

# Migration: a “common bugbear in epidemiological or ecological studies”

(Learmonth 1988: 122)

Paul Norman

School of Geography, University of Leeds

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## Selective migration affecting local health rates?

Farr (1864)

- Migrants from urban to rural areas differ in their health from migrants moving from rural to urban areas

Welton (1872)

- South coast destination of persons with 'consumption' (TB) will have high death rates
- Return migration by elderly to their families
- Younger migrants leaving rural areas for cities healthier than those remaining behind so that origin area mortality rates were raised

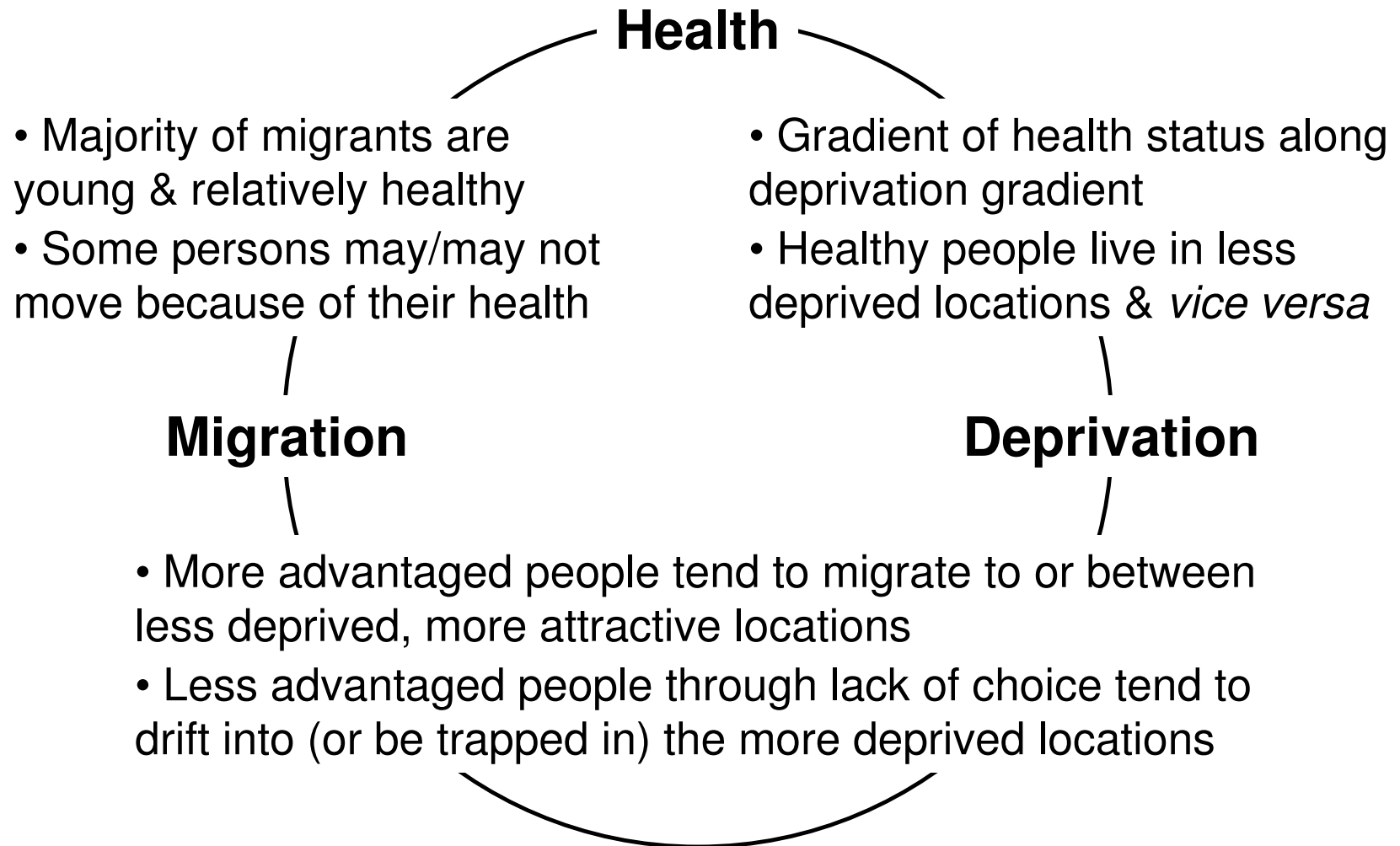
Migration a neglected factor?

- Prothero (1977), Learmonth (1988), Bentham (1988), Gatrell (2002)

Clarifications

- Migration = sub-national migration (cf. international) & = semi-permanent change of address (cf. 'mobility')
- Health = mortality, self-reported, chronic (cf. (highly) infectious disease)
- Migration process may 'cause' poor health

## Inter-relationships: health, deprivation & migration



## Population migration & small area health statistics

Various factors affect whether or not migrants **are** in and/or are **accounted for** in the numerator & denominator

### Selection

#### 2 Health-selective migration

- Are the number of 'health' events occurring likely to be affected by migration?

### Uncertainty

#### 4 Person-time-exposure

- Health outcomes dependent on: predisposition, exposure to risk, prior state, lag times, behaviours, etc. over time

Events

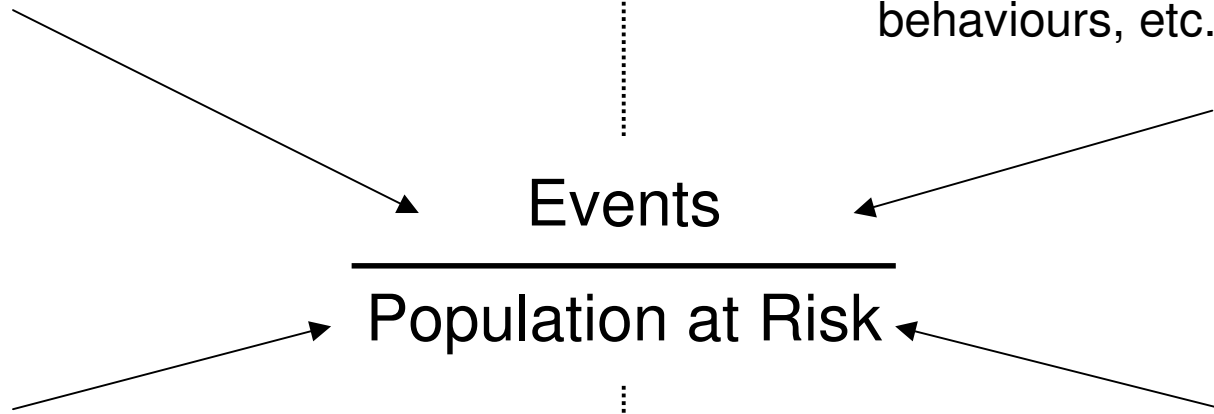
Population at Risk

#### 3 Age-sex-selective migration

- Is the size & age-sex composition of the denominator likely to be affected by migration?

#### 1 Small area denominators

- Rarely account for migration in estimates



## Population migration & small area health statistics

Some 'bugbears' ...

