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## Short report

The Scottish excess in mortality compared to the English and Welsh: Is it a country of residence or country of birth excess?

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## Abstract

Scotland has a higher mortality rate than England and Wales that is only partially explained by differences in socio-economic deprivation. Within Scotland those born in England and Wales have a lower mortality rate than the Scottish born. Within England and Wales, Scottish born immigrants have a higher mortality rate than those born in England and Wales. These results raise the question of whether the greater Scottish mortality is a country of birth rather than a country of residence excess. Our analysis, around the 2001 census, suggests that country of birth is more important than country of residence, indicating that early life factors may be important for the Scottish excess.

**Keywords:** Scotland, England and Wales, mortality, country of birth.

## **Introduction**

It is well established that the mortality rate in Scotland is higher than in neighbouring England and Wales (Hanlon et al., 2005). It is also known that those born in Scotland but living in England and Wales have a higher mortality rate than those born in England and Wales (Wild et al., 2007; Wild and Mckeigue 1997). Recently it has also been shown for the period around the 2001 census that within Scotland those born in England and Wales (Scotland's largest immigrant group) have a lower mortality rate than the Scottish born (Fischbacher et al. 2007). These findings raise the question of whether the Scottish excess in mortality may actually be a country of birth excess rather than a country of residence excess. To date there has been no study jointly comparing mortality in both countries by country of birth and country of residence to test this hypothesis.

## **Methods**

We obtained from the Office for National Statistics (ONS) in England and Wales and the General Register Office for Scotland (GROS) death registration counts and census population counts by combinations of country of birth and country of residence by 5 year age groups (up to 85 and then 85 and over) and sex. All aforementioned studies have also been based on such death registration (numerator) and census population counts (denominator).

To describe the mortality differences separately and jointly by country of birth and country of residence we used Poisson models with robust standard errors. We conducted analysis for those aged 25 and over using deaths from 2000-2002. We checked the consistency of these results with those for the working age (25 to 64) and post working age (65 plus) populations. All models control for age and sex.

## **Results**

Focusing on country of birth for those aged 25 and over, Model A (Table 1) shows that, as expected, the risk of death is significantly higher for those born in Scotland than for persons born in England and Wales. By country of current residence, Model B shows those living in Scotland have a higher risk of death than those living in England. Jointly accounting for country of birth and residence sees a clear attenuation of the relative risk for country of residence rather than country of birth (Model C).

Model D groups country of residence and country of birth and confirms the increased mortality risk associated with being born in Scotland. There was a slight increased risk for the Scottish born living in Scotland compared to Scottish born living in England and Wales, and a slightly reduced risk for the English and Welsh born if living in Scotland, compared to those living in England and Wales.

Similar patterns of results are seen for those aged 25 to 64 (Table 2) and 65 and over (Table 3). Although relative risks were consistently higher for the 25 to 64 year olds this reflects their much lower absolute rate of death. This is because relative risks are not independent of the overall rate and will tend to be higher when the absolute rate is low(er) (Houweling et al., 2007). Absolute differences (not shown) were actually higher in the older age group.

## Discussion

Our results suggest that the Scottish excess is considerably more strongly related with country of birth than country of residence. There are at least two explanations for this. First, the results could be an artefact; it is well recognised that country of birth analyses which rely on data from two unlinked sources (death registration and census) may be subject to numerator / denominator bias (Marmot et al., 1984). In this case we are comparing data across two contexts where there may be differences in this effect. However, while Scotland technically conducts its own census and has a separate vital registration system to England and Wales, there are strong similarities in practices, so there is unlikely to be any major bias due to differences across the two systems. Also, previous individual-level linked studies of country of birth mortality conducted in the UK have tended to produce similar patterns to those observed in unlinked studies, suggesting that such biases are generally not significant (Harding and Balarajan, 2001).

Second, if these results are not an artefact then they will be due to differences in the prevalence of mortality risk factors by country of birth. Previous comparative studies of mortality in Scotland and England, which did not account for country of birth, have focused on current socio-economic differences as an explanation for the Scottish excess, given the higher rates of deprivation in Scotland. The most recent study found that current differences in deprivation explain only a part of Scotland's higher mortality (Hanlon et al., 2005).

