

Longitudinal Studies Centre - Scotland

Home of the Scottish Longitudinal Study



Space, Migration and Health: Learning from Routine Data

Paul Boyle

The value of routine administrative data

Routine administrative data provide large longitudinal samples

Cheap to create and update

Little response bias or attrition

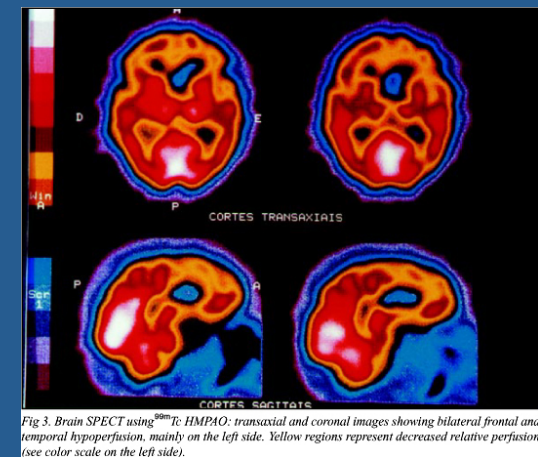
Ability to explore local, geographical variation for spatial analysis

Amyotrophic Lateral Sclerosis (ALS)

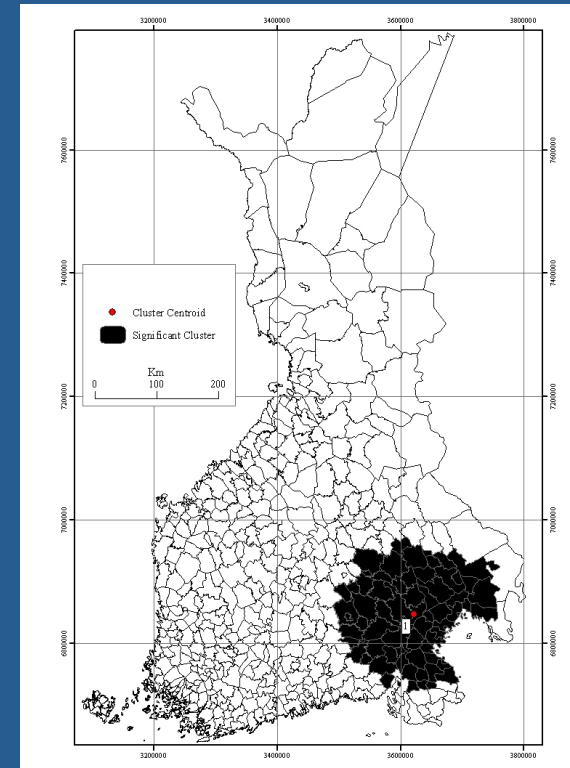
Most common form of motor neuron disease

A rapidly progressive, fatal neuromuscular disease, with no known cause or cure

Around 5-10% of ALS cases are likely inherited, but the relative influence of genes vs environment yet to be determined



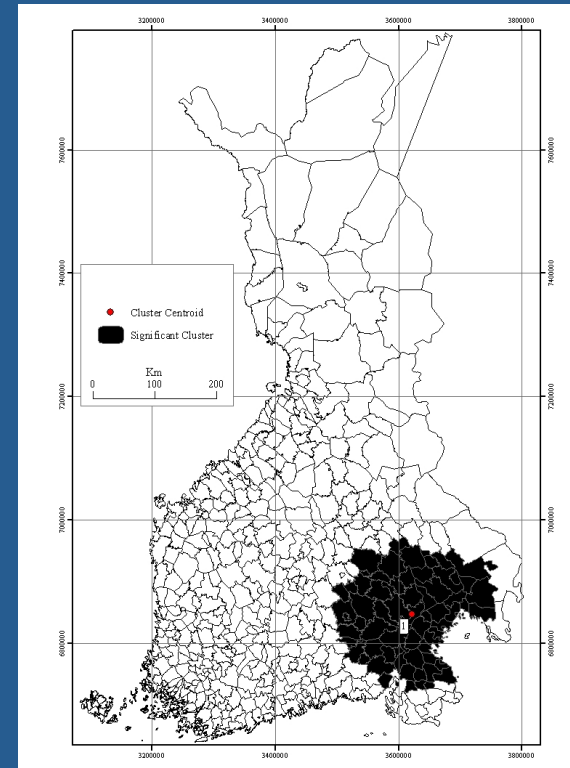
Previous case-control study found significant clustering of ALS at the time of birth in south-east Finland



Sabel CE, Boyle PJ, Löytönen M, Gatrell AC, Jokelainen M, Flowerdew R and Maasilta P 2003 The spatial clustering of Amyotrophic Lateral Sclerosis in Finland at place of birth and place of death *American Journal of Epidemiology* 157: 898-905

Previous case-control study found significant clustering of ALS at the time of birth in south-east Finland

This could support either a genetic or an environmental hypothesis...



Sabel CE, Boyle PJ, Löytönen M, Gatrell AC, Jokelainen M, Flowerdew R and Maasilta P 2003 The spatial clustering of Amyotrophic Lateral Sclerosis in Finland at place of birth and place of death *American Journal of Epidemiology* 157: 898-905

The population may be genetically susceptible

Finland's unique history of population settlement: small original founding population, subsequent isolation, then rapid expansion

A number of dominant and, in particular, recessive disorders exist in higher frequency in Finland than elsewhere in the world

Considerable environmental pollution, largely from ex-Soviet era industrial waste

Heavy pollution load in forests; deforestation linked to sulphur emissions in Russia; high levels of heavy metals

Heavy metal contamination consistently implicated, but not yet proven, in ALS aetiology

Migration analysis

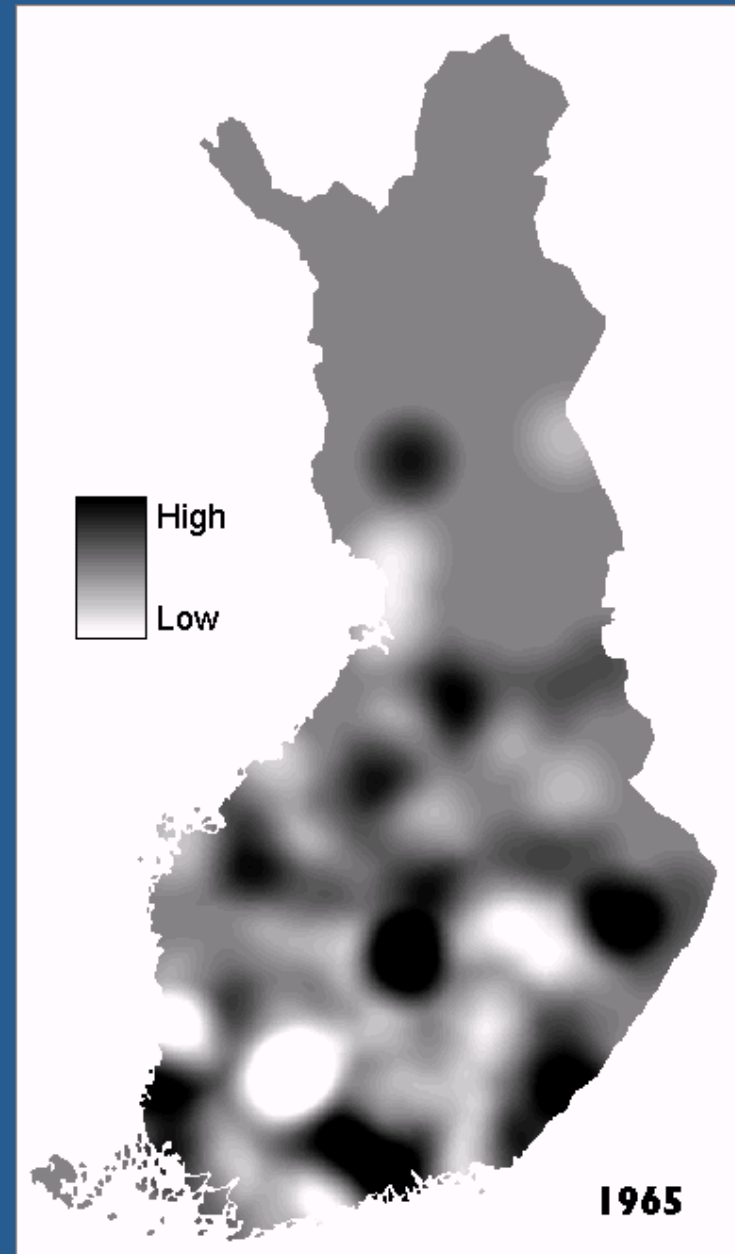
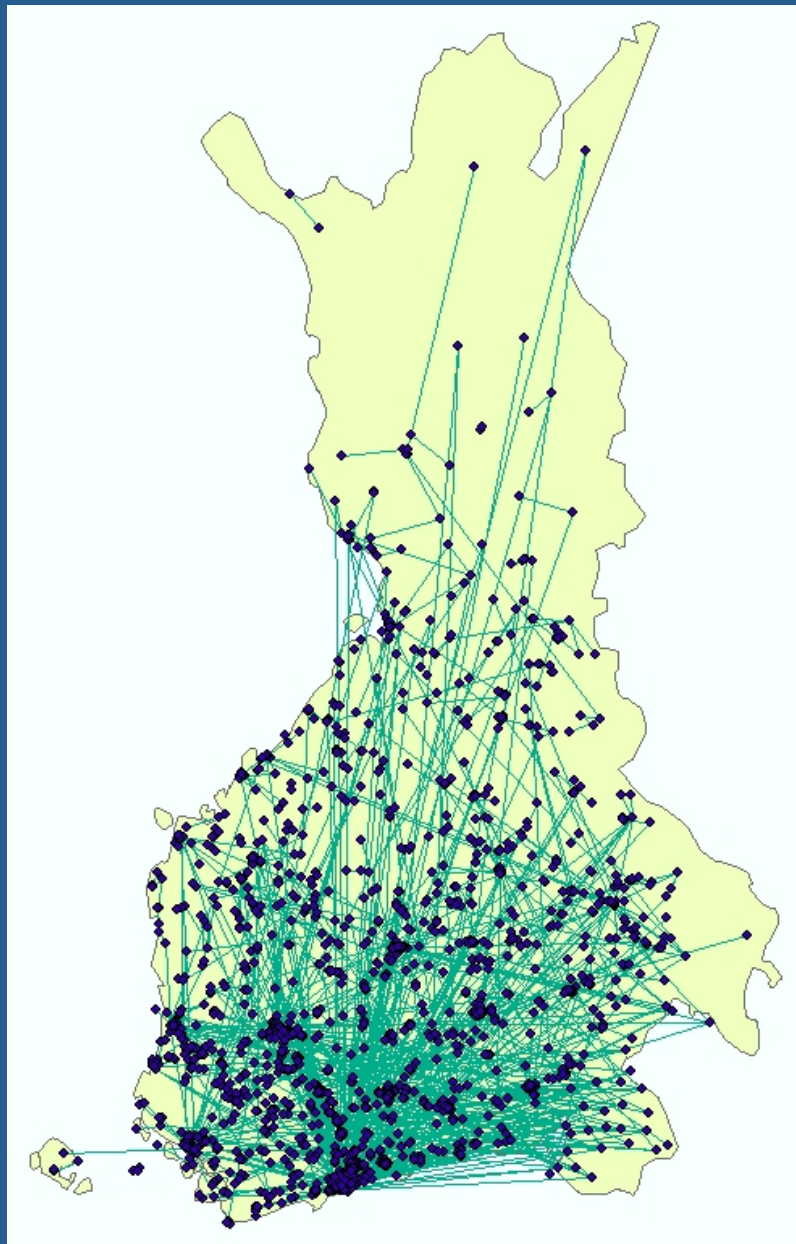
Is moving away from south-east Finland protective? (are cases more likely to have stayed than controls?)

Hence, is there evidence for an environmental influence on ALS associated with that region?

Which has an impact after birth...

Compare the lifetime residential histories of 1000 ALS cases and 1000 controls, matched by birth date, sex and municipality of birth

Focus on those born in the south-east cluster and compare the subsequent residential mobility of these two groups



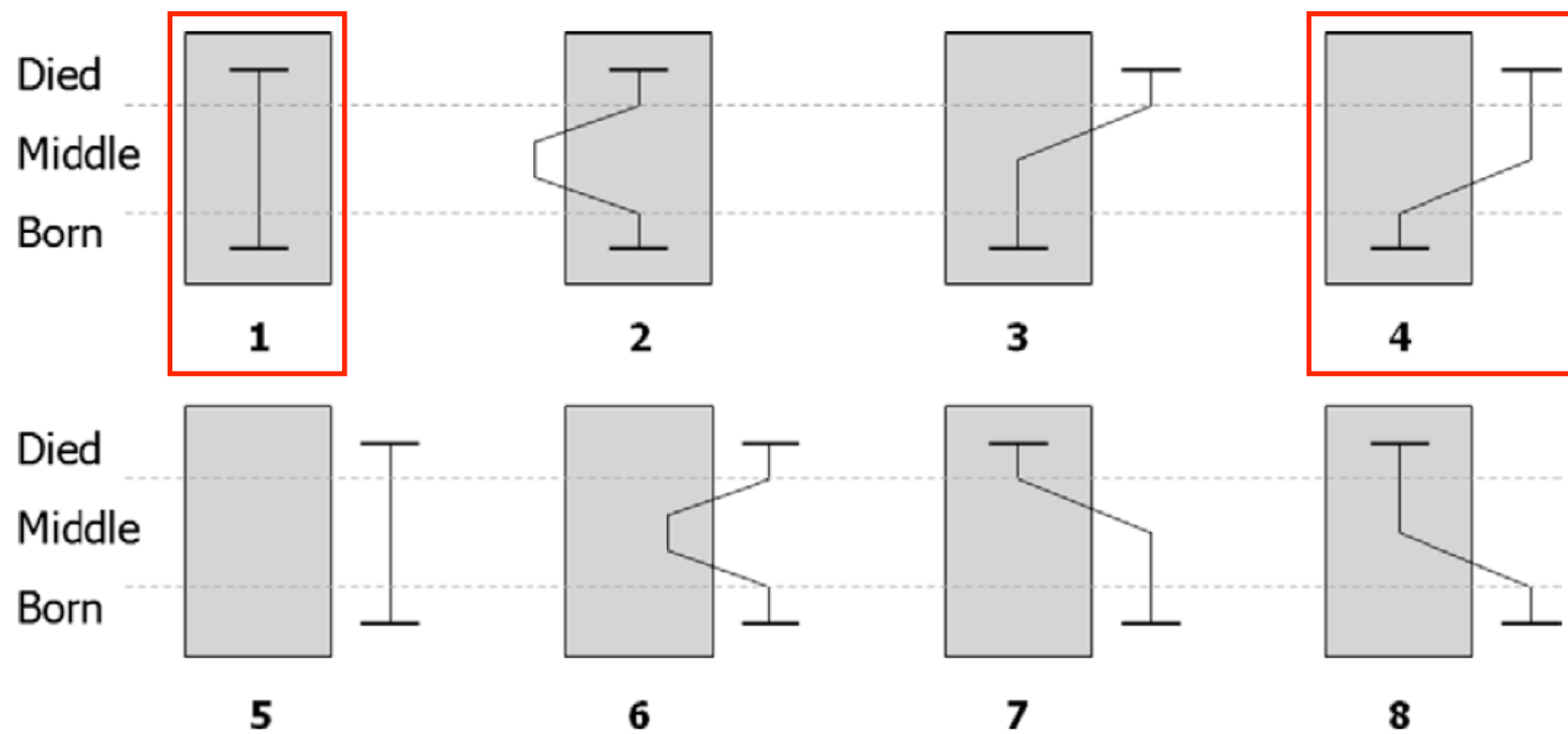


Fig. 5. Case-control migration models.

Table 1
Matched case-control pair migration models.