- Technical & practical aspects, *not about* health
- Applied aspects, *about* health

1. Small area denominators
2. Selection effects (numerators)
3. Selection effects (denominators)
4. Person-time-exposure

## Time series annual small area (ward) estimates

### 1. Addressing denominator uncertainties

Convention is for mid-year estimates (MYE) of residential populations

Migrants are entering & leaving the population during a year

MYE assumes even distribution: wrong, but accepted

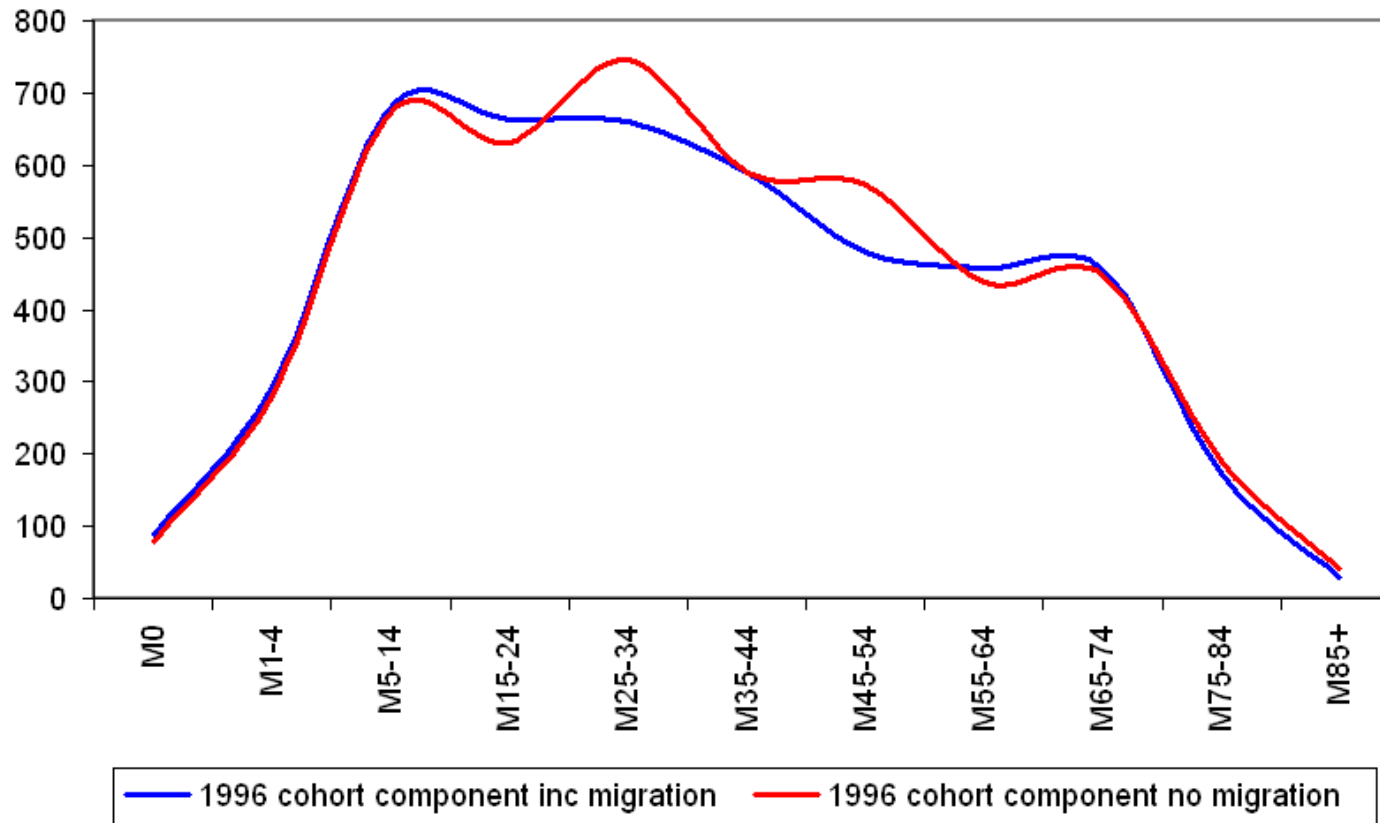
— 01/01 ————— 30/06 ————— 31/12 —→

Versatile estimates?

Mid-year estimates for wards with & without allowances for migration (various methods)

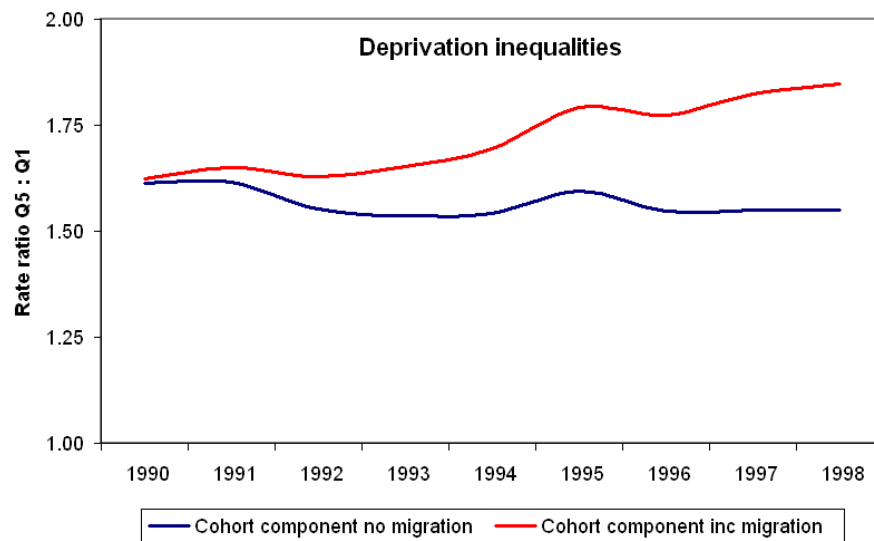
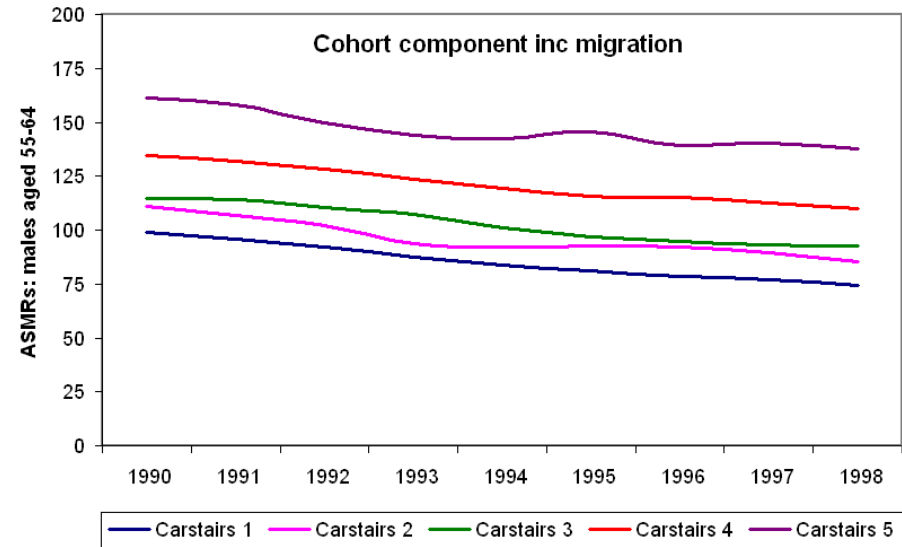
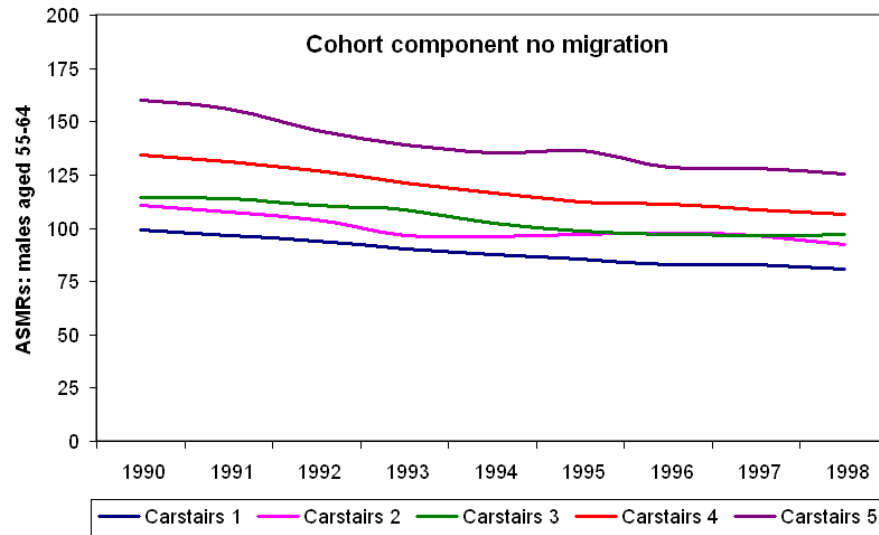
Harmonised for ward boundary changes

