How Big An Impact Does Socio-economic Status Have On Cause Of Death Rates?

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Joint work with C. Redondo, D. Blake, K. Dowd, M. Kallestrup-Lamb, C. Rosenskjold, A.S. Macdonald

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Outline

- Danish data:
  - affluence
  - education
  - cause of death
- US cause of death data by education group
- Comparison: Denmark vs US
- English data: early stages
Purpose of looking at cause of death data

- What are the key drivers of all-cause mortality?
- How are the key drivers changing over time?
- Which causes of death have high levels of inequality:
  - by education;
  - by affluence?
- Can we point to specific causes of death as responsible for growing inequality?
- Beware of
  - changes in ICD classification of deaths (1998-99)
  - drift in how deaths are classified
  - changing education levels (grade inflation)
- Insight into mortality underpinning life insurance and pensions
Danish Data: Cairns et al. (2017)

- Statistics Denmark National Register Database

- Key data (amongst others) for each individual:
  - Date of birth (⇒ age)
  - Date of death
  - Wealth
  - Income
  - Affluence = Wealth + 15 × Income
  - Education
  - Cause of Death
### Education (Denmark)

<table>
<thead>
<tr>
<th>Education Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low education</td>
<td>Primary and lower secondary education</td>
</tr>
<tr>
<td>Medium education</td>
<td>Upper secondary education</td>
</tr>
<tr>
<td>High education</td>
<td>Tertiary education</td>
</tr>
</tbody>
</table>

*(No education data for cohorts born before 1922.)*

### Affluence

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Low affluence <em>decile</em></td>
</tr>
<tr>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>10</td>
<td>High affluence <em>decile</em></td>
</tr>
</tbody>
</table>
Age Standardised Death Rates, Age Group 55-64

Age Standardised Mortality Rates per 1000 Ages 55–64 by Affluence

Age Standardised Mortality Rates per 1000 Ages 55–64 by Education

Low Affluence
High Affluence

Low Education
High Education

Andrew J.G. Cairns Socio-Economic Mortality
Deaths subdivided into 29 CoD groups
Age groups 31-35, 36-40, ..., 91-95
Compare affluence groups
Compare education groups
<table>
<thead>
<tr>
<th></th>
<th>Cause of Death Data – Health Inequalities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1. Infectious diseases incl. tuberculosis</td>
</tr>
<tr>
<td>2</td>
<td>2. Cancer: mouth, gullet, stomach</td>
</tr>
<tr>
<td>3</td>
<td>3. Cancer: gut, rectum</td>
</tr>
<tr>
<td>4</td>
<td>4. Cancer: lung, larynx, ..</td>
</tr>
<tr>
<td>5</td>
<td>5. Cancer: breast</td>
</tr>
<tr>
<td>6</td>
<td>6. Cancer: uterus, cervix</td>
</tr>
<tr>
<td>7</td>
<td>7. Cancer: prostate, testicular</td>
</tr>
<tr>
<td>8</td>
<td>8. Cancer: bones, skin</td>
</tr>
<tr>
<td>9</td>
<td>9. Cancer: lymphatic, blood-forming tissue</td>
</tr>
<tr>
<td>10</td>
<td>10. Benign tumours</td>
</tr>
<tr>
<td>11</td>
<td>11. Diseases: blood</td>
</tr>
<tr>
<td>12</td>
<td>12. Diabetes</td>
</tr>
<tr>
<td>13</td>
<td>13. Mental illness</td>
</tr>
<tr>
<td>14</td>
<td>14. Meningitis + nervous system (Alzh.)</td>
</tr>
<tr>
<td>15</td>
<td>15. Blood pressure + rheumatic fever</td>
</tr>
<tr>
<td>16</td>
<td>16. Ischaemic heart diseases</td>
</tr>
<tr>
<td>17</td>
<td>17. Other heart diseases</td>
</tr>
<tr>
<td>18</td>
<td>18. Diseases: cerebrovascular</td>
</tr>
<tr>
<td>19</td>
<td>19. Diseases: circulatory</td>
</tr>
<tr>
<td>20</td>
<td>20. Diseases: lungs, breathing</td>
</tr>
<tr>
<td>21</td>
<td>21. Diseases: digestive</td>
</tr>
<tr>
<td>22</td>
<td>22. Diseases: urine, kidney,...</td>
</tr>
<tr>
<td>23</td>
<td>23. Diseases: skin, bone, tissue</td>
</tr>
<tr>
<td>24</td>
<td>24. Senility without mental illness</td>
</tr>
<tr>
<td>25</td>
<td>25. Road/other accidents</td>
</tr>
<tr>
<td>26</td>
<td>26. Other causes</td>
</tr>
<tr>
<td>27</td>
<td>27. Alcohol → liver disease</td>
</tr>
<tr>
<td>28</td>
<td>28. Suicide</td>
</tr>
<tr>
<td>29</td>
<td>29. Accidental Poisonings</td>
</tr>
</tbody>
</table>
Denmark – Affluence – Top 10 CoD

