

Is there a 'Scottish effect' for mortality? Prospective observational study of census linkage studies

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ABSTRACT

Background Scotland's mortality rate is higher than England and Wales' and this difference cannot be explained by differences in area-level socio-economic deprivation. However, studies of this 'Scottish effect' have not adjusted for individual-level measures of socio-economic position nor accounted for country of birth; important as Scottish born living in England and Wales also have high mortality risk.

Methods Data sets (1991–2001 and 2001–2007) were obtained from the Scottish Longitudinal Study and the Office for National Statistics England and Wales Longitudinal Study that both link census records to subsequent mortality. Analysis was limited to those aged 35–74 at baseline with people followed to emigration, death or end of follow-up.

Results Those born in Scotland living in either England and Wales or Scotland had a higher mortality rate than the English born living in England and Wales that was not fully attenuated by adjustment for car access and housing tenure.

Conclusion Adjusting for household-level differences in socio-economic deprivation does not fully explain the Scottish excess mortality that is seen for those born in Scotland whether living in England and Wales or Scotland. Taking a life course approach may reveal the cause of the 'Scottish effect'.

Keywords mortality, socio-economic factors

Background

The mortality rate is higher in Scotland than in neighbouring England and Wales.^{1,2} Early studies at around the time of the 1981 census showed that adjusting for Scotland's higher rates of socio-economic deprivation (measured at the small-area level) explained the majority of this excess.¹ However, similar analyses around the time of the 1991 and 2001 censuses showed that <50% of the excess could be explained.² The Scottish excess was found across the deprivation range (in both rich and poor areas), although it was greatest in the most deprived areas.² This unexplained excess mortality has been named the 'Scottish effect'² and the term has since entered the Scottish policy lexicon.

To date studies of the Scottish effect have not taken a life course approach; most have compared death rates controlling for area-based measures of current deprivation. Positioning the Scottish effect in a life course context could be important as the Scottish-born living in England and

Wales have been shown to have higher mortality than the English born³ and recent research shows that the Scottish excess mortality over the English is more strongly related to country of birth rather than country of residence.⁴ In this paper, we therefore extend these previous analyses by adopting a life course approach, based on longitudinal data drawn from the Office for National Statistics England and Wales Longitudinal Study (ONS LS) and the Scottish Longitudinal Study (SLS). Unlike previous studies of the 'Scottish effect', this allows us to assess the role of country of birth, controlling for differences in household socio-economic position. This may provide a better control for socio-economic circumstances than area-based measures of deprivation that have been used previously. This is because individual- or

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household-level socio-economic position may better capture disadvantage compared with potentially more heterogeneous area-based measures.⁵

Methods

The SLS⁶ and the ONS LS both link mortality registrations to decennial census data for a sample of their country's population (5.3% in the SLS, beginning with the 1991 census; 1% in ONS LS starting with the 1971 census). As these are separate studies with strict disclosure control, combined analysis of them at present is limited to the analysis of aggregate data sets that do not breach disclosure rules. The scope for controlling for a wide range of variables in British-wide analyses is therefore somewhat limited.⁷

In this study we combine data for England and Scotland for people from the 1991 census following them to either date of emigration, date of death or the date of the 2001 census. We also followed-up people from the 2001 census with follow-up to the end of 2007.

We limited our analysis to those aged 35–74 at each census and used 5-year age groups to adjust for age. We did combined analysis for men and women and adjusted for sex. We excluded people resident in communal establishments. We limited analysis to those born in England and Scotland in each country.