## Time series annual small area (ward) estimates



- Migrants, majority being young adults, if not included in estimates then population appears older in many areas
- Leads to higher 'expected' events & thus lower indirectly standardised ratios

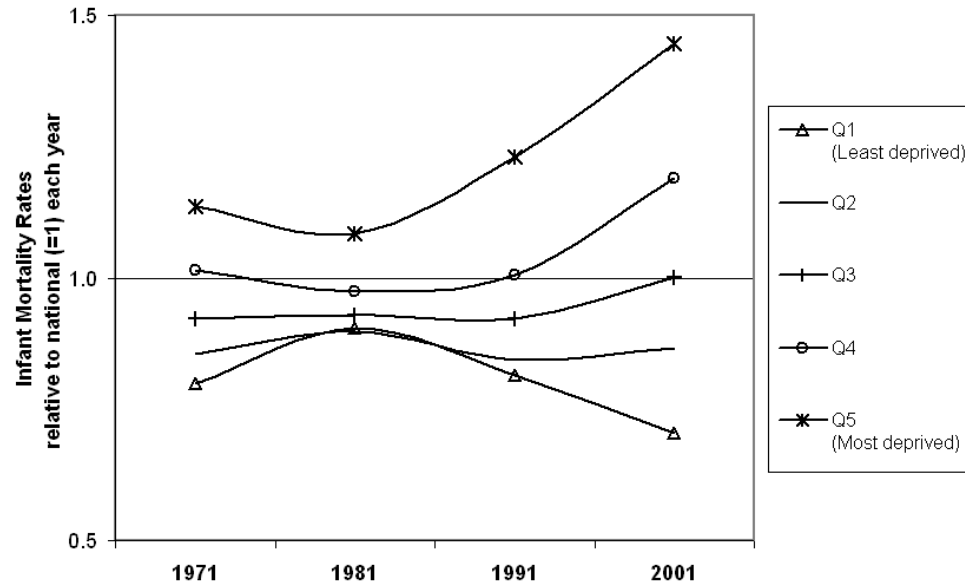
# Time series of rates in relation to deprivation



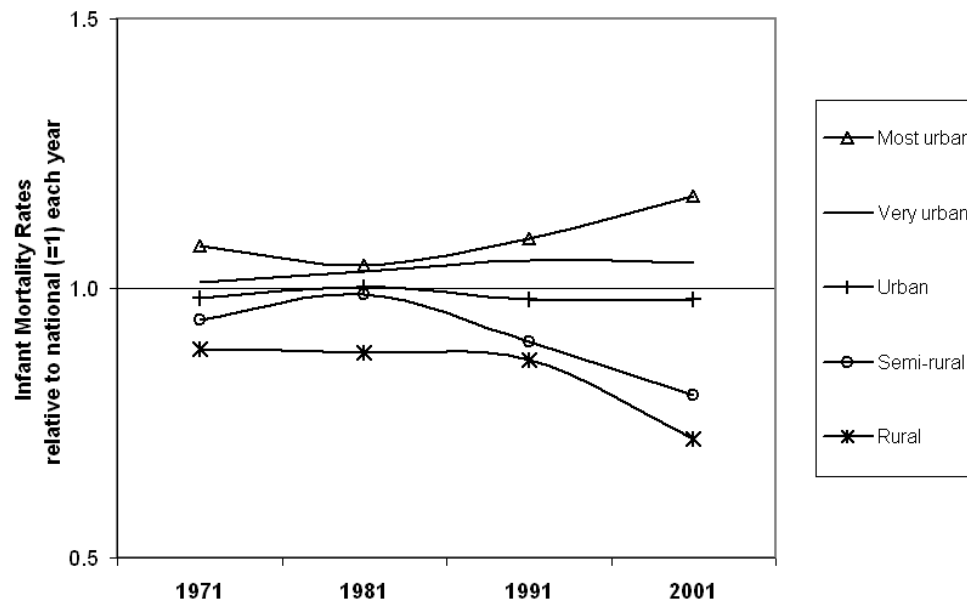
Mortality trends for males aged 55-64 ...

- Seem very similar
- Inequality interpretation might be different

# Time series of infant mortality rates: ward types



Deprivation



Urbanisation

## Population migration & small area health statistics

### 2. & 3. Selection effects

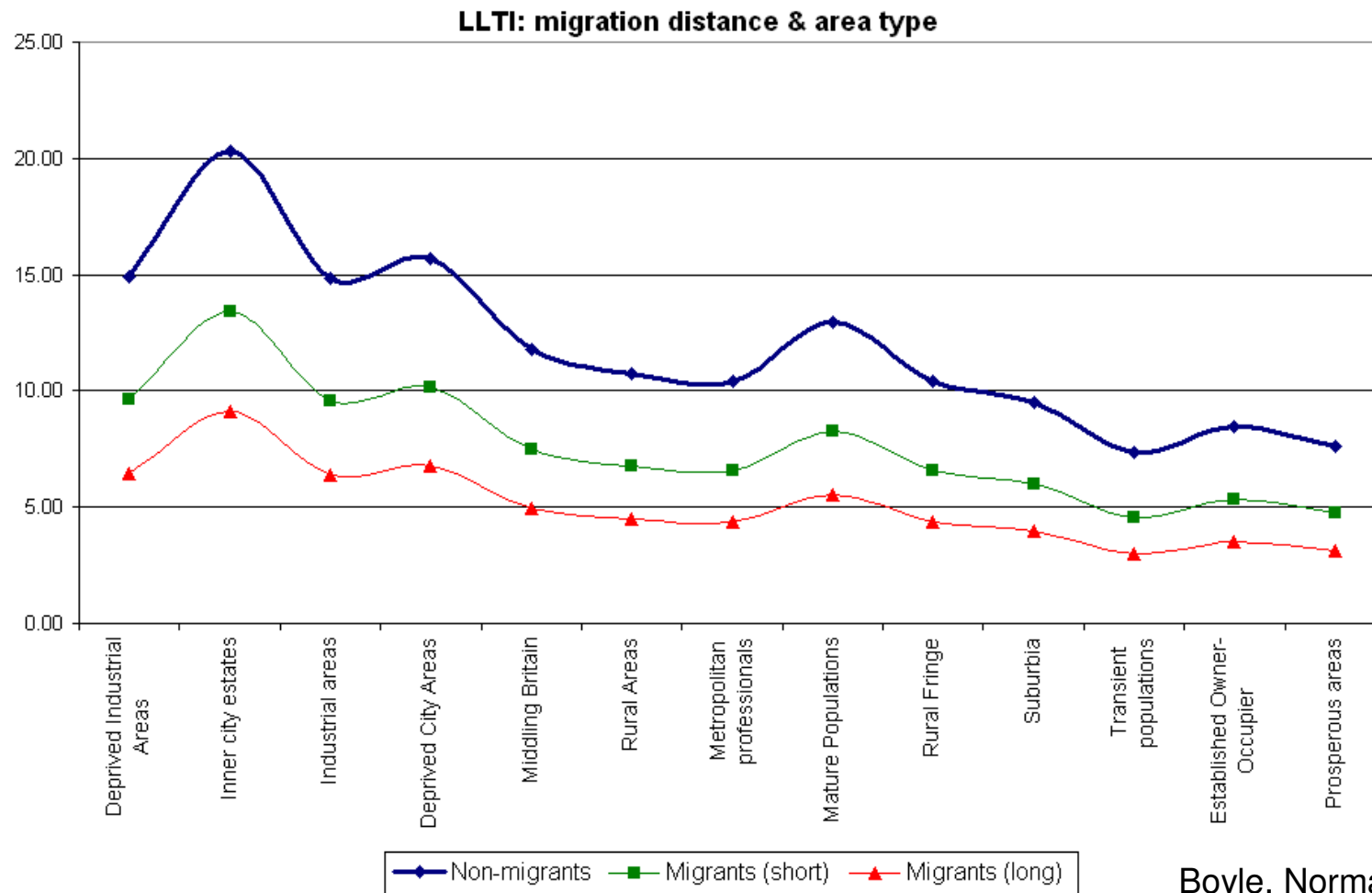
$$\frac{\text{Events}}{\text{Population at Risk}}$$

- a. Are migrants different from non-migrants & from each other?
- b. Are small area differences in health affected by migration?

