991 to 2001 deprivation). The highest gradients were seen for those who lived in the quintile in both time periods with in- and out-migrants having smaller gradients; in-migrants had a slightly higher gradient than out-migrants. This led to a slightly larger gradient for 2001 residence compared to when we placed people back to their 1991 residence. Thus there is evidence that migration did lead to some widening of 2001-06 mortality gradient when using a contemporary measure of deprivation. These findings are in line with other studies<sup>12,13</sup>.

However, this increase in the overall gradient 2001-06 was not seen when we categorised areas by 1991 deprivation as the gradient for in-migrants was lower compared to that for out-migrants. The lower gradient for in-migrants was due to a relatively low mortality rate for those entering the most deprived quintile in 2001 when based on 1991 deprivation. Why this is the case requires further research but could be due to regeneration of some areas that were very deprived in 1991 meaning that they attracted relatively more healthy in-migrants in 2001.

As it is, perhaps, intuitive to use a contemporaneous deprivation index when studying changing mortality gradients over time, our results suggest that it would be appropriate to assess the degree to which any widening of the mortality gap is influenced by selective migration as it is possible that the gap may be smaller if people are returned to their previous residence.

However in the case of Greater Glasgow, even when people were returned to their 1991 residence the mortality gradient had still widened considerably for 2001-06 compared to its level in 1991-96. The widening mortality gap appears not only to be due to health-selective internal migration between deprivation quintiles.

### **Ethical approval**

The study was approved by the Geography and Geosciences committee of the University of St Andrews Teaching and Research Ethics Committee.

### **Acknowledgements**

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## Appendix

**Table A1. Changes in population composition 1991 to 2001 for 1991 deprivation. (Source: Scottish Longitudinal Study)**

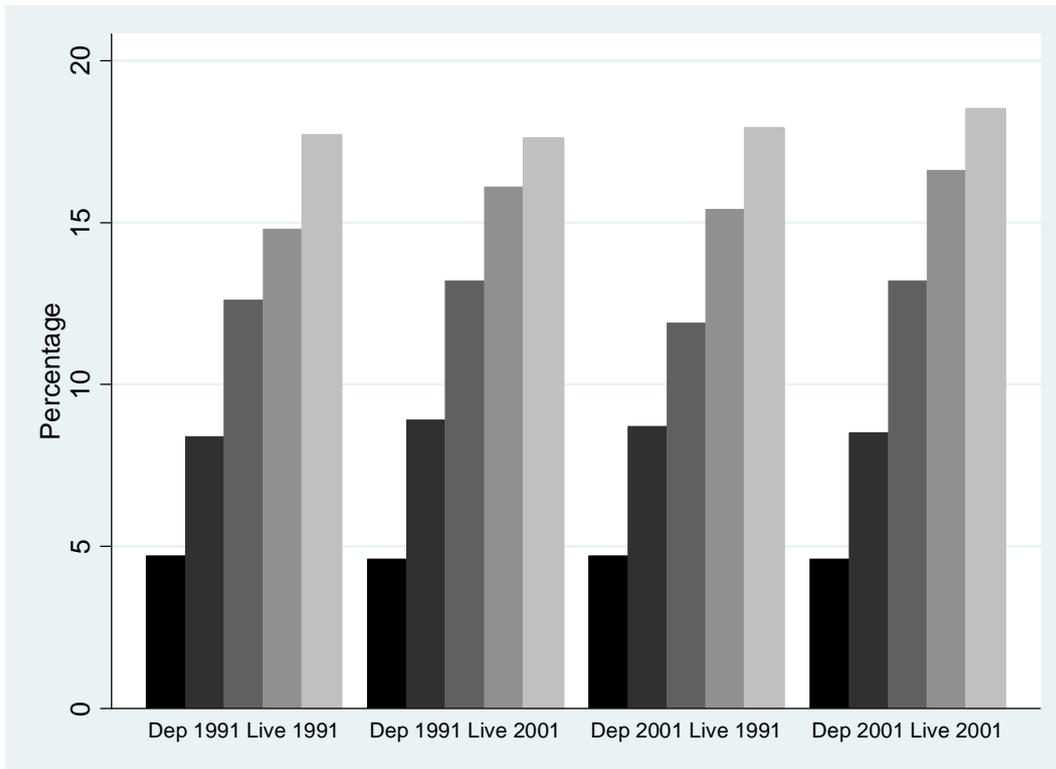
Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
7806	6916	6045	5558	5370
-827 (-10.6)	-655 (-9.5)	461 (-7.6)	-340 (-6.1)	-328 (-6.1)
-1157 (-14.8)	-1791 (-25.9)	1906 (-31.5)	-1924 (-34.6)	-1967 (-36.6)
5822 (74.6)	4470 (64.6)	3678 (60.8)	3294 (59.3)	3075 (57.3)
466 (6)	420 (6.1)	319 (5.3)	256 (4.6)	134 (2.5)
1811 (23.2)	2424 (35)	1901 (31.4)	1711 (30.8)	898 (16.7)
8099 (103.8)	7314 (105.8)	5898 (97.6)	5261 (94.7)	4107 (76.5)

Notes: The top row of the table is population in 1991 and this is followed by out-migration (on the left those exiting Greater Glasgow and on the right those exiting to another quintile within Greater Glasgow). The next row gives the number static in that quintile, with the row after that giving entries to Greater Glasgow in 2001 (again on the left entries are from outwith Greater Glasgow and on the right from within). The bottom row gives the 2001 population. Percentages based on the 1991 population are given in brackets.