A previous joint analysis based on the 2001 census of the data sets used a five-point deprivation scale based on four socio-economic measures, but this approach introduced considerable levels of missing data.⁷ Although the 2001 census did impute missing values, only the ONS LS holds these, so to control for socio-economic circumstances we simply chose two household-level variables with very low levels of missing data that have been used previously in studies of mortality; housing tenure (owners versus renters) and household car access (car access versus no car access).^{8,9}

The ONS LS released an aggregated data set containing the number of person-years of exposure and number of deaths for all combinations of age, sex, tenure, car access and country of birth. We created the same aggregated data set for the SLS and combined these aggregated data sets for joint analysis. We calculated age- and sex-standardized mortality rates using the European Standard population. We calculated relative differences in mortality risk between country of birth, country of residence and their combinations using Poisson regression with person-years as the offset. After fitting an age and sex adjusted model, we then assessed attenuation by additionally adjusting, in turn, for tenure and car access and then both of these variables. We quantified

the percentage change in the relative risk by: (relative risk in the age and sex adjusted model) – (relative risk in the socio-economic adjusted model)/(relative risk in the age and sex model – 1)¹⁰

Results

Tables 1 and 2 provide descriptive data for the populations by the combinations of country of residence and country of birth. In socio-economic terms, the largest difference is seen between those born in and living in Scotland compared with the other three combinations. Those living in Scotland and born in Scotland were more likely to live in rented accommodation and not to have car access. The groups with the lowest mortality rate were those living in Scotland born in England, followed by the English born living in England and Wales, Scottish born living in England and Wales and, finally, the Scottish-born living in Scotland.

Adjusting for car access and tenure separately and jointly attenuated the relative risk of death for those born in Scotland living in Scotland compared with those born in England living in England and Wales (the reference group) as shown in Tables 3 and 4. However, the higher relative risk for those born in Scotland living in England and Wales and the lower relative risk for those born in England living in Scotland were not greatly changed when adjusting for socio-economic differences (that were small compared with those born in England living in England and Wales as shown in Tables 1 and 2). Tables 3 and 4 show that the Scottish excess by country of birth or country of residence was not fully attenuated by adjustment for these limited socio-economic measures, although the greatest attenuation was seen when both were adjusted for. In 2001 this adjustment attenuated the relative risk of death by 43% for those born in Scotland living in Scotland down from the 67% reduction in 1991. This difference may reflect the increased relative risk of death for Scottish residents (whether born in England or Scotland) in the 2001 compared with the 1991 analysis.

Discussion

Main finding of this study

There was an excess mortality risk for those born in Scotland whether living in either Scotland or England and Wales, compared with those born in England. A good deal of this excess, but not all, for those living in Scotland was explained by their higher levels of socio-economic disadvantage but this was not the case for the Scottish-born living in

Table 1 Descriptive statistics by combinations of country of residence and birth in 1991 census sample

	<i>Born England, lives England and Wales</i>	<i>Born Scotland, lives England and Wales</i>	<i>Born England, lives Scotland</i>	<i>Born Scotland, lives Scotland</i>
Total person-years	1 577 355	35 416	84 720	971 904
Number of people	167 005	3800	8959	104 373
Number of deaths	20 918	562	854	15 174
Standardized mortality rate (per 100 000 person-years)	1257	1500	1022	1559
Sex (%)				
Male	49	52	50	48
Female	51	48	50	52
Age (%)				
35–39	14	14	15	15
40–44	16	17	19	16
45–49	14	15	16	13
50–54	12	11	12	13
55–59	12	11	10	12
60–64	12	11	9	12
65–69	11	12	11	11
70–74	9	9	8	8
Car access (%)				
Owns car	80	77	83	66
No car	20	23	17	34
Housing tenure (%)				
Owner occupier	77	73	75	57
Renter	23	27	25	43

Source: SLS and ONS Longitudinal Study.

England and Wales who were on average socio-economically similar to the English born living there.

What is already known on this topic

Scotland's higher rates of socio-economic deprivation (measured at the small-area level) used to explain the majority of this mortality excess.¹ More recent analyses around the time of the 1991 and 2001 censuses showed that <50% of the excess could be explained²

What this study adds

This study confirms findings from a previous study demonstrating that country of birth plays a stronger role than country of residence in explaining Scottish and English mortality differences.⁴ To some extent the evidence supports the existence of a 'Scottish effect' as there was a Scottish excess after controlling for current socio-economic differences and the degree of attenuation seems to have reduced over time.

