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Mortality inequalities: Scotland versus England and Wales

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ABSTRACT

This paper is an observational study of particular historical trends in mortality inequality within Great Britain, comparing England and Wales with Scotland for the period 1925–2005. The inequalities in mortality within Great Britain have become more apparent over time. Growing inequality in premature mortality in Britain affected young Scottish men most severely after 1995. It would appear that something dramatic happened to the Scottish population in early 1970s which accelerated these broad and very important mortality differentials within Great Britain. The divergence in mortality within Great Britain is notable in successive male cohorts and to a lesser extent in women.

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1. Introduction

There have been numerous studies of inequalities in health between various population sub-groups within Britain. Several studies have highlighted growing health inequalities between regions and between Britain's constituent nations (Dorling, 1997; Mitchell et al., 2000; Townsend et al., 1988; Walsh et al., 2008). The existence of a widening 'North–South' divide in health (Shaw et al., 1999) within Britain is acknowledged and is thought to reflect a wider social and economic divide, a divide which is currently still widening rapidly (Bajekal et al., 2013; Barr et al., 2012; Thomas et al., 2010). The general trend is that the north of England and Scotland have experienced, and continue to experience, worse health outcomes than areas in the south of England (Hacking et al., 2011; Townsend et al., 1988).

This study explores the north/south health divide through a comparison of historical trends in mortality between Scotland, and England and Wales. Previous work has mapped historical spatial patterns of mortality in Britain (Dorling, 1997). Dorling asserted that 'between 1950 and 1985 the standard mortality rate for Scotland, relative to England and Wales as 100, never fell below 111 or rose above 112' (Dorling, 1997, p. 27) suggesting a consistent and persistent Scottish disadvantage. In this study we build upon

previous work by investigating and visualising historical trends in mortality for Scotland, relative to England and Wales. Our analysis tracks changes in relative differences in mortality within Britain over time. We highlight when differences in mortality between Scotland, and England and Wales began to alter, for which specific groups of the populations, and at which ages. We present analyses separately for men and women. This reflects the consistently longer life expectancy for women, relative to men, within Britain as in developed countries worldwide (Kruger and Nesse, 2004; Rigby and Dorling, 2007). Within the United Kingdom (UK) the gap in life expectancy between men and women is greatest in Scotland (Gjonca et al., 2005) a gap of around 5 years.

The next section discusses the data and methods used, explaining in detail the utility of considering mortality differentials using Lexis diagrams. We then show our results from applying the Lexis method, pinpointing the beginning of the current divergence in mortality rates within Britain and charting the subsequent development. Finally, we discuss the results, their implications and possible links to key historical events and developments throughout the study period.

2. Methods

The data used were derived from the Human Mortality Database (HMD). The HMD has a full methods protocol available detailing how the data were constructed (see Wilmoth et al.,

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2007). The data consist of annual death rates for England and Wales and Scotland by single year of age and sex. The data cover the time period 1925–2005. Since the data captured mortality in the entire population, there was a very large sample size, allowing for fine grained analysis. The data for 2005, for example, included 2,456,109 Scottish men and 2,638,691 Scottish women, and 26,096,092 English and Welsh men and 27,142,483 English and Welsh women. The total sample size for the study is 58,333,375, which is the count of people in 2005 alone.

Data analysis was undertaken using the statistical software R. Two types of analysis were undertaken. First, rate ratios for mortality in Scotland relative to England and Wales were calculated. Second, Lexis diagrams were constructed (Lexis, 1875). The Lexis diagrams were drawn using the Lexis map software, following the approach taken by Rigby and Dorling (2007) in their study of temporal trends in gender differences in mortality. The Lexis diagram, (or Lexis map), is 'one of the most useful technical devices of demography' (Alho and Spencer, 2005, p. 17). However, any reader unfamiliar with a Lexis diagram will need some orientation.

