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https://doi.org/10.1016/j.healthplace.2011.08.004

Published in:
Health and Place

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Download date: 02. Dec. 2018
Selective internal migration. Does it explain Glasgow’s worsening mortality record?

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A R T I C L E   I N F O

Article history:
Received 15 April 2011
Received in revised form 25 July 2011
Accepted 4 August 2011
Available online 22 August 2011

Keywords:
Mortality
Selective migration
Glasgow
Scotland
Inequality

A B S T R A C T

The mortality difference between Glasgow and the rest of Scotland has been increasing and mortality rates are higher than Glasgow’s excess deprivation would suggest. One plausible explanation for this excess is selective migration. A sample of 137,073 individuals aged 15 to 64 in 1991 from the Scottish Longitudinal Study was used to test this explanation. Three geographic areas were compared: Glasgow; Aberdeen, Dundee and Edinburgh cities combined and the rest of Scotland. The impact of selective migration was assessed by calculating age and sex standardised mortality rates for 2001/03 by residence in 2001 and by residence in 1991. Glasgow experienced the greatest loss of population (7.1%) between 1991 and 2001 but this was not strongly related to deprivation. It had the highest mortality at baseline and the difference between it and the other areas increased over the ten years. This pattern was not significantly affected by calculating death rates according to area of residence at 1991 or in 2001. Our results suggest that the increasing difference in mortality rates between Glasgow and the rest of Scotland over this period was probably not caused by selective migration.

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1. Introduction

Glasgow is recognised as one the least healthy cities in Europe. In the period 2006/08 male life expectancy at birth was just 70.7 years, the lowest for a local government area in the UK and over ten years less than the local government area with the highest (Office for National Statistics, 2009). For women life expectancy at birth in Glasgow was also the lowest for local government areas in the UK. Glasgow’s mortality record compared to rest of Scotland has also worsened over recent decades (McCarron et al., 1994; Leyland et al., 2007).

There are various potential explanations for Glasgow’s comparatively poor mortality record. Perhaps most obviously Glasgow is more deprived than the rest of Scotland and has become relatively more deprived over the past twenty years (Leyland et al., 2007). The proportion of the population living in the most deprived areas (DEPCAT 7 according to the Carstairs index (Carstairs & Morris, 1991)) increased from 37% in 1981 to 41% in 1991 and 44% in 2001 compared to just 7% nationally. However, a more recent examination demonstrates that, while this deprivation explains much of Glasgow’s mortality excess compared to the rest of Scotland, it is not the entire explanation (Leyland et al., 2007).

Another possible explanation for Glasgow’s particularly poor and worsening mortality record is 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 deprived and unhealthy people in more deprived areas. Although the potential contribution of migration to Glasgow’s health was recognised as long ago as the early 19th Century, when a large influx of largely unskilled Irish migrants (by 1831 constituting almost 18% of the population) increased both the relative poverty and the mortality rates of the city (McRaild, 1999), relatively little attention has been given to selective migration as a possible contributor to Glasgow’s more recent mortality record.

There is growing evidence that selective migration can have a significant impact on the spatial distribution of ill-health, contributing to a widening of health inequalities (Boyle, 2004; Brimblecombe et al., 1999; Norman et al., 2005; O’Reilly and Stevenson, 2003). This is often accompanied by a net decline in the number of people living in the most deprived places. One study has indicated that selective migration may have been responsible for about 50% of the increase in the socioeconomic gradient in mortality in England and Wales during the 1990s (Connolly et al., 2007). Cox et al. (2007) have also shown that differential migratory patterns lead to the residualisation of
unhealthy individuals in deprived areas, thereby exaggerating the relationship between diabetes prevalence and material deprivations in Scotland. If selective migration does play an important role in the widening health gap this could have implications for the study of area based interventions aimed at improving health because the negative effect of selective migration may mask improvements in population health for the more permanent population (Bailey and Livingston, 2008).