Limitations of this study

However, there are caveats. First, this analysis utilized only two socio-economic control variables and it may be that fuller control for household circumstances may reduce the differences between the English and Scottish. Second, and this applies to all other studies of the 'Scottish effect', unmeasured confounding by socio-economic differences across the life course is a real possibility.¹¹ It is not necessarily the case that control variables captured in adulthood – two household-level measures in our study or one area-based measure of socio-economic deprivation as used in previous 'Scottish effect' studies – will fully capture socio-economic differences across the life course. To some extent present socio-economic disadvantage may reflect life course disadvantage, but for Scottish migrants living in England and Wales, average socio-economic circumstances are comparatively good and so may not reflect socio-economic disadvantage in earlier life. Unfortunately, we lack earlier life socio-economic data in both studies at present as the SLS started with the 1991 census and although the ONS LS goes back to 1971 only the younger groups in our

Table 2 Descriptive statistics by combinations of country of residence and birth in 2001 census sample

	<i>Born England, lives England and Wales</i>	<i>Born Scotland, lives England and Wales</i>	<i>Born England, lives Scotland</i>	<i>Born Scotland, lives Scotland</i>
Person-years	113 8684	25 413	67 762	676 845
Number of people	175 298	3933	10 810	105 350
Number of deaths	9344	254	451	7134
Standardized mortality rate (per 100 000 person-years)	767	935	712	1036
Sex (%)				
Male	49	51	50	48
Female	51	49	50	52
Age (%)				
35–39	16	12	18	16
40–44	14	14	15	15
45–49	13	15	13	14
50–54	15	16	15	14
55–59	12	15	13	12
60–64	11	10	10	11
65–69	10	10	8	10
70–74	9	8	6	8
Car access (%)				
Owns car	87	86	89	77
No car	13	14	11	23
Housing tenure (%)				
Owner occupied	82	81	79	73
Renter	18	19	21	27

Source: SLS and ONS Longitudinal Study.

Table 3 Relative risk of death for 1991 census sample followed to 2001 census

	<i>Age and sex adjusted</i>	<i>Plus car access</i>	<i>Plus housing tenure</i>	<i>Plus both</i>
Born England, lives England and Wales	1	1	1	1
Born Scotland, lives England and Wales	1.19 (1.09–1.29)	1.19 (1.09–1.29) (0% reduction)	1.18 (1.08–1.28) (5% reduction)	1.18 (1.08–1.28) (5% reduction)
Born England, lives Scotland	0.81 (0.76–0.87)	0.84 (0.78–0.9) (16% reduction)	0.81 (0.75–0.86) (0% reduction)	0.83 (0.77–0.88) (11% reduction)
Born Scotland, lives Scotland	1.24 (1.21–1.26)	1.15 (1.12–1.17) (38% reduction)	1.11 (1.08–1.13) (54% reduction)	1.08 (1.06–1.1) (67% reduction)
Born England or Scotland, lives in England and Wales	1	1	1	1
Born England or Scotland, lives in Scotland	1.2 (1.17–1.22)	1.12 (1.1–1.14) (40% reduction)	1.08 (1.06–1.1) (60% reduction)	1.06 (1.04–1.08) (70% reduction)
Born in England, lives in England and Wales or Scotland	1	1	1	1
Born in Scotland, lives in England and Wales or Scotland	1.25 (1.22–1.27)	1.16 (1.13–1.18) (36% reduction)	1.12 (1.1–1.14) (52% reduction)	1.09 (1.07–1.12) (64% reduction)

Source: SLS and ONS Longitudinal Study.

samples would have been children then. The strength of the country of birth effect suggests that early life circumstances may be particularly important to control for.

Scotland has had higher deprivation levels for some time.¹ As it is known that migration rates are highest in early adulthood,¹² it is likely that the majority of people who