The horizontal axis on the Lexis diagrams (Figs. 1–4) represents time. In this case it shows the study period, from 1925 to 2005. The vertical axis represents age, from age 0 to age 90+. This combination of 81 years (columns), by 91 age groups (row) creates a matrix of 7371 cells. In Figs. 1 and 2 (for England & Wales and Scotland respectively), each cell is then shaded by the mortality rate for that age group, in that year (darker shading indicating lower mortality rate, lighter shading indicating higher mortality rate). The resulting diagram summarises a complex three dimensional distribution; mortality, by age and time (Gjonca et al., 2005, p. 11). In Figs. 3 and 4 (for women and men respectively), each cell is shaded by the mortality rate ratio (the age and time specific rate in Scotland divided by that in England and Wales); lighter shading denoting higher mortality rates in Scotland as against England and Wales. So, Figs. 1 and 2 map mortality rates for populations by single year of age and time, and Figs. 3 and 4 map the ratio of those age specific rates between Scotland, and England and Wales, over time. Diagrams show results for men and women separately.

The great strength of Lexis diagrams is that they enable identification of age, period and cohort effects. Age effects are apparent as horizontal lines of similar grey scale shading; if everyone in a particular age group has a similar mortality rate, or rate ratio, the shading for that age group will be similar. Cohort effects are apparent as diagonally upwardly sloping lines of similar shading (as people age over time). Period effects are shown as vertical columns of a similar grey scale shade; if mortality rates or rate ratios are similar within time points, the shading for that time will be similar. Lexis diagrams are designed to enable 'contour' shading, so that distinctions between 'areas' with similar rates can be highlighted. These are the grey lines that appear to emphasise the differences between 'clumps' of combinations of age and year with similar mortality rates or rate ratios.

3. Results

The most striking pattern in Figs. 1 and 2 is the darkening shade, indicating falling Age Specific Death Ratios ASDRs, as you move from left to right (i.e. from the past to the present), particularly at younger ages. This shows the gradual decline in mortality rate over time; population health has improved, particularly for children and young adults. Generally speaking the increasing risk of mortality with age is also very clear; the shading gets lighter towards the top of both Figs. 1 and 2. A good illustration of the power of Lexis diagrams is in how they allow

the viewer to visualise the impact of the Second World War on mortality rates. For men (Figs. 1b and 2b), there is a dramatic lightening of the shade for those aged about 18–28, in the years labelled World War II. The contrast between the figures for men and women is also striking. Women's greater longevity is clearly shown by the persistence of darker shading at greater ages (compare Fig. 1a and b). However, the change over time (i.e. from left to right) is also very different. For women from about 1950 onwards much lower rates establish themselves, at a wider range of ages. This is shown by the growing (from left to right) expanse of the darkest shading.

Figs. 3 and 4, show that trends in *rate ratios* between Scotland, and England and Wales, are more complex than trends in mortality for each geographic entity. For both men and women, the most striking feature on the diagrams is the apparent impacts of World War II. Scotland fared relatively worse than England and Wales. Young women in Scotland died at an enhanced rate compared to women in England and Wales through to at least 1955 (Fig. 3). For men, the upwards and rightwards diagonal of pale shading, indicating higher mortality rates in Scotland, extends into the 1960s (Fig. 4). Children's mortality rates appear worse affected by wartime in Scotland as compared to England and Wales (indicated in both Figs. 3 and 4).

For men in particular, there are three more striking features not directly associated with war-time. First, there is an upwards and rightwards pale band for those aged 30–40 from 1925 up until at least aged 70–80 by 1975. This indicates that Scottish men born about 1885–1895 experienced a worsening of their mortality rate, relative to those in England and Wales. In some ways, Scotland's relatively worse mortality experience began a long time ago. Second, there is a very considerable upwards and rightwards pale diagonal, extending from those aged about 30 in the early 1970s, persisting through to 2005 (by which time, these men are aged 65). This denotes a cohort effect. Third, there is a very substantial pale shading feature ranging from ages 17 around 1992, continuing through to these people's mid 40s, and persisting from about the early 1990s right through to 2005. The figure shows that those men who were aged about 20 in 1995 had mortality rates 1.4 times greater than men in the rest of Britain. Those aged about 20 in 1995 were, of course, born about 1975, the same era as the start of the visible cohort effect on those aged about 30 in 1975 (their fathers' generation). Cohort effects for women are more subtle (Fig. 3), but also show a worsening over time since the 1970s.