Some argue that the effects of selective migration are evident only in small areas (such as electoral wards or postcode sectors), but not in larger areas due to the small relative population movement that crosses their boundaries (Brimblecombe et al., 2000). However, one study looking at changes in mortality rates and net migratory patterns around Belfast and Dublin concluded that migration from more deprived inner city areas towards the affluent hinterlands may well have had a significant influence on the spatial distribution of health within and around these cities (O'Reilly et al., 2001). An analysis of migratory patterns using 2001 Census data shows that, with the exception of London, most large British cities have been losing population through migration to other parts of the UK (Champion et al., 2007). This was most marked in cities with higher levels of deprivation, overcrowding and burglary, with out-migration rates being highest for those in the professional classes, concuring with previous research showing that the more materially disadvantaged tended to be less geographically mobile (Boyle et al., 2002; Fielding, 1997; Hughes & McCormick, 1994).

This study therefore investigates the influence of selective migration on the relative mortality status of Glasgow. This is in a context where Glasgow has been losing population at a faster rate than other parts of Scotland – between 1981 and 2001 its population fell by 18.8% compared to 5.9% for the rest of the larger conurbation Glasgow is situated in and a growth of 0.4% for the rest of Scotland. The key research questions are: first, whether the observed increased mortality in Glasgow is due to selective migration, and second, whether the extent of any identified selective mobility could make a significant contribution to Glasgow's worsening mortality record during the 1990s.

2. Methods

2.1. Samples

This study used samples drawn from the Scottish Longitudinal Study (SLS), an anonymous 5.3% representative sample of the Scottish population linking 1991 and 2001 census records, health records (mortality, hospital admission and cancer registration) and other vital events data (Boyle et al., 2009a, 2009b). The estimated response rates for the 1991 and 2001 censuses in Scotland were 96 and 95%, respectively.

The main sample was closed (hereafter called the closed sample), consisting of those 137 073 men and women in the SLS aged 15 to 64 at the 1991 census who were also enumerated in the 2001 census (then aged 25 to 74). In addition to being enumerated in the 1991 and 2001 censuses they also had to have been traced in the National Health Services Central Register (NHSCR) as this tracing was needed in order to facilitate linkage of people between censuses and to mortality records (Boyle et al., 2009a, 2009b). The SLS’ tracing rate to the NHSCR was very high at 98.1%. Analysis by the SLS suggests that 85.7% of those enumerated in the 1991 census in the SLS who were expected to be linked to a 2001 census return (because they were neither recorded as having died or migrated between the censuses) were actually linked to their 2001 census return (Hattersley and Boyle, 2009).

Our focus is on internal migration within Scotland and we limited our closed sample to those aged 15 or over (then aged 25 or over in 2001) to minimise the impact of temporary moves for educational studies in 2001, as college students living away from home in the 2001 census were enumerated at their term time (college) address rather than their (parental) home address as in the 1991 census. The upper age limit of 64 (then aged up to 74 in 2001) for the closed sample was chosen as previous work had found that selective migration may be especially important for the widening premature mortality gap (Connolly et al., 2007). Details of the additional sample used in the mortality analysis for 1991/93 are given in the mortality section of the methods.

2.2. Migration

In our analysis we compared Glasgow local government area (11.4% of the 2001 Scottish census population) to the next three largest cities in Scotland combined (Edinburgh, Aberdeen and Dundee local government areas – 15.4% of the 2001 population) and also to the remaining 28 local government areas combined. Local government area boundaries were chosen as these had been used in the most recent analysis of Scottish mortality trends to compare Glasgow to other areas of Scotland (Leyland et al., 2007). A migrant was defined as someone who had moved from one of the three broad areas in 1991 to another in 2001.

2.3. Demographic and socio-economic profile

To assess the impact of selective migration on the socio-economic profile of Glasgow compared to the other areas we used socio-economic characteristics captured at the 1991 census, the start of the study period. In addition to age (coded in 10 year age groups), we extracted data on a variety of socio-economic measures including housing tenure (owner occupied, private rented and social rented), car ownership and occupational social class (using the National Statistics Socio Economic Classification (NSSEC) based on present or last held occupation in the 10 years preceding the census). For those under 16, we used parents’ highest social class or the head of the household’s and for those 16 or over who were presently full-time students their partner’s or the highest of their parents or, finally, their head of household. Similarly, for those who had never worked or who had never worked in the last 10 years we used their partner’s or parents’ or head of household’s social class. There were a very small number of individuals classified as full-time students and slightly more as having never worked or not worked in the last ten years at the end of this process.

We created a summary individual deprivation score using our three measures from the 1991 census (housing tenure, car ownership and occupation). We coded deprivation as 1 for each measure (social rented household, no car household or routine social class or never worked / not worked in last ten years) and non deprived (all other groups) as 0. We then summed the result so that the score ranged from 0 (least deprived) to 3 (most deprived).