Case model	Control model	Count
1	1	59
1	3	3
1	4	40
3	1	1
3	4	2
4	1	22
4	2	1
4	3	4
4	4	95
5	5	727
5	6	4
5	8	20
6	5	2
8	5	19
8	8	1
Sum		1000

McNemar test: 5.23; p-value = 0.03

The cases were significantly more likely to remain in SE Finland after birth, compared to the geographically matched controls

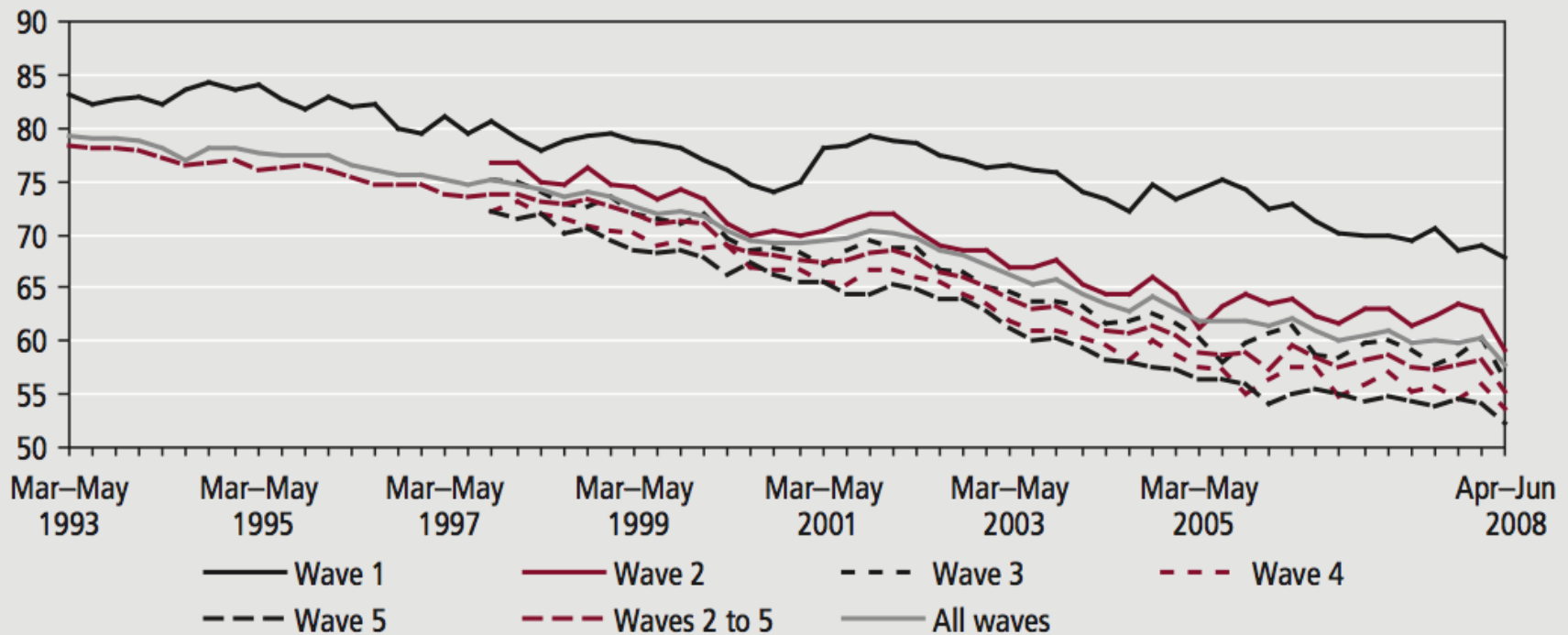
Moving away may be protective, pointing towards an environmental risk factor after birth being implicated in the aetiology of the disease

So, why don't we make
more use of routine
administrative data in
the UK?

Figure 1

LFS response rates, 1993 to 2008

Percentages



For many reasons, the public are rightly apprehensive about the general erosion of privacy of information

For many reasons, the public are rightly apprehensive about the general erosion of privacy of information

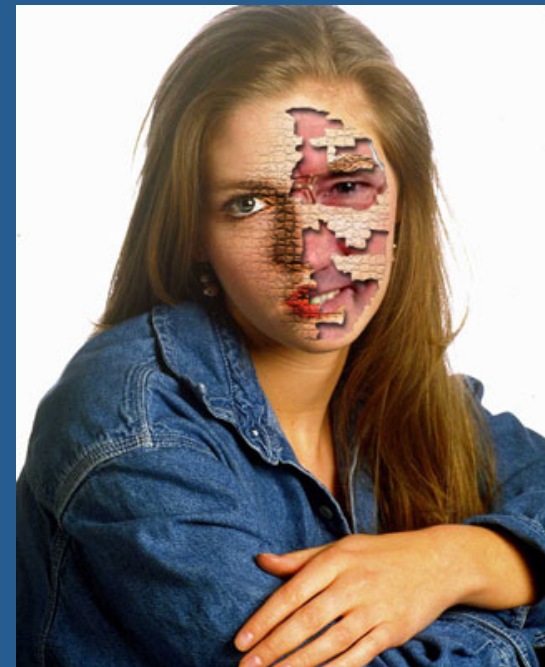
Surveillance society...



For many reasons, the public are rightly apprehensive about the general erosion of privacy of information

Surveillance society...

Identity theft...

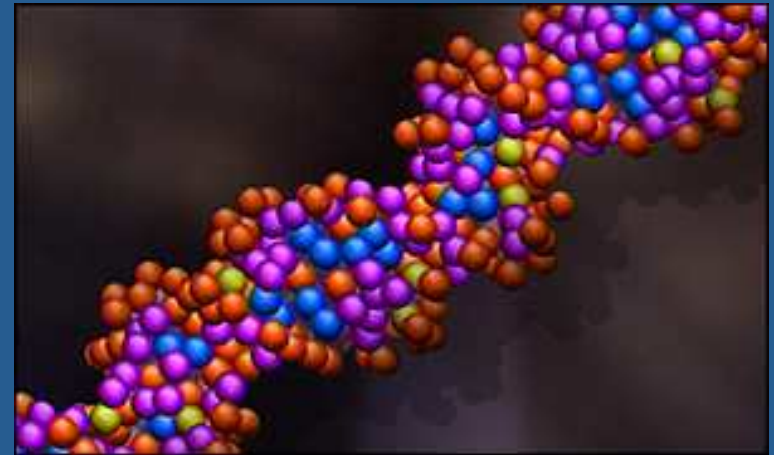


For many reasons, the public are rightly apprehensive about the general erosion of privacy of information

Surveillance society...

Identity theft...

Use of DNA material...



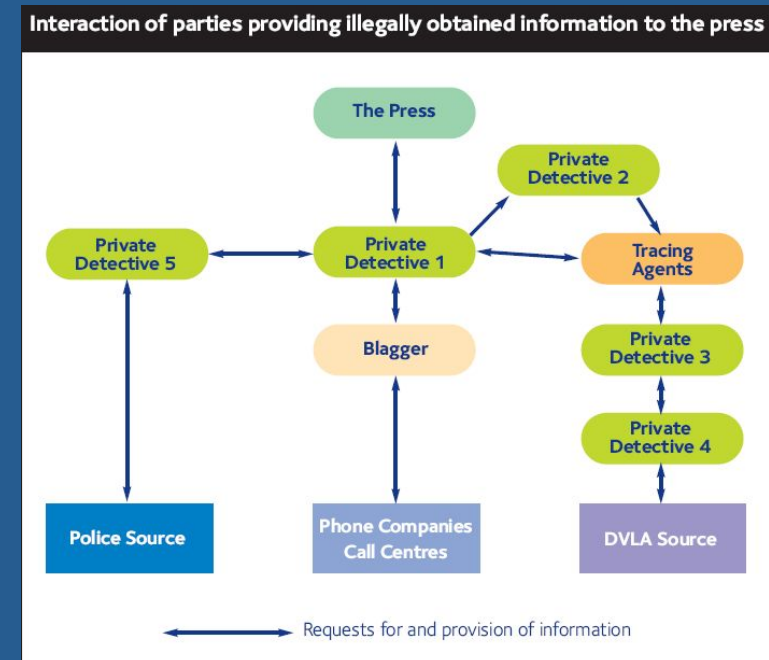
For many reasons, the public are rightly apprehensive about the general erosion of privacy of information

Surveillance society...

Identity theft...

Use of DNA material...

Theft of personal data...



For many reasons, the public are rightly apprehensive about the general erosion of privacy of information

Surveillance society...

Identity theft...

Use of DNA material...

Theft of personal data...

Data losses...



For many reasons, the public are rightly apprehensive about the general erosion of privacy of information

Surveillance society...

Identity theft...

Use of DNA material...

Theft of personal data...

Data losses...

Even links to insurance cover...



And the Conservative party has bought into the rhetoric...

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Tory plans to cut 'surveillance'

The Conservatives have set out plans to reverse what they describe as "the rise of the surveillance state".

They have pledged to scrap two new databases - the ID card register and ContactPoint - and strengthen powers of the Information Commissioner.

The Conservatives say they want to restore public trust in the use of personal data by the state.



PA

The Tories say they will scrap the ID card register

And the Conservative
party has bought into the
rhetoric...

guardian.co.uk

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Tories vow to save money by scrapping national NHS database

Tories pledge to decentralise IT provision in the NHS, allowing trusts to buy their own computer systems provided they are compatible with others in the health service

Andrew Sparrow and agencies
guardian.co.uk, Monday 10 August 2009 09.51 BST
[Article history](#)

The [Conservatives](#) today claimed that they would save the taxpayer money by scrapping the government's plans for a national [NHS](#) database of patient records.

Britain is monitored by over 4.5 million CCTV cameras

One of the most 'watched' nations in the world

20% of global total

Each person is caught on camera an average of 300 times daily



Most people commit to loyalty cards, sharing various data with retail organisations

The benefits are apparently clear

But, the concept of ID cards is reviled

A failure to argue convincingly for the benefits?



Information Commissioner's Office survey 2005

1st: Preventing crime

2nd: Improving standards in education

3rd equal: Protecting people's personal information
& the National Health Service

Ahead of other issues, including equal rights for everyone, freedom of speech and national security

protection of people's privacy ...

versus

... creation of bona fide and valuable
knowledge about population and
society

“Despite my background as a civil libertarian... I question the primacy of individual freedom (and its associated concepts – autonomy, privacy, and liberty) as the prevailing social norm. Freedom is a powerful and important idea, but I think scholars have given insufficient attention to equally strong values that are captured by the notions of partnership, citizenship, and community....”

Lawrence Gostin 2000 *Public Health Law* (University of California Press)

We need more active engagement with the public – a ‘social contract’ based on an informed understanding of research benefits

Explain how data can be properly managed

The failure to make better use of routinely-collected public data can be argued to be a criminal waste of public resources

The Scottish Longitudinal Study

Longitudinal Studies Centre - Scotland

Home of the Scottish Longitudinal Study

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Linking lives through time

The Longitudinal Studies Centre - Scotland (LSCS) is responsible for the establishment and maintenance of the Scottish Longitudinal Study (SLS). This dataset includes a large sample of the Scottish population and links together various demographic, socio-economic and health data about these individuals. The data are available to academics and support is provided *free of charge* by a team of researchers.

Training courses introducing the dataset are run regularly and information about these is made available on this website. In addition, the LSCS provides training in longitudinal data handling, analysis and modelling. It also hosts events designed to encourage the use of longitudinal data and to identify state-of-the-art research in the field. The LSCS involves staff from a variety of backgrounds, providing an inter-disciplinary team who are also engaged in longitudinal research themselves.

The LSCS is funded by the:

- [Scottish Funding Council](#) (SFC)
- [Chief Scientist Office](#) (CSO)
- [General Register Office for Scotland](#) (GROS)
- [Economic and Social Research Council](#) (ESRC)
- [The Scottish Executive](#) (SE)



Latest News

SLS training on 15 September at the University of Stirling

Abstract deadline for health conference extended to June 15

SLS Research working paper 3 online

LSCS Working paper 3 online

Conference and training workshop "Exploiting Existing Data for Health Research"

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Website comments to lscs@st-andrews.ac.uk

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SLS Sample

Provides linked data from the Scottish Census and administrative records

Sampling based on 20 'semi-random' birthdays (5.3%)

Initial sample drawn from the 1991 Census (265,321) and 2001 Census (193,717)

SLS Data Sources

Census

1991 Census, 2001 Census:

Including data on age, sex, occupation, economic activity, social class, housing, ethnicity, marital status, household composition, health, education, country of birth, migration, workplace, religion etc.

Information on SLS member and other household members

Population data

Immigration

Emigration

Vital statistics

Births (SLS birthdate)

Births (to sample members)

