Life-course predictors of mortality inequalities

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Outline

Background & Aims

Methods

- New Zealand Longitudinal Census (NZLC)
- New Zealand Census Mortality Study (NZCMS)

Some early results

- Siblings discordant for income
- Unemployment

Conclusions and Next Steps
Background

Mortality rates in New Zealand (and worldwide) continue to decline

- Number of deaths per year standardised by age, sex

But socio-economic inequalities have increased (or, at least, not decreased)

- Large variation in mortality rates by socio-economic conditions (and ethnicity)

What can be done about this?

- Need to understand nature of socio-economic influences in mortality in New Zealand, and the factors that ameliorate the effects of socio-economic risk.
  - One way – take a life-course approach
Background

- **New Zealand Census Mortality Study (NZCMS)**
  - Linked Mortality Data to each Census from 1981–2006
  - Number of proximal factors important
    - Socio-economic status (SES), ethnicity, smoking, air pollution
  - Determine time trends and cause of death trends

- **New Zealand Longitudinal Census (NZLC)**

- Linking the two gives up to 25 years of socio-economic & other data linked to mortality
  - Understand life-course factors important for mortality
Aims

Four research aims:

1. To test which ‘life-course hypotheses’ best explain associations between socio-economic status and mortality
2. To test whether social and cultural factors protect against socio-economic risk
3. To assess whether ethnic disparities in mortality are explained by the greater experiences of long-term socio-economic disadvantage
4. To assess mortality among siblings discordant for (i) socio-economic risk, or (ii) social and cultural factors
Aim 1.
Life course Hypotheses

1. Accumulation Hypothesis
- Socio-economic influence on mortality accumulates across the life-course
  - Mortality risk increases with increasing time in poverty

2. Critical or Sensitive Period Hypothesis
- Critical. Socio-economic circumstances affect mortality only if experienced at certain periods of life
- Sensitive. Effect of socio-economic experiences on mortality are stronger at some ages than others.
Aim 1.
Life course Hypotheses

3. Social Mobility Hypothesis
- Directional change in socio-economic circumstances impact mortality
  - Mortality risk increases with deteriorating socio-economic conditions; and decreases with improving socio-economic conditions

4. Instability Hypothesis
- Unstable socio-economic conditions over the life-course will be associated with mortality
  - Mortality risk increases with increasing socio-economic instability
Life course Hypotheses
Intervention Implications

- **Accumulation hypothesis** suggests an intervention targeting all age groups.

- **Critical/Sensitive period hypothesis** suggests intervention at certain life-stages only.

- **Mobility hypothesis** suggests lifting people out of poverty (or preventing slides into poverty) should be an intervention target.

- **Instability hypothesis** suggests buffering against unpredictability.
Aim 2.
Social and Cultural Factors

What ameliorates effects of socio-economic conditions?

- Important from intervention point of view

- Social factors? Social support has been shown to lower mortality risk
  - Other factors: volunteering

- Cultural factors? Ethnic density (neighbourhood concentration of one’s own ethnic group) has been associated with better health among Māori, and with mortality in other jurisdictions
  - Other factors: language, religion, time in New Zealand
Aim 3. Explain Ethnic disparities

- Ethnic disparities in mortality in NZ are large
  - Māori have mortality rates that are 2.5 times, and Pacific 1.6 times, that of non-Maori, non-Pacific.

- 30-40% of inequalities between Māori and non-Māori explained by socio-economic factors in the years immediately preceding death.
  - How much could be explained if socio-economic factors were assessed over a greater portion of the life course?
  - And do social and cultural factors play a role?
Aim 4. Discordant Sibling Analyses

- Use of a Census cohort containing data within family units allows us to compare mortality rates for siblings differently exposed to socio-economic risk
  - ‘Discordant sibling design’ eliminates confounding associated with shared family background, and partly controls for genetic confounding

- RQ: Is life course SES associated with mortality once family background effects have been controlled using a discordant sibling design
METHODS
Methods - Overview

Link
Longitudinal census records (NZLC)

To
Mortality records (NZCMS)
  • 3 years following 1981, 1986, 1991 and 1996 censuses
  • 5 years following 2001 and 2006 censuses

Using
Census IDs
Privacy and Ethics

- Individuals not identifiable, and not monitored. Group comparisons only.

- Two privacy impact assessments undertaken for NZLC
  - “risk to an individual of a privacy breach is extremely low”
  - Risk of breach no greater than for individual census data use

- NZCMS undergone privacy assessment and has ethical approval from the Central Regional Ethics Committee

- University of Auckland Human Ethics Committee granted approval for proposed research (ref 012400)
NZLC
- What is it?

  - ‘Backwards’: $t \rightarrow t-1$ (e.g., 2006 → 2001)

- Theoretical population: those $\geq$5yo who have lived in the country for at least 5 years (82-88% of total popn)

- Largely deterministic, based on sex, dob, area of residence 5y ago, (country of birth, Māori descent)
  - Approx 3% probabilistic

- 15 cohorts altogether
  - Joining links of adjacent Censuses
## NZLC - 15 Cohorts

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Linkage Bias
-Why an issue with NZLC?

- Linkage bias is a specific type of ‘selection bias’
  - Those linked (selected) differ from those not linked
  - X-Y associations in the selected sample differ from X-Y associations in the full sample

- Bias likely because
  - Incomplete linkage (31%-75% of population)
  - Linkage varies as a function of various factors
    - Age, Sex, Residential mobility, Deprivation, Relationship Status, Housing Tenure, Ethnicity

- Are associations biased?
Linkage Bias
-Why an issue with NZLC?