Using published 2001 census tables, we calculated the current deprivation situation for those aged 16 and over by the four combinations of country of birth and residence (the available census tables for country of birth only divided people 0 to 15, 16 to pension age and pension age and over, rather than 25 and over). We used the Carstairs score as our measure of deprivation and calculated it jointly for all three countries at the postcode sector level (in Scotland) and ward level (in England and Wales) as this was the deprivation score and geographical level used in the most recent study (Hanlon et al., 2005). Figure 1 illustrates that within England and Wales those born in Scotland have a deprivation distribution and mean score (0.??) very similar to those born in England and Wales (0.??). Within Scotland, those born in Scotland had a higher (more deprived) mean deprivation score (2.24?) than those born in England and Wales (0.85) which in turn was closer to that of those living in England and Wales. This analysis highlights how current deprivation is unlikely to be the only explanation of the country of birth excess found in this study as the Scottish born living in England and Wales, on average, experience lower levels of deprivation than found in Scotland.

One limitation of using small area deprivation is that there may still be differences in individual socio-economic circumstances. However recent evidence suggests that while the Scottish born living in Scotland have, on average, the worst individual socio-economic circumstances, the socio-economic characteristics of the English born living in Scotland and the Scottish and English born in England are similar (Popham, 2006). This supports the idea that current socio-economic differences in adulthood will not be the only explanation of the Scottish country of birth excess.

Given that many major risk factors for mortality are likely to vary because of differences in the socio-economic environment experienced across the lifecourse, both in childhood and adulthood, (Ben Shlomo and Kuh, 2002; Lynch & Smith, 2005) it is plausible that differences in prenatal and childhood socio-economic circumstances, as well as in adulthood, could explain our findings. It is known that most migrants from Scotland to England and Wales moved in early adulthood

(Jones, 1992). Hence, it is reasonable to expect that, on average, those born in the country of residence generally spent their formative years growing up there. As there is evidence that prenatal and childhood deprivation can have a lasting impact on both adult health and health behaviours (Galobardes et al., 2004; Heckman, 2007) it is plausible that Scotland's historically higher rates of socio-economic deprivation (Carstairs and Morris, 1989) mean that average prenatal and childhood circumstances were worse for the Scottish born compared to the English or Welsh born in this study.

Another possible explanation for the mortality differences between those born in Scotland and England and Wales is genetic difference. While there are some genetic variations between the Scottish and English born, to date, genes that have been associated with risk of major diseases do not seem to vary between these populations (The Wellcome Trust Case Control Consortium, 2007). However, it is also increasingly recognised that later life health effects of poor early environments may in part be because the environment causes gene expression that raises susceptibility to disease in later life (Gluckman et al., 2008; Heckman, 2007). This means that gene environment interactions may be important for future health (Heckman, 2007).

In summary, the results presented here suggest that Scotland's excess mortality is a country of birth, rather than a country of residence effect. This points to the potential importance of (socio-economic) circumstances in early life possibly expressed, in part, through the interaction between environment and genes. Neither early life experiences nor genetics are included in most studies that identify a 'Scottish effect', which have tended to focus on small-area deprivation measures as explanatory variables (Hanlon et al., 2005). Further research to tease out Scotland's poor record is required.

#### *Ethical approval*

The project was approved by the Geography and Geosciences School Ethics Committee of the University Teaching and Research Ethics Committee of the University of St Andrews

#### *Competing interests*

None

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**Table 1 Age and sex adjusted relative risk of death for those aged 25 and over by country of birth and residence**

| <b>2000-02</b>   | <b>Model A</b>      | <b>Model B</b>      | <b>Model C</b>      | <b>Model D</b>      |
|--|---------------------|---------------------|---------------------|---------------------|
| Born in England and Wales (n = 31,557,272)                             | 1                   |                     | 1                   |                     |
| Born in Scotland (n = 3,741,507)                                       | 1.19 (1.12 to 1.26) |                     | 1.17 (1.11 to 1.24) |                     |
| Lives in England and Wales (n = 31,9442,16)                            |                     | 1                   | 1                   |                     |
| Lives in Scotland (n = 3,354,563)                                      |                     | 1.17 (1.10 to 1.25) | 1.02 (0.96 to 1.08) |                     |
| Born in England and Wales, Lives in England and Wales (n = 31,225,017) |                     |                     |                     | 1                   |
| Born in England and Wales, Lives in Scotland (n = 332,255)             |                     |                     |                     | 0.95 (0.89 to 1.01) |
| Born in Scotland, Lives in England and Wales (n = 719,199)             |                     |                     |                     | 1.15 (1.07 to 1.22) |
| Born in Scotland, Lives in Scotland (n = 3,022,308)                    |                     |                     |                     | 1.20 (1.12 to 1.29) |