Stillbirths

Infant mortality

Deaths

Widow(er)hoods

Divorces

Marriages

Health data

Cancer registrations

Hospital episodes

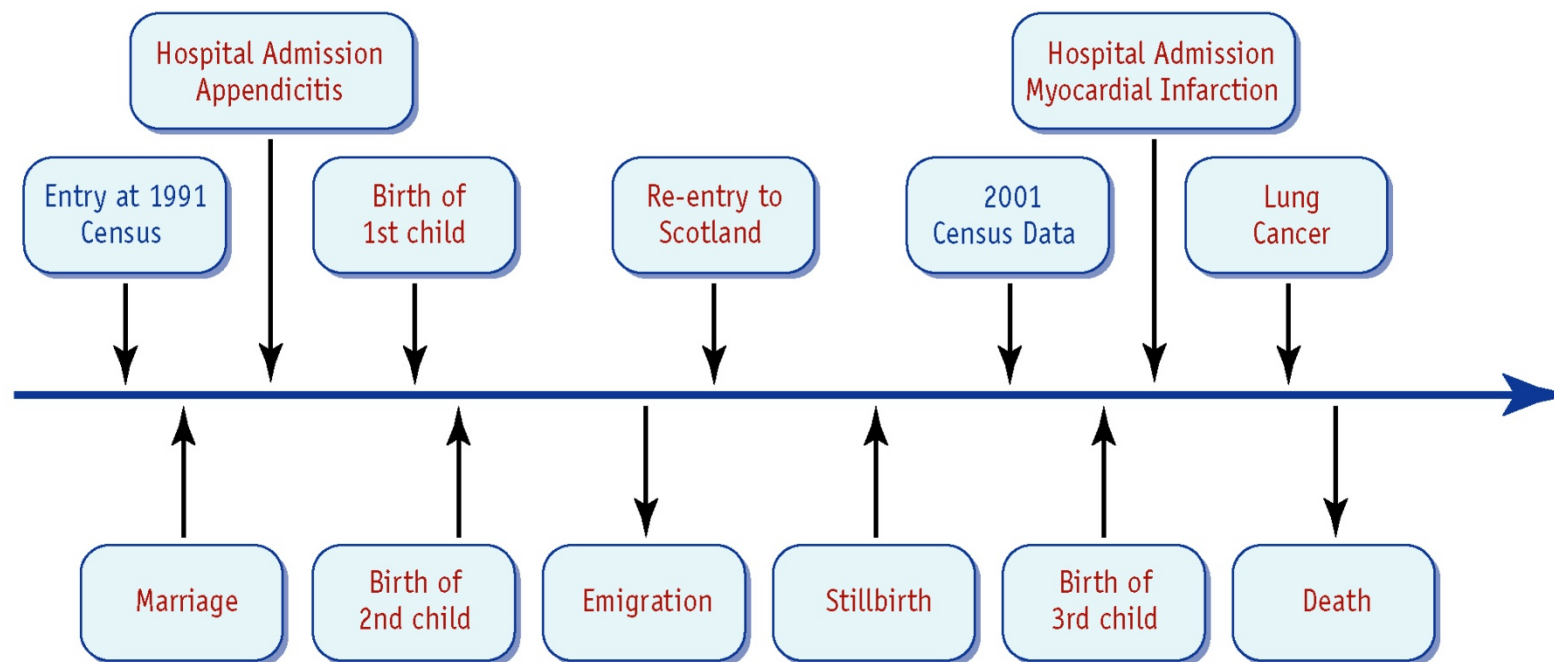
Education data

School census

Exam results

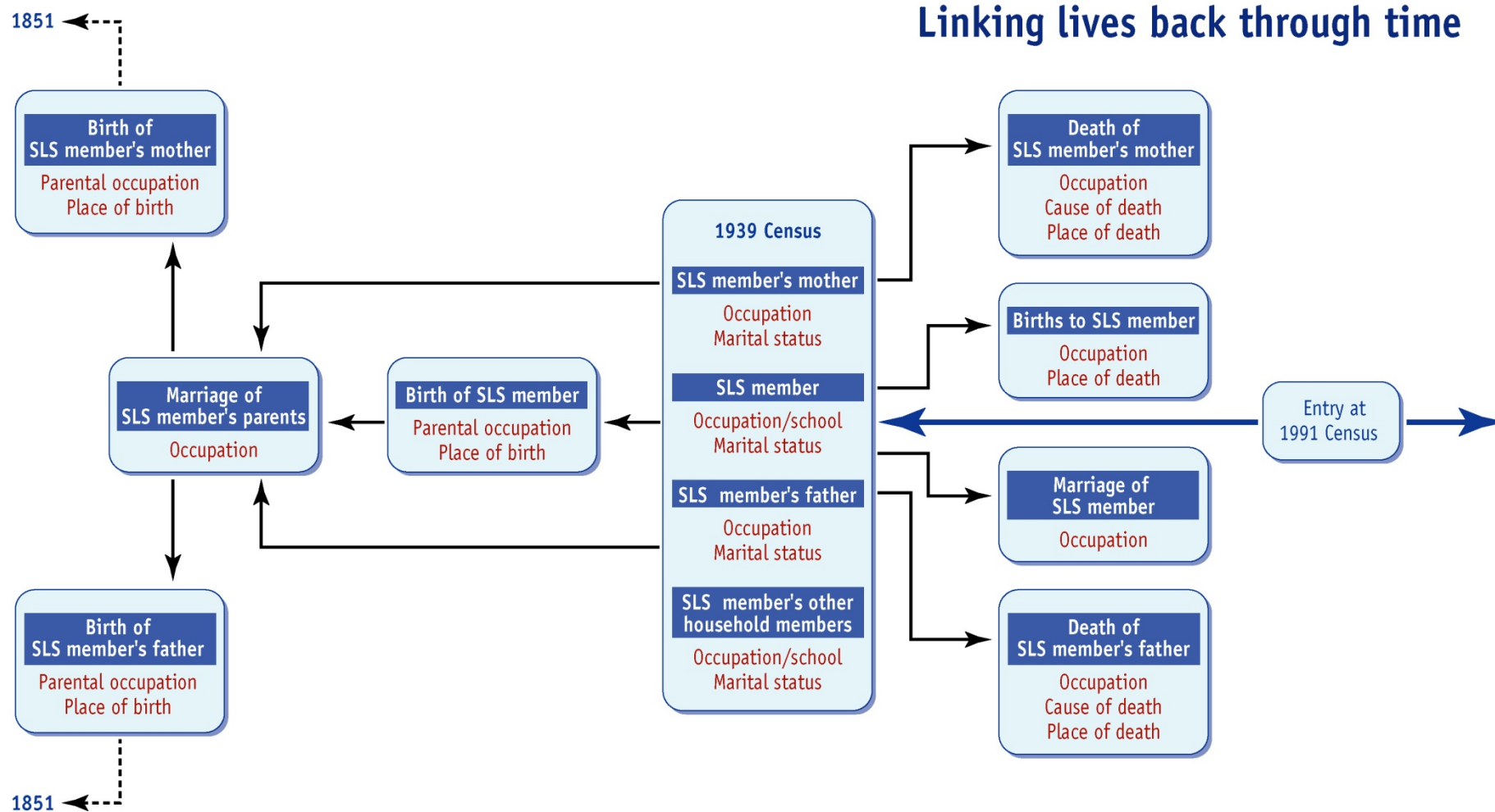
Absences, exclusions

Example Event History of a Female SLS Member aged 21 at 1991 Census



Extending the SLS back
through time

Linking lives back through time



Making use of the Scottish Longitudinal Study

Paul Boyle, Peteke Feijten, Gillian Raab and Lin Hattersley: "Marital status, health and mortality: the role of living arrangement".

Gillian Raab, Lin Hattersley and Marion Henderson: "Regional patterns of teenage births in relation to social factors and educational and social outcomes for young women following a teenage birth".

Frank Popham: "Permanent sickness, returning to employment and health".

Gillian Raab, Paul Boyle and Lin Hattersley: "Health and social mobility between 1991 and 2001".

Maarten van Ham and Allan Findlay: "Residential location, migration and occupational achievement in Scotland 1991-2001".

David Manley, Maarten van Ham and Joe Doherty: "Effects of mixed tenure on mixed tenure neighbourhood residents in Scotland 1991-2001".

Rosaline Barbour: "Post-Partum Psychiatric Illness in Scotland 1991-2001".

Christopher Holligan: "Sectarianism in the West of Scotland".

Chris Dibben, Zhiqiang Feng and Alison Macfarlane: "Time-space geographies and exposure to air pollution: examining the impact of varying exposure to air pollution on the health of adults and birth outcomes".

Judith Brown, Ewan Macdonald, Phil Hanlon, Ivan Turok, David Webster and James Arnott: "Using the SLS to study flows between the economic active and inactive groups and the link with health status".

Ganka Mueller, Lin Hattersley, Susan Wallace, Mary Macdonald and Neil Bowie: "Linkage Validation Study".

Alastair Leyland and Ruth Dundas: "Understanding changes in NS-SEC between Census and death".

Nick Bailey and Mark Livingston: "Neighbourhood change: selective migration versus in situ change".

Zhiqiang Feng, Paul Boyle, Maarten van Ham and Gillian Raab: "The growth of mixed-ethnic unions and their changing geographical distribution between 1991 and 2001".

Jasper van Dijck, Peteke Feijten and Paul Boyle: "Spatial differences in secularisation in Scotland".

Boris Portnov, Abraham Haim and Itai Kloog: "Investigating the link between Light at Night (Light pollution) and the incidence of hormonal dependent cancers in the Scotland".

Mairi Harper, Ronan O'Carroll, and Rory O'Connor: "Adaptive and Maladaptive Coping in Bereaved Parents".

Tom Clemens and Paul Boyle: "Health at older age: comparison of longitudinal data in Scotland and England".

Paul Boyle, Zhiqiang Feng and Gillian Raab: "Does being widowed increase the risk of death?".

Lin Hattersley, Paul Boyle and Zhiqiang Feng: "Once a NEET always a NEET? Are NEETs (not in education, employment or training) a distinct group or do they change over time and does mobility make a difference?".

David Bell and Elizabeth Roberts: "Healthy Life expectancy in Scotland".

Emily Grundy, Paul Boyle, Dermot O'Reilly and Harriet Young: "Developing integrated analyses of the England and Wales, Scottish and Northern Ireland Census Longitudinal Studies: health and mortality as a case study".

Paul Boyle, Frank Popham, Dermot O'Reilly and Alastair Leyland: "How much of Glasgow's poor health record can be explained by selective migration?".

Helen Brown, Narinder Bansal and Raj Bhopal "Estimating Migration Rates in Scotland by Ethnic Group".

Paul Boyle, Gillian Raab and Lee Williamson: "Understanding Scottish birth parity - a comparison of different data".

Paul Boyle, Frank Popham, Murray Smith, Luke Vale, Diane Stockton, Peter Craig and Anne Ludbrook: "Economic appraisal of the choice and targeting of lifestyle interventions to prevent disease in deprived populations".

Paul Boyle, Frank Popham, Dermot O'Reilly and Alastair Leyland: "Exploring the impact of selective migration on the deprivation mortality gap within Greater Glasgow".

David McCollum and Jackie Horne: "The Economic Impact of Return Migrants to Scotland: Evidence from the Scottish Longitudinal Study".

Paul Boyle and Frank Popham: "Assessing socio-economic inequalities in mortality at the Scottish national level, incorporating a comparison between mortality in Scotland and England".

Katharine Sharpe, David Conway, David Brewster and Alex McMahon: "Area-based versus Individual Measures of Socioeconomic Background - How do they compare in predicting cancer incidence?".

Gavin MacColl, Karen MacNee and Julie Ramsay: "The Determinants of Self-Assessed Health in Scottish Adults".

David Pevalin: "Social Inequalities in Avoidable Mortality".

Daryll Archibald and Paul Boyle: "Does Area Regeneration Improve Residents' Health & Well-being?".

Denise Brown, Alastair Leyland, Dermot O'Reilly, Paul Boyle and Sally Macintyre: "Population mobility and its role in widening health inequalities in Scotland".

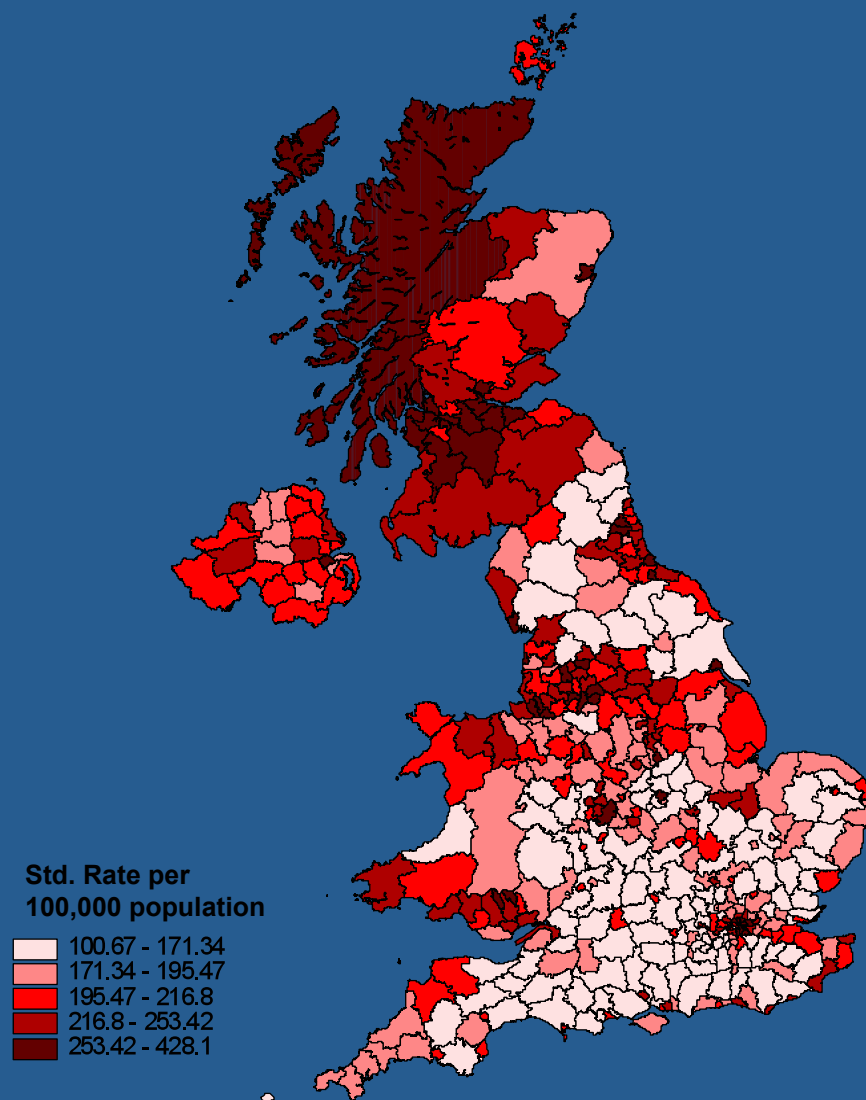
Claudia Geue, Andrew Briggs, James Lewsey and Paula Lorgelly: "Population Ageing: What are the implications for healthcare expenditure in Scotland?".

Self-reported health and mortality

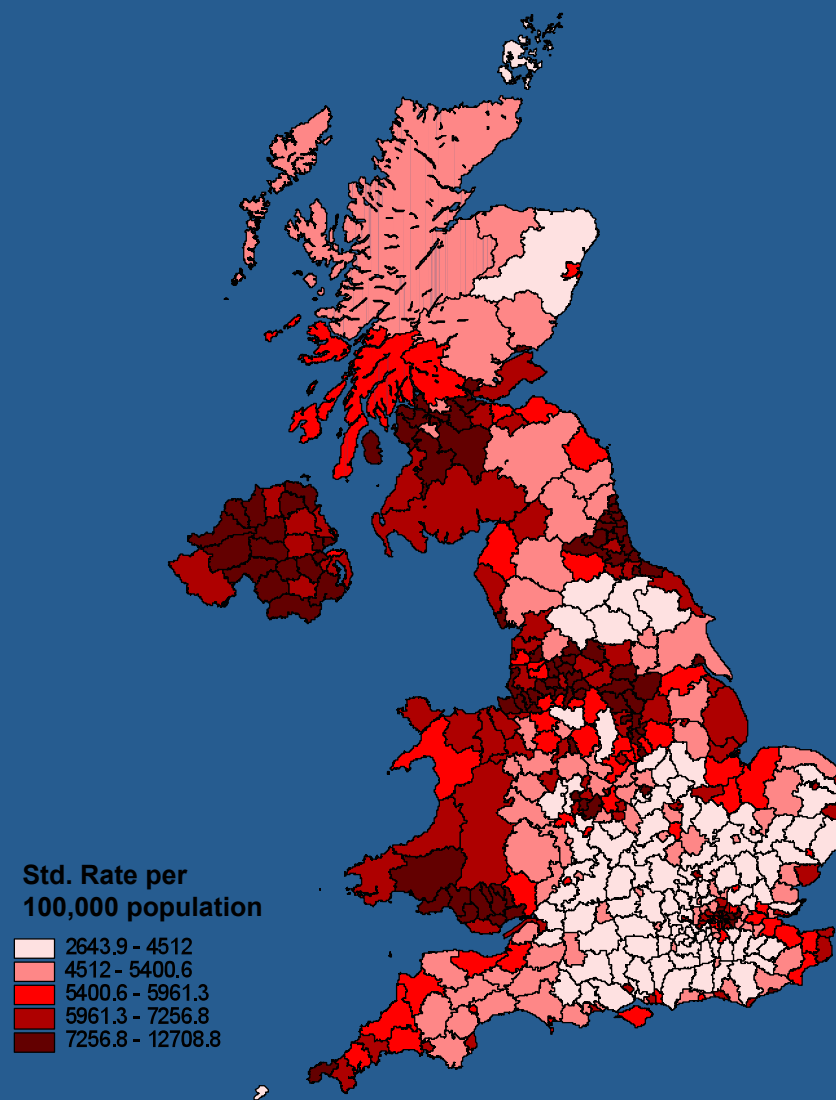
To demonstrate how parallel analyses of the 3 datasets can give UK-wide results

To analyse associations between reporting of health status in 2001 and subsequent mortality

Directly standardised mortality rates by Local Authority for population aged 16-64, UK



Directly standardised rates of poor self-rated health by Local Authority for population aged 16-64, UK



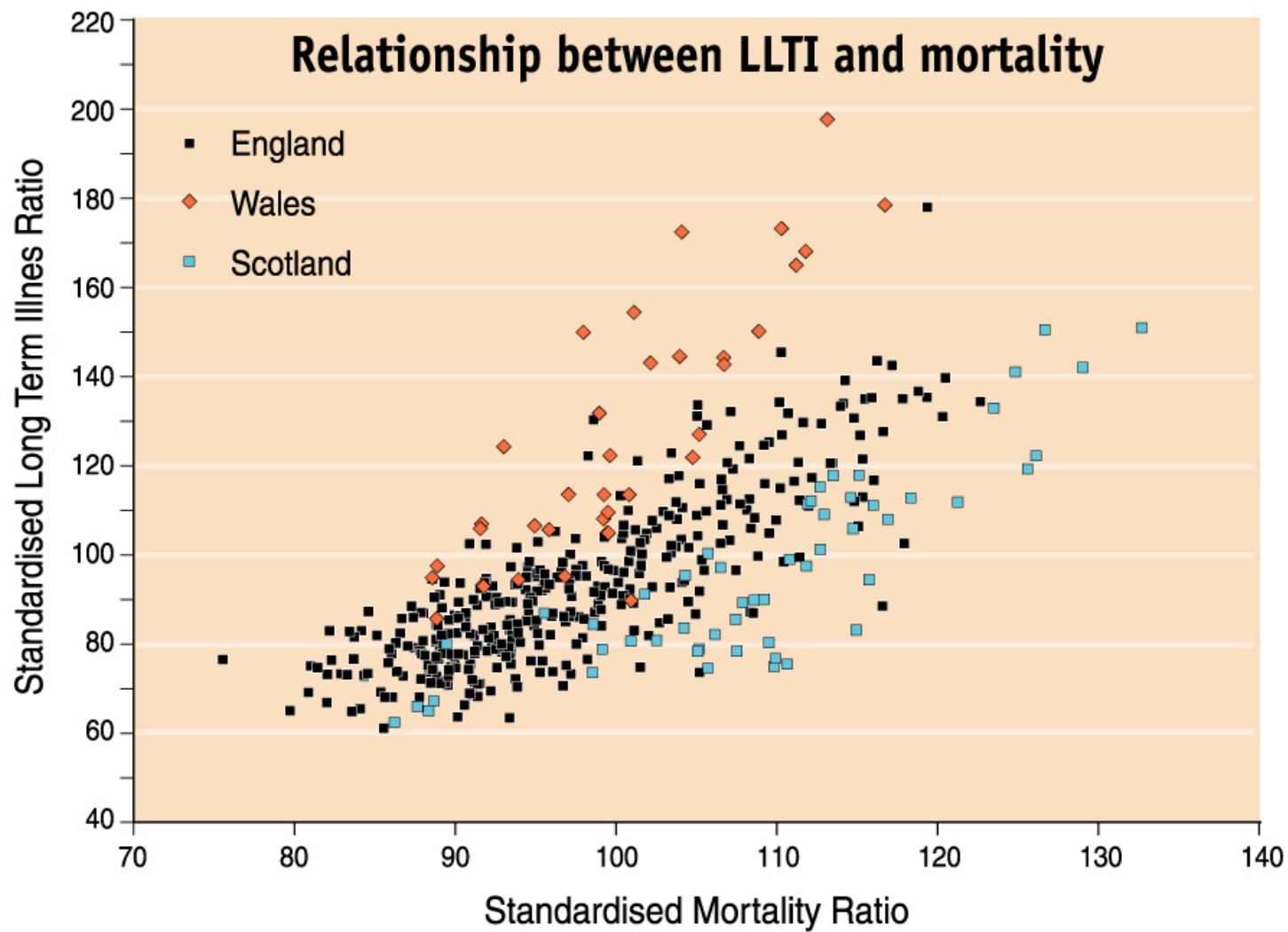
How much more unhealthy is Scotland than England/Wales?

