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Selective internal migration. Does it explain Glasgow's worsening mortality record?

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Summary

Background

Glasgow is one the least healthy cities in Europe. 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 (the 'Glasgow Effect'). One plausible explanation for this excess is selective migration.

Methods

A sample of 137,073 individuals aged 15 to 64 in 1991 from the Scottish Longitudinal Study, who were alive and captured in 2001, was used. 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.

Results

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; (absolute difference from 337 to 359 per 100,000 person-years between Glasgow and the three other cities; and from 254 to 303 between Glasgow and elsewhere in Scotland). This pattern was not significantly affected by calculating death rates according to area of residence at 1991 or in 2001.

Conclusions

The increasing difference in mortality rates between Glasgow and the rest of Scotland over this period was probably not caused by selective migration, although it could have contributed in earlier years. The 'Glasgow Effect' remains unexplained but may be related to population loss per se.

1. Introduction

Glasgow is recognised as one the least healthy cities in Europe. In 2006 male life expectancy at birth was less than 70 years, the lowest in the UK and almost ten years less than the local authority with the highest [1]. For women life expectancy at birth in Glasgow was also the lowest in the UK. Glasgow's mortality record compared to rest of Scotland has also worsened over recent decades [2] [3].

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 [3]. The proportion of the population living in the most deprived areas (DEPCAT 7 according to the Carstairs index[4]) 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.[3]

Another possible explanation for Glasgow's particularly poor and worsening mortality record is selective migration. 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[5], 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, 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, can have a significant impact on the spatial distribution of ill-health, contributing to a widening of health inequalities [6-9]. 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 [10]. Cox et al. [11] 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 deprivation in Scotland.

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 [12]. 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 [13]. 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 [14]. 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, concurring with previous research showing that the more materially disadvantaged tend to be less geographically mobile [15-17].

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 Clydeside conurbation and a growth of 0.4% for the rest of Scotland. The key research questions are, first, whether this population redistribution was selective of those with more privileged socio-economic and health characteristics and, second, whether the extent of any identified selective mobility could make a significant contribution to Glasgow's worsening mortality record during the 1990s. If selective migration is important for the widening health gap it may be masking relative improvements in population health for the more permanent population, resulting from, for example, Government area based interventions [18].

2. Methods

Sample

This study used a sample drawn from the Scottish Longitudinal Study (SLS), a 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 [19]. The sample was closed, 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). The sample also had to have been traced in the National Health Services Central Register (NHSCR) as this was needed in order to facilitate data linkage [19]. The SLS' tracing rate to the NHSCR was very high at 98.1%.

Our focus is on internal migration within Scotland and we limited our sample to those aged 15 or over (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 (74 in 2001) was chosen as previous work had found that selective migration may be especially important for the widening premature mortality gap [10].

In our analysis we compared Glasgow council area (11.4% of the 2001 Scottish census population) to the next three largest cities in Scotland combined (Edinburgh, Aberdeen and Dundee council areas – 15.4% of the 2001 population) and also to the remaining 28 local councils combined. Council 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 [3]. A migrant was defined as someone who had moved from one of the three broad areas in 1991 to another in 2001.

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 the 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 not 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 classed 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.

Mortality

To assess the mortality rate in the three areas in 1991/93 (3755 deaths) and 2001/03 (2821 deaths) we calculated the age and sex directly standardised rate of mortality using the 2001 census population of Scotland as the standard. Mortality rates are expressed as per 100 000 per person-year 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 analysis but put people back to their 1991 area of residence and compared rates for 2001/03 by area of residence in 1991 and 2001. The 1991/93 analysis was based on all those aged 25 to 74 in 1991, while the 2001/03 analysis was based on our closed sample. In sensitivity analysis we reran the 2001/03 analysis including all those aged 25 to 74 in the 2001 census (e.g. adding those in this age group enumerated in 2001 for the first time to the closed sample); however the pattern of results and thus the conclusions were not changed.

3. Results

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 (results not shown). This correlation 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.

Table 1: Demographic and socio-economic characteristics of study areas in 1991 and net intercensal changes between 1991 and 2001

		Glasgow			3 Cities			Rest Scotland	
	1991 No's	2001 No's	% change	1991 No's	2001 No's	% change	1991 No's	2001 No's	% change
Population									
15-24	2,934	2,996	2.1	4,041	4,409	9.1	19,822	19,392	-2.2
25-34	4,104	3,421	-16.6	5,325	4,758	-10.6	23,685	24,935	5.3
35-44	2,864	2,672	-6.7	4,653	4,495	-3.4	23,569	23,919	1.5
44-54	2,430	2,327	-4.2	3,687	3,479	-5.6	19,380	19,691	1.6
55-64	2,362	2,232	-5.5	3,203	3,053	-4.7	15,014	15,294	1.9
Pop 15-64	14,694	13,648	-7.1	20,909	20,194	-3.4	101,470	103231	1.7
Population characteristics									
Least deprived	3,850 (26.4%)	3,624 (26.8%)	-5.9	9,586 (46.3%)	9,400 (47.0%)	-1.9	44,274 (44.0%)	44,686 (43.6%)	0.9
2nd	3,311 (22.7%)	2,938 (21.8%)	-11.3	5,273 (25.5%)	4,943 (24.7%)	-6.3	27,147 (27.0%)	27,850 (27.2%)	2.6
3rd	3,269 (22.4%)	3,026 (22.4%)	-7.4	3,397 (16.4%)	3,267 (16.3%)	-3.8	17,072 (17.0 %)	17,445 (17.0%)	2.2
Most deprived	4,136 (28.4%)	3,912 (29.0%)	-5.4	2,437 (11.8%)	2,388 (11.9%)	-2.0	12,210 (12.1%)	12,483 (12.2%)	2.2
LLTI no	12,606 (85.8%)	11,669 (85.5%)	-7.4	19,335 (92.5%)	18,647 (92.3%)	-3.6	92,713 (91.4%)	94,338 (91.4%)	1.8
yes	2,088 (14.2%)	1,979 (14.5%)	-5.2	1,574 (7.5%)	1,547 (7.7%)	-1.7	8,757 (8.6%)	8,893 (8.6%)	1.6