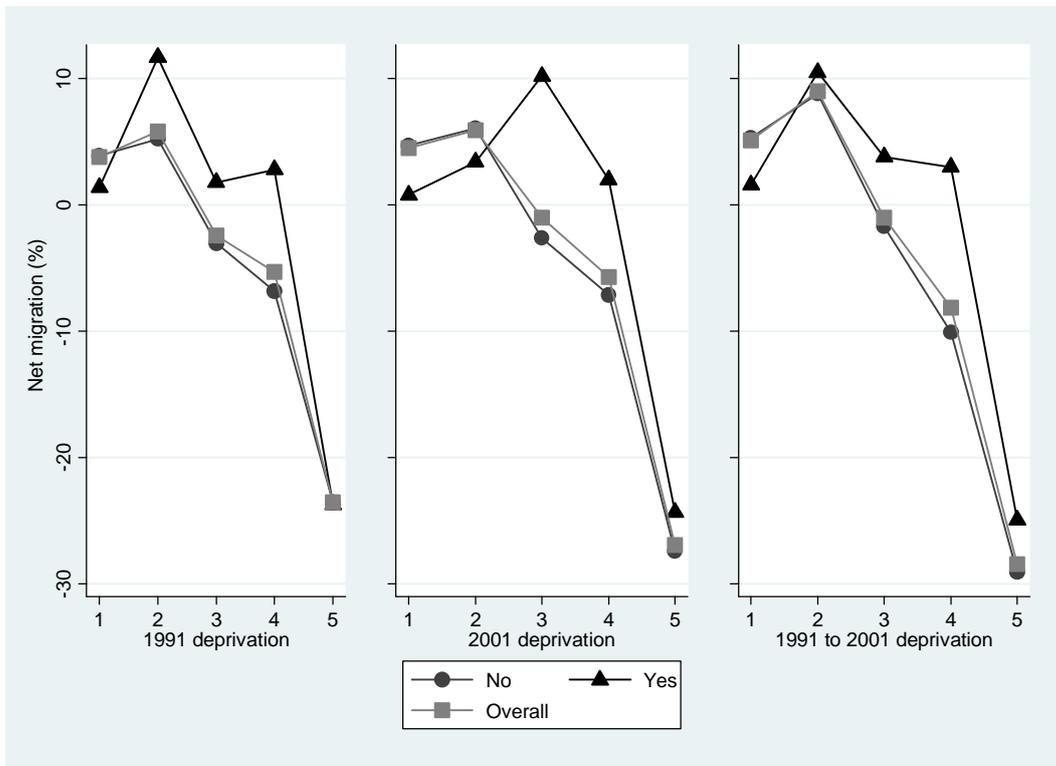
**Table A2. Changes in population composition 1991 to 2001 for 1991 to 2001 deprivation. (Source: Scottish Longitudinal Study)**

Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
7806	6916	6045	5558	5370
-827 (-10.6)	-655 (-9.5)	-461 (-7.6)	-340 (-6.1)	-328 (-6.1)
-1694 (-21.7)	-2931 (-42.4)	-3208 (-53.1)	-3265 (-58.7)	-2677 (-49.9)
5285 (67.7)	3330 (48.1)	2376 (39.3)	1953 (35.1)	2365 (44)
524 (6.7)	473 (6.8)	296 (4.9)	195 (3.5)	107 (2)
2398 (30.7)	3732 (54)	3313 (54.8)	2959 (53.2)	1373 (25.6)
8207 (105.1)	7535 (109)	5985 (99)	5107 (91.9)	3845 (71.6)

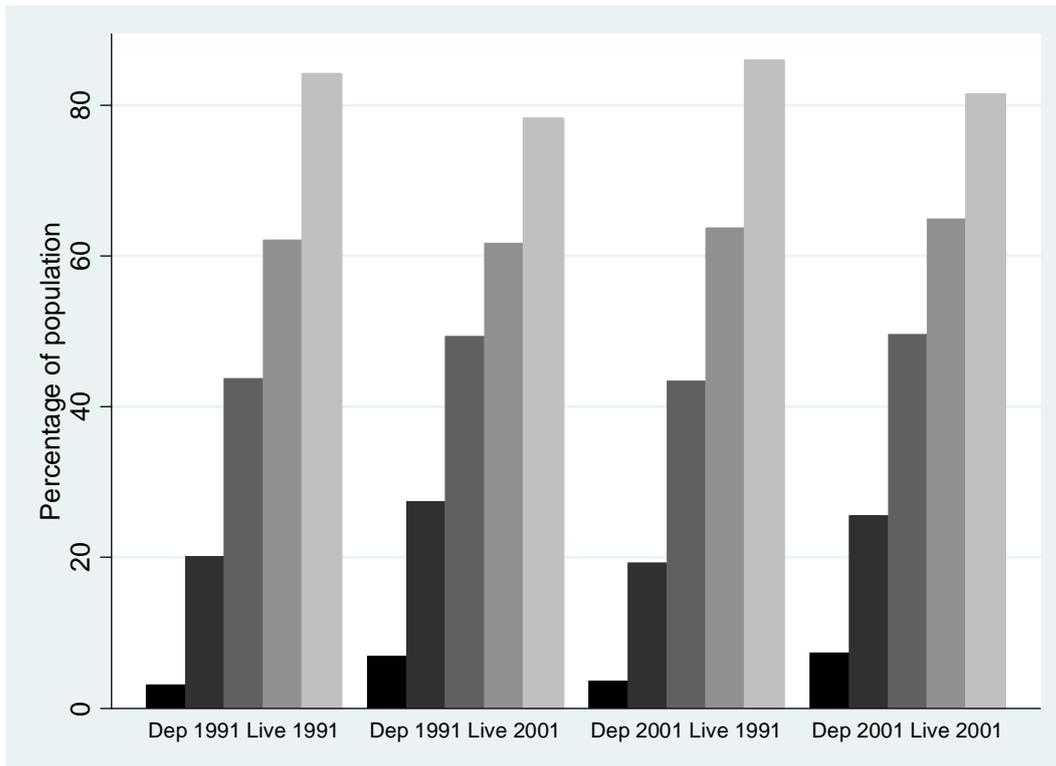
Notes: The top row of the table is population in 1991 and this is followed by out-migration (on the left those exiting Greater Glasgow and on the right those exiting to another quintile within Greater Glasgow). The next row gives the number static in that quintile, with the row after that giving entries to Greater Glasgow in 2001 (again on the left entries are from outwith Greater Glasgow and on the right from within). The bottom row gives the 2001 population. Percentages based on the 1991 population are given in brackets.