A further feature in Figs. 3 and 4 is the concentration of darker shades in the under 20 year olds, post-1950. For these age groups in these years, the rate ratios less than 1 means that Scotland's mortality rates are lower than those in England and Wales. The pattern for males and females is similar, but more marked for girls and young women. There is a noticeable Scottish advantage in comparison to the rest of Britain for women under 20 years old between approximately 1965 and 2005. Scottish males aged up to 15 fare relatively well compared to their English and Welsh counterparts in the period following 1990. It is the sudden reversal of fortunes once males reach age 16 to 18 (perhaps linked to labour market entry, perhaps also to car driving) that is noteworthy.

The gradual slide from equality with England and Wales to elevated mortality in Scotland can be seen by looking at men aged 45. Starting at the bottom of the distribution in 1925 (rate ratio 1) and reaching the top of the distribution by the end of the period (rate ratio 1.35), working age males' relative mortality prospects have been gradually declining over time. This means that for every 100 men dying in England and Wales aged 45 in 2005; the equivalent is 135 men aged 45 dying in Scotland. This compares with equal numbers in both England and Wales and Scotland in 1925, for 45 year old men.

Overall, Figs. 3 and 4 show that the gap in mortality rate between Scotland, and England and Wales, has increased since the 1950s and is now wider than at any time since World War II, is greater for men than women and that for men the inequality is currently greatest from about age 17, through to men's mid forties. The figures suggest that something dramatic happened to mortality rates in Scotland, relative to England and Wales, from about the early 1970s onwards. However, there were also earlier periods of heightened Scottish inequality, a worse impact of wartime on mortality in Scotland, but a better experience of post-war childhood in terms of lower mortality than in England and Wales. This persisted through to at least the year 2000.

4. Discussion

Our analyses show that mortality differentials between Scotland and the rest of Britain have changed over time, largely to the detriment of Scotland. The deterioration in Scotland's position began for its men born about 1885. This deterioration continues to the end of the study period, when the rate ratio has increased to its highest levels since World War II.

World War II had a massive and lasting impact on the mortality rate ratio between Scotland and England. For Scottish men, this effect lasted at least twenty years postwar. It is interesting to note in relation to this that Scottish males were more likely to smoke as teenagers during the second world war compared to teenagers in England and Wales (Gompertz, 1825; Kermack et al., 2001; Smith and Kuh, 2001) and this may be a possible partial explanation for this apparent cohort effect.

Perhaps the most striking trends shown by these diagrams, however, is the apparent worsening of Scotland's relative mortality rate from the 1970s onwards, particularly for men. This is especially visible for those aged about 30 at that time, and for almost all those born since. What might explain this? In seeking an explanation, we note that much attention has been paid to the so-called *Scottish Effect* and *Glasgow Effect* (Collins and McCartney, 2011; McCartney et al., 2012; Reid, 2009). These are terms describing the apparent excess mortality rates in that city, compared to other cities in England with similar levels of socio-economic deprivation, and the extension of these ideas to Scotland as a whole. Systematic analysis has explored competing hypotheses for this difference in mortality rate. One conclusion, proposed by Collins and McCartney, is that the policies of the Conservative governments from 1979 onwards had particularly negative consequences for Scotland (BBC, 2012; Collins and McCartney, 2011), but that those consequences built on a slight disadvantage already established in the early 1970s. Collins and McCartney's thesis is that Scotland was exposed to a sustained 'political attack' after 1979 that this, and the growing societal inequalities within Scotland which the attack created, had and have long term implications for mortality.