**Table 2 Age and sex adjusted relative risk of death for those aged 25 to 64 by country of birth and residence.**

| <b>2000-02</b>   | <b>Model A</b>      | <b>Model B</b>      | <b>Model C</b>      | <b>Model D</b>      |
|--|---------------------|---------------------|---------------------|---------------------|
| Born in England and Wales (n = 24,056,510)                             | 1                   |                     | 1                   |                     |
| Born in Scotland (n = 2,869,603)                                       | 1.41 (1.36 to 1.46) |                     | 1.37 (1.31 to 1.42) |                     |
| Lives in England and Wales (n = 24,343,497)                            |                     | 1                   | 1                   |                     |
| Lives in Scotland (n = 2,582,616)                                      |                     | 1.37 (1.30 to 1.43) | 1.04 (0.99 to 1.09) |                     |
| Born in England and Wales, Lives in England and Wales (n = 23,788,684) |                     |                     |                     | 1                   |
| Born in England and Wales, Lives in Scotland (n = 267,826)             |                     |                     |                     | 0.93 (0.88 to 0.98) |
| Born in Scotland, Lives in England and Wales (n = 554,813)             |                     |                     |                     | 1.32 (1.27 to 1.37) |
| Born in Scotland, Lives in Scotland (n = 2,314,790)                    |                     |                     |                     | 1.43 (1.38 to 1.48) |

**Table 3 Age and sex adjusted relative risk of death for those aged 65 and over by country of birth and residence.**

| <b>2000-02</b>  | <b>Model A</b>      | <b>Model B</b>      | <b>Model C</b>      | <b>Model D</b>      |
|---|---------------------|---------------------|---------------------|---------------------|
| Born in England and Wales (n = 7,500,762)                             | 1                   |                     | 1                   |                     |
| Born in Scotland (n = 871,904)  | 1.14 (1.07 to 1.22) |                     | 1.13 (1.07 to 1.20) |                     |
| Lives in England and Wales (n = 7,600,719)                            |                     | 1                   | 1                   |                     |
| Lives in Scotland (n = 771,947)                                       |                     | 1.13 (1.06 to 1.21) | 1.01 (0.95 to 1.08) |                     |
| Born in England and Wales, Lives in England and Wales (n = 7,436,333) |                     |                     |                     | 1                   |
| Born in England and Wales, Lives in Scotland (n = 64,429)             |                     |                     |                     | 0.95 (0.88 to 1.02) |
| Born in Scotland, Lives in England and Wales (n = 164,386)            |                     |                     |                     | 1.11 (1.04 to 1.19) |
| Born in Scotland, Lives in Scotland (n = 707,518)                     |                     |                     |                     | 1.15 (1.07 to 1.24) |

