Trends in social inequalities in life expectancy at older ages in England from 1981 to 2007: *decomposition by age and cause of death*

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Outline

• Background, research questions
• Why use decomposition? Methods
• Trends in inequality in life expectancy (LE) by socio-economic circumstances (SEC)
• Decomposing LE change within SEC groups
• Decomposing LE difference between SEC groups
• Limitations
• Summary
Background

• Actuaries set mortality assumptions for people in different socioeconomic groups
• May use pensioners data to establish current differences in mortality between groups
• But modelling of future trends by **socioeconomic position** uncertain because:
  – Lack of reliable historical trend data
  – Lack of understanding of contributory factors to change in mortality patterns
Previous research: key insights into UK trends overall

- ‘ageing of mortality improvement’ in 2nd half of 20th C – Willets. Modal age of death peaking at progressively higher ages for both sexes
- Mortality improvements accelerated in last decade of 20th C
- Attributed mostly to rapid falls in heart disease mortality
- Inequality gap – manual workers mostly die from the same diseases as non-manual, but at a higher rate at any given age – Ridsdale & Gallop
Why decomposition?

• Trends in the gap in LE between groups are a function of both:
  – Differentials in the pace of decline in age-specific mortality (differentials in rates of improvement)
  – Inter-group differences in the age pattern of mortality (differentials in baseline mortality)
• Decomposition quantifies and summarises the effect of both these sets of changes:
  – across time AND between groups;
  – by age and cause of death (CoD)
• Method – Andreev E, Shkolnikov V.
Our research questions

• Primary focus on trends in INEQUALITIES
• Which causes of death contributed to gains in life expectancy at older ages between 1985 and 2005 in different socioeconomic groups? By how much and at what age?
• Which causes of death contributed most to the inequality gap in life expectancy? And have these changed over the period?
Methods

• Inequalities by socioeconomic circumstances (SEC): census areas grouped into quintiles by increasing deprivation (IMD 2007)

  **Q1=least deprived  Q5=most deprived**

• Data: 1981-2007, England by SEC quintiles. Mortality counts from ONS; population estimates from Dr Paul Norman, Leeds University

• Estimates calculated as 3-year averages

• Cause of Death (CoD) – adjusted for ICD change using ONS bridge coded dataset 1999

• Decomposition method : Shkolnikov, Andreev
Trends in life expectancy at age 65, least and most deprived quintiles, England

Males, 1982-2006

Females, 1982-2006
Males: Trends in Qx’s for ages over 65 least vs most deprived
25 year trends in Qxs for ages over 65, Females: least vs most deprived

Least Deprived (Q1)

Most Deprived (Q5)
Gradient in LE@65 gains, 1981-2007
To recap..

- LE@65 has increased year on year for both men and women in England
- It has increased both in advantaged and deprived groups
- But there is a social gradient in gains, with differentials greater in men than in women
- The gap in LE between the most and least deprived fifths of the population has increased by about one year in both sexes
- ….similar results to previous analysis, but more robust with annual trend data of total population
Decomposition of LE@50

Analysis of change:
1. Within SEC groups over time (trend decomposition):
   1. which age groups contributed most to the increase in LE?
   2. Which causes of death contributed most to gains?

2. Between SEC groups (gap decomposition):
   1. Which causes of death contributed, and by how much, to the SEC differential in years 1985, 1995 and 2005?

• Decomposition into 6 ICD chapters + ‘Other’
• Separate analysis by sex
## Common causes of death under each ICD Chapter group (age 50+, England)