McCartney et al. (2012) identified and explored seventeen hypotheses which might explain why Scotland has higher mortality rates, analysing factors ranging from deprivation and migration (described as possible 'artefactual explanations'), health behaviours and individual values (described as 'downstream explanations') to 'cultures of substance abuse', family and gender relations, 'lower social capital', health service supply or demand, deprivation concentration (described as 'midstream explanations') inequalities and deindustrialisation (which they describe as 'upstream explanations') and possible genetic explanations. They concluded that between 1950 and 1980 high Scottish mortality 'may be linked to particular industrial, employment, housing and cultural patterns' whereas from 1980 onwards it may be explained by a synthesis beginning with 'the changed political context of the 1980s, and the

consequent hopelessness and community disruption experienced' (McCartney et al., 2012, p. 459). 'In all of the deindustrializing regions of the United Kingdom in the 1980s there would have tended to be feelings of disempowerment and loss of control as jobs were lost, regional economies declined, and inequality and what would later be called 'social exclusion' grew. Such feelings are both a well-established cause of ill-health and an active barrier to the effective management of chronic illness and changing adverse health behaviours' (Collins and McCartney, 2011, p. 518).

In particular, it has been argued that the neo-Liberal policies of that era arguably continuing through John Major's government (which held office between 1990–1997) and to some extent that of New Labour (from 1997 to 2010), had a particularly detrimental effect on younger adults and on the environments they grew up in. Whilst deindustrialisation was largely finished long before the cohort born in the 1970s was seeking work, the legacy of economic, social and cultural change deindustrialisation left still has potent effects. This has been labelled the 'aftershock of deindustrialisation' (Walsh et al., 2008), and Walsh et al. noted that Scotland has been particularly slow to recover, in comparison with other countries which experienced similar industrial decline.

The economic 'restructuring' and monetarist neoliberal policies of the 1970s, 1980s and early 1990s have significantly increased income and wealth inequalities between people, communities and whole countries and there is little doubt that the distribution of income in Britain has become even more unequal since 1979 as a direct result of these policies (Atkinson, 1996; Hills, 1996; Hills and Stewart, 2005). From a geographical point of view, there were very significant implications for particular parts of Britain and particularly for Scotland. At the national level, although average real incomes grew until 2008, at the bottom of the scale there has been little or no rise in real income, while top incomes have risen a great deal faster than the average (Atkinson, 1996; Ballas et al., 2007; Dorling, 2013; Green, 1996; Green, 1998; Pearce and Paxton, 2005). This revival of inequality meant that Britain – by the start of the 21st century – was back at levels of inequality last experienced at the height of the 1930s depression. In terms of the relative chances of being rich or poor as measured between social groups and by area Britain is as unequal at the end of our study period as it was then (Ballas et al., 2007; Dorling, 2013; Dorling et al., 2007).

There is a large literature on the possible effects of income inequalities, which shows a strong relationship between income inequality, and health behaviours and outcomes (Davey Smith, 1996; Wilkinson and Pickett, 2009, 2006). Income inequality could, therefore, be part of the explanation for the diverging mortality trends shown in Figs. 3 and 4, especially considering the rise in income inequality since the 1970s in Britain (Dorling, 2013; Jenkins, 1996). A good example to illustrate this point is to compare, the concentration of low rate ratios in the early 1960s (which, as noted above, was a period of greater equality) for men aged approximately 15–20 years old, to the years 1995 onwards (see Fig. 4). The polarisation of the housing, labour and education 'markets' also resulted in a growing dichotomy between 'work rich' and 'work poor' households, perhaps also contributing to these growing mortality differentials. The possible effect of psycho-social influences on health (James, 2007; Marmot, 2005) is also well documented.

It is important to note however, that not all the observed trends are to the detriment of Scotland. People under 35 (and especially children) appear to have lower ASDRs between 1945 and 1980. This may be related to trends towards increasing equality in the distribution of income and wealth in the period between the end of World War II (and especially in the 1960s) and the 1970s, which benefited Scottish children more, as more children were poor in Scotland to begin with in 1945. The improvement in Scottish