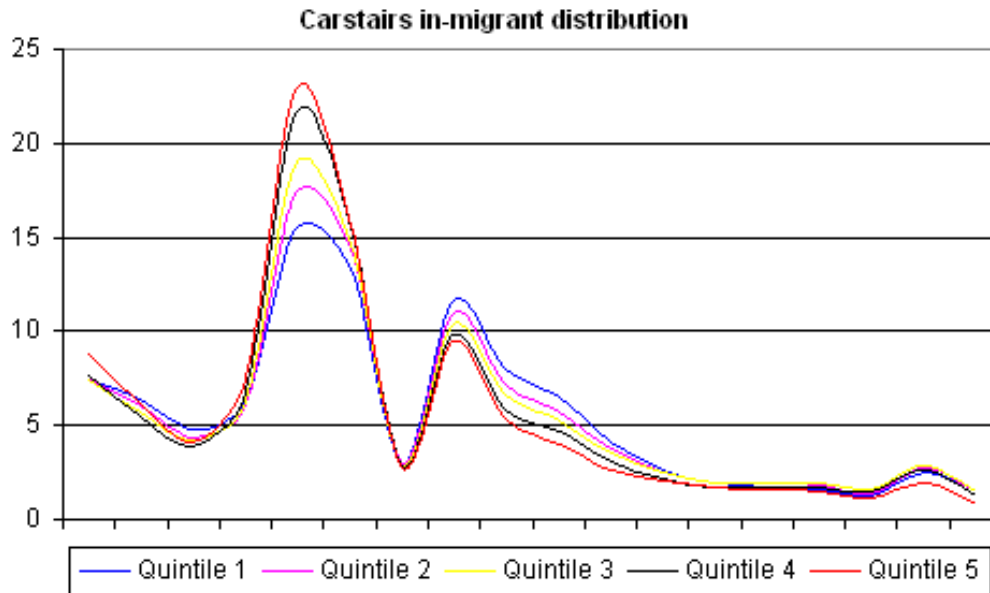
# Are migrants different from non-migrants & from each other?

1991 Sample of Anonymised Records

Modelled probability of limiting long-term illness (LLTI)

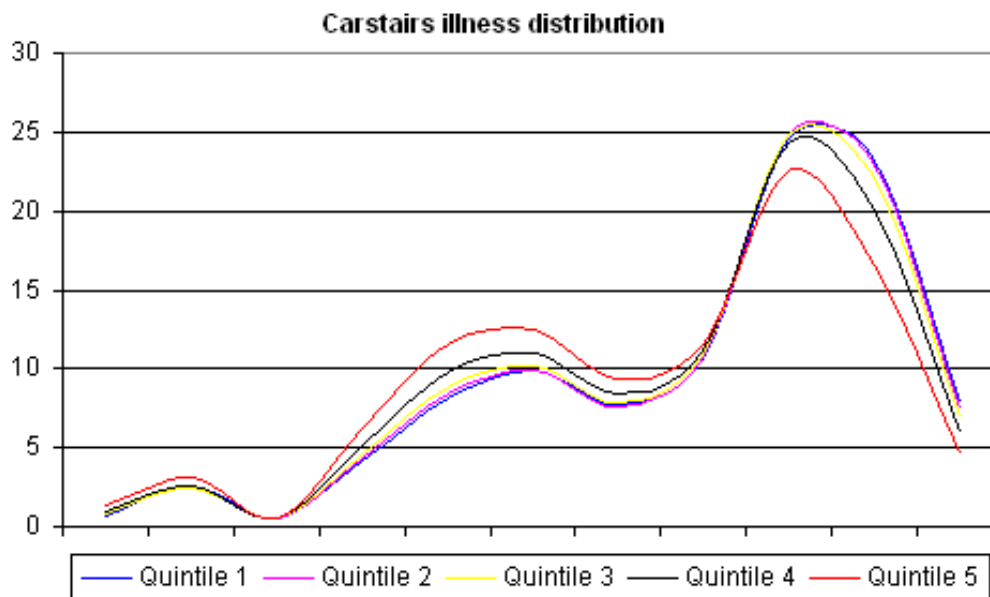


## Distinctive age profiles in relation to deprivation (LBS)



Age distribution of migration events

- Q5: younger profile
- Q1: more 'middle aged'