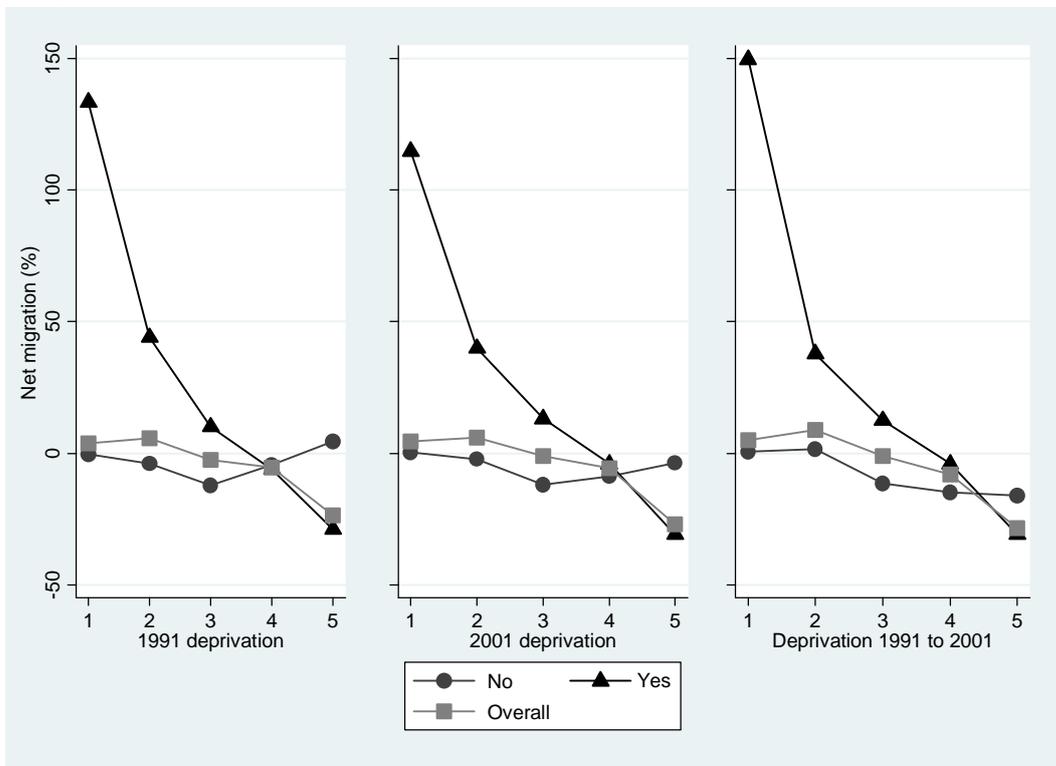
**Figure A1. Percentage of each deprivation quintile (1 dark, 5 light) with a limiting illness in 1991 by whether deprivation measured (dep) in 1991 or 2001 and residence (live) in 1991 or 2001 (Source: Scottish Longitudinal Study)**



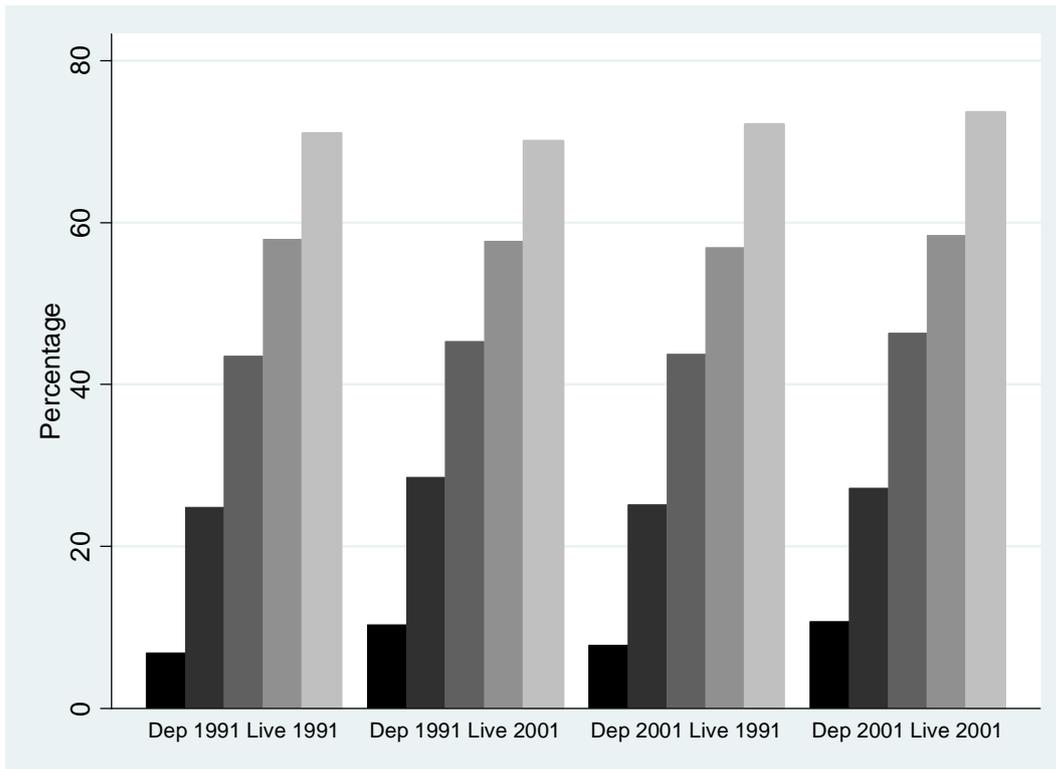
**Figure A2. Net migration of people from 1991 to 2001 with (yes) and without (no) a limiting illness in 1991 by deprivation quintile based on 1991, 2001 and 1991 to 2001 deprivation (Source: Scottish Longitudinal Study)**