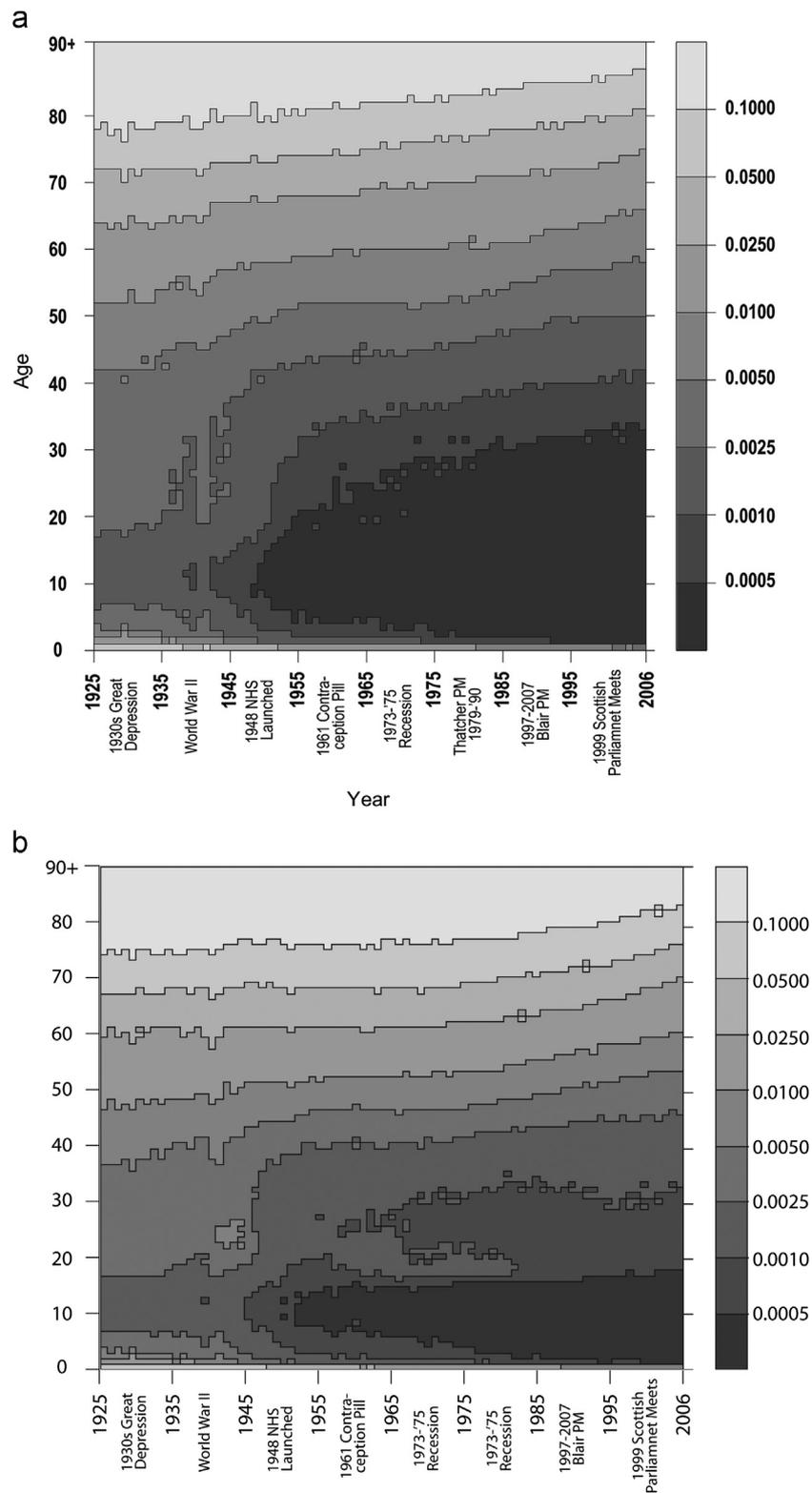


Fig. 1. (a) Age specific death rates in England and Wales: females. (b) Age specific death rates in England and Wales: males.

mortality is particularly noticeable for 20–30 year olds in the 1960s during which time there is also an overall reduction of ASDRs in Scotland compared to England and Wales (see Figs. 3 and 4). In addition, what can be seen in the figures relating to ASDRs (see Figs. 1 and 2) is that from the 1970s onwards, there is an absolute improvement in mortality for everyone. This pattern is in

stark contrast to the concentration of low rate ratios in the early 1960s (which was a period of greater equality) for men aged approximately 15–20 years old. That then was a time of near full employment across all of Great Britain.