<table>
<thead>
<tr>
<th>ICD Chapter</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cancer</td>
<td>Lung (trachea, bronchus), Colon (rectum, anus), Breast, Prostate</td>
</tr>
<tr>
<td>Circulatory</td>
<td>Ischemic heart disease, Cerebrovascular disease</td>
</tr>
<tr>
<td>Respiratory</td>
<td>Influenza &amp; pneumonia, Chronic obstructive respiratory disease (bronchitis, emphysema, asthma, other chronic)</td>
</tr>
<tr>
<td>Digestive</td>
<td>Peptic ulcer, Cirrhosis and chronic liver disease, Hernia</td>
</tr>
<tr>
<td>Mental/Behavioural</td>
<td>Dementia, Substance abuse</td>
</tr>
<tr>
<td>Injury/Poisoning</td>
<td>Non-transport accidents, Intentional self-harm, Motor vehicle accidents</td>
</tr>
<tr>
<td>Other</td>
<td>Diabetes mellitus, Renal failure, Parkinson’s, Alzheimer’s disease</td>
</tr>
</tbody>
</table>
Within group change: (1)

**Gains in LE@50 over time**

<table>
<thead>
<tr>
<th>LE@50</th>
<th>1985</th>
<th>1995</th>
<th>2005</th>
<th>Total Change 1985-2005 (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MALES</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q1</td>
<td>27.5</td>
<td>29.3</td>
<td>32.1</td>
<td>4.6</td>
</tr>
<tr>
<td></td>
<td>(+1.8)</td>
<td>(+2.8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q5</td>
<td>22.2</td>
<td>24.1</td>
<td>26.3</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>(+1.9)</td>
<td>(+2.1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FEMALES</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q1</td>
<td>31.9</td>
<td>33.0</td>
<td>34.9</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>(+1.2)</td>
<td>(+1.9)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q5</td>
<td>27.8</td>
<td>29.2</td>
<td>30.6</td>
<td>2.8</td>
</tr>
<tr>
<td></td>
<td>(+1.4)</td>
<td>(+1.4)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Decomposition by age of within group difference in LE@50 over 2 decades: Men

Men 1985 to 1995
Q1 (affluent)= 1.8 years gained
Q5 (deprived) = 1.9 years gained

Men 1995 to 2005
Q1 (affluent)= 2.8 years gained
Q5 (deprived) = 2.1 years gained
Decomposition of within group difference in LE@50 over whole period 1985 to 2005, Men and Women

Men
Q1 (affluent) = 4.6 years gained
Q5 (deprived) = 4.0 years gained

Women
Q1 (affluent) = 3.0 years gained
Q5 (deprived) = 2.8 years gained
Cause decomposition of within group change in LE@50: 1985 to 2005, Men

Men, Q1 (4.6 years)

Men, Q5 (4.0 years)
Cause decomposition of within group change in LE@50: 1985 to 2005, Women

Women, Q1 (3.0 years)  

Women, Q5 (2.8 years)
Summarising the ‘within group’ trends:
Men

- LE gains concentrated in ages 70+ (55%) affluent men, but in ages <70 in deprived men (57%)
- For both affluent and deprived groups, decline in heart disease mortality major contributor to LE gains, adding more years in Q1 than Q5 (3.4y vs 2.9y).
- In contrast, gains from redn in Cancer mortality were larger in Q5 (0.9y vs 0.6) but were negated by increases in digestive disease mortality -0.2y).
Summarising the ‘within group’ trends: Women

• Large gains in years at older ages due to declining circulatory disease, particularly in most affluent
• Decretments in gains in Q1 only at the oldest age (85+) attributable to Alzheimer's/ Parkinson’s
• But decrements for women in Q5 due to excess mortality from digestive diseases <65, and respiratory diseases 65+
## Between group change: Gaps in LE@50 over time

<table>
<thead>
<tr>
<th>LE@50</th>
<th>1985</th>
<th>1995</th>
<th>2005</th>
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<tr>
<td><strong>MALES</strong></td>
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<td></td>
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<tr>
<td>Q1</td>
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<td>32.1</td>
<td>4.6</td>
</tr>
<tr>
<td>Q5</td>
<td>22.2</td>
<td>24.1</td>
<td>26.3</td>
<td>4.0</td>
</tr>
<tr>
<td>Gap, M</td>
<td>5.3</td>
<td>5.2</td>
<td>5.9</td>
<td></td>
</tr>
<tr>
<td><strong>FEMALES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q1</td>
<td>31.9</td>
<td>33.0</td>
<td>34.9</td>
<td>3.0</td>
</tr>
<tr>
<td>Q5</td>
<td>27.8</td>
<td>29.2</td>
<td>30.6</td>
<td>2.8</td>
</tr>
<tr>
<td>Gap, F</td>
<td>4.0</td>
<td>3.8</td>
<td>4.3</td>
<td>21</td>
</tr>
</tbody>
</table>
Inequality: difference between groups, Q1 vs Q5, Men