Risk ratios* for people aged 35-74

	Mortality	Self-reported general health
England & Wales	1.00	1.00
Scotland	1.19 (1.15, 1.23)	0.96 (0.95, 0.97)

* Fully adjusted for age, sex, marital status and deprivation

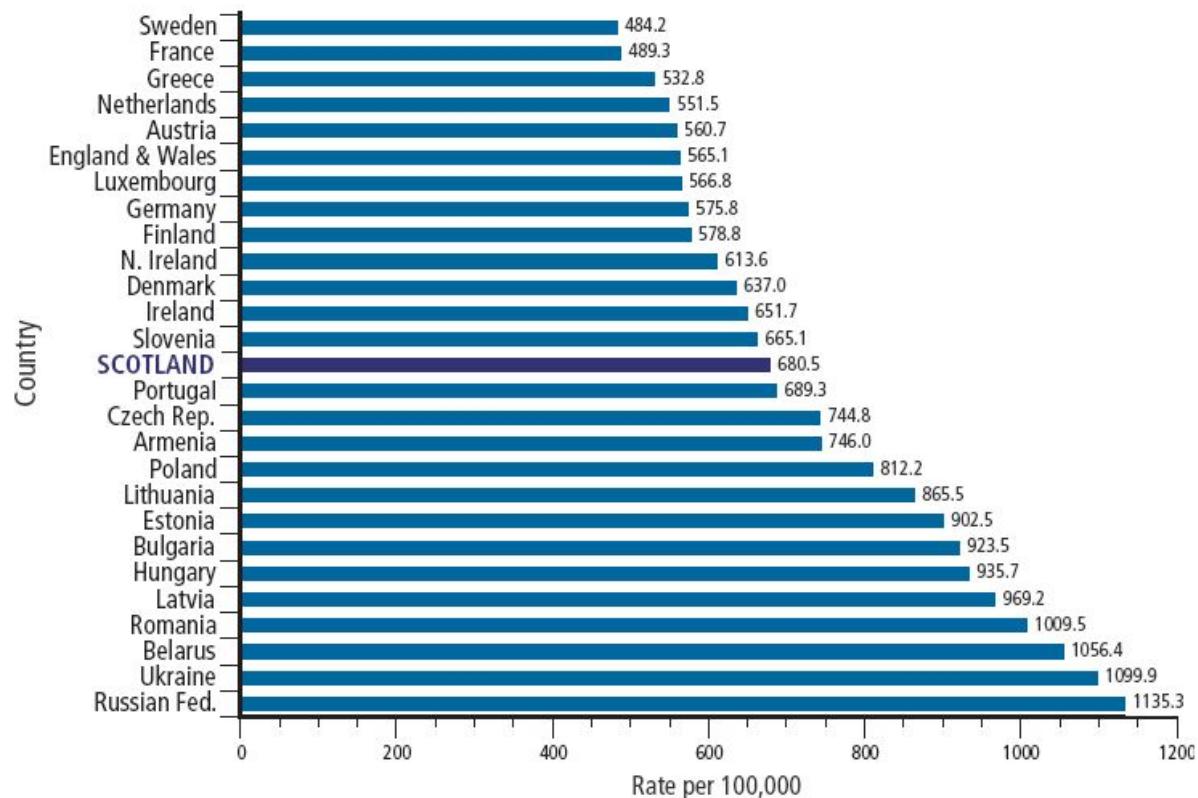
Source: Analyzing the 3 UK Longitudinal Studies: Young, Grundy, Boyle & O'Reilly, ESRC Census Programme



Health inequalities in Scotland

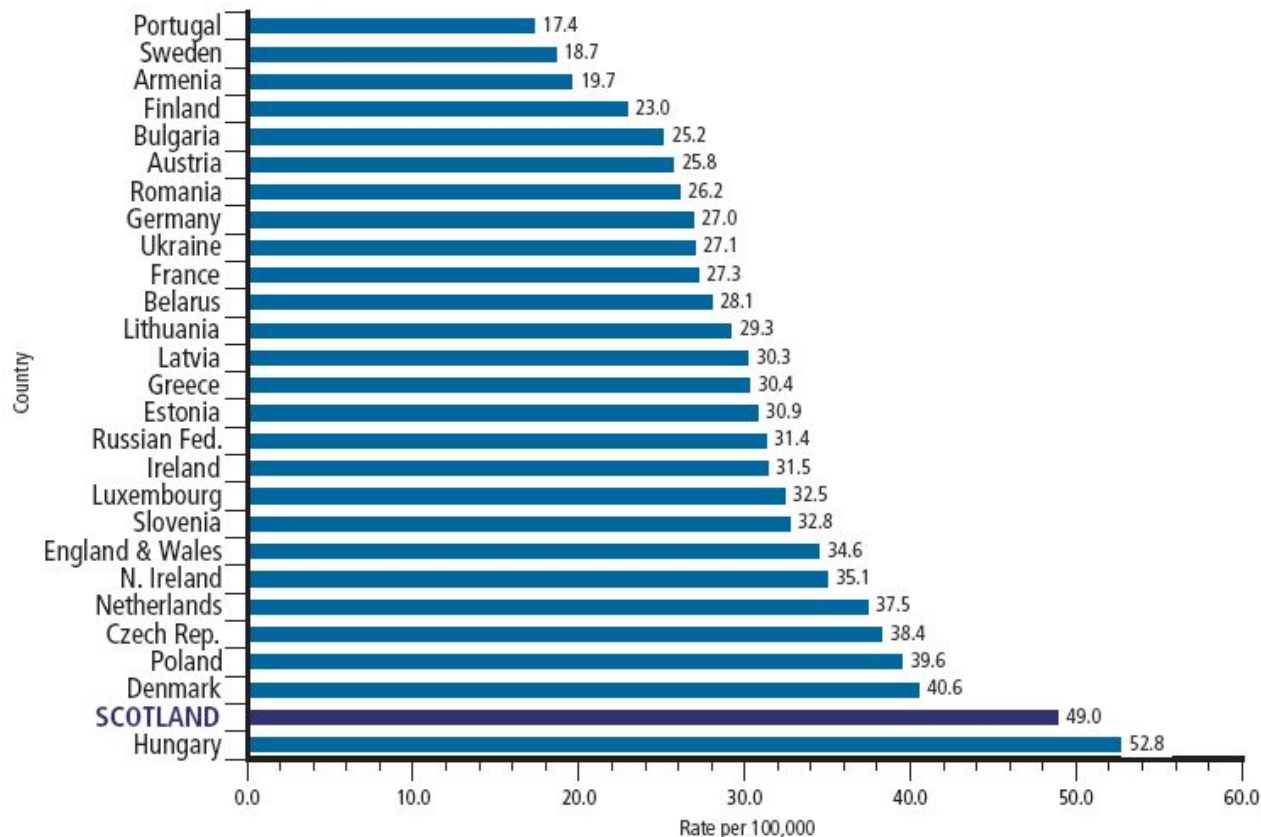
Scotland has a poor health record compared to the rest of Europe

Fig. 1: 1996 age-standardised all-cause mortality rates per 100,000 pop. for selected European countries (Source: W.H.O.)

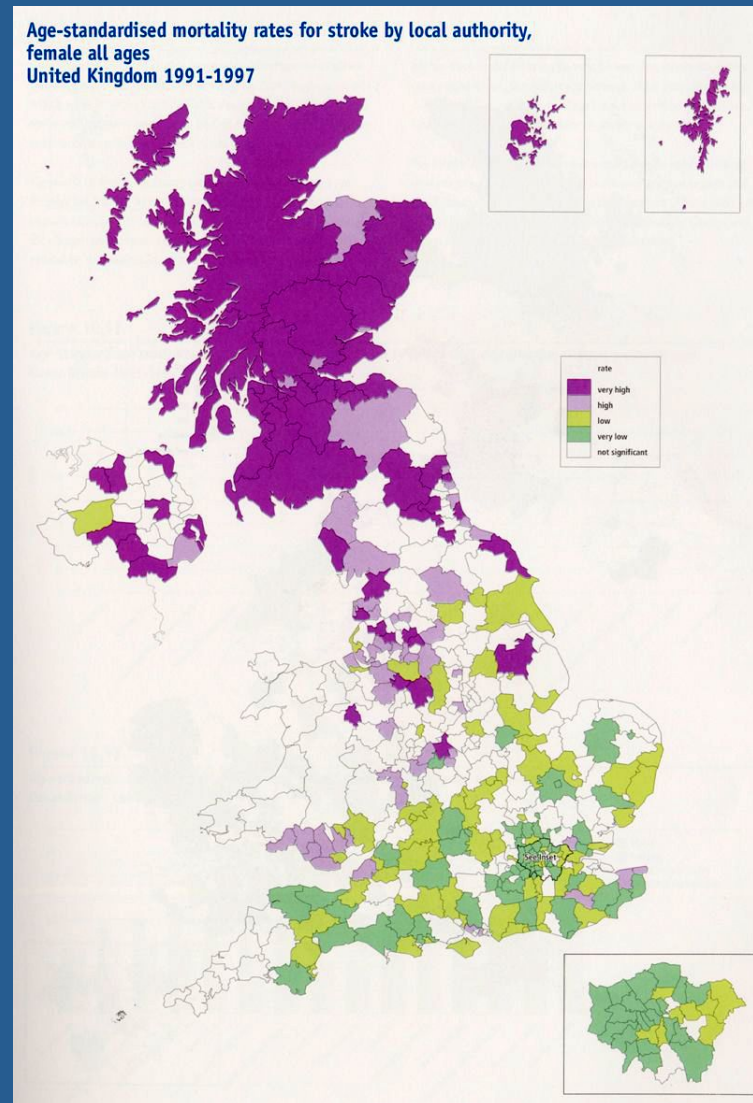


Scotland has a poor health record compared to the rest of Europe

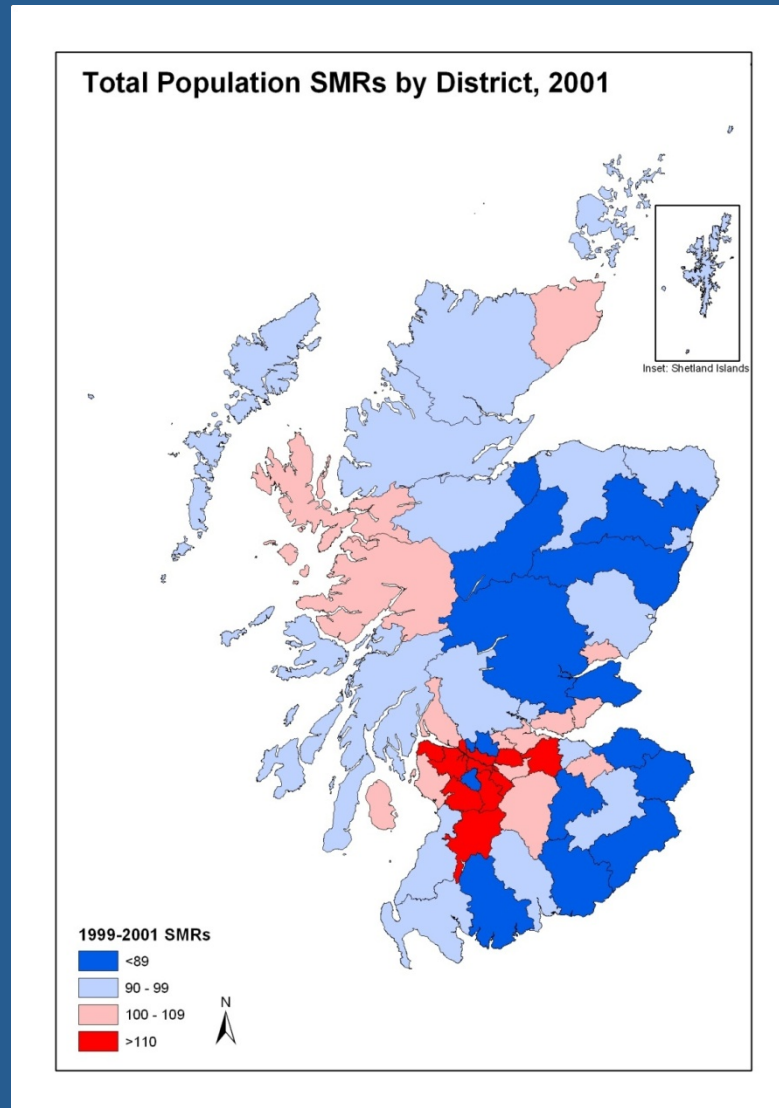
Fig. 4. 1996 age-standardised mortality rates for MALIGNANT NEOPLASM OF TRACHEA, BRONCHUS & LUNG per 100,000 population for selected European countries (Source: W.H.O.)



Scotland's record is also poor compared to the rest of the UK

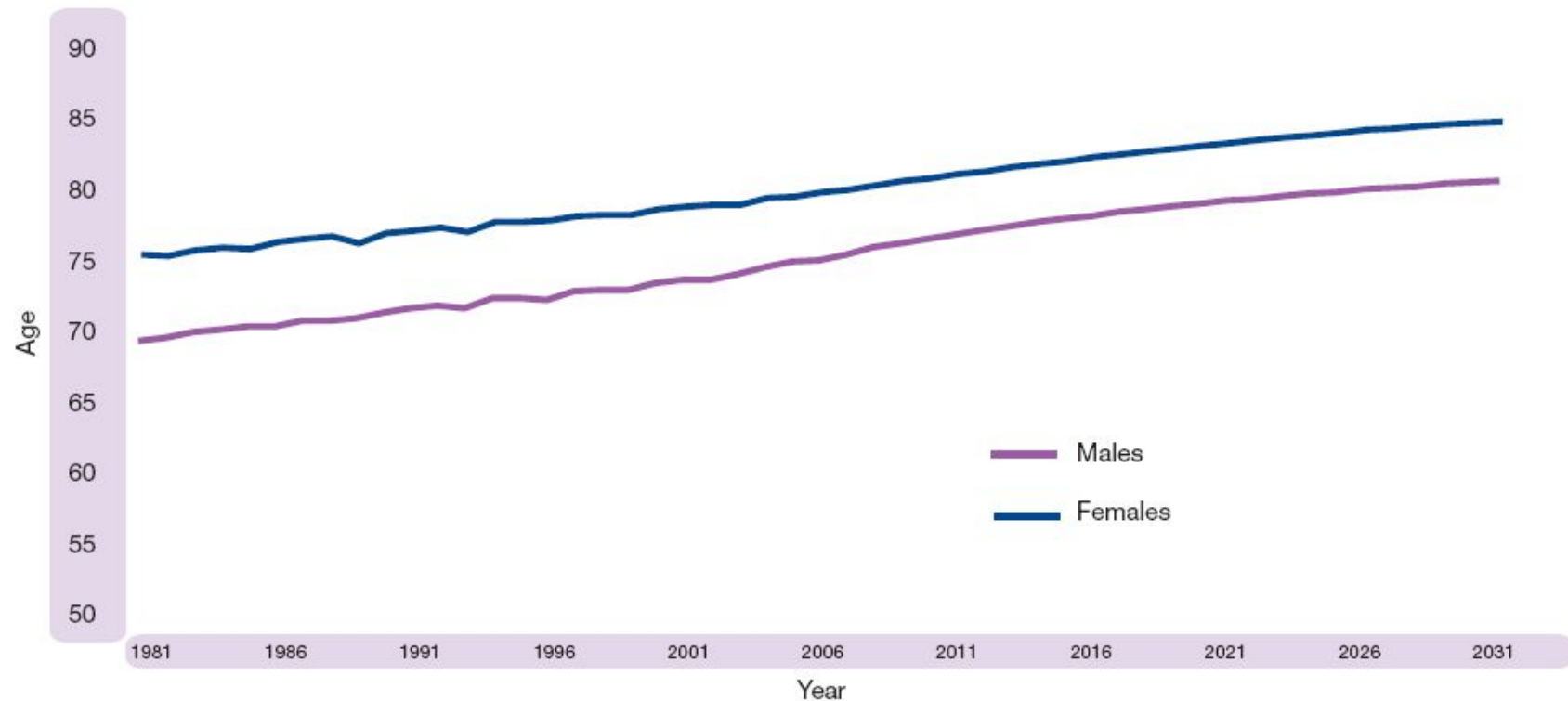


And there is considerable geographical variation within Scotland



Even so, life expectancy has increased steadily for Scotland over the last 20 years

Figure 1.21 Expectation of life at birth¹, Scotland, 1981-2031



Is the deprivation
health gap widening in
Scotland?