A lack of suitable employment opportunities resulting in high rates of unemployment compared to the rest of Britain

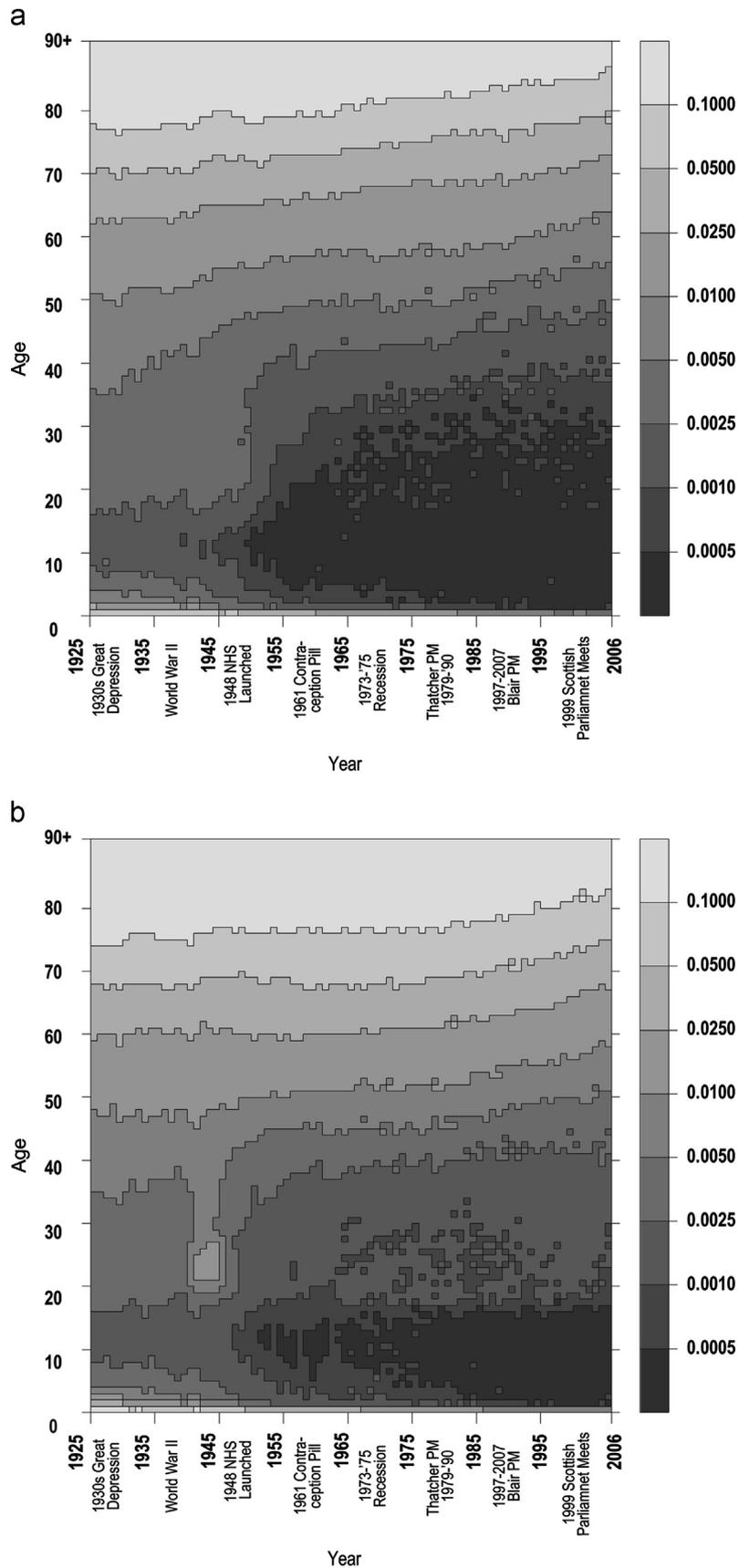


Fig. 2. (a) Age specific death rates in Scotland: females. (b) Age specific death rates in Scotland: males.

which have not been sufficiently addressed and have grown steadily since the 'full employment' peaks in the 1960s, may also contribute a large part of the eventual explanation of these

trends (Martikainen and Valkonen, 1996; Morris et al., 1994). In turn, the relatively recent worsening mortality ratio, for men specifically, is likely linked to the emerging public problems of