Table 4 Relative risk of death for 2001 census sample followed to end of 2007

	<i>Age and sex adjusted</i>	<i>Plus car access</i>	<i>Plus housing tenure</i>	<i>Plus both</i>
Born England, lives England and Wales	1	1	1	1
Born Scotland, lives England and Wales	1.2 (1.06–1.36)	1.2 (1.05–1.35) (0% reduction)	1.19 (1.05–1.35) (5% reduction)	1.19 (1.05–1.35) (5% reduction)
Born England, lives Scotland	0.93 (0.84–1.02)	0.96 (0.87–1.05) (43% reduction)	0.94 (0.85–1.03) (14% reduction)	0.96 (0.87–1.05) (43% reduction)
Born Scotland, lives Scotland	1.35 (1.31–1.39)	1.24 (1.2–1.28) (31% reduction)	1.24 (1.21–1.28) (31% reduction)	1.2 (1.16–1.24) (43% reduction)
Born England or Scotland, lives in England and Wales	1	1	1	1
Born England or Scotland, lives in Scotland	1.31 (1.27–1.35)	1.21 (1.18–1.25) (32% reduction)	1.21 (1.18–1.25) (32% reduction)	1.17 (1.14–1.21) (45% reduction)
Born in England, lives in England and Wales or Scotland	1	1	1	1
Born in Scotland, lives in England and Wales or Scotland	1.35 (1.31–1.39)	1.24 (1.2–1.28) (31% reduction)	1.25 (1.21–1.28) (29% reduction)	1.2 (1.16–1.24) (43% reduction)

Source: SLS and ONS Longitudinal Study.

had moved from their country of birth spent their formative years in their country of birth and so those born in Scotland who moved to England and Wales may have been more likely to grow up in poorer circumstances that can have a long-term impact on mortality risk.¹³ Genetic differences seem an unlikely explanation as evidence suggests they are relatively minor between the English and the Scottish¹⁴ and moreover Scotland's mortality situation has not always been so poor in comparison with England's.¹⁵

It is likely that differences in health behaviours will be part of the explanation for the Scottish excess as rates of smoking, alcohol and diet-related causes of mortality are higher amongst those born in Scotland living in England and Wales³ and those born and living in Scotland.¹⁶ There is evidence that health behaviours are developed over the life course reflecting, in part, childhood socio-economic circumstances.¹⁷ Variation in health behaviours across the life course is an important mechanism through which socio-economic position produces mortality inequality.¹⁸ Thus, it is an important limitation of the research that we did not have data on health behaviours across the life course. For example, existing evidence points to poorer health behaviours (diet and smoking), poorer health behavioural environments (more parental smoking) and more socio-economic deprivation for Scottish teenagers growing up in the 1980s compared with those living in England.¹⁹ The most recent comparative evidence suggests that Scottish adults smoke more and are less likely to meet recommended levels of fruit and vegetable consumption than their English counterparts,²⁰ although it

should be noted that difference in heart disease prevalence between the populations was not explained by differences in adult health behaviours.²¹

Recently, Scotland's mortality rate has declined less quickly than England and Wales's and this could explain why for those living in Scotland their relative risk of mortality was increased in the 2001 sample compared with 1991.¹⁵ Given that both countries have free access health care under the NHS (albeit with country-specific jurisdiction), differences in the health system seem an unlikely explanation. Further work is needed to understand the reasons for this trend.

In conclusion, this study showed that a good deal of the Scottish mortality effect can be explained controlling for only two contemporary household-level variables. Given the similarity of the results for the Scots living in Scotland and England and Wales (the latter having experienced a rather different socio-economic environment) suggests that although a good deal of the Scottish excess can be explained by present socio-economic disadvantage taking a life course approach may hold the key to understanding the 'Scottish effect'.

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.

Acknowledgements

The permission of the Office for National Statistics to use the Longitudinal Study is gratefully acknowledged, as is the help provided by staff of the Centre for Longitudinal Study Information and User Support (CeLSIUS), in particular Chris Marshall. CeLSIUS is supported by the ESRC Census of Population Programme (Award Ref: RES-348-25-0004). The authors alone are responsible for the interpretation of the data.

The help provided by staff of the Longitudinal Studies Centre – Scotland (LSCS) is acknowledged. The LSCS has been supported by the ESRC, JISC, the Scottish Funding Council, the Chief Scientist's Office and the Scottish Government. The authors alone are responsible for the interpretation of the data.

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Funding

This study was funded by the Scottish Collaboration for Public Health Research and Policy. The opinions expressed in this paper are those of the authors alone.

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