Measuring health inequalities

‘Health inequality’ is a major political issue in the UK, and elsewhere

Understanding geographical inequities is important academically

They also provide the justification for many geographically targeted public health interventions and policy recommendations

Here we focus on Scottish health variations

Health inequality research often compares the mortality / deprivation relationship

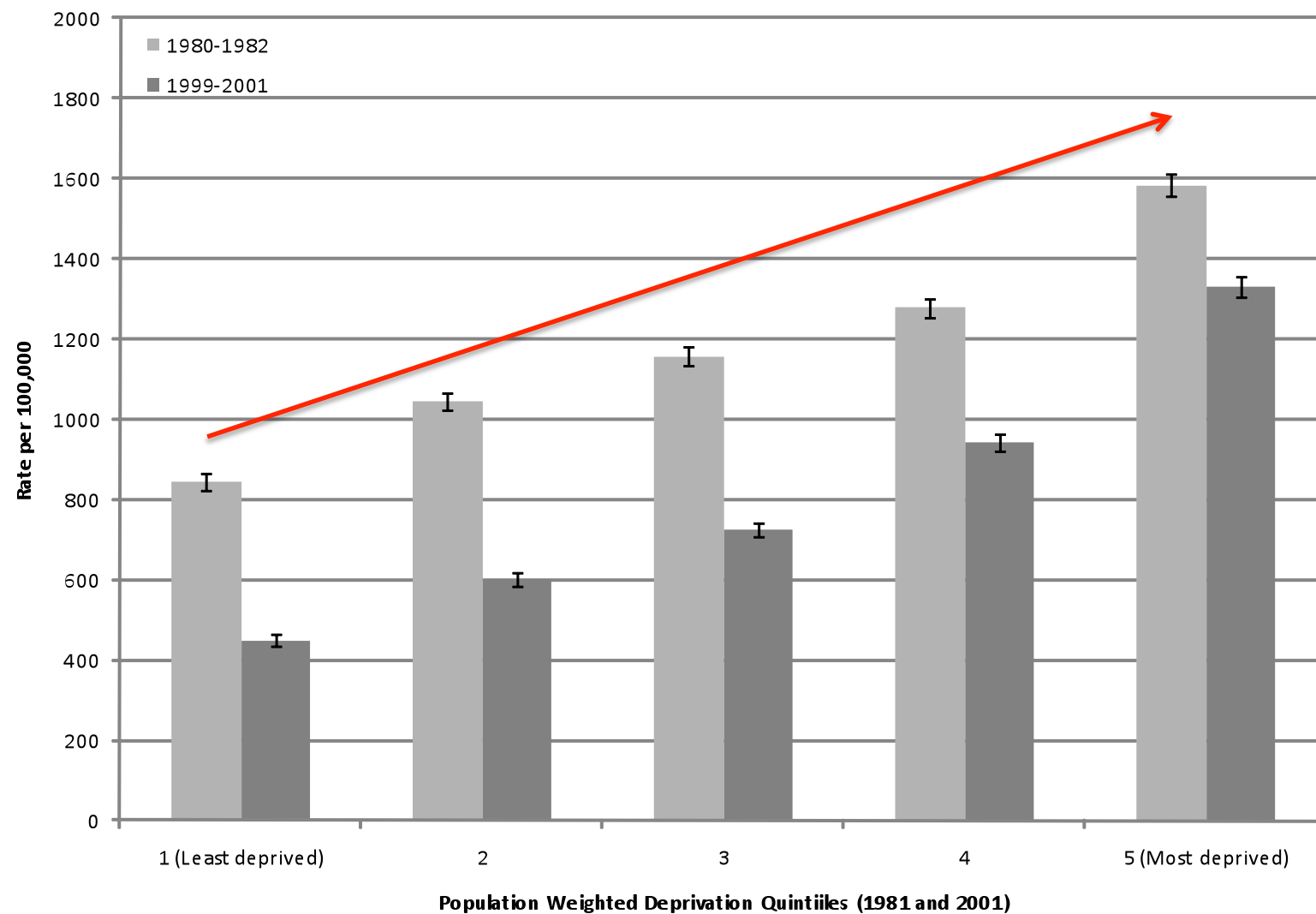
Typically, assess the relative improvement or worsening of inequalities between the mortality rates in the 'least deprived' and 'most deprived' areas at two time points

Approach is based on period-specific deprivation scores calculated for small areas, which are then divided into categories, such as quintiles

Data on premature deaths (0-64) from all causes in 1980-2 (48,592 deaths) and 1999-2001 (35,306 deaths)

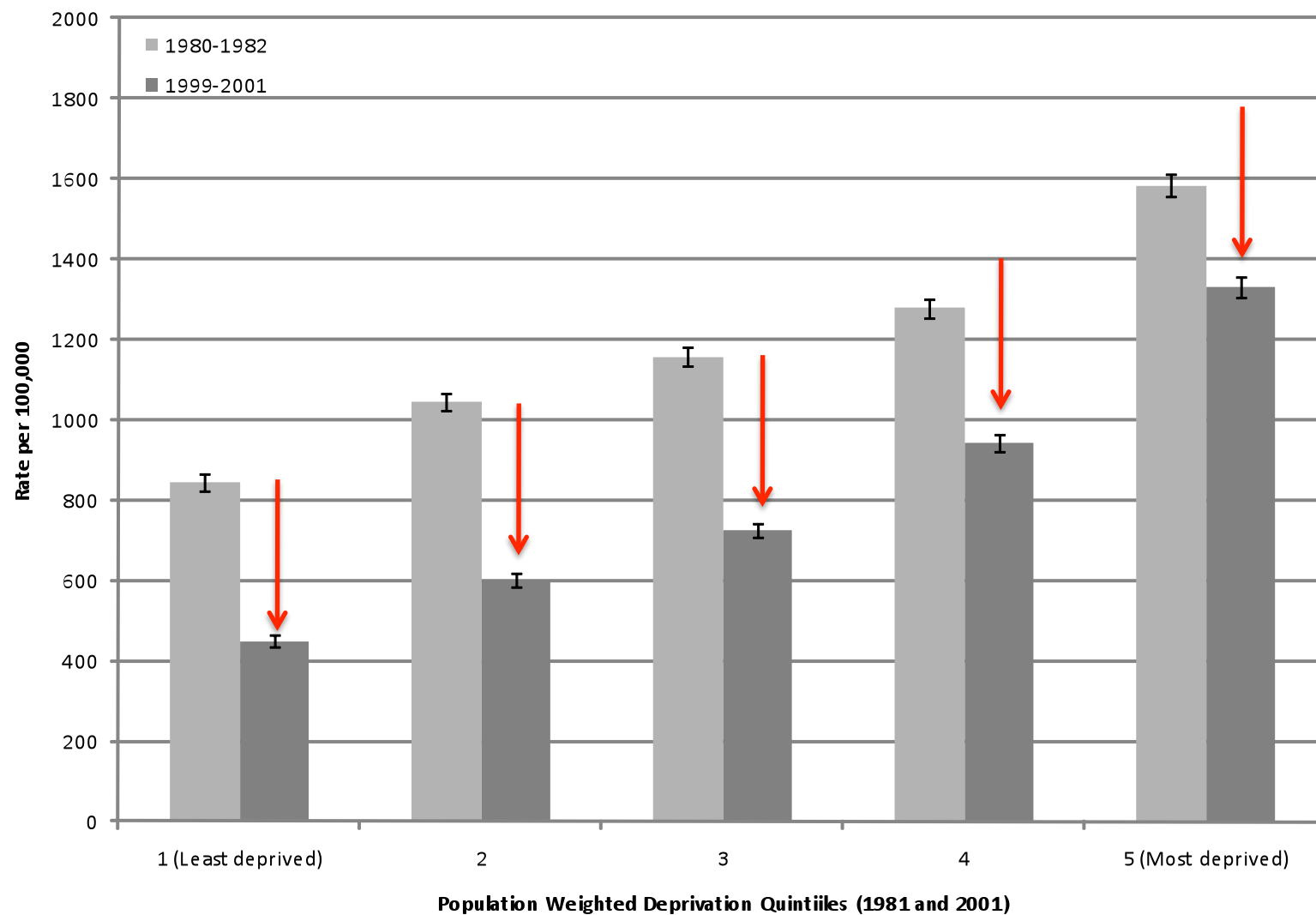
Denominators from 1981 and 2001 census

All-cause premature mortality in Scotland 1980-2 and 1999-2001, by deprivation (1981 and 2001)



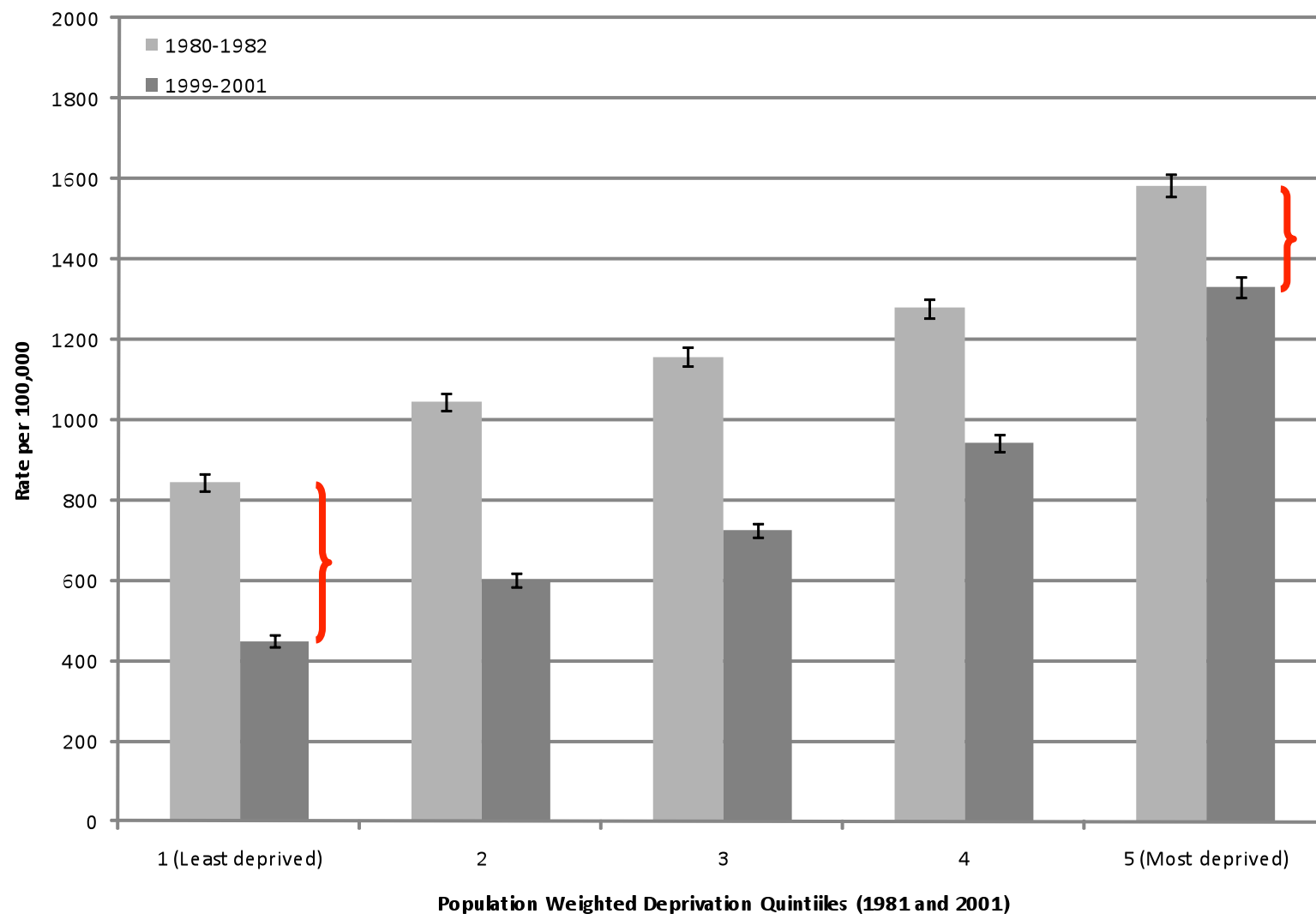
Boyle PJ, Exeter D and Flowerdew R 2004 The widening mortality gap in Scotland and the role of population change *Area* 36 164-73

**All-cause premature mortality in Scotland 1980-2 and 1999-2001,
by deprivation (1981 and 2001)**



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**All-cause premature mortality in Scotland 1980-2 and 1999-2001,
by deprivation (1981 and 2001)**



Boyle PJ, Exeter D and Flowerdew R 2004 The widening mortality gap in Scotland and the role of population change *Area* 36 164-73

Discussion

A significant mortality gradient from the least to the most deprived quintiles

Life expectancy decreased across all 5 quintiles

However, the largest improvements in the least deprived quintile; smallest in the most deprived

The mortality gap has widened in Scotland

But, how do we
account for the
changing nature of
places?