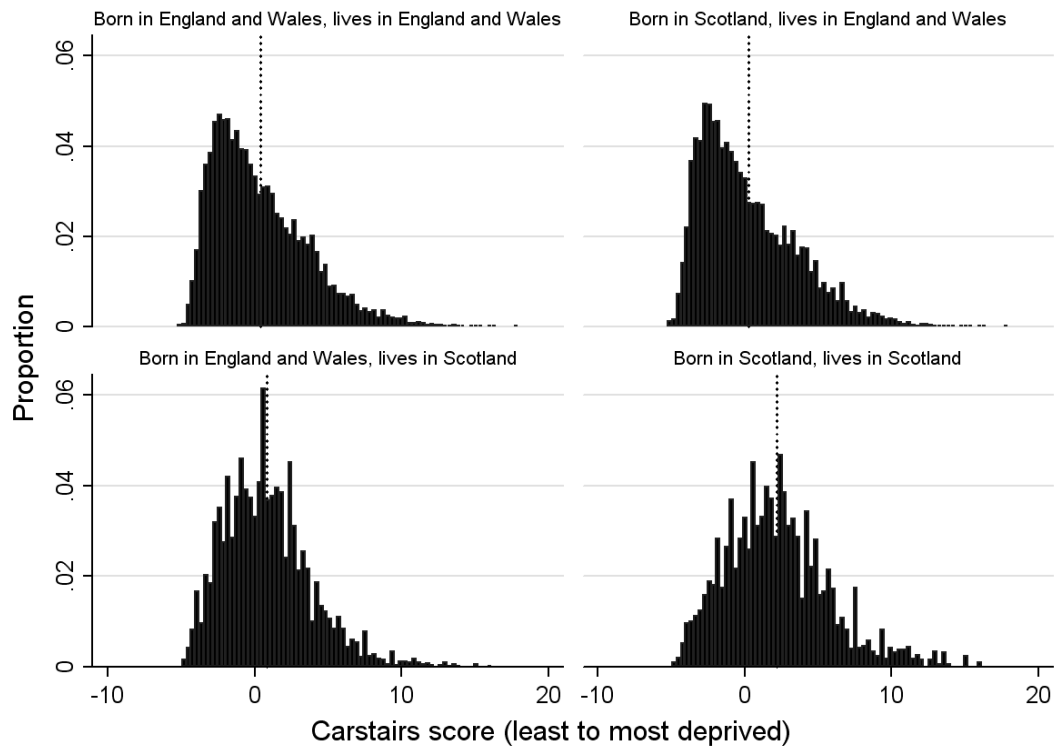


Figure 1 Distribution and mean of Carstairs score in 2001 (calculated jointly for Scotland and England and Wales) by country of birth and country of residence for those aged 16 and over in 2001. The mean Carstairs score is represented by the dotted lines.

## References

- Ben Shlomo, Y., & Kuh, D. (2002). A life course approach to chronic disease epidemiology: Conceptual models, empirical challenges and interdisciplinary perspectives. *International Journal of Epidemiology*, 31(2), 285-293.
- Carstairs, V., & Morris, R. (1989). Deprivation: Explaining differences in mortality between Scotland and England and Wales. *BMJ*, 299, 886-889.
- Fischbacher, C. M., Steiner, M., Bhopal, R., Chalmers, J., Jamieson, J., Knowles, D. et al. (2007). Variations in all cause and cardiovascular mortality by country of birth in Scotland, 1997-2003. *Scottish Medical Journal*, 52(4), 5-10.
- Galobardes, B., Lynch, J. W., & Davey Smith, G. (2004). Childhood socioeconomic circumstances and cause-specific mortality in adulthood: Systematic review and interpretation. *Epidemiologic Reviews*, 26(1), 7-21.

Gluckman, P. D., Hanson, M. A., Cooper, C., & Thornburg, K. L. (2008). Effect of in utero and early-life conditions on adult health and disease. *The New England Journal of Medicine*, 359(1), 61-73.

Hanlon, P., Lawder, R. S., Buchanan, D., Redpath, A., Walsh, D., Wood, R. et al. (2005). Why is mortality higher in Scotland than in England and Wales? Decreasing influence of socioeconomic deprivation between 1981 and 2001 supports the existence of a 'Scottish effect'. *Journal of Public Health*, 27(2), 199-204.

Harding, S., & Balarajan, R. (2001). Mortality of third generation Irish people living in England and Wales: Longitudinal study. *BMJ*, 322(7284), 466-467.

Heckman, J. J. (2007). The economics, technology, and neuroscience of human capability formation. *Proceedings of the National Academy of Sciences*, 104(33), 13250-13255.

Houweling, T., Kunst, A., Huisman, M., & Mackenbach, J. (2007). Using relative and absolute measures for monitoring health inequalities: Experiences from cross-national analyses on maternal and child health. *International Journal for Equity in Health*, 6(1), 15.

Jones, H. (1992). Migration trends for Scotland: Central losses and peripheral gains. In J. Stillwell, P. Rees & P. Boden (Eds.), *Migration process and patterns: population redistribution in the United Kingdom* (pp. 100-113). London: Belhaven Press.

Lynch, J., & Davey Smith, G. (2005). A life course approach to chronic disease epidemiology. *Annual Review of Public Health*, 26(1), 1-35.

Marmot, M. G., Adelstein, A. M., & Bulusu, L. (1984). Lessons from the study of immigrant mortality. *Lancet*, 1(8392), 1455-1457.

Popham, F. (2006). Is there a "Scottish effect" for self reports of health? individual level analysis of the 2001 UK census. *BMC Public Health*, 6(1), 191.

The Wellcome Trust Case Control Consortium (2007). Genome-wide association study of 14,000 cases of seven common diseases and 3,000 shared controls. *Nature*, 447(7145), 661-678.



Wild, S. H., Fischbacher, C., Brock, A., Griffiths, C., & Bhopal, R. (2007). Mortality from all causes and circulatory disease by country of birth in England and Wales 2001-2003. *Journal of Public Health*, 29(2), 191-198.

Wild, S., & Mckeigue, P. (1997). Cross sectional analysis of mortality by country of birth in England and Wales, 1970-92. *BMJ*, 314(7082), 705.