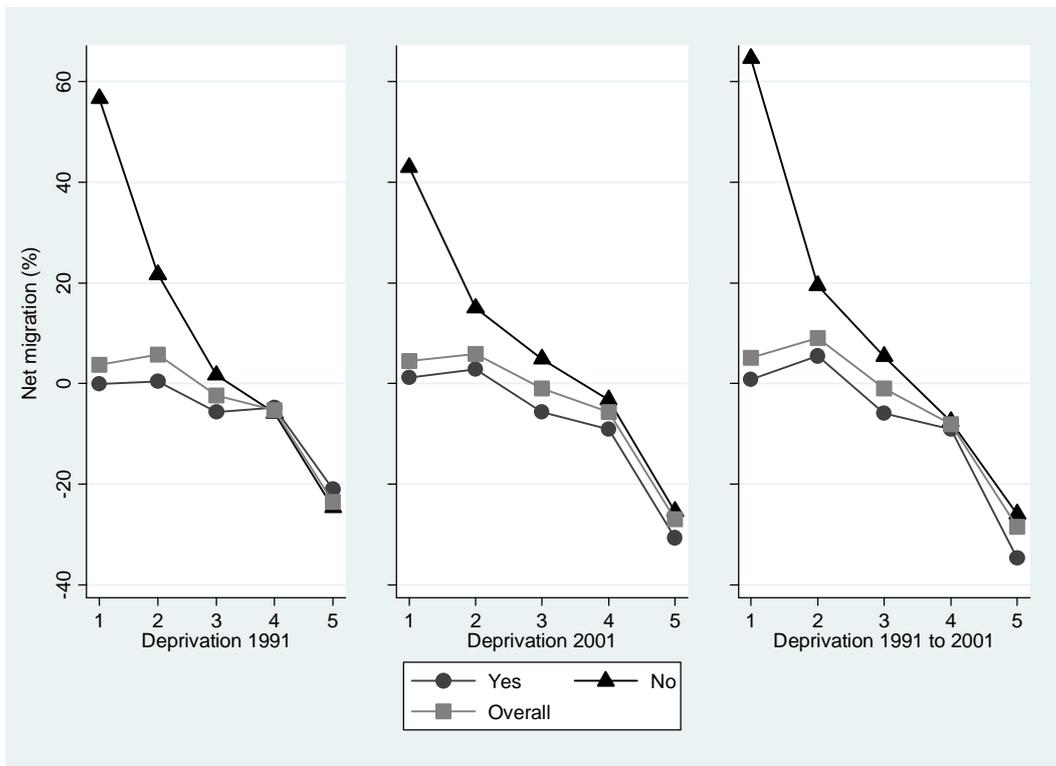
**Figure A3. Percentage of population who lived in social rented accommodation in 1991 in each deprivation quintile by whether deprivation measured (dep) in 1991 or 2001 and residence (live) in 1991 or 2001 (Source: Scottish Longitudinal Study)**



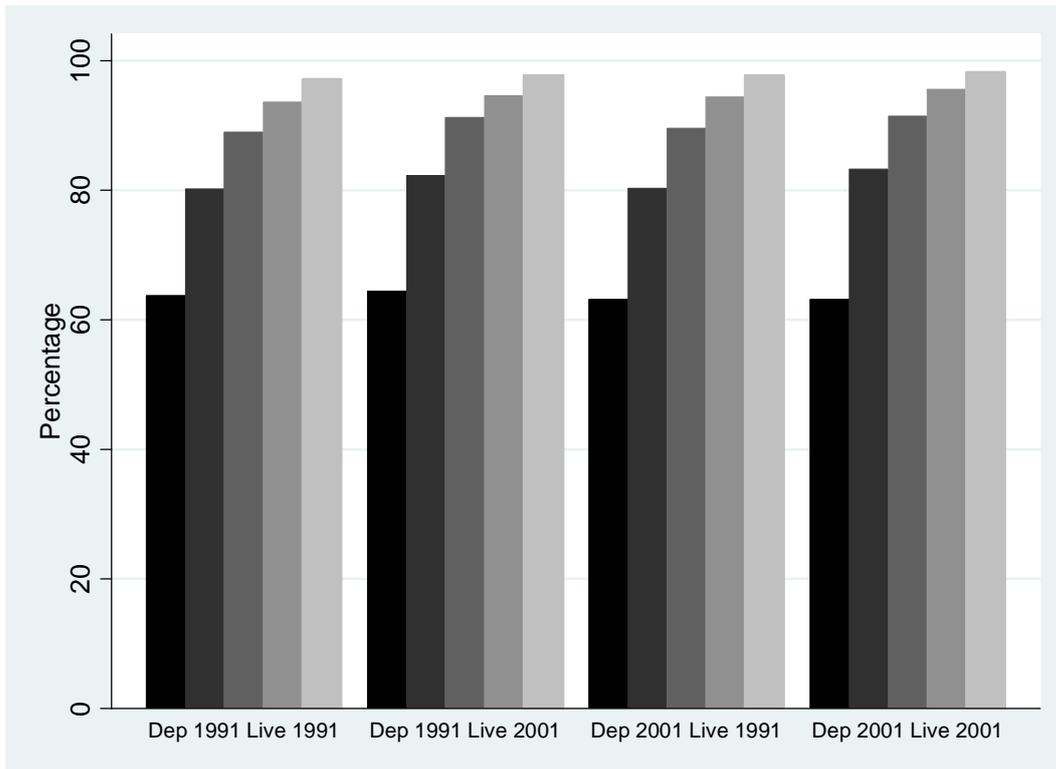
**Figure A4. Net migration of people from 1991 to 2001 living in (yes) or not (no) social rented housing in 1991 by deprivation quintile based on 1991, 2001 and 1991 to 2001 deprivation (Source: Scottish Longitudinal Study)**