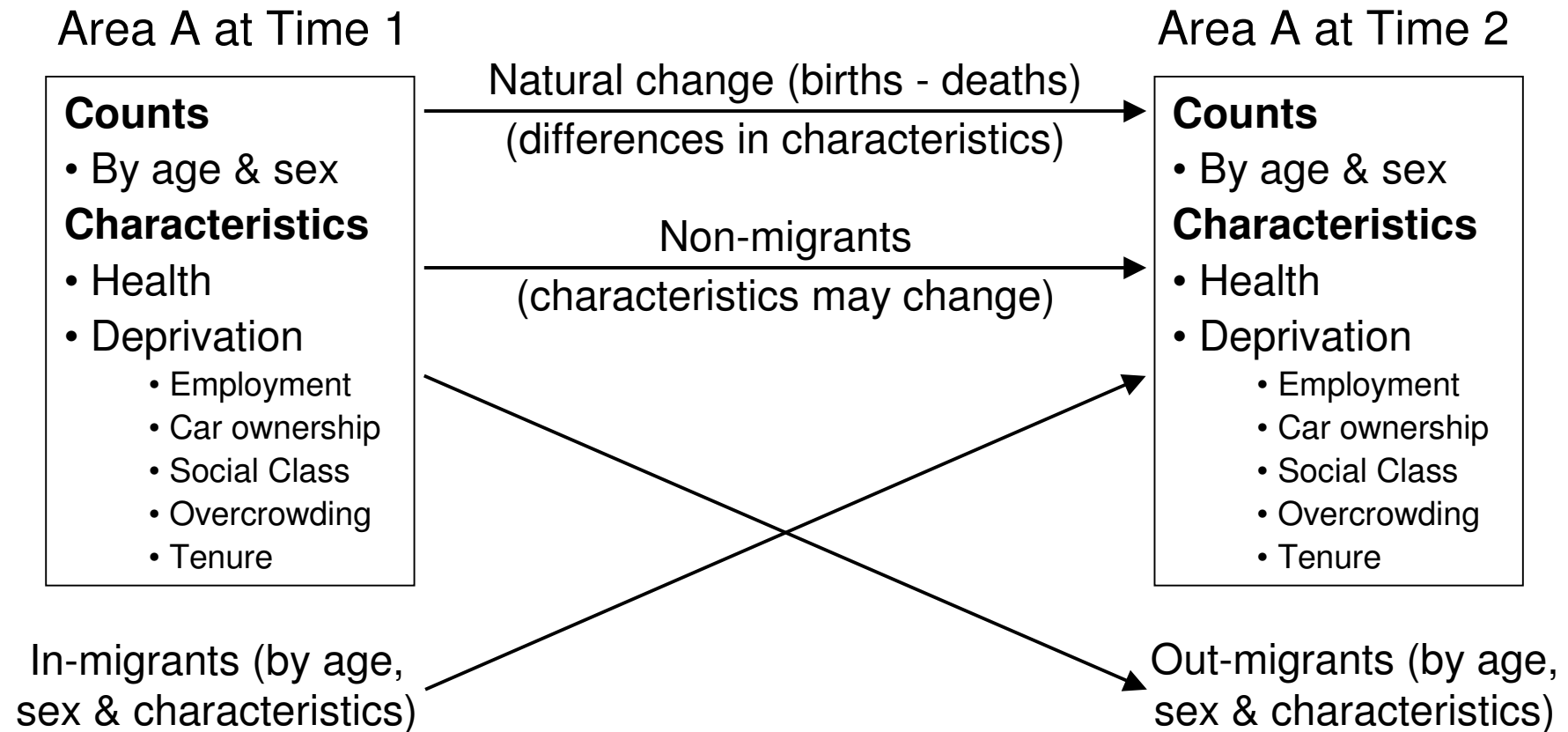
Age distribution of LLTI events

- Q5: younger profile
- Q1 & 2: older profile

*But,* only destination in SARs & LBS

## Time elements relating to health-deprivation relationship

- Population age-sex structure changes
- Population characteristics change



Do deprivation characteristics of previous time points influence health more than that of the time point of analysis?

## **Inter-relationships between health, deprivation & migration using ONS Longitudinal Study data**

Health studies often ecological, aggregate at small area (ward) level

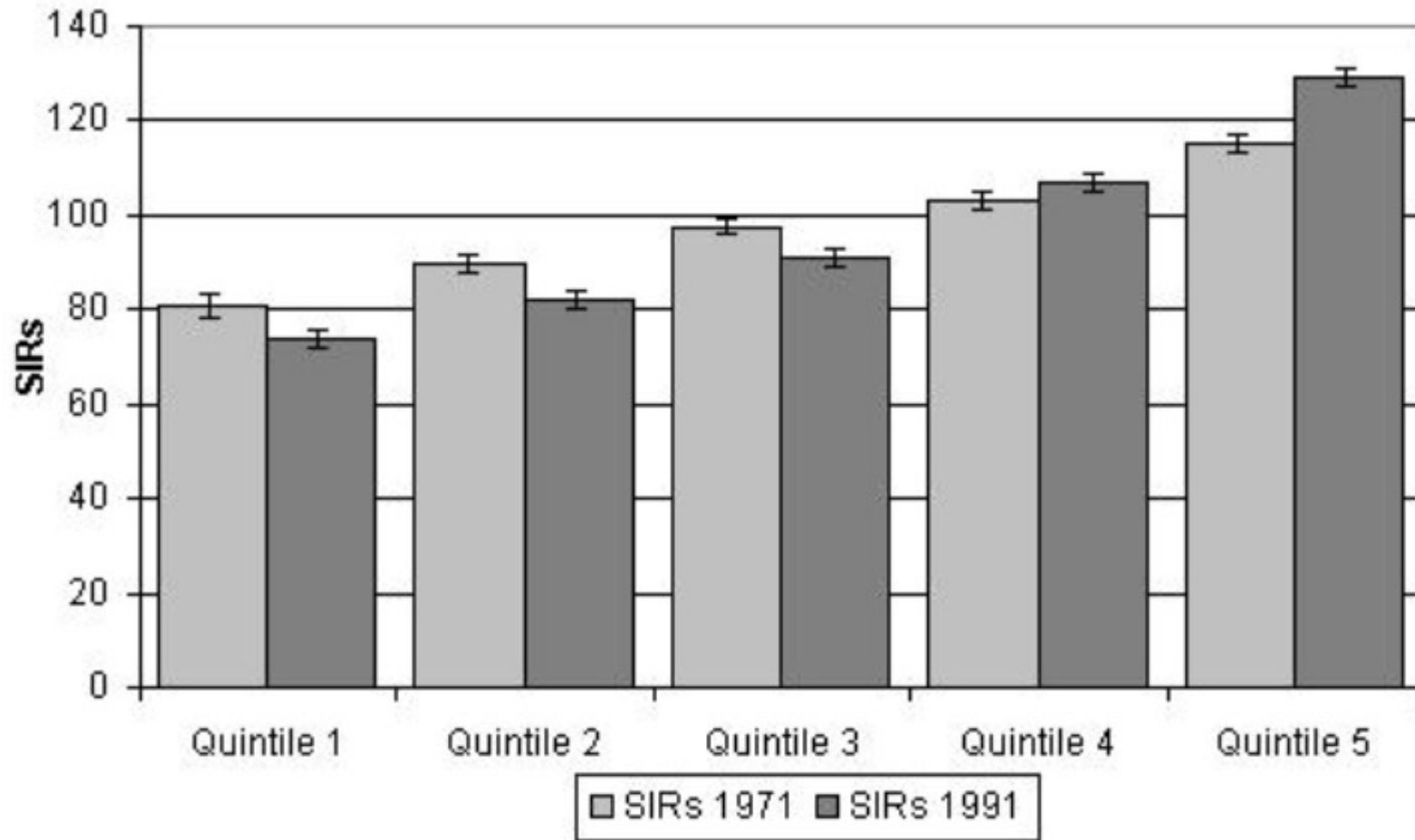
Deprivation scores ward level aggregates of individual characteristics

Aggregate individual microdata at different time points by:

- Deprivation quintile of ward of residence
- Migrant status
- Reporting of LLTI in 1991

Determine whether any differences in area-based health measures affected by migration between areas of differing deprivation level

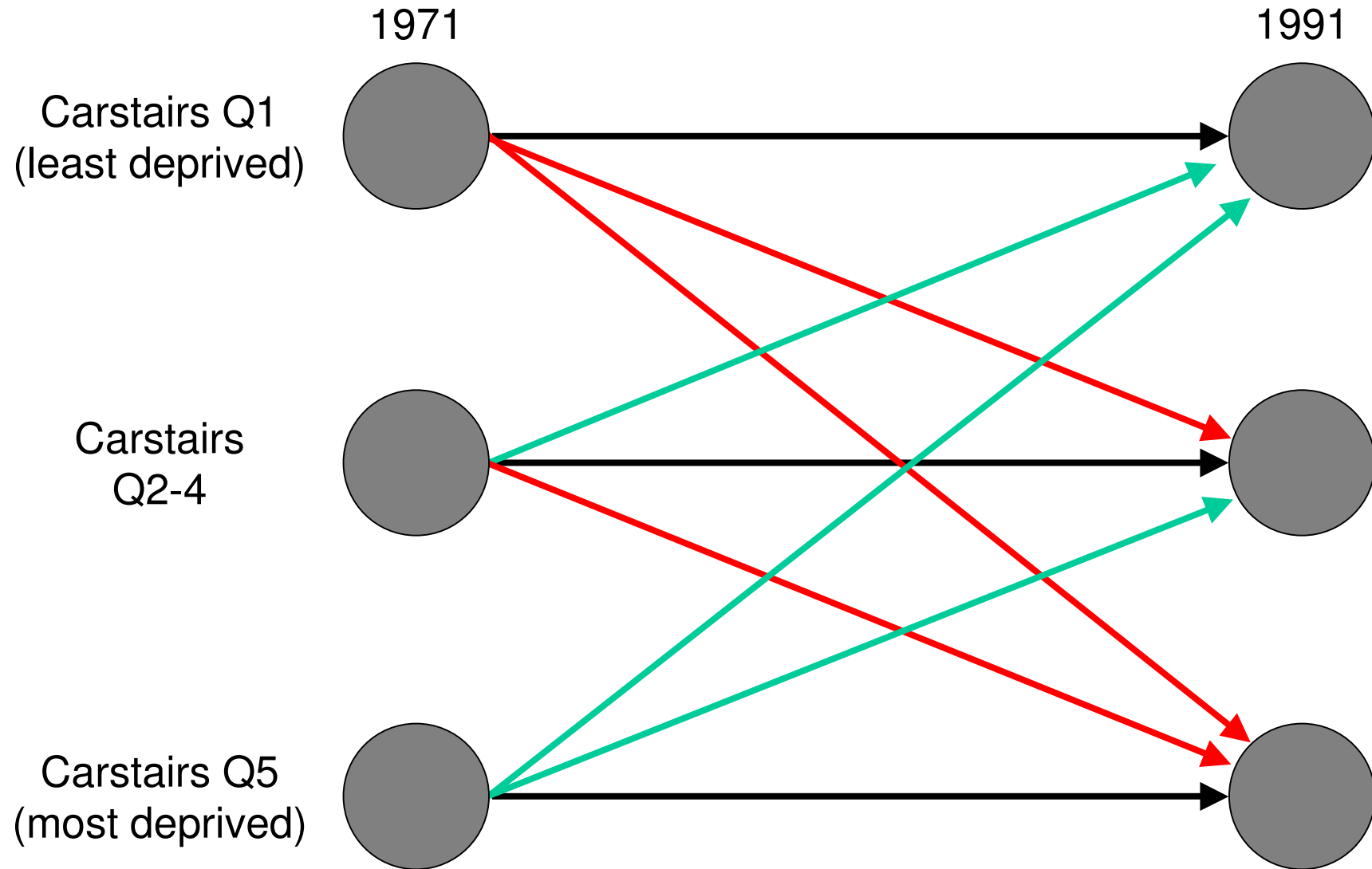
## Relationship between LLTI & deprivation