Finally the 1991 census asked “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?” We compared those with a limiting long-term illness to those without.

We calculated in- and out- migration rates and net population changes (using the 1991 population as the denominator) for each age, socio-economic and limiting illness group in each area and then compared the gap between Glasgow and the other areas based on the 1991 and 2001 distribution of the characteristics in the closed sample.
2.4. Mortality

To assess whether the mortality gap for Glasgow compared to the other areas had widened in 2001/03 from 1991/93 we calculated the age and sex directly standardised rate of mortality for each area using the 2001 census population of Scotland as the standard. A priori we chose to study deaths to the end of 1993 and 2003, respectively, to provide a sufficient number of deaths. By definition our closed sample (who had to be alive at the 2001 census) could not be used to calculate the 1991/93 death rates. So we used an additional 1991 census sample of all those enumerated aged 25–74 in the 1991 census in the SLS. There were 3,755 deaths until the end of 1993 in this additional 1991 sample. We chose the age range 25–74 for this additional 1991 sample as that would be the age range of our closed sample at the 2001 census. The 2001/03 mortality analysis was conducted on the closed sample and there were 2,821 deaths until the end of 2003. Mortality rates are expressed as per 100,000 person-years with the person-years denominator accounting for censoring by date of emigration (where known) and date of death.

To assess whether any widening of the mortality gap between Glasgow and elsewhere from 1991/93 to 2001/03 was the result of selective migration we repeated the 2001/03 mortality rate analysis on our closed sample but put people back to their 1991 area of residence and then compared mortality rates for 2001/03 for the closed sample by their area of residence in 1991 versus 2001. In sensitivity analysis we reran the 2001/03 analysis on all those aged 25–74 in the 2001 census rather than just our closed sample (e.g. adding those in this age range enumerated in 2001 not in the closed sample to the closed sample); however the pattern of results and thus the conclusions were not changed.

3. Results

3.1. Demographic and socio-economic profile

Overall Glasgow saw a net loss 1991 to 2001 (−7.1%, see Table 1) due to internal migration (out-migration rate 18.4% and in-migration rate 11.3%) and this loss was greater than that of the other three cities combined (−3.4% net, out-migration 14.8%, in-migration 11.4%). All the other areas of Scotland combined saw a net gain of 1.7% (out-migration 3.7%, in-migration 5.4%).

In- and out-migration rates by demographic and socio-economic group were positively correlated, so both were highest amongst younger age groups, the least deprived and those without a limiting illness. The following examples illustrate this. The out-migration rate from Glasgow for those aged 15–24 in 1991 was 29.2% while it was only 7.7% for those aged 55–64 in 1991. The in-migration rates for Glasgow were 31.3% for those aged 15–24 in 1991 and 2.2% for those aged 55–64 in 1991. For the least deprived the out-migration rate from Glasgow was 24.9% while the in-migration rate was 8.4% and 3.0% for out and in-migration, respectively. Finally, for those without a limiting illness the out and in-migration rates were 19.9% and 12.5% while for those with a limiting illness the out and in-migration rates were 9.4% and 4.2%, respectively.

The correlation between in and out-migration rates resulted in only limited differences in net migration (see Table 1). Table 1 shows that Glasgow saw net loss in all age groups, apart from the youngest where there was a small net gain. The rates of net loss were not very different across deprivation categories and by whether people had a limiting or non limiting illness, the result being that net internal migration was not highly selective. Although net population movements increased slightly the percentage in Glasgow from the most deprived background, there was also a slight increase in those from a least deprived background. These internal population movements did increase Glasgow’s relative difference in the percentage of those from the most deprived background when compared to the percentage in the other areas in 2001 but the changes were again slight.

Fig. 1 displays the age and sex standardised mortality rate for the three areas for 1991/93, 2001/03 and 2001/03 based on 1991 area of residence (put back). As expected the mortality rate fell in all three areas from 1991/03 to 2001/03. The absolute and relative gap between Glasgow and the three other cities widened in 2001/03 from 1991/93 (absolute difference was 337 and rate ratio of 1.42 in 1991/93 while in 2001/03 the gap was 359 and 1.53). However, putting people back to their 1991 area of residence made virtually no difference to the 2001/03 gap (361 and 1.54). The gap also widened for Glasgow compared to elsewhere in Scotland (254 and 1.29 in 1991/93 to 303 and 1.42 in 2001/03). However, putting people back to their 1991 residence had no impact on the 2001/03 gap (303 and 1.42).