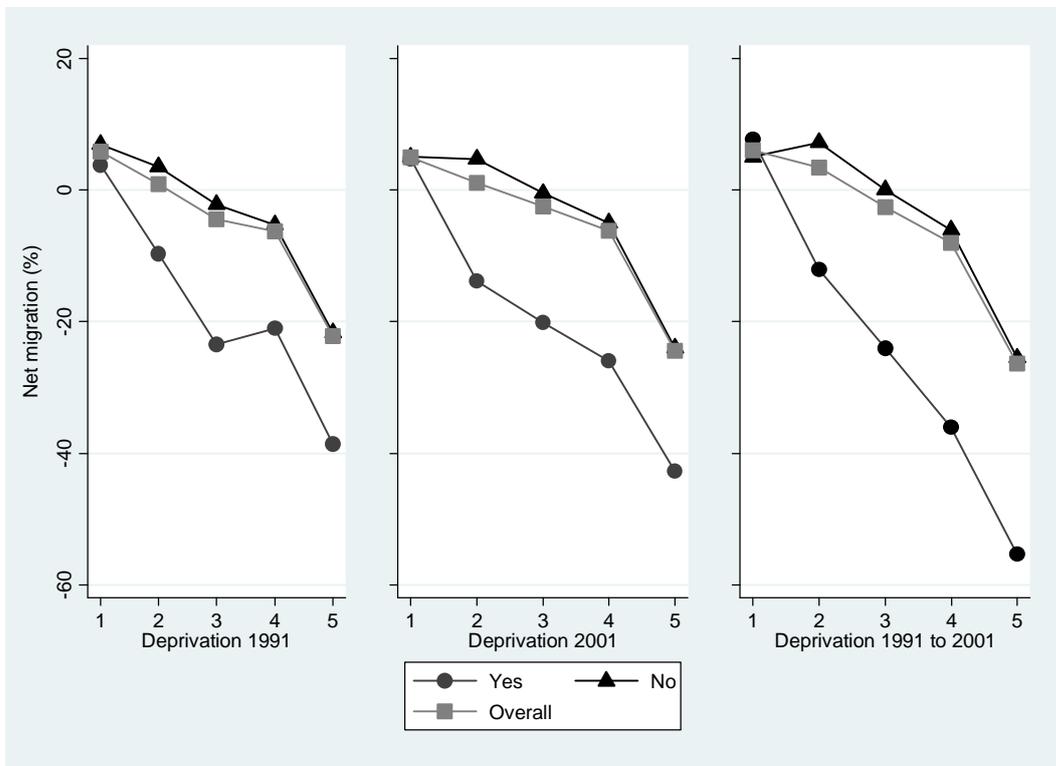
**Figure A5. Percentage of population who had no car access in 1991 in each deprivation quintile by whether deprivation measured (dep) in 1991 or 2001 and residence (live) in 1991 or 2001 (Source: Scottish Longitudinal Study)**



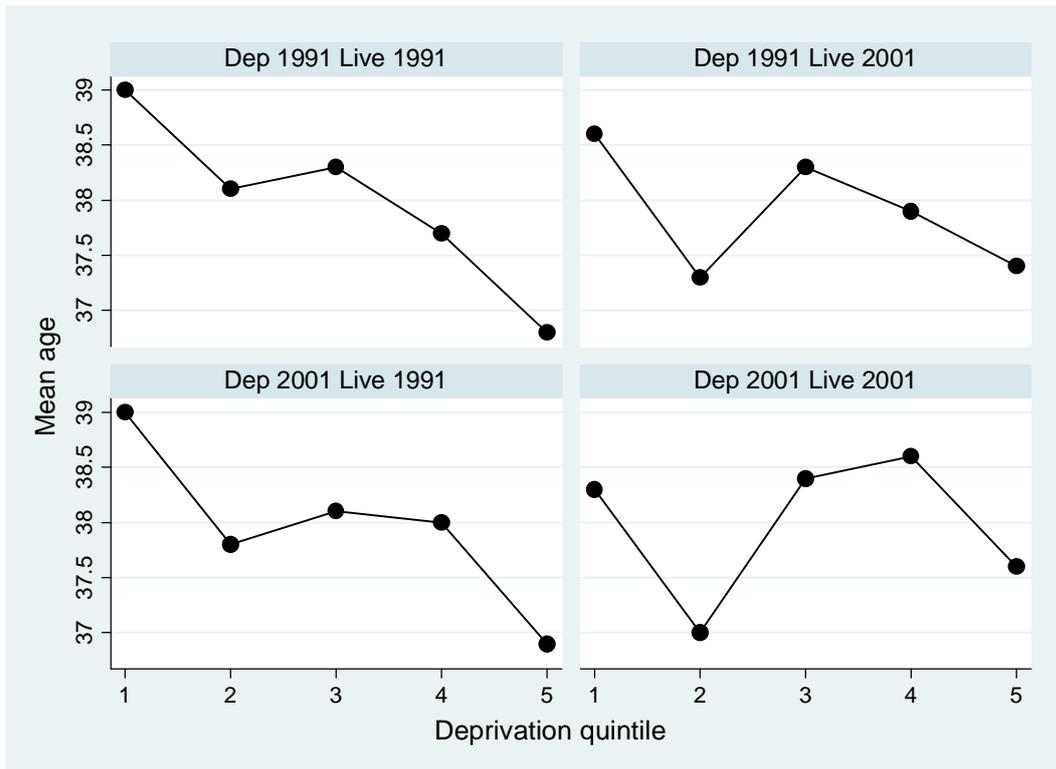
**Figure A6. Net migration of people from 1991 to 2001 with (yes) and without (no) car access in 1991 by deprivation quintile based on 1991, 2001 and 1991 to 2001 deprivation (Source: Scottish Longitudinal Study)**