Problems with measuring geographical health inequalities

As deprivation is calculated relative to the period, the levels are not equivalent

The most deprived places in the recent period will be better-off than the most deprived places in the earlier period

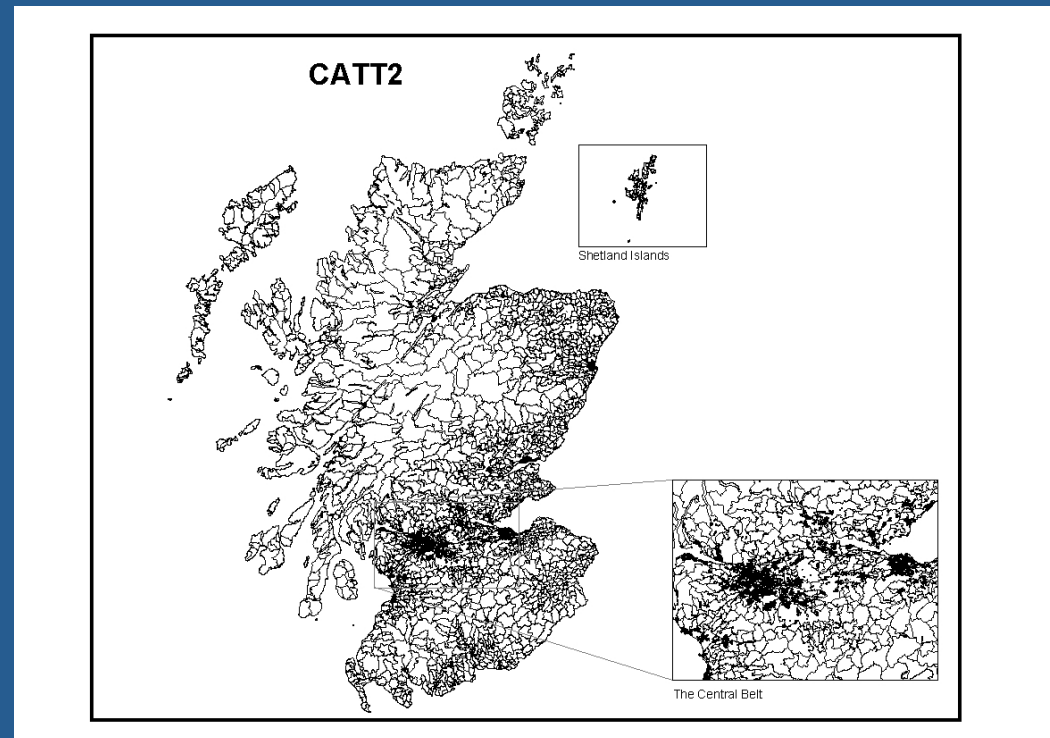
Problems with measuring geographical health inequalities

The census area boundaries change over the period

It is therefore impossible to compare rates for places which have remained similarly deprived, or have changed their relative deprivation, over the period

Consistent Areas Through Time (CATTs)

A unique set of areas whose boundaries are consistent for the 1981, 1991 and 2001 censuses periods



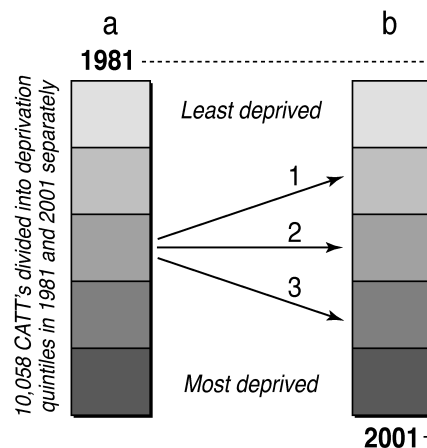
Stacked deprivation

Traditional approach is to calculate deprivation in 1981 and 2001 separately

Here, we calculated one index using data from both periods

Based on 20,116 'stacked' observations (10,058 CATTs in each period)

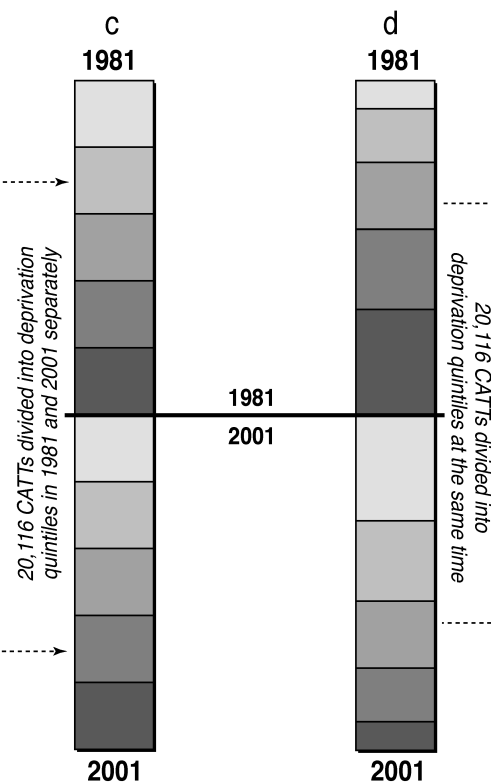
Standard Approach for Analysing Geographical Health Inequalities



A **CATT** may become relatively less deprived (1), remain relatively similarly deprived (2), or become relatively more deprived (3).

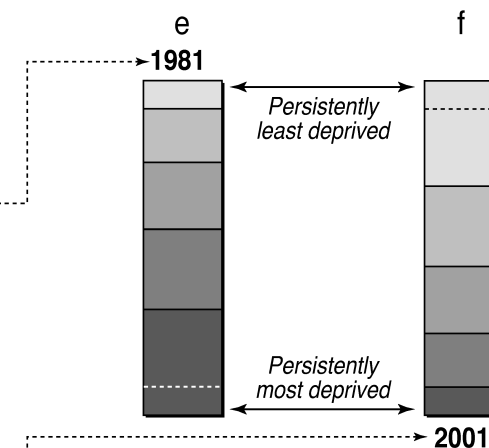
We can 'stack' areas having calculated deprivation separately in 1981 and 2001, giving 20,116 observations.

Calculating Stacked Deprivation



Alternatively we can 'stack' the areas and then calculate deprivation score once for both 1981 and 2001. Most deprived places are more common in 1981 and least deprived places are more common in 2001 as, overall, places are becoming less deprived over time.

Stacked Approach for Analysing Geographical Health Inequalities



The columns calculated in **d** are separated into **e** and **f** for the health inequalities analysis. This allows identification of similarly deprived areas in both periods.

		2001 Deprivation Quintiles					
		1	2	3	4	5	Total
1981 Deprivation Quintiles	1	1,230	100	11	0	0	1,341
	2	794	413	64	4	1	1,276
	3	424	794	364	51	7	1,640
	4	215	807	999	351	47	2,419
	5	64	271	1,020	1,434	593	3,382
	Total	2,727	2,385	2,458	1,840	648	10,058

Mortality results

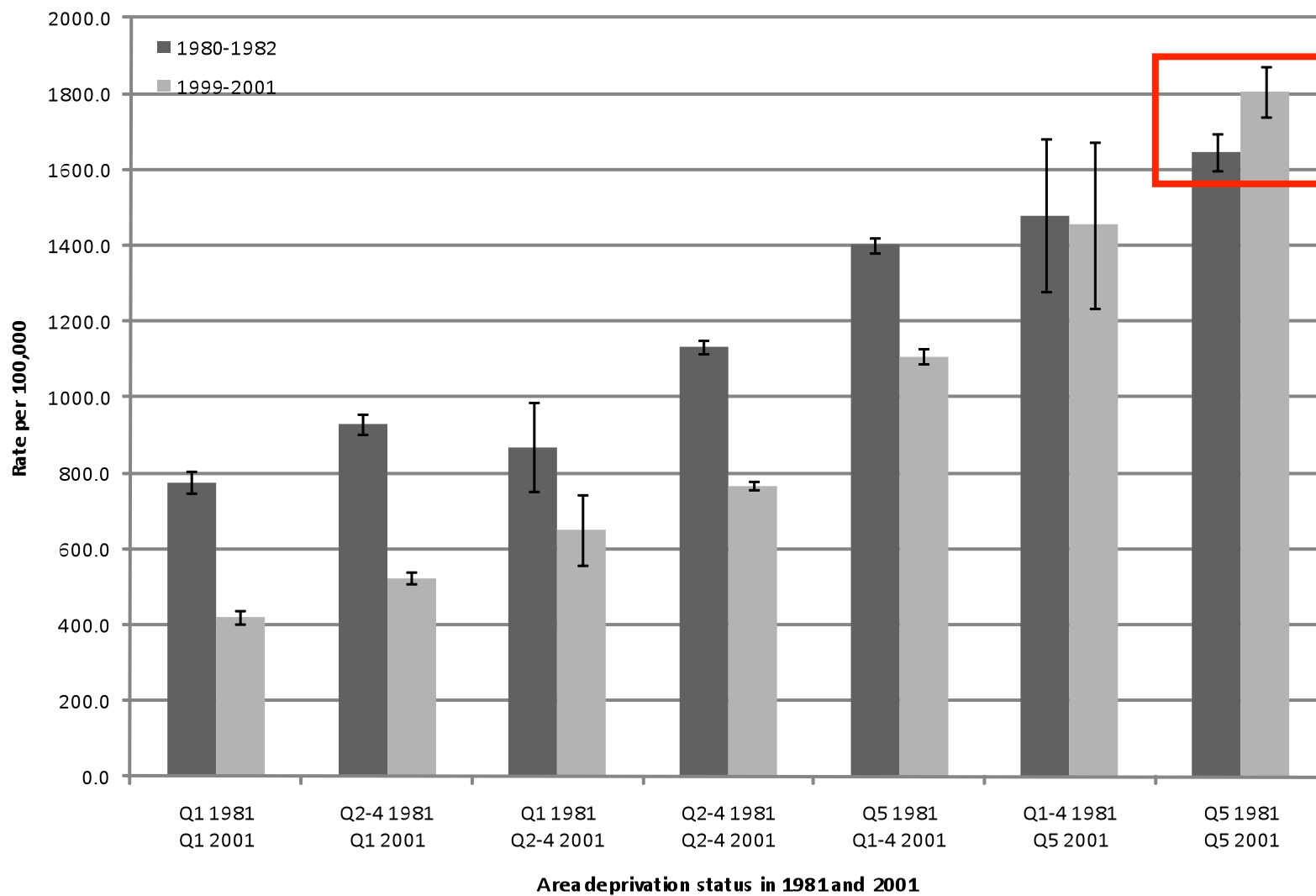
Calculated premature (0-64) all-cause mortality rates (per 100,000) in 1980-2 and 1999-2001

Age standardised to the European Standard Population with 95% confidence intervals

Identified 7 'deprivation (im)mobility' categories (rather than reporting results for all 25 possible combinations)

		2001 Deprivation Quintiles					
		1	2	3	4	5	Total
1981 Deprivation Quintiles	1	1,230	100	11	0	0	1,341
	2	794	413	64	4	1	1,276
	3	424	794	364	51	7	1,640
	4	215	807	999	351	47	2,419
	5	64	271	1,020	1,434	593	3,382
	Total	2,727	2,385	2,458	1,840	648	10,058

All-cause premature mortality in Scotland 1980-2 and 1999-2001, by deprivation (im)mobility group



Summary

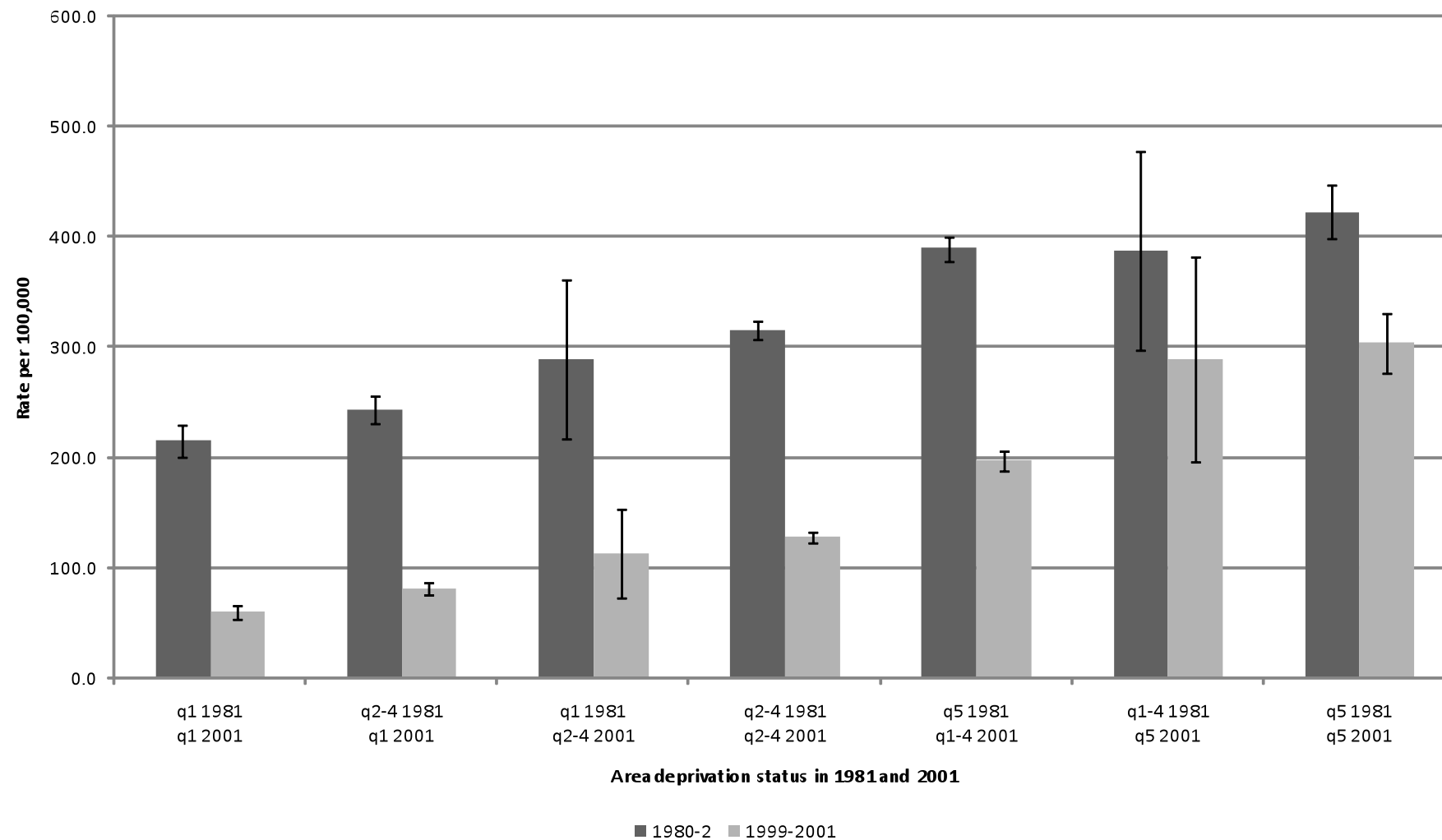
Areas that were always least deprived had the lowest mortality

Areas of upward mobility showed better health improvements than areas of downward mobility

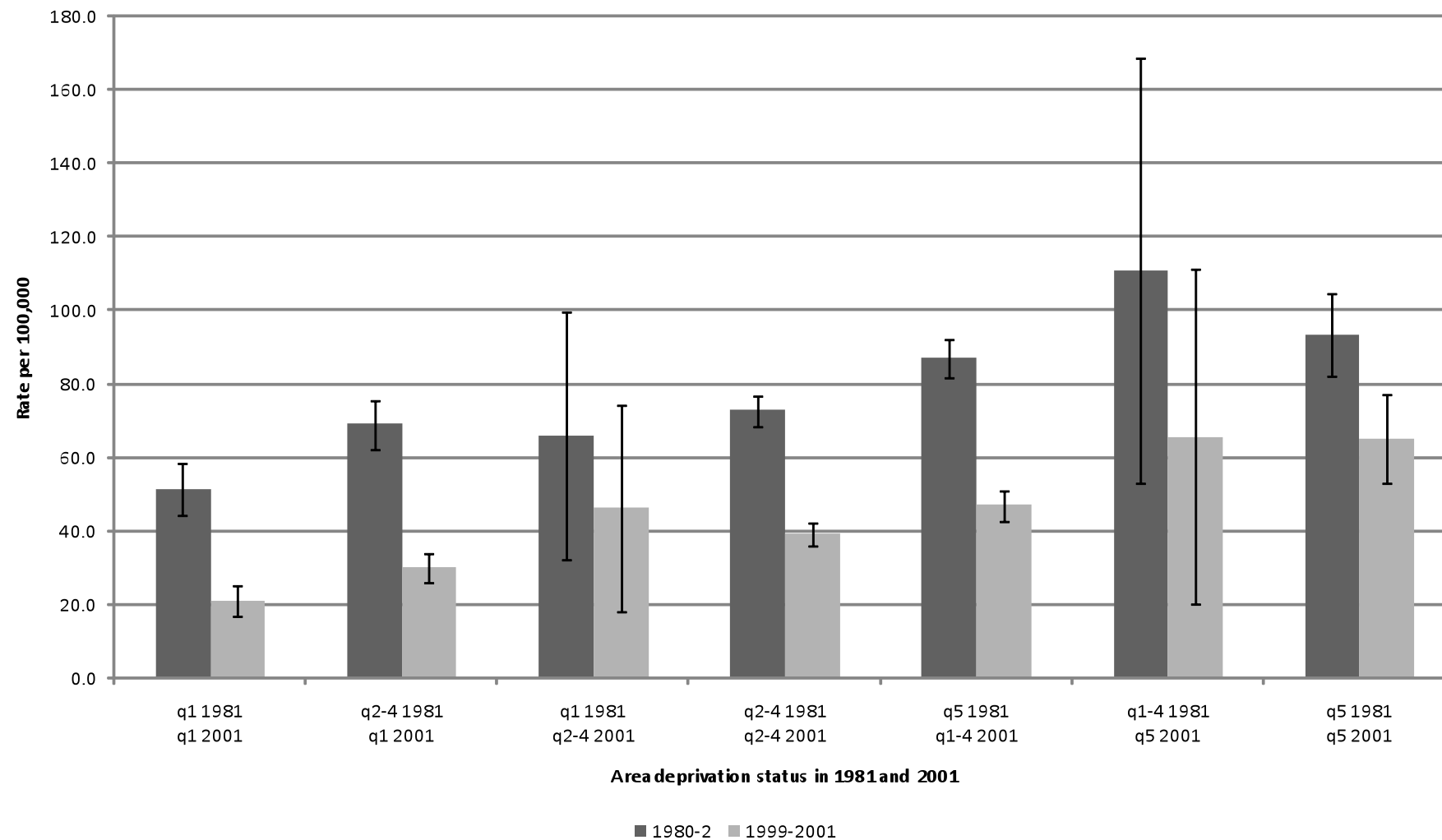
The 593 persistently most deprived areas experienced increased mortality

What causes of death account for this outcome?