Ages 71-75; Years 2005-2009

<table>
<thead>
<tr>
<th>Rank</th>
<th>Least Affluent</th>
<th>Most Affluent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ischaemic heart</td>
<td>Skin/bone cancer</td>
</tr>
<tr>
<td>2</td>
<td>Respiratory</td>
<td>Ischaemic heart</td>
</tr>
<tr>
<td>3</td>
<td>Lung cancer etc.</td>
<td>Prostate cancer</td>
</tr>
<tr>
<td>4</td>
<td>Skin/bone cancer</td>
<td>Respiratory</td>
</tr>
<tr>
<td>5</td>
<td>Other</td>
<td>Lung cancer etc.</td>
</tr>
<tr>
<td>6</td>
<td>Cerebrovascular</td>
<td>Cerebrovascular</td>
</tr>
<tr>
<td>7</td>
<td>Other heart</td>
<td>Other</td>
</tr>
<tr>
<td>8</td>
<td>Diabetes</td>
<td>Other heart</td>
</tr>
<tr>
<td>9</td>
<td>Gut cancer</td>
<td>Gut cancer</td>
</tr>
<tr>
<td>10</td>
<td>Prostate cancer</td>
<td>Alzheimers etc.</td>
</tr>
</tbody>
</table>

Prostate: almost no inequality
### Denmark – Education – Top 10 CoD

Ages 71-75; Years 2005-2009

<table>
<thead>
<tr>
<th>Rank</th>
<th>Low Education</th>
<th>High Education</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ischaemic heart</td>
<td>Skin/bone cancer</td>
</tr>
<tr>
<td>2</td>
<td>Respiratory</td>
<td>Ischaemic heart</td>
</tr>
<tr>
<td>3</td>
<td>Lung cancer etc.</td>
<td>Lung cancer etc.</td>
</tr>
<tr>
<td>4</td>
<td>Skin/bone cancer</td>
<td>Respiratory</td>
</tr>
<tr>
<td>5</td>
<td>Cerebrovascular</td>
<td>Prostate cancer</td>
</tr>
<tr>
<td>6</td>
<td>Other heart</td>
<td>Cerebrovascular</td>
</tr>
<tr>
<td>7</td>
<td>Other</td>
<td>Other heart</td>
</tr>
<tr>
<td>8</td>
<td>Prostate cancer</td>
<td>Other</td>
</tr>
<tr>
<td>9</td>
<td>Gut cancer etc.</td>
<td>Gut cancer etc.</td>
</tr>
<tr>
<td>10</td>
<td>Circulatory</td>
<td>Circulatory</td>
</tr>
</tbody>
</table>
Denmark: Cause of Death Data 2005-2009

Danish Males by Education
Diabetes

Danish Males by Affluence
Diabetes

Affluence ⇒ much wider
High levels of mortality inequality
Denmark: Cause of Death Data 2005-2009

Danish Males by Education
Liver diseases (e.g. alcohol)

Danish Males by Affluence
Liver diseases (e.g. alcohol)

Very large differences in middle ages.
Danish Males by Education
Accidental Poisonings

Danish Males by Affluence
Accidental Poisonings

Low affluence ⇒ over 20× at young ages
Many causes of death have known risk factors or drivers
e.g. smoking, diet, healthy lifestyle etc.
⇒ clear socio-economic differences

Biggest differences at ages < 60

Affluence ⇒ stronger predictor than education
(sometimes very much stronger)

Other diseases do not have strong differences:
Denmark: Cause of Death Data 2005-2009

Danish Males by Education
Cancer: prostate, testicular

Danish Males by Affluence
Cancer: prostate, testicular

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Denmark: Cause of Death Data 2005-2009

Danish Males by Education
Cancer: lymphatic, blood-forming tissue

Danish Males by Affluence
Cancer: lymphatic, blood-forming tissue

Education ⇒ no effect
Affluence ⇒ small effect
Denmark: Cause of Death Data 2005-2009

Danish Males by Education
Cancer: gut, rectum

Danish Males by Affluence
Cancer: gut, rectum

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Denmark: Cause of Death Data – Health Inequalities

- Some causes of death have no obvious link to lifestyle/affluence/education
  e.g. Prostate Cancer
  CancerUK: *Prostate cancer is not clearly linked to any preventable risk factors.*
  Possible unavoidable risk factors: genetic; race