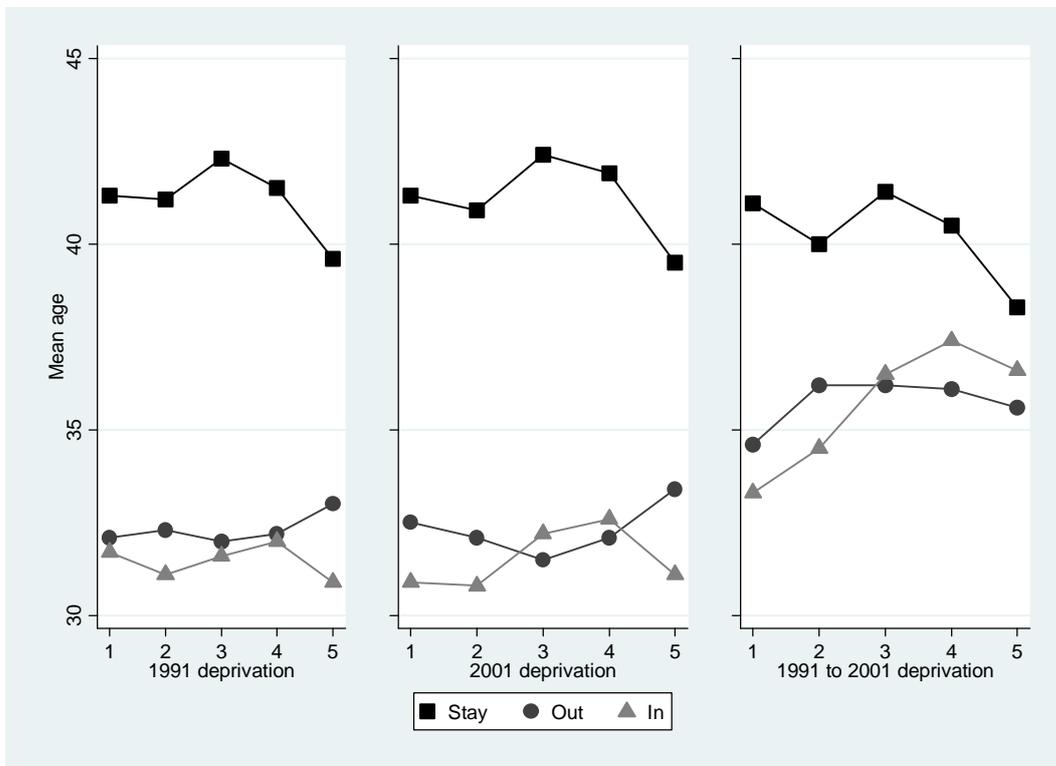
**Figure A7. Percentage of population with no higher qualification in 1991 in each deprivation quintile by whether deprivation measured (dep) in 1991 or 2001 and residence (live) in 1991 or 2001 (Source: Scottish Longitudinal Study)**



**Figure A8. Net migration of people from 1991 to 2001 with (yes) and without (no) a higher education qualification in 1991 by deprivation quintile based on 1991, 2001 and 1991 to 2001 deprivation (Source: Scottish Longitudinal Study)**



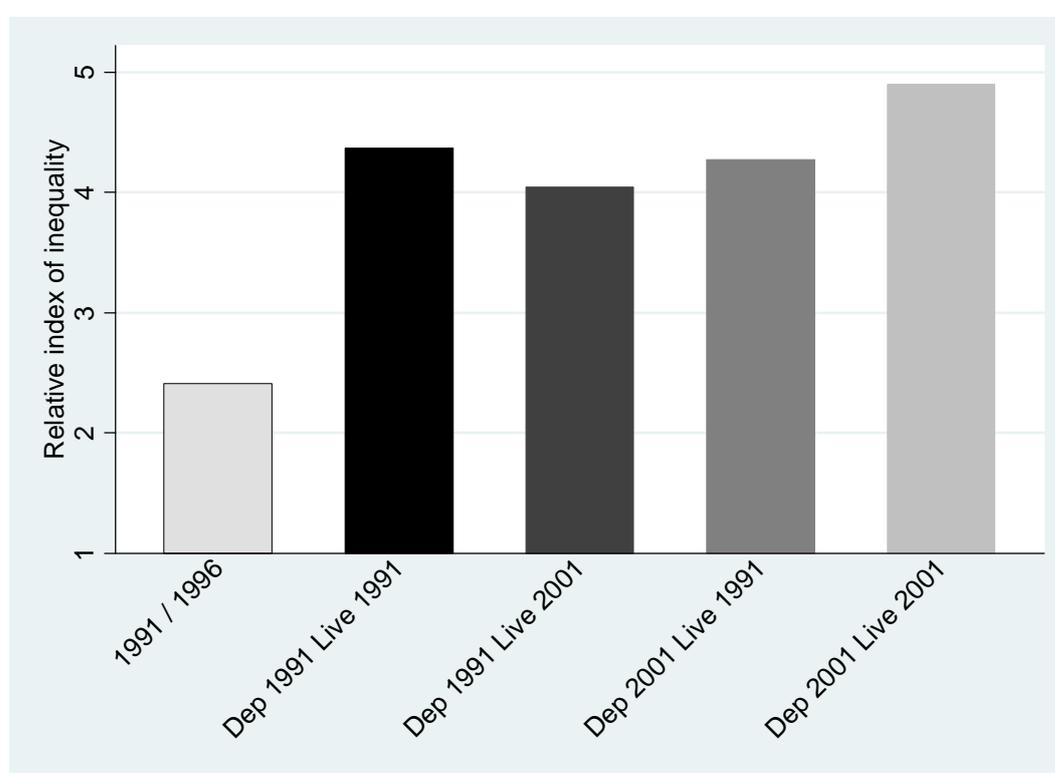
**Figure A9. Mean age (based on 1991 age) of people resident in each deprivation quintile by deprivation (dep) and residence (live) in 1991 and 2001 (Source: Scottish Longitudinal Study)**