Source: Scottish Longitudinal Study

Figure 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).

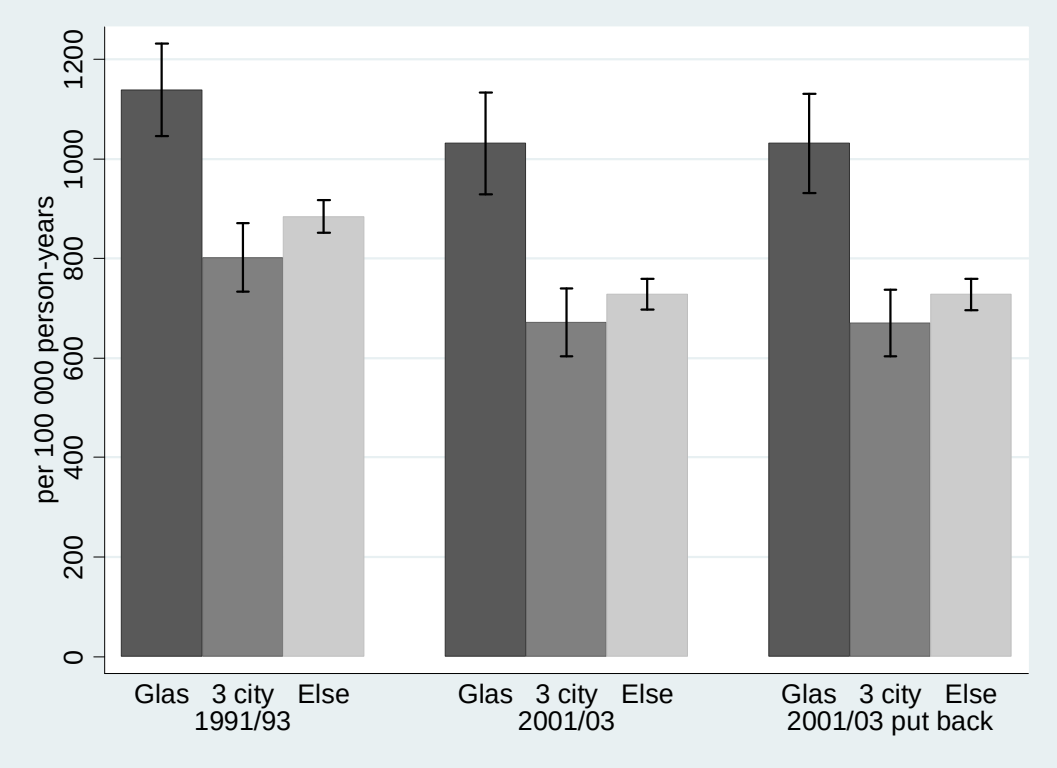

Figure 1. Age and sex standardised mortality rates for those aged 25 to 74 in Glasgow (Glas), Edinburgh, Aberdeen and Dundee (3 city) and all other council areas in Scotland (Else) for 1991-93, 2001-03 and 2001-03 by 1991 area of residence (put back). Source: Scottish Longitudinal Study

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

Further, limiting the 2001/03 analysis to non migrants in the closed sample who thus lived in the same area in both 1991 and 2001 produced very similar results to that seen when migrants from the closed sample were included. The gap between Glasgow and the three other cities was 364 and 1.54, and with all other areas in Scotland it was 307 and 1.42.

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 [3, 20-23]. Despite generally falling rates of mortality in all areas, the fall has been greater in socio-economically advantaged areas [3, 20-23]. 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.* [3] 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 [3, 24]. 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 [25] 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 [15] 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 council areas in Scotland [26].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 [6, 10, 11, 25, 27]. A notably exception was the study by Brimblecombe et al. [7] who found that 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 [8].

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. It is also possible that significant selective movement has been occurring *within* Glasgow during the study period that has contributed to widening health inequalities but this will not be evident at the aggregate level. This could explain the disproportionate decline in the population of Glasgow's most deprived neighbourhoods and the widening in mortality inequalities between Glasgow's worst and least deprived neighbourhoods [28]. Additionally, as within Glasgow migration could lead to a further concentration of deprived individuals in deprived areas this could result in increased area deprivation and thus further amplification of the negative effects of individual disadvantage on mortality risk [29]. This may not be captured in our city level analysis but could still worsen mortality rates for Glasgow as a whole.

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 [30-32]. Analysis of districts throughout Britain has shown a close correlation between population shrinkage and mortality [33]. Although adjustment for deprivation attenuates this association [34, 35], 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 [36].

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.

Ethical approval

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

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