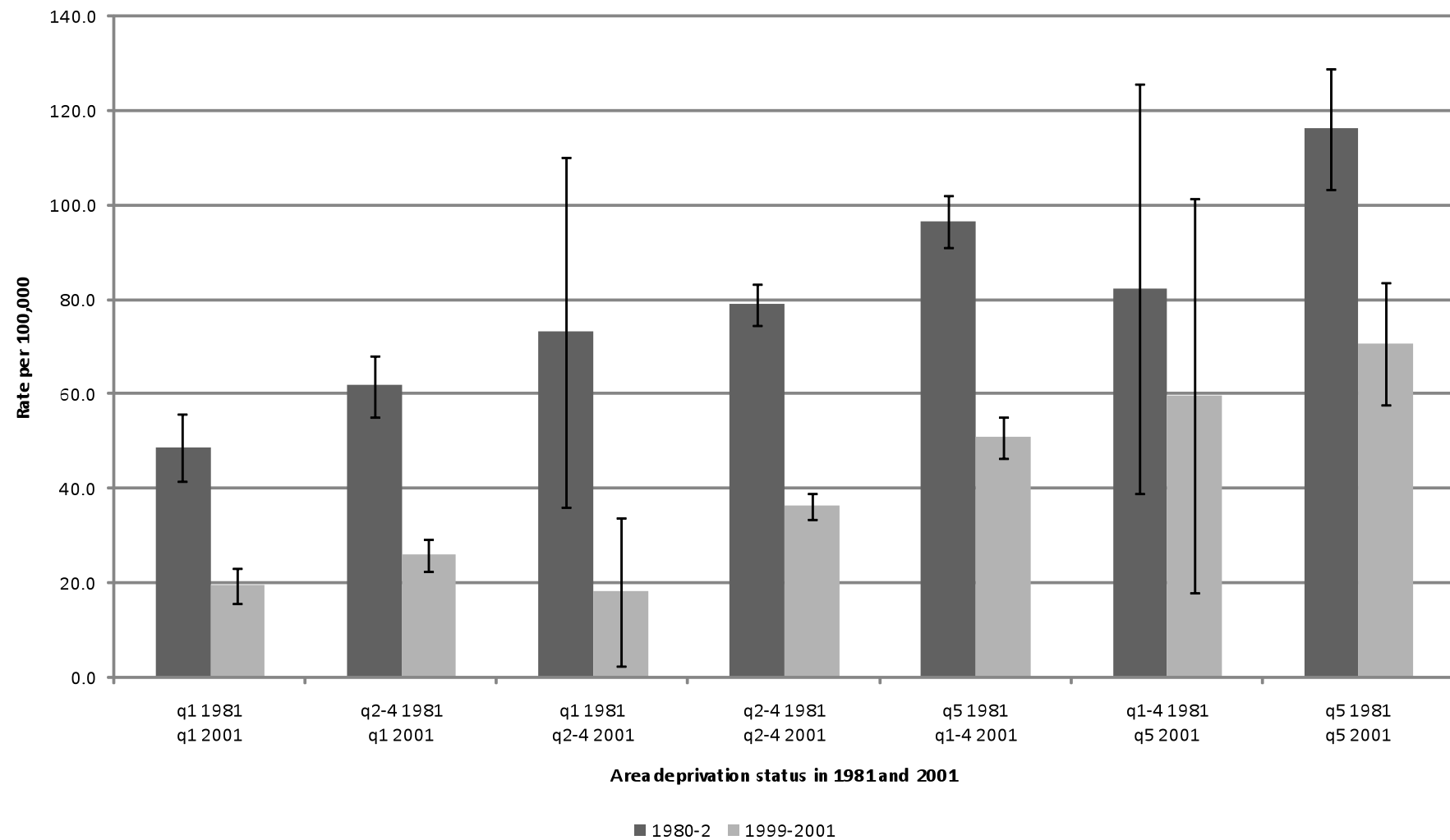
Premature mortality from heart disease in Scotland, 1980-2 and 1999-2001, by deprivation (im)mobility group



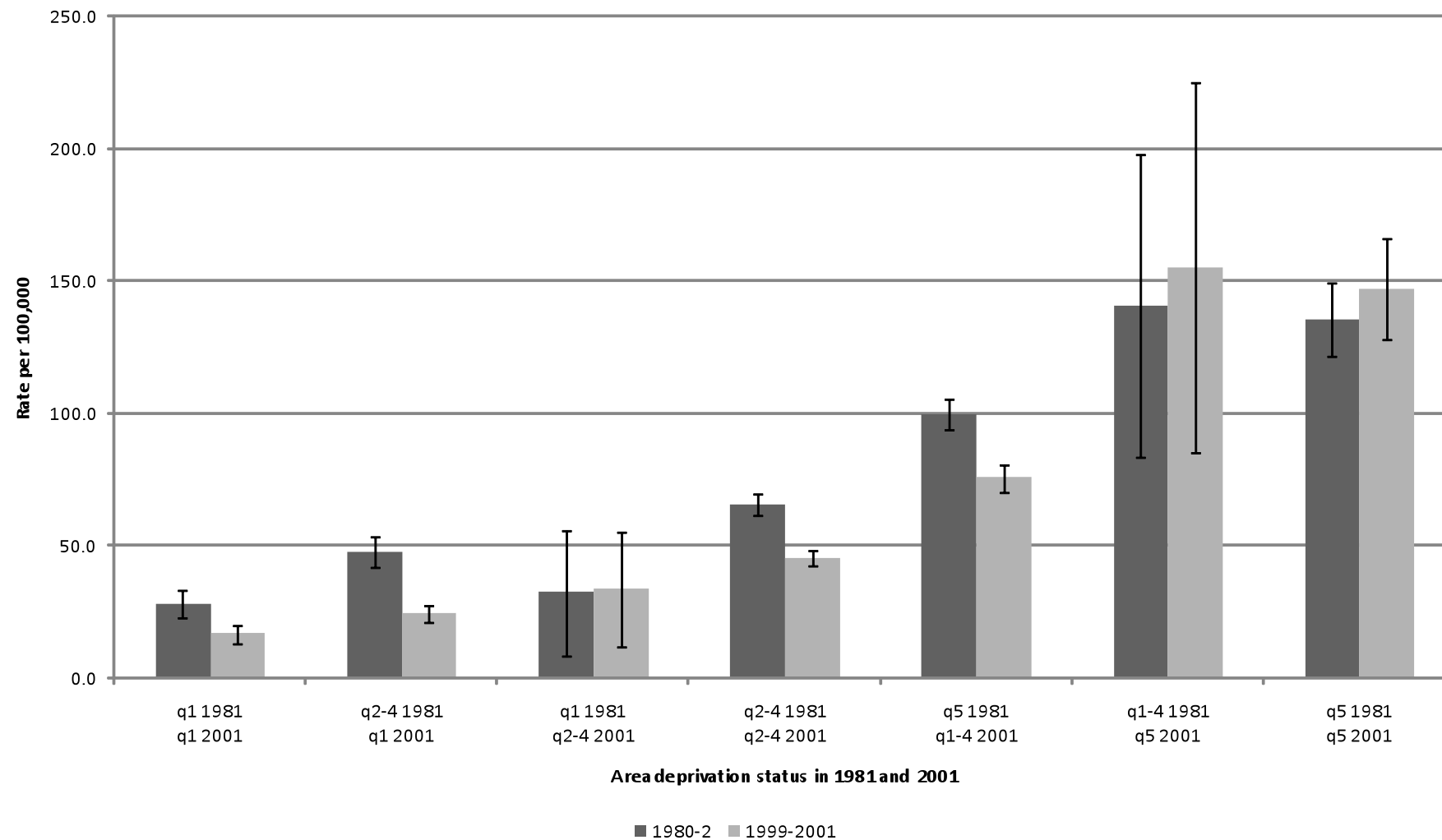
Premature mortality due to accidents in Scotland, 1980-2 and 1999-2001, by deprivation (im)mobility group



Premature mortality from stroke in Scotland, 1980-2 and 1999-2001, by deprivation (im)mobility group



Premature mortality from respiratory disease in Scotland, 1980-2 and 1999-2001, by deprivation (im)mobility group



Premature mortality due to cancers in Scotland, 1980-2 and 1999-2001, by deprivation (im)mobility group

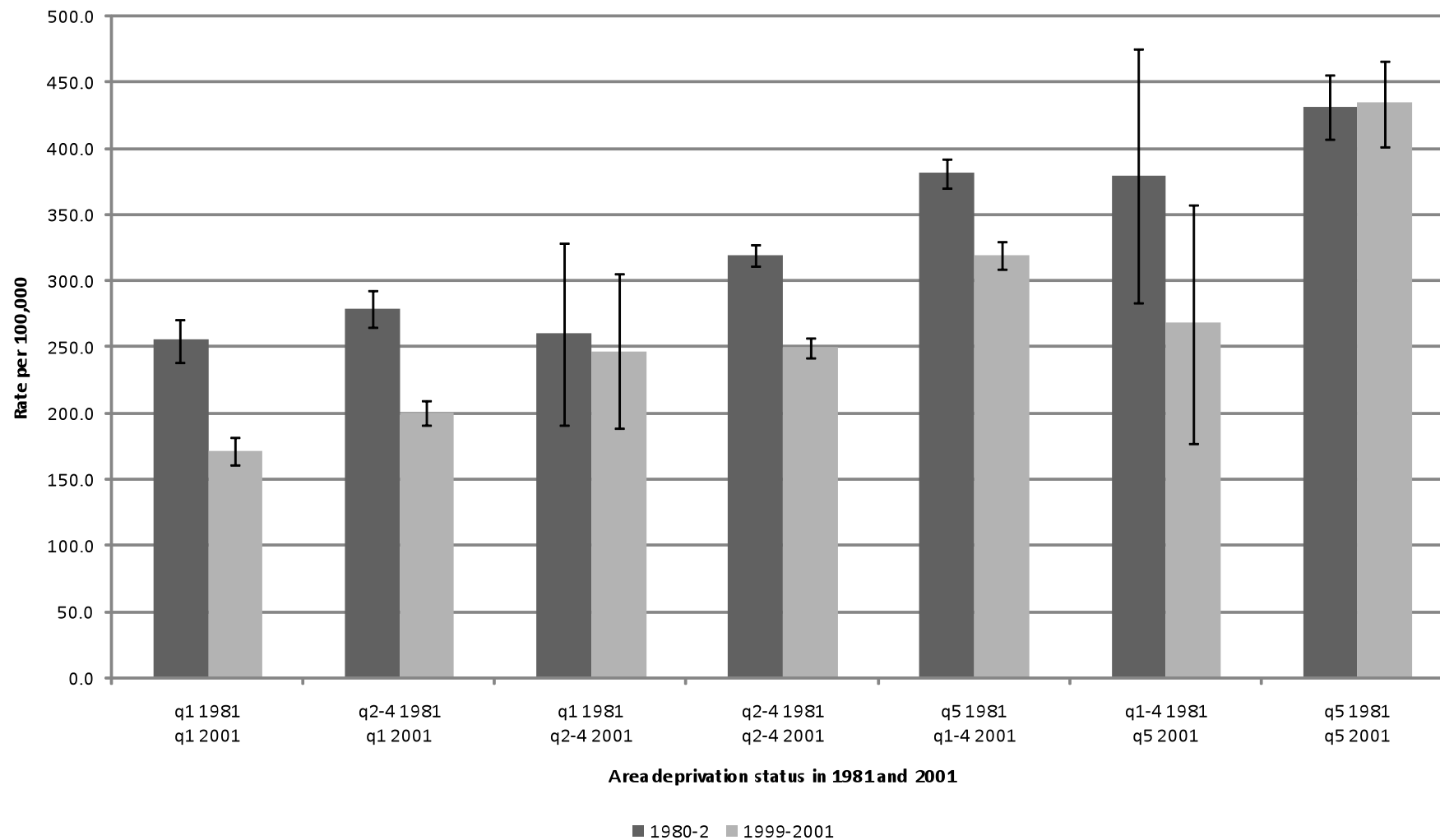
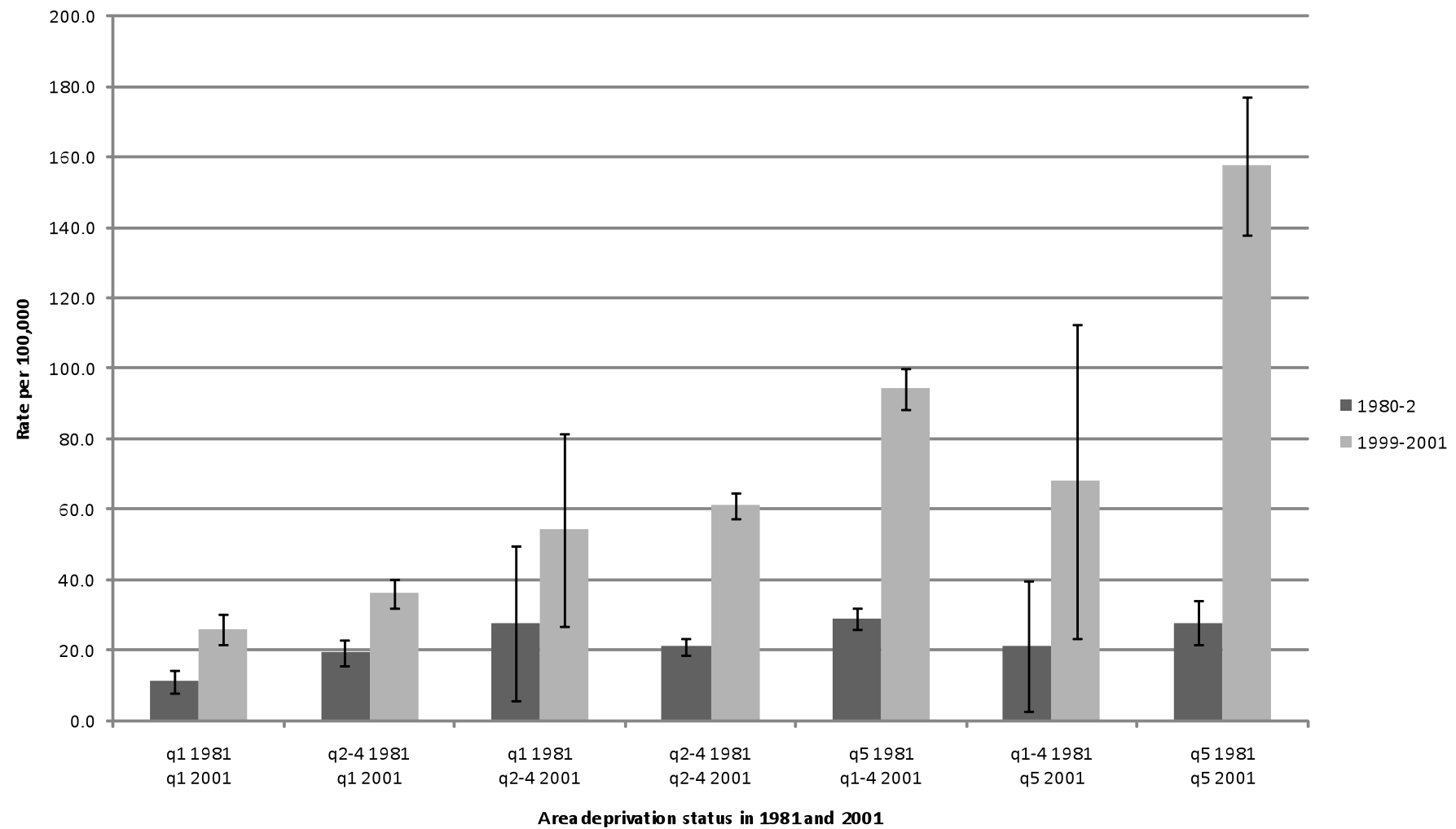
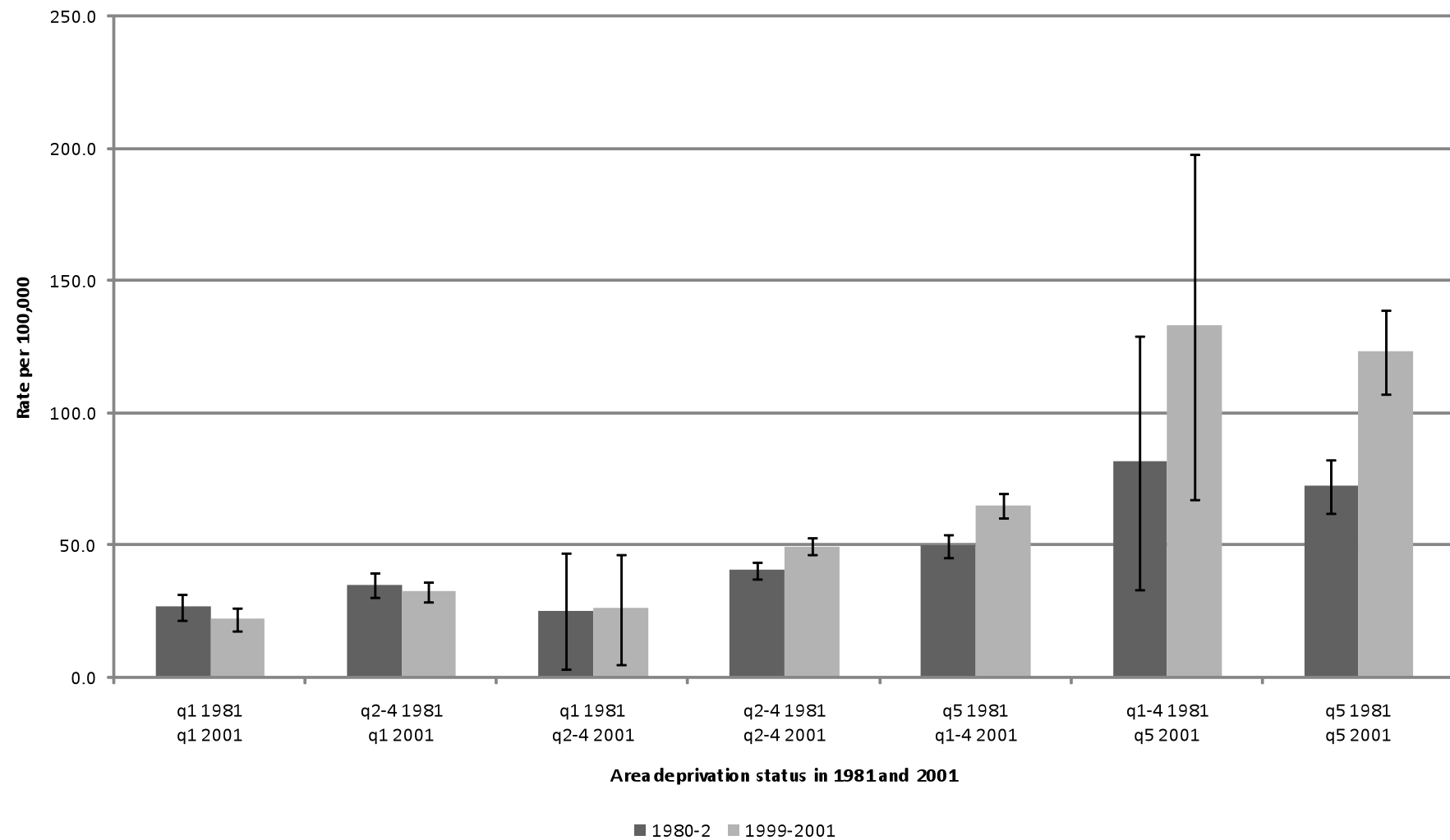