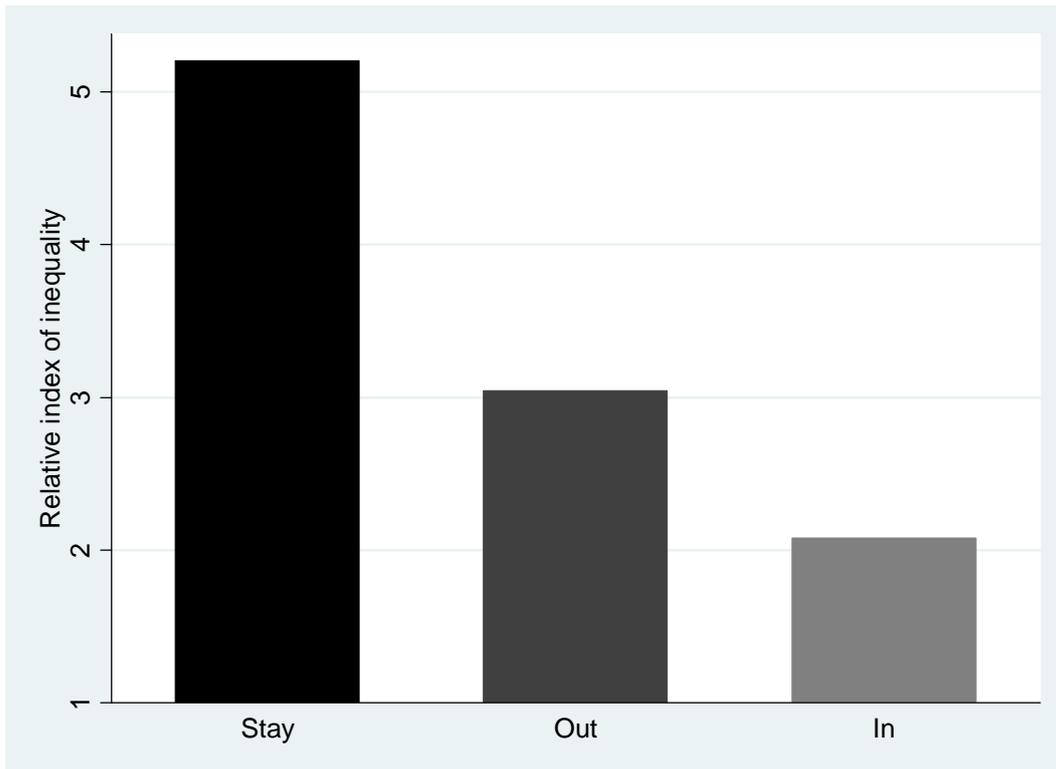
**Figure A10. Mean age of those remaining (stay) and in- and out-migrants by deprivation quintile for deprivation measured in 1991, 2001 and 1991 to 2001 (Source: Scottish Longitudinal Study)**

**Table A3. Age and sex adjusted mortality rate per 100,000 person years (95% CI) for 2001-06 for the most deprived quintile based on 1991, 2001 and 1991 to 2001 deprivation (Source: Scottish Longitudinal Study)**