In sensitivity analysis we extended the closed sample to include all those aged 25 to 74 enumerated in the 2001 census.

### Table 1


<table>
<thead>
<tr>
<th>Age</th>
<th>1991 Number</th>
<th>2001 Number</th>
<th>% change</th>
<th>1991 Number</th>
<th>2001 Number</th>
<th>% change</th>
<th>1991 Number</th>
<th>2001 Number</th>
<th>% change</th>
</tr>
</thead>
<tbody>
<tr>
<td>15–24</td>
<td>2,934</td>
<td>2,996</td>
<td>2.1</td>
<td>4,041</td>
<td>4,409</td>
<td>9.1</td>
<td>19,822</td>
<td>19,392</td>
<td>−2.2</td>
</tr>
<tr>
<td>25–34</td>
<td>4,104</td>
<td>3,421</td>
<td>−16.6</td>
<td>5,325</td>
<td>4,758</td>
<td>−10.6</td>
<td>23,685</td>
<td>24,935</td>
<td>5.3</td>
</tr>
<tr>
<td>35–44</td>
<td>2,864</td>
<td>2,672</td>
<td>−6.7</td>
<td>4,653</td>
<td>4,495</td>
<td>−3.4</td>
<td>21,569</td>
<td>23,919</td>
<td>1.5</td>
</tr>
<tr>
<td>44–54</td>
<td>2,430</td>
<td>2,327</td>
<td>−4.2</td>
<td>3,687</td>
<td>3,479</td>
<td>−5.6</td>
<td>19,380</td>
<td>19,691</td>
<td>1.6</td>
</tr>
<tr>
<td>55–64</td>
<td>2,362</td>
<td>2,232</td>
<td>−5.5</td>
<td>3,203</td>
<td>3,053</td>
<td>−4.7</td>
<td>15,014</td>
<td>15,294</td>
<td>1.9</td>
</tr>
<tr>
<td>Total 15–64</td>
<td>14,694</td>
<td>13,648</td>
<td>−7.1</td>
<td>20,909</td>
<td>20,194</td>
<td>−3.4</td>
<td>101,470</td>
<td>103,231</td>
<td>1.7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Deprivation</th>
<th>1991 Number</th>
<th>2001 Number</th>
<th>% change</th>
<th>1991 Number</th>
<th>2001 Number</th>
<th>% change</th>
<th>1991 Number</th>
<th>2001 Number</th>
<th>% change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Least deprived</td>
<td>3,850 (26.4%)</td>
<td>3,624 (26.8%)</td>
<td>−5.9</td>
<td>9,586 (46.3%)</td>
<td>9,400 (47.0%)</td>
<td>−1.9</td>
<td>44,274 (44.0%)</td>
<td>44,686 (43.6%)</td>
<td>0.9</td>
</tr>
<tr>
<td>2nd</td>
<td>3,311 (22.7%)</td>
<td>2,938 (21.8%)</td>
<td>−11.3</td>
<td>5,273 (25.5%)</td>
<td>4,943 (24.7%)</td>
<td>−6.3</td>
<td>27,147 (27.0%)</td>
<td>27,850 (27.2%)</td>
<td>2.6</td>
</tr>
<tr>
<td>3rd</td>
<td>3,269 (22.4%)</td>
<td>3,026 (22.4%)</td>
<td>−7.4</td>
<td>3,397 (16.4%)</td>
<td>3,267 (16.3%)</td>
<td>−3.8</td>
<td>17,072 (17.0%)</td>
<td>17,445 (17.0%)</td>
<td>2.2</td>
</tr>
<tr>
<td>Most deprived</td>
<td>4,136 (28.4%)</td>
<td>3,912 (29.0%)</td>
<td>−5.4</td>
<td>2,437 (11.8%)</td>
<td>2,388 (11.9%)</td>
<td>−2.0</td>
<td>12,210 (12.1%)</td>
<td>12,483 (12.2%)</td>
<td>2.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Limiting long term illness</th>
<th>1991 Number</th>
<th>2001 Number</th>
<th>% change</th>
<th>1991 Number</th>
<th>2001 Number</th>
<th>% change</th>
<th>1991 Number</th>
<th>2001 Number</th>
<th>% change</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>12,606 (85.8%)</td>
<td>11,669 (85.5%)</td>
<td>−7.4</td>
<td>19,335 (92.5%)</td>
<td>18,647 (92.3%)</td>
<td>−3.6</td>
<td>92,713 (91.4%)</td>
<td>94,338 (91.4%)</td>
<td>1.8</td>
</tr>
<tr>
<td>Yes</td>
<td>2,088 (14.2%)</td>
<td>1,979 (14.5%)</td>
<td>−5.2</td>
<td>1,574 (7.5%)</td>
<td>1,547 (7.7%)</td>
<td>−1.7</td>
<td>8,757 (8.6%)</td>
<td>8,893 (8.6%)</td>
<td>1.6</td>
</tr>
</tbody>
</table>
(this includes those not enumerated in the 1991 census and immigrants who were excluded from the closed sample). Although Glasgow’s gap in 2001/03 was very slightly larger than for the closed sample (382 and 1.58; 330 and 1.46 for Glasgow compared to three other cities and compared to elsewhere in Scotland, respectively) putting internal migrants back to their 1991 residence again had little impact on the 2001/03 gap (383 and 1.58; 330 and 1.46).