1985 (5.3 years)

2005 (5.9 years)
Inequality: difference between groups, Q1 vs Q5, Women

1985 (4.0 years)

2005 (4.3 years)
Summary - 1

- Inequalities in the life expectancy gap at age 50 have increased between 1985 and 2005 for both sexes
- Because
  - The pace of decline in mortality rates in all age groups faster in affluent areas, particularly from 1995 onwards
  - Large gains from fall in heart disease mortality across all SEC groups, but again faster in affluent areas particularly at older ages
  - Heart disease gains offset by real increases in rates of digestive and respiratory disease mortality in deprived groups
  - The contribution of cancer to the inequality gap remained relatively constant (ie pace of change similar in Q1 and Q5)
Summary - 2

- Men gained more years than women overall, but women gained more years at oldest ages.
- Life expectancy gap remained wider for men than women, and increased more between 1985-2005
- Wider messages:
  - Attention needed to stem the increase in digestive, respiratory deaths in deprived populations by focusing on behavioural change (alcohol, smoking) at younger ages
  - Considerable scope to reduce heart disease mortality in disadvantaged groups
  - With continued falls in heart disease mortality at older ages, cancer may soon overtake it as the leading cause of death (NZ)
Limitations

• Vulnerable to systematic changes in cause coding over time or between groups
• Reliability of cause-coding at oldest ages?
• Affords insights not explanations: difference in death rates between 2 groups/2 periods may be due to changing:
  – Severity of disease
  – Quality of care
• Quintile allocation fixed over time
• IMD - Health domain included, ecological fallacy
Next steps

- Understand trends in annual rates of improvement in total mortality by SEC 1981-2007 (paper in progress)
  - …and by main causes of death by SEC (paper in progress)
- …… Build epidemiological CHD model by SEC 2000-07 (completed, paper submitted)
- …………to help develop epidemiological projection models.
Thanks to my co-authors..

- **Shaun Scholes**, Research Fellow, UCL
- **Joseph Lu**, Mortality Risk Actuary, L&G
- **Prof David Blane**, Imperial College
- **Prof Rosalind Raine**, Head, Healthcare Evaluation Group, UCL
Questions or comments?

Thank you.

The views expressed in this presentation are those of the presenter.
RESERVE slides
Index of Multiple Deprivation, 2007

- IMD 2007: a composite Index of Multiple Deprivation calculated at lower super output area (LSOA) level (av pop=1,500).
- IMD combines 7 domains of relative deprivation: Income, employment, health & disability, education & skills, access to services & housing, crime, quality of physical environment
- LSOAs grouped into equal fifths of areas by increasing deprivation (Q1 = affluent; Q5 = most deprived)
- LSOA deprivation group allocation in 2007 remained fixed over the whole analysis period (1994-2008)
Decomposition Method

- Decomposition aims at estimating contributions of differences between elementary rates of demographic events (age-specific rates) to the overall difference between two values of the aggregate measure (e.g., life expectancy).
- Uses stepwise replacement method to calculate the contribution of age components of overall life expectancy difference.
- Age component difference partitioned in proportion to the cause-specific death rate difference in each age group.

Refs
Age decomposition equations

\[ e_0^2 - e_0^1 = \sum_{x=0}^{\omega-1} \delta_{x}^{2-1} \]

\[ \delta_{x}^{1-2} = l_{x}^{1}(e_{x}^{1} - e_{x}^{2}) - l_{x+1}^{1}(e_{x+1}^{1} - e_{x+1}^{2}) \]

\[ \delta_{x} = \frac{1}{2} \cdot (\delta_{x}^{2-1} - \delta_{x}^{1-2}) \]