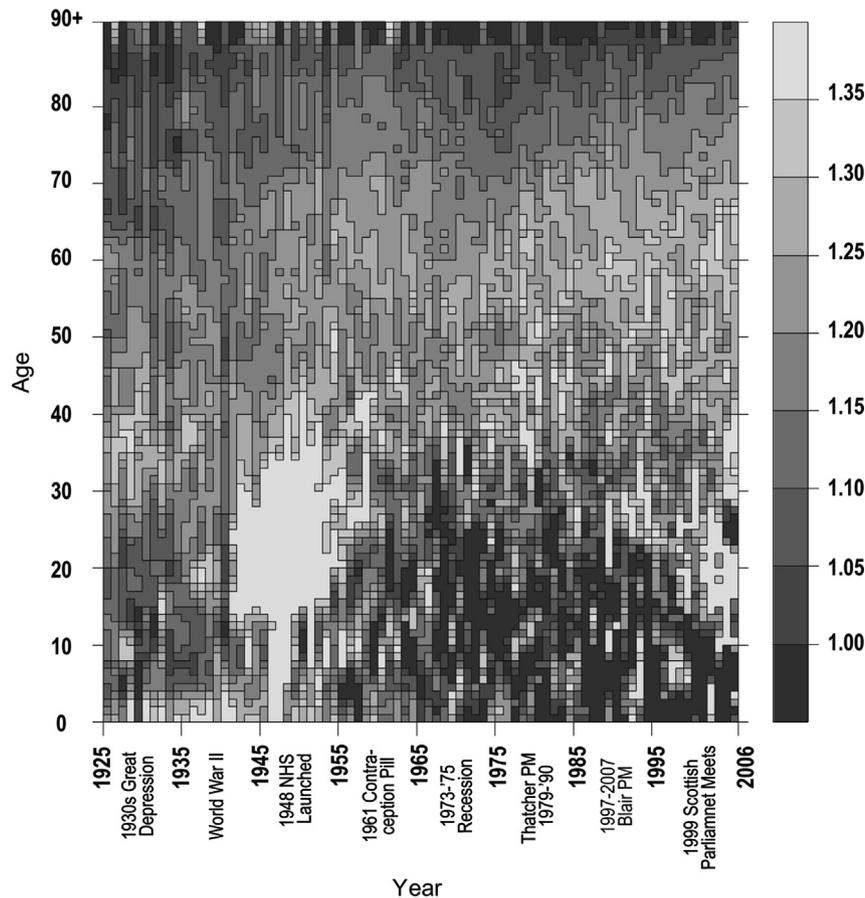


Fig. 3. Rate ratio Scotland over England and Wales, females, 1925–2005.

violence, drug and alcohol abuse and the more recent crisis in mental health (Leyland, 2006), which are in turn linked both to living with continuous high rates of poverty and to the wider effects of established and continuous high socio-economic inequality. Men appear to be more adversely affected by these particular health issues of living under a regime of great inequality (Kraemer, 2000). 'Homicide rates in Scotland have increased considerably over the past 20 years, particularly amongst young men, with the increase largely attributable to homicides involving knives' (Leyland, 2006, p. 146). Other health behaviours, such as smoking and poor diet have also been strongly linked to life in relative deprivation and facing high levels of societal inequality.

The emergence of relatively poor mortality rates from the 1970s is in stark contrast to the concentration of low rate ratios in the early 1960s (a period of greater equality) for men aged approximately 15–20 years old. It is important that we look back to the 1960s at least, to understand that the period since then, especially for Scotland, has been abnormal. Almost no other European countries experienced an increase in economic inequalities on the scale of Great Britain's increase, since 1979. In that context, it is hardly surprising that Scotland, containing some of the poorest parts of the UK, also contains some of the lowest life expectancies in Western Europe.