4. Discussion

Repeat cross-sectional studies within industrialised countries have shown consistent evidence that inequalities in premature mortality between socio-economically advantaged and disadvantaged cities, and similar large administrative areas, have widened recently (Davey Smith et al., 2002; Krieger et al., 2008; Leyland, 2004; Leyland et al., 2007; Pearce and Dorling, 2006). Despite generally falling rates of mortality in all areas, the fall has been greater in socio-economically advantaged areas (Davey Smith et al., 2002; Krieger et al., 2008; Leyland, 2004; Leyland et al., 2007; Pearce and Dorling, 2006). Glasgow, which has an exceptionally poor mortality record compared to the rest of Scotland, the rest of the UK and Europe as a whole, has experienced such a worsening of its mortality record relative to other places. A recent report by Leyland et al. (2007) shows that Glasgow, because of its size, contributes significantly to overall Scottish mortality levels. If Glasgow deaths were excluded, premature mortality levels in Scotland would have been 5% lower in 1981. By 2001 this contribution had risen to 7%.

The excess mortality in Glasgow compared to the rest of Scotland has been described as the ‘Glasgow Effect’ because the relatively high mortality cannot be explained solely by the higher levels of deprivation in the city. Other factors may come into play. In this study we explored whether selective migration into and out of the city may have contributed to the worsening health situation of Glasgow compared to the rest of Scotland between 1991 and 2001 using data from the Scottish Longitudinal Study (SLS).

Our study shows that Glasgow lost a significant proportion of its population between 1991 and 2001; at over 7% this was twice the attrition rate of the next three largest Scottish cities. This is a continuation of a trend going back many decades (Devine, 1999; Leyland et al., 2007). Population loss from Glasgow during this period was not; however, strongly associated with baseline socio-economic factors so that although Glasgow was more deprived than other areas in 1991, the relative distribution of baseline deprivation was not changed significantly by 2001. Consequently it was not surprising to find the mortality patterns unchanged when ‘mapped’ according to residence in 1991 as well as in 2001 as these were unlikely to be different in the absence of significant selective migration.

These findings for Glasgow are in contrast to those from a similar study in England and Wales over the same period (Connolly and O’Reilly, 2007), which concluded that migration was responsible for perhaps half of the increased mortality gap between areas. That study, however, found significant selective migration effects. Another difference between the studies was the geographic scale of the analysis. In the current study large geographical units corresponding to cities, groups of cities and the rest of Scotland were used, much larger than the neighbourhoods used in the earlier study. It is recognised that most internal migrants do not move far from their point of origin (Boyle et al., 2002) so movement across the boundaries of larger geographical units will be relatively infrequent and will mask significant population movements within their boundaries. Migration between neighbourhoods is far more common than migration between local government areas in Scotland (Fleming, 2005). Of the few longitudinal studies exploring the impact of selective migration on widening health inequalities, most have studied smaller neighbourhoods rather than larger administrative areas (Boyle et al., 2009a, 2009b; Connolly and O’Reilly, 2007; Connolly et al., 2007; Cox et al., 2007; Norman et al., 2005). A notable exception was the study by Brimblecombe et al. (1999) who found that the migration between large administrative areas (such as cities), but not between larger regions, explained the mortality difference when all areas were grouped in low and high mortality areas though that study was based on a low number of deaths and only compared two aggregates of areas (Boyle, 2004).