Standardised Illness Ratios (SIRs) for LS members, aggregated into Carstairs quintiles for wards in 1971 & 1991

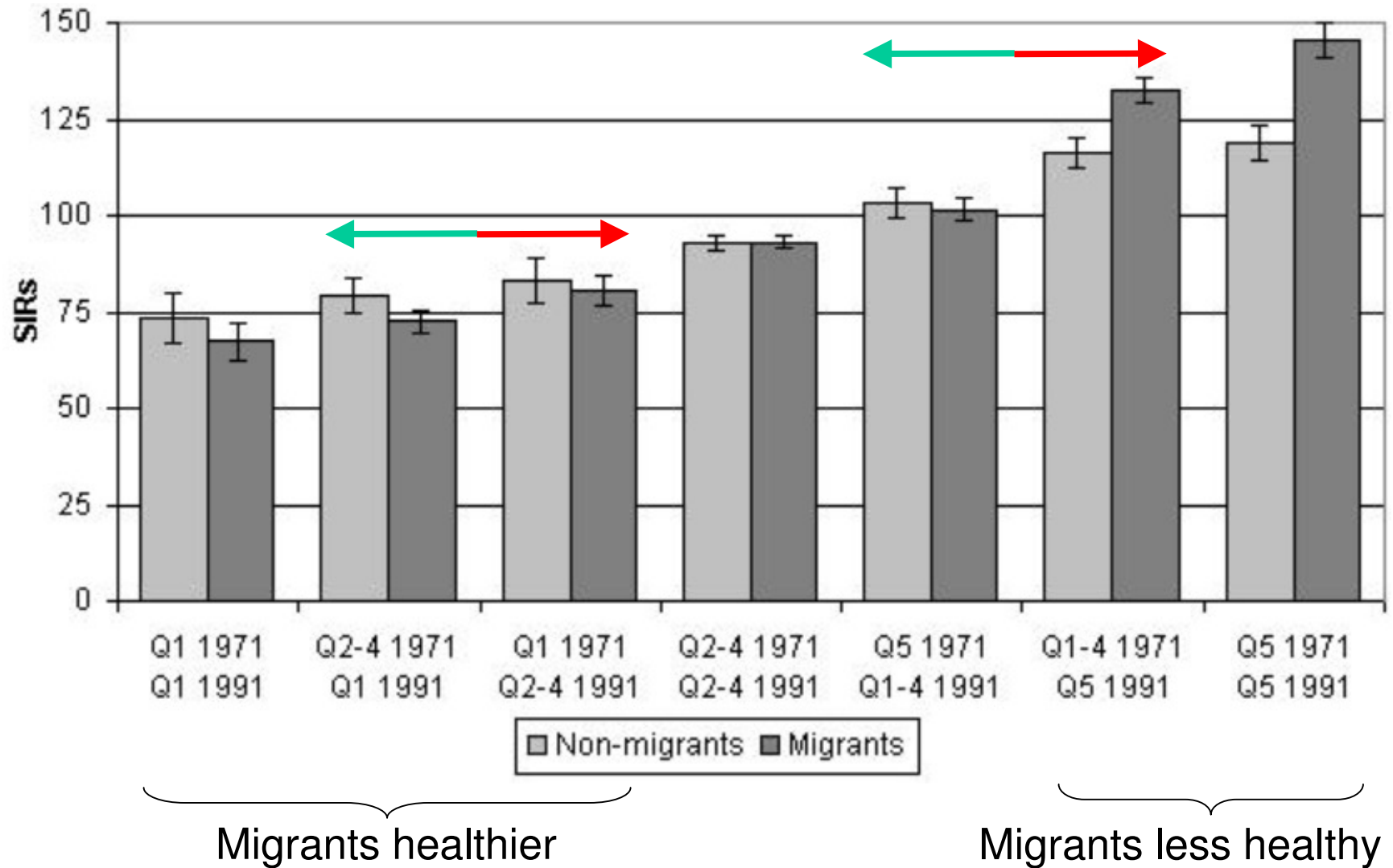
U P T A P

## Transitions between Carstairs quintiles



U P T A P

# What accounts for the inequality change? Are migrants healthier than non-migrants?



## Inter-relationships between health, deprivation & migration using LS data

### Dominant flows / processes

- Healthy, young adult migrants moving from more to less deprived areas
- Unhealthy migrants, both young & middle aged adults moving from less to more deprived areas
- Unhealthy non-migrants, immobile but in areas becoming more deprived

### But ...

- Unhealthy elderly migrants moving from more to less deprived areas

Same effects for non-migrants whose areas change deprivation

## Recent extensions to the LS work

Controlling for factors related to health inequalities & transitions between various states ...

Individual level: age, sex &

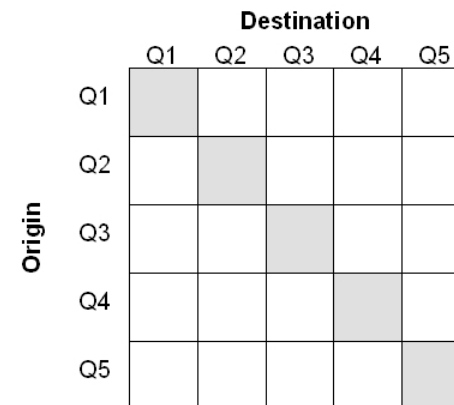
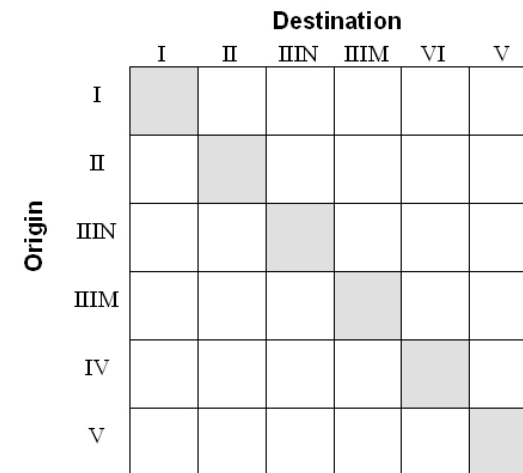
- Social mobility
- Change in tenure
- Change in car access
- Change in economic activity
- Change in living arrangements