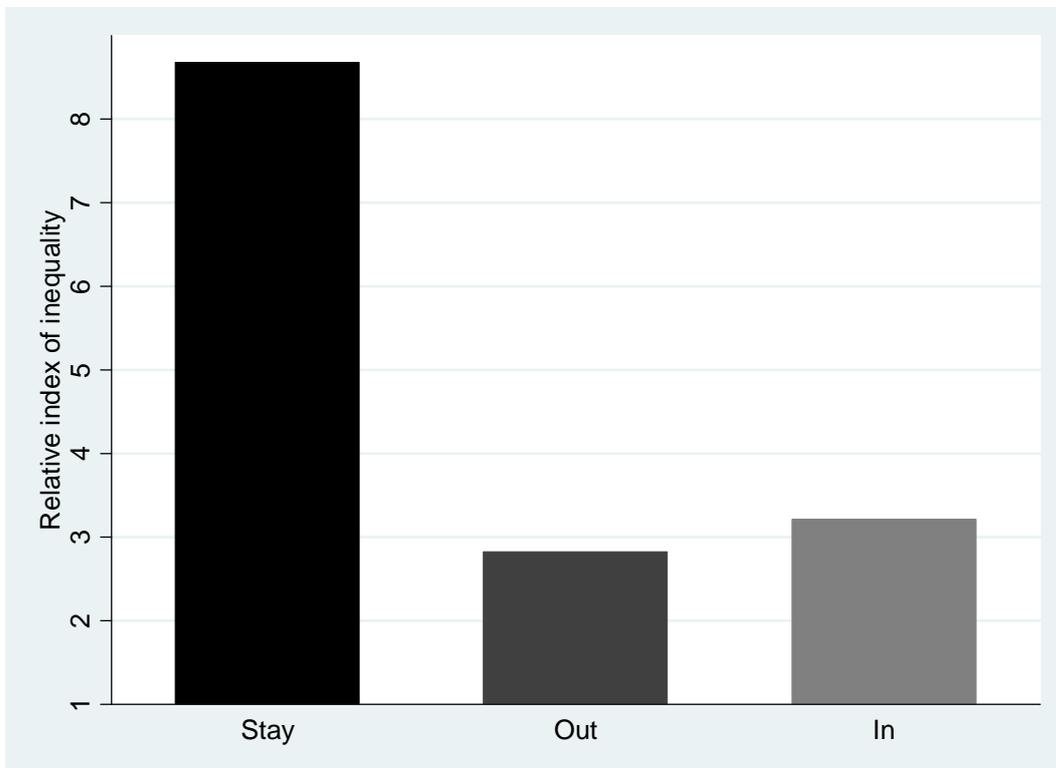
	1991 deprivation	2001 deprivation	1991 to 2001 deprivation
Stay	1356 (1191 to 1522)	1439 (1262 to 1615)	1460 (1256 to 1664)
Out (1991 only)	1374 (1123 to 1626)	1221 (984 to 1457)	1259 (1076 to 1441)
In (2001 only)	1068 (707 to 1429)	1396 (913 to 1879)	1363 (1096 to 1630)
Stay plus out (1991)	1342 (1207 to 1477)	1344 (1207 to 1482)	1342 (1207 to 1477)
Stay plus in (2001)	1307 (1159 to 1455)	1414 (1254 to 1575)	1414 (1254 to 1575)



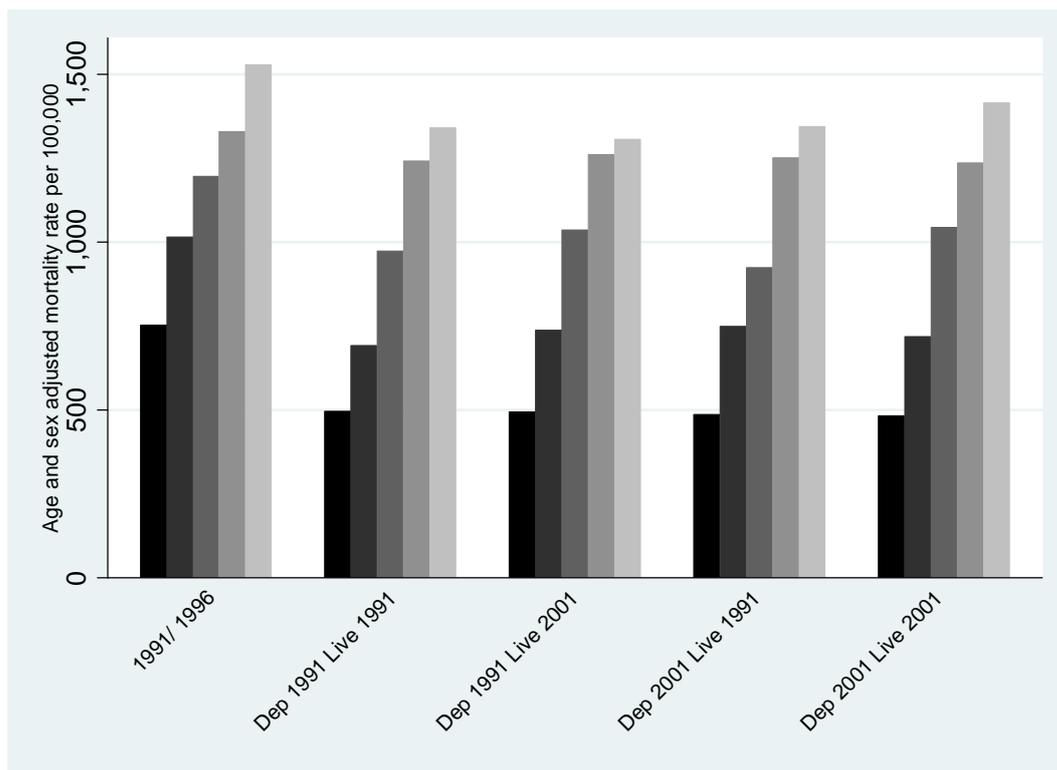
**Figure A11. Relative index of inequality for age and sex adjusted mortality 2001-2006 by deprivation (dep) and residence (live) in 1991 and 2001 compared to 1991-1996 mortality for deprivation and residence in 1991 (Source: Scottish Longitudinal Study)**



**Figure A12. Relative index of inequality for age and sex adjusted mortality 2001-2006 by 1991 deprivation for those remaining in the deprivation quintile (stay) and in- and out-migrants (Source: Scottish Longitudinal Study)**



**Figure A13. Relative index of inequality for age and sex adjusted mortality 2001-2006 by 1991 to 2001 deprivation for those remaining in the deprivation quintile (stay) and in- and out-migrants (Source: Scottish Longitudinal Study)**



**Figure A14. Age and sex adjusted mortality 2001-2006 by deprivation (dep) and residence (live) in 1991 and 2001 compared to 1991-1996 mortality for deprivation and residence in 1991 (Source: Scottish Longitudinal Study)**