It is, however, possible that selective migration did play a significant part in earlier years as Glasgow was becoming relatively more deprived compared to other parts of Scotland. Given that Glasgow’s population has been declining since the 1960s there is an identified need to research the health impacts of these
long-term trends (McCartney et al., 2011). It is also possible that significant selective movement has been occurring within Glasgow during the study period and that this could have contributed to widening health inequalities between Glasgow and elsewhere in Scotland that we may not have observed in our city level analysis. For example, within Glasgow migration could lead to greater deprivation at not only the individual level but also at the area level in deprived areas. Given that area deprivation may amplify the effects of individual disadvantage on mortality risk (Macintyre, 2007) – i.e. through a neighbourhood effect – then Glasgow's aggregate health could deteriorate due to within Glasgow migration. Such a process may not be captured in our city level analysis although such a process may be less likely given that deprived areas within Glasgow shrank considerably over the period under study lessening the numbers exposed to these particularly deprived circumstances. Within Glasgow migration could also explain the widening in mortality inequalities between Glasgow's most and least deprived neighbourhoods (Hanlon et al., 2006) although recent SLS based research suggests that the impact of selective migration on widening within Glasgow mortality inequalities has been small (Popham et al., 2010).

Although we have found that the current relative worsening of mortality in Glasgow appears not to be due to selective migration it is possible that population loss per se, which was more evident in Glasgow than elsewhere, has contributed. Depopulation resulting in population instability may be associated with a reduction in the sense of community, social cohesion, provision of amenities and quality of life, for example (Kawachi and Berkman, 2000; Putnam, 1995; Sampson and Groves, 1989). Analysis of districts throughout Britain has shown a close correlation between population shrinkage and mortality (Davey Smith et al., 1998). Although adjustment for deprivation attenuates this association (Exeter et al., 2005; Exeter et al., 2009), UK research comparing the most deprived areas found those that had not experienced large population loss had a relatively better mortality record than those that had, with qualitative evidence that social cohesion declined with population loss (Mitchell et al., 2009).

Strengths of the study included the large and representative sample size of a census based study and the high levels of linkage between the two censuses. There are limitations also. Census non-response is not random and more likely amongst younger male adults and the more socio-economically deprived. However, the effect of correcting for this non-response on area death rates has been shown to be insignificant (Norman et al., 2008). The non-linkage of people from census to census could also potentially introduce bias as this was more common amongst younger adults and the socio-economically deprived (Hattersley and Boyle, 2009). Research by the SLS suggests that a substantial proportion of the loss to follow-up in 2001 is due to missed UK and international emigration from Scotland amongst young adults (Hattersley and Boyle, 2009) and so these individuals would not have been included in our closed sample anyway if their emigration had been known. Additionally a significant proportion of non-linkages occurred because of linkage failure due to changes and errors in key variables used to link SLS members across censuses (Hattersley and Boyle, 2009). While it is not possible to assess the impact of non-linkage on our results it was notable that the 2001/2003 death rates were not significantly different when estimated for the closed sample compared to the sample including all those enumerated in 2001 census in the SLS as this second sample will include some of those not linked from 1991 due to errors and changes in linkage variables.

In conclusion, although Glasgow continued to experience significant decline in population between 1991 and 2001 net migration was not strongly related to socio-economic factors and so selective migration may not explain the increasing mortality differences between it and the rest of the country. The ‘Glasgow Effect’ remains to be explained.

5. Ethical approval

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

Acknowledgements

This study was funded by a small grant from the Chief Scientist Office of the Scottish Government Health Directorates (CZG/2/400). The views expressed are those of the authors and not the funder. The help provided by staff of the Longitudinal Studies Centre – Scotland (LSCS) is acknowledged. The LSCS is supported by the ESRC/JISC, the Scottish Funding Council, the Chief Scientist Office and the Scottish Government. The authors are responsible for the interpretation of the data. Census output is Crown copyright and is reproduced with the permission of the Controller of HMSO and the Queen's Printer for Scotland.

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