Area level

- Deprivation mobility

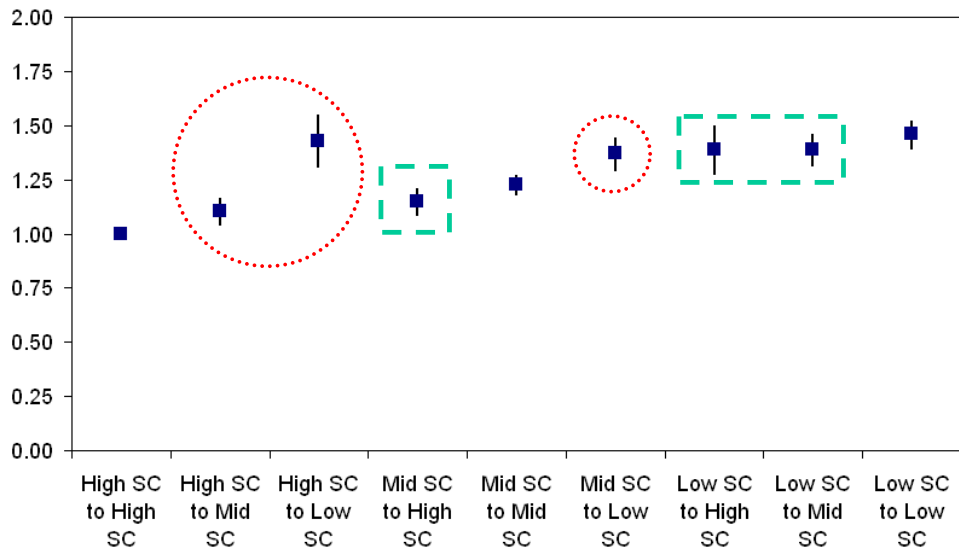
Study population

- By sub-groups which start the time period healthy
- For persons, migrants & non-migrants



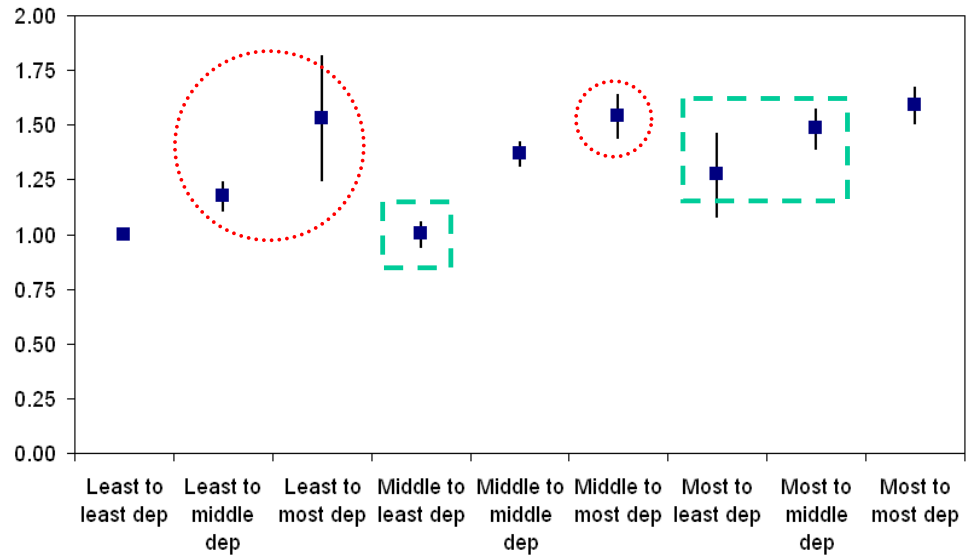
U P T A P

# Transitions between various states ... odds of LLTI in 2001



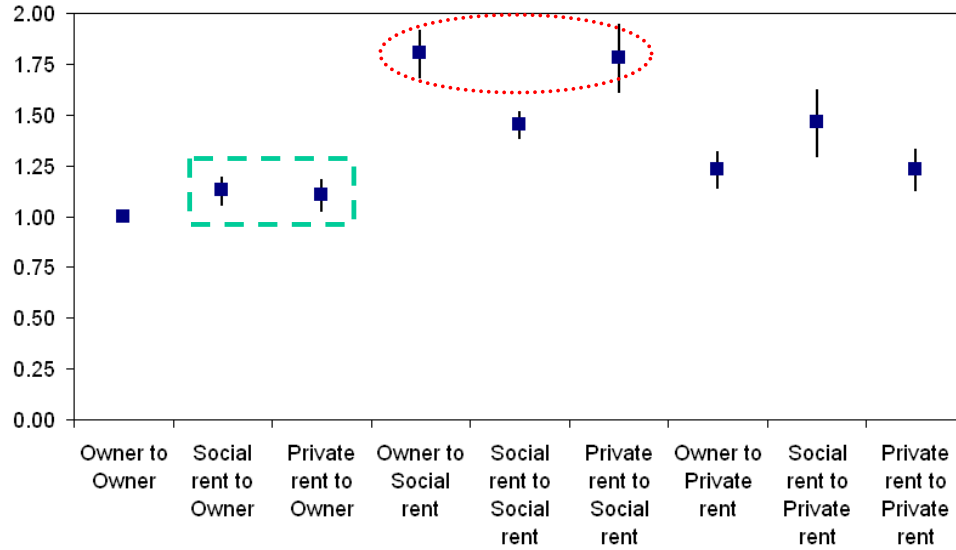
Upwardly mobile

Downwardly mobile



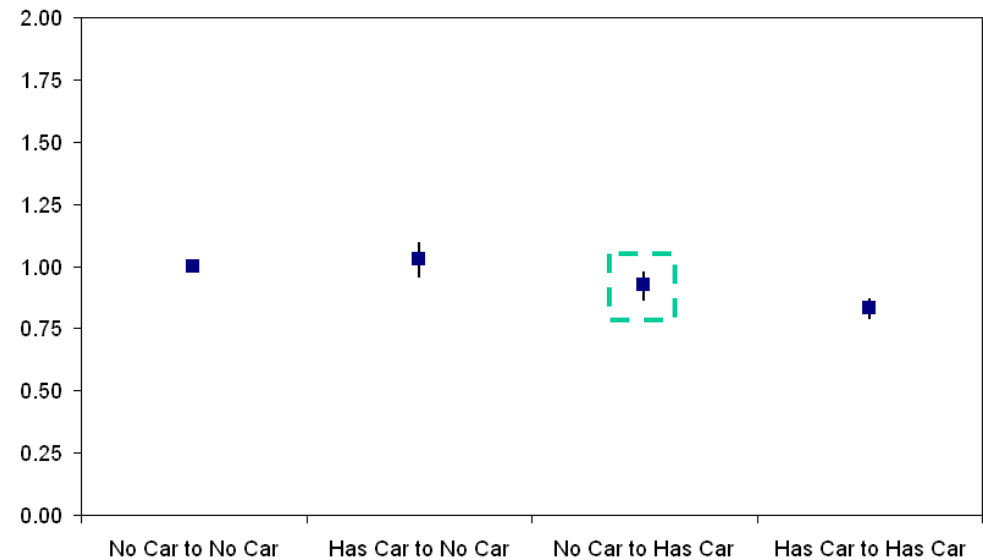
U P T A P

# Transitions between various states ... odds of LLTI in 2001



Into social rent

Into ownership



## Population migration & small area health statistics

### 4. Person-time-exposure

- Health outcomes dependent on: predisposition, exposure to risk, prior state, lag times, behaviours, etc. over time
- Health status at diagnosis or death may relate more to previous circumstances than current social class or area deprivation
- Biological development in context where advantages & disadvantages cluster cross-sectionally & accumulate longitudinally (Blane 1999)
- For population need GP records & full migration & employment history, etc
- Most life-course / cohort studies do not include information on residential area