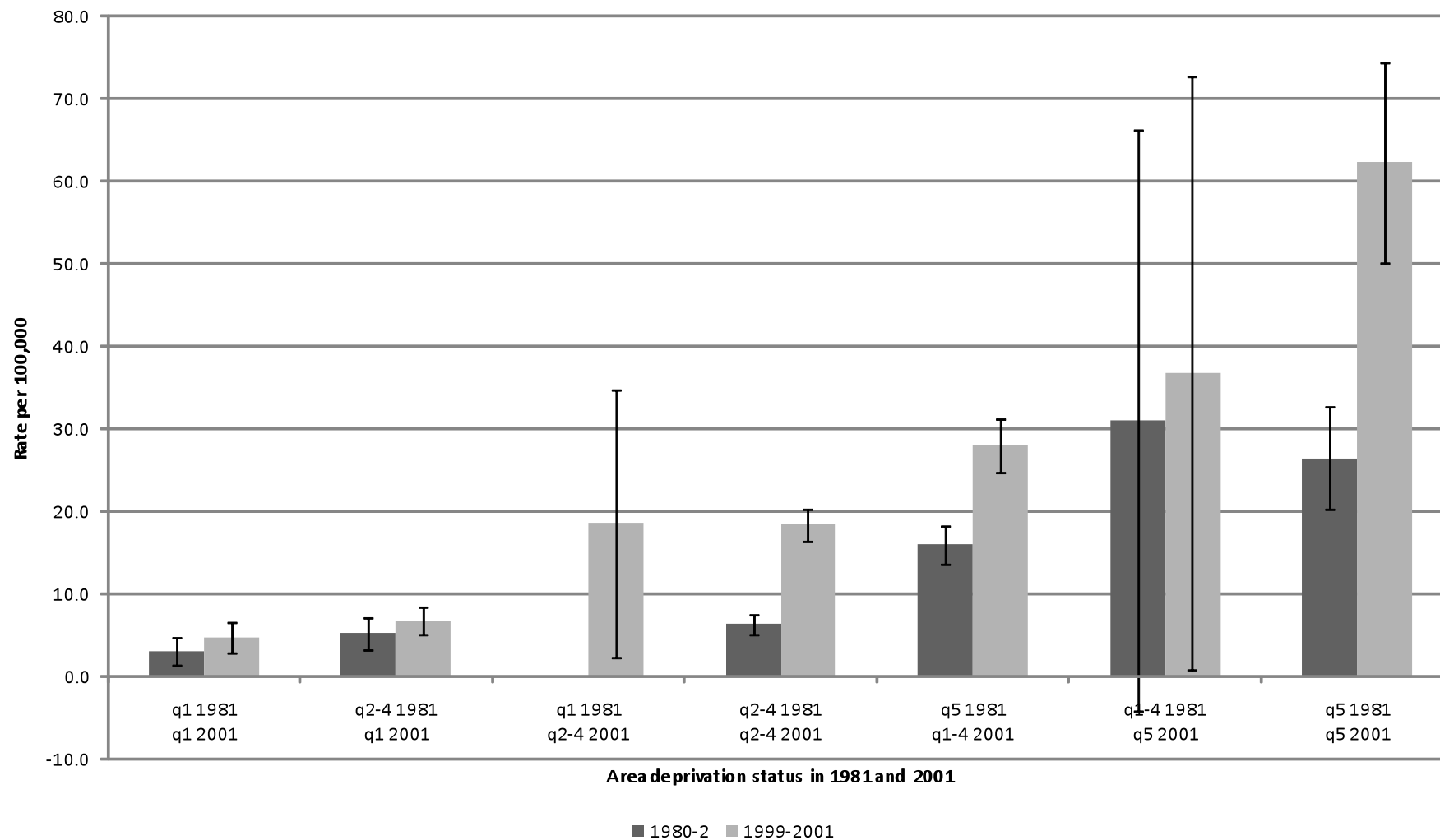
Figure 4: Premature mortality from lung cancer in Scotland, 1980-2 and 1999-2001, by deprivation (im)mobility group



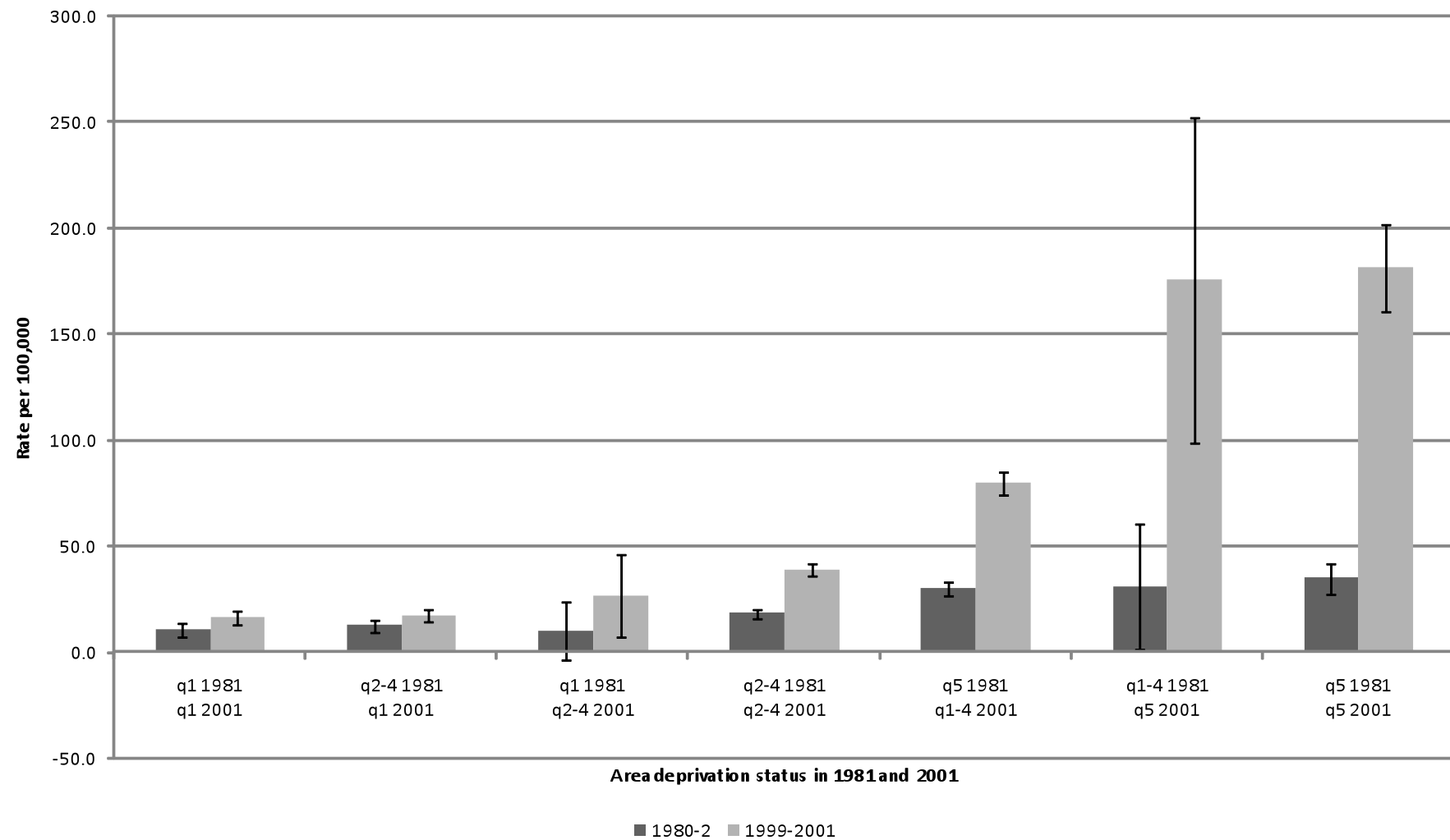
Premature mortality from suicide in Scotland, 1980-2 and 1999-2001, by deprivation (im)mobility group



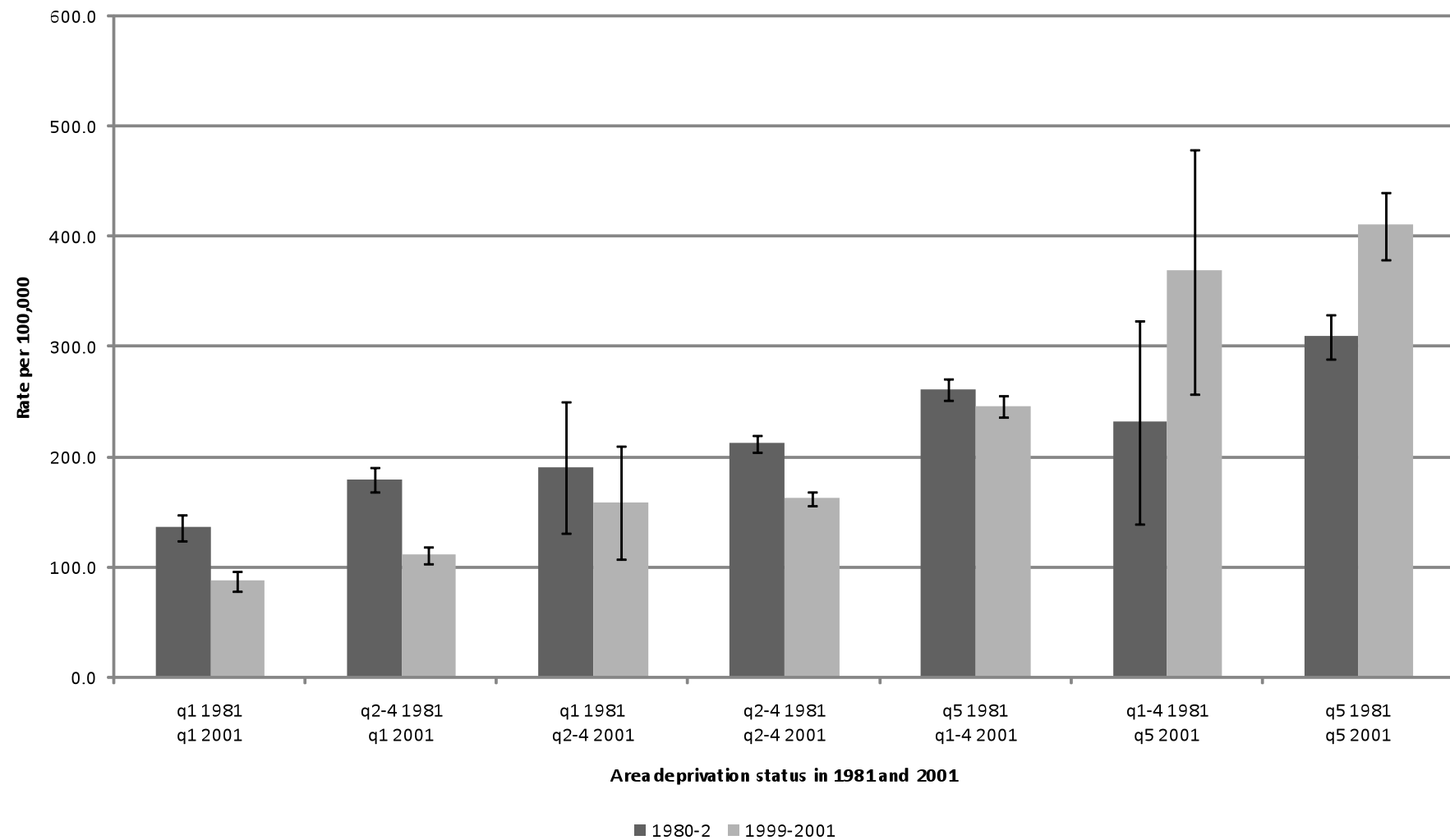
Premature mortality due to alcohol-related mental disorders in Scotland, 1980-2 and 1999-2001, by deprivation (im)mobility group



Premature mortality due to chronic liver disease in Scotland, 1980-2 and 1999-2001, by deprivation (im)mobility group



Premature mortality from all other causes combined in Scotland, 1980-2 and 1999-2001, by deprivation (im)mobility group



Discussion

Persistently deprived areas experienced falls in some major causes of death (IHD, stroke)

However, falls in IHD deaths were smaller than elsewhere and there was no fall in cancer or respiratory disease mortality

Causes of death accounting for the rise were lung cancer, suicide and alcohol-related deaths – ‘newer’ causes of death, related to ‘unfavourable lifestyles’

Discussion

Rising mortality has been identified in some other countries – Ezzati *et al.* (2008) reported rising or stagnant mortality between the 1980s and 1990s in severely poor US counties

Russia as a whole has experienced rising mortality, but this country has undergone significant socio-economic instability and associated declines in health-related behaviours

Our results represent a major public health concern in a comparatively wealthy country where a national system of health care is provided virtually free at the point of delivery

Area-based initiatives to improve the health of residents would do well to target these 593 areas that included approximately 4% of the Scottish population in 2001