- But Affluence ⇒ inequalities

- Possible explanations (a very non-expert view)
  - *onset* is not dependent on lifestyle/affluence/education
  - BUT less affluent/educated ⇒
    - ??? later diagnosis
    - ??? engage less well with treatment process
    - ??? unhelpful environment
    - ??? genetic/racial
US Education Data

Data sources:

- Human Mortality Database (aggregate exposures)
- CDC individual deaths records
- Current Population Survey (CPS) ⇒ population education levels
US Education Data

- Males and Females (2)
- Single ages 40-89 (50)
- Single years 1989-2015 (27)
- Causes of death (30)
- Low ($\leq$ high school) & high ($\geq$ some college) education level (2)

Note 1: further separation of high into (a) < bachelors degree and (b) $\geq$ bachelors degree was found to be unreliable.
Note 2: HMD’s Human Cause of Death Database ⇒
All ages (5’s), 1999-2013 BUT no education subdivision
US Education Data

Note 1: some improvements above age 60
Note 2: widening gap
Recall: Denmark ⇒ very narrow gap
US wider gap: health insurance inequalities; genetic/racial
US Education Data: Males Age 55 – Top Causes

Year 2000
Ischaemic heart diseases

Year 2015
Ischaemic heart diseases

Improvements
Widening gap
Widening gap
Some worsening, some improving
Widening gap, some improvements

Improvements possibly linked to smoking prevalence
US Education Data

Widening gap
Modest improvements
US Education Data

Case & Deaton (2015) ⇒ Deaths of Despair
Widening gap
Modest improvements for high education
US Education Data

Mixed picture
US Education Data

Year 2000
Accidental Poisonings

Year 2015
Accidental Poisonings

Case & Deaton (2015) ⇒ Deaths of Despair

Socio-Economic Mortality
US Education Data

Case & Deaton (2015) ⇒ Deaths of Despair↗
US Males Age 63 / 61-65

Males, Age 63, All Cause Mortality

Death Rate (log scale)

Year

US low education
US high education

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Socio-Economic Mortality
US Males Aged 63, Low Education, Changes in CoD Death Rates

- Ischaemic heart diseases
- Cancer: lung, larynx, ...
- Cancer: bones, skin
- Diseases: lungs, breathing
- Other heart diseases
- Diabetes
- Cerebrovascular diseases incl. stroke
- Cancer: mouth, gullet, stomach
- Cancer: gut, rectum
- Road/other accidents
- Alcohol −> liver
- Cancer: lymphatic, blood−forming tissue
- Blood pressure + rheumatic fever
- Diseases: digestive
- Infectious Diseases, excl HIV
- Diseases: urine, kidney, ...
- Nervous system incl. Alzheimers
- Diseases: circulatory
- Other causes
- Cancer: prostate, testicular
- Mental illness
- Suicide
- Diseases: blood
- Accidental Poisonings
- HIV/AIDS
- Diseases: skin, bone, tissue
- Benign tumours
US versus Denmark, Males Age 63 / 61-65

Males, Age 63, Ischaemic heart diseases

Death Rate (log scale)

Year


ICD−9 ICD−10

Denmark low education
Denmark medium education
Denmark high education
US low education
US high education

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Socio-Economic Mortality
US versus Denmark, Males Age 63 / 61-65

Males, Age 63, Cancer: bones, skin

Year
Death Rate (log scale)

ICD-9
ICD-10

Denmark low education
Denmark medium education
Denmark high education
US low education
US high education
US versus Denmark, Males Age 63 / 61-65

Males, Age 63, Diseases: lungs, breathing

Year

Death Rate (log scale)
1e-05 5e-05 5e-04 5e-03
● ● ● ● ●

US low education
US high education
Denmark low education
Denmark medium education
Denmark high education

ICD−9 ICD−10

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Socio-Economic Mortality
US versus Denmark, Males Age 63 / 61-65

Males, Age 63, Other heart diseases

Death Rate (log scale)


Denmark low education
Denmark medium education
Denmark high education
US low education
US high education

Denmark not impacted by IMD change???

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Socio-Economic Mortality
Wider US gap: access to healthcare post-diagnosis + genetic/racial???
No preventable risk factors, but Denmark much higher???
Potentially genetic/racial???
Further remarks

- Need to factor in changing levels of educational attainment
- Can we link smoking prevalence to e.g. lung cancer mortality?
- Working on obtaining English data by socio-economic × geographic groups and cause of death
- Built from small geographical areas rather than individual records.
Summary

- Affluence better than education for all CoD if you have the data
- Impact of affluence/education varies with CoD
- Significant levels of inequality for most of the big CoD’s
- Impact of education varies between countries (e.g. different health systems)
- Work in progress!

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Thank You!

Questions?

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