Planning a study with Jan Rigby (Sheffield) on women's breast cancer registrations & mortality using:

- Survey data collected during screening checks
- ONS Longitudinal Study

a.) Cumulative influences on health; b.) Social Class by own, spouse & parental

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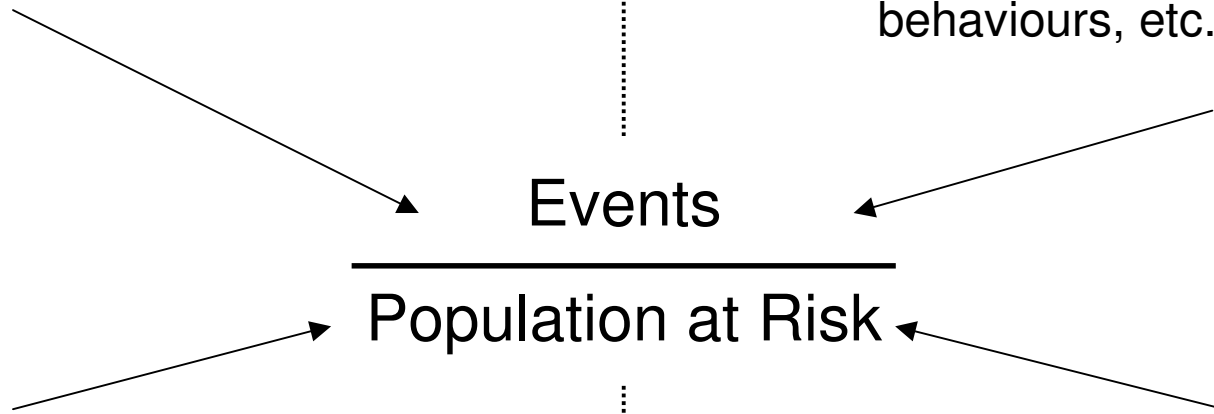
Population at Risk

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## Micro-geography of UK demographic change: 1991-2001

### Aim

- Quantify & map changes in population size & social characteristics occurring in UK's small geographical areas between the 1991 & 2001 Censuses

### Population change

- Which demographic components account for change? Balance between natural change & migration change
- Is the population ageing evenly?

### Area characteristics change

- Are areas becoming more or less deprived over time?

### Health change

- Relationship to changes in population & deprivation

## Micro-geography of UK demographic change: 1991-2001

Resources developed by consistent geography

UK: for 2001 wards & equivalents

- 1991 to 2002 annual age-sex estimates
- 1990 to 2002 births & deaths
- 1991 & 2001 Townsend & Carstairs deprivation scores

Norman (2006)

Norman, Simpson & Sabater (2007)

England & Wales: for 2001 wards

- 1981 to 2002 annual age-sex estimates
- 1990 to 2002 births & deaths
- 1981, 1991 & 2001 Townsend & Carstairs deprivation scores

Geographical Data Conversions

- 1981 & 1991 Census data to 2001 geography

Norman, Rees & Boyle (2003)

## Micro-geography of UK demographic change: 1991-2001

Resources can enable analyses ...

- Time-series of demographic & health rates
- Mortality & limiting long-term illness change in relation to changing deprivation
- Mortality & limiting long-term illness change in relation to changing population (shrinking populations)
- Postcoded data can be linked to ward geography

Income inequalities? Investigate as deprivation inequalities

A pull-up / pull-down model?

- “Poorer areas surrounded by less deprived areas would benefit from the better resources in the wider locality, while less deprived areas surrounded by poorer areas may be hampered by the poorer resources available nearby” Cox, Boyle et al. (2007)

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## References (PN)

- Boyle P, Norman P & Rees P (2002) Does migration exaggerate the relationship between deprivation and limiting long-term illness? A Scottish analysis. *Social Science & Medicine* 55: 21-31
- Boyle P, Norman P & Rees P (2004) Changing places: do changes in the relative deprivation of areas influence limiting long-term illness and mortality among non-migrant people living in non-deprived households? *Social Science & Medicine* 58: 2459-2471
- Norman P (2006) Sociodemographic spatial change in the UK: data and computational issues and solutions. *GIS Development special issue Maps & Census* 10(12): 30-34
- Norman P, Boyle P & Rees P (2005) Selective migration, health and deprivation: a longitudinal analysis. *Social Science & Medicine* 60(12): 2755-2771
- Norman P, Gregory I & Dorling D (2007) Geographical trends in infant mortality: England and Wales, 1971-2001. *Health Statistics Quarterly* (submitted)
- Norman P, Rees P & Boyle P (2003) Achieving data compatibility over space and time: creating consistent geographical zones. *International Journal of Population Geography*. Vol 9, Issue 5, September-October 2003: 365-386
- Norman P, Simpson S & Sabater A (2007) 'Estimating with Confidence' and hindsight: new UK small area population estimates for 1991. *Population, Space & Place* (submitted)
- Rees P, Brown D, Norman P & Dorling D (2003) Are socioeconomic inequalities in mortality decreasing or increasing within some British regions? An observational study, 1990-98. *Journal of Public Health Medicine*. 25(3): 208-214
- Rees P, Norman P & Brown D (2004) A framework for progressively improving small area population estimates. *Journal of the Royal Statistical Society A*. Vol. 167 Part 1: 5-36

## References (others)

- Bentham G (1988) Migration and morbidity: implications for geographical studies of disease. *Social Science & Medicine* 26 49-54
- Blane D (1999) The life course, the social gradient and health. In Marmot M & Wilkinson R G (eds.) *Social Determinants of Health*. Oxford: Oxford University Press
- Cliff A D & Haggett P (1988) *Atlas of Disease Distributions: Analytical Approaches to Epidemiological Data*. Blackwell: Oxford
- Cox M, Boyle P J, Davey P G, Feng Z & Morris A D (2007) Locality deprivation and Type 2 diabetes incidence: A local test of relative inequalities. *Social Science & Medicine*, 65(9): 1953-1964
- Farr, W. (1864). Supplement to the 25th Annual Report of the Registrar General. HMSO: London
- Gatrell A C (2002) *Geographies of health: an Introduction*. Blackwell: Oxford
- Inskip H, Beral V, Fraser P & Haskey J (1983) Methods for age adjustment of rates. *Statistics in Medicine* 2: 455-466
- Julious S A, Nicholl J & George S (2001) Why do we continue to use standardised mortality ratios for small area comparisons? *Journal of Public Health Medicine* 23(1): 40-46
- King P E (1979) Problems of spatial analysis in geographical epidemiology. *Social Science & Medicine* 13D: 249-52
- Learmonth A (1988) *Disease Ecology: an Introduction*. Basil Blackwell: Oxford
- Openshaw S & Taylor P J (1981) The modifiable areal unit problem in *Quantitative Geography: A British View* edited by Wrigley N & Bennett R J. Routledge & Kegan Paul: London; 335-50
- Prothero R (1977) Disease and mobility: a neglected factor in epidemiology. *International Journal of Epidemiology* 6: 259-67
- Robinson W S (1950) Ecological correlations and the behaviour of individuals. *American Sociological Review* 15: 351-357
- Welton, T.A. (1872). On the effect of migrations in disturbing local rates of mortality, as exemplified in the statistics of London and the surrounding country, for the years 1851-1860. *Journal of the Institute of Actuaries* 16: 153
- Yule G U (1934) On some points relating to the vital statistics of occupational mortality. *Journal of the Royal Statistical Society* 97: 1