Finally, another key event at the end of the study period is the Labour government from 1997 and the devolution of powers to a Scottish parliament following the Scotland Act in 1998. This development may have important long term health implications through the so called pathways to health, illness and well-being from the perspective of power and control (Collins and McCartney, 2011; McCubbin, 2001) which

could perhaps start offsetting feelings of disempowerment experienced in the 1980s across poorer regions and poorer countries in the UK which, as Collins and McCartney (2011) pointed out were particularly acute in Scotland: '*In the Scottish case, however, such feelings would be compounded by the perception, not just of individual, community, or regional disempowerment, but of a national disempowerment. During the 1980s this was increasingly formulated in terms of the basic democratic legitimacy of government in Scotland*' (Collins and McCartney, 2011, p. 518). In addition, there have already been examples of how devolved powers may result in differences in health policy (e.g. the early smoking ban in Scotland, see Cairney (2007)) and social policy in general (Mooney and Scott, 2005).

5. Conclusion

The widening gap between mortality rates in Scotland, as compared to England and Wales, continues to be of great importance in health inequalities research, especially as it continues to grow. This study has shown that the gap has a very long historical precedent, but that its current extent is due to the widening which began in the 1970s, *before* the 1979 Thatcher government. It was greatly exacerbated during her period of office, but the trend was established before she gained power, just as deindustrialisation in Scotland intensified. A large number of theories exist to explain what is now a very long term trend. Analysis that looks at different age groups separately, and women and men separately, may well help assess the plausibility of competing ideas.

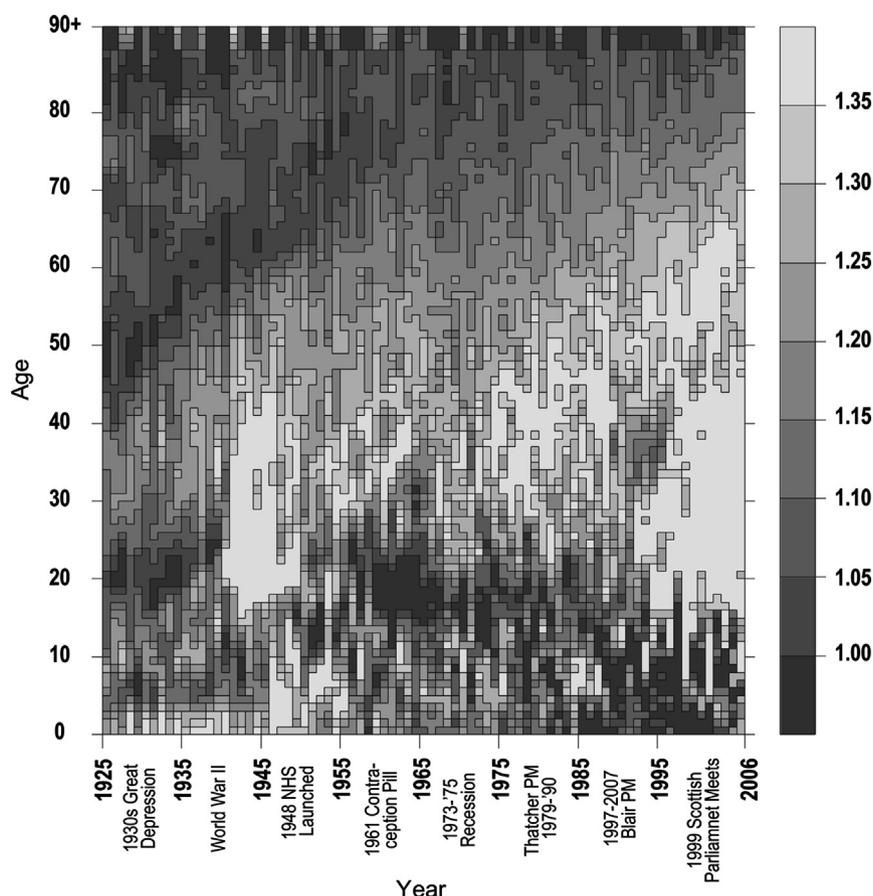


Fig. 4. Rate ratio Scotland over England and Wales, males, 1925–2005.

Contributorship

MC collected and analysed data and wrote the first draft; DB, DD and RM made suggestions regarding the analysis and interpretation and also co-authored and edited the manuscript.

Competing interest

None to declare.

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