- CAN’T assess full extent of bias
  - Don’t know associations among the unlinked

- BUT each linked cohort is nested within another (or within a single Census)

- So, CAN assess bias of nested cohort against cohort (or Census) one level up. E.g.,
  - Among those linked back from 2006 to 2001, are 2006 associations biased?
  - Among those linked back from 2006 to 1996, are 2006-2001 associations biased?
Linkage Bias - Can we adjust for it?

- Compare two-way correlations
  - Full census vs sample linked back to previous census
  - Consider <.01 magnitude differences as unbiased...
  - Modest improvement across all cohorts; more for adults
  - Similar results for ‘longer’ cohorts (3+ censuses)

Children, 5-14

Adult, 15+
Linkage Bias - Mortality associations

- However, few associations with mortality biased (except 1986-81)
NZCMS
- What is it?

- Probabilistic linkage of each Census (1981-2006) to subsequent (3 or 5 year) mortality records
  - Proportion of mortality records linked ranges from 71% (1981) to 81% (2001)
  - Accuracy of linkage estimated at 97-98%.

- Bias weights (similarly) estimated based on the characteristics predicting linkage
RESULTS
Preliminary Analyses

- A first peek (preliminary)
- Adjusted for bias (NZLC bias weight x NZCMS bias weight)
- Logistic regression only (dead vs not)
- All cause mortality only
- Analyses among those surviving 1981-2006, who then died (or not) in the subsequent 5 years
- Rudimentary longitudinal variables
1. Sibling comparisons
- Income and mortality

Is the effect of income on mortality due to familial confounding?

Test by comparing mortality risk (2006-2010) among siblings discordant for income:
- Number of times in lowest income quintile 1981-2006
- Controls: birth order (age), sex, socio-economic factors (education, unemployment, motor vehicle access), family factors (household size and structure, residential moves), disability

First, need to identify sibling pairs
1. Sibling comparisons
   - Identify sibling pairs

From 1981 census

- All individuals: ≈ 3.14 million

- Family code '00'
  - 1st family in the dwelling
  - Sibling pairs in 1981
    - Son/daughter to occupier
      - Linked from 1981-2006
        - Siblings
          ≈ 30,000 pairs

- Family code '01'
- Family code '02'
- Family code '03'
- Family code '04'
- Family code '05'

- ≈ 517,000 pairs
1. Sibling comparisons
- Income and mortality
1. Sibling comparisons
- Income and mortality

Increased odds of death among ‘poorer’ sibling

Age & Gender
1. Sibling comparisons
- Income and mortality

Increased odds of death among ‘poorer’ sibling
1. Sibling comparisons
- Income and mortality

Increased odds of death among ‘poorer’ sibling

- Age & Gender
- Socioeconomic factors
- Family factors
1. Sibling comparisons
- Income and mortality

Increased odds of death among ‘poorer’ sibling

- Age & Gender
- Socioeconomic factors
- Family factors
- Disability
1. Sibling comparisons
- Income and mortality

Excess deaths compared to richer sibling (%)

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<th>Number of additional times in poverty</th>
<th>0.55%</th>
<th>1.25%</th>
<th>2.10%</th>
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Increased % mortality, poorer sibling

- 1 time in poverty: 0.55%
- 2 times in poverty: 1.25%
- 3+ times in poverty: 2.10%
2. Unemployment and mortality

- Evidence that periods of unemployment and mortality
  - Mostly short term
  - Often comparing country/state unemployment rates and their effect on mortality rates (as opposed to associations at the individual level)

- Assess impact of number of times unemployed 1981-2006 on subsequent mortality 2006-2010
  - Control factors: Age, gender, ethnicity, socio-economic factors (education, deprivation, crowding, tenure), smoking, family structure, disability
2. Unemployment and mortality

Unemployment and Mortality

Odds Ratio (95% CI)

Once
Two or more
2. Unemployment and mortality

Unemployment and Mortality

Odds Ratio (95% CI)

Age & Gender
Ethnicity

Once
Two or more
2. Unemployment and mortality

Unemployment and Mortality

Odds Ratio (95% CI)

- Once
- Two or more

Factors:
- Age & Gender
- Ethnicity
- Socio-economic factors
2. Unemployment and mortality

Unemployment and Mortality

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<thead>
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<th>Odds Ratio (95% CI)</th>
<th>Age &amp; Gender</th>
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</table>
2. Unemployment and mortality

Unemployment and Mortality

Odds Ratio (95% CI)

- Red circles: Once
- Blue circles: Two or more

Factors:
- Age & Gender
- Ethnicity
- Socio-economic factors
- Smoking
- Family structure
2. Unemployment and mortality

Unemployment and Mortality

Odds Ratio (95% CI)

- Once
- Two or more

Factors:
- Age & Gender
- Ethnicity
- Socio-economic factors
- Smoking
- Family structure
- Disability
CONCLUSIONS
Conclusions

- LOTS of possibilities with these data
  - More nuanced analyses, with more sensitive variables, will help elucidate association between life-course SES and mortality, and mediating factors

- Early analyses are revealing
  - Association between life-course poverty and mortality robust to family confounding
  - Periods of unemployment increase risk of mortality (mediated by other socio-economic factors, family turmoil and disability)
Next Steps

- Test the life-course hypotheses
- Investigate how much of ethnic differences in mortality risk is explained life-course socio-economic experiences
- Further test of sibling analyses
- Explore the role of social and cultural factors
  - Ethnic density appears to have some effects (need to disaggregate by ethnicity)
  - Living alone (lack of social support) also appeared to be important
QUESTIONS?

Acknowledgments

- Stats NZ: Robert Didham, Kirsten Nissen, Wendy Dobson, Microdata Access team
- COMPASS team: Peter Davis, Roy Lay-Yee, Jessica McLay, Vera Puti Puti Clarkson, Rahul Singhal, Liza Bolton, Fui Swen Kuh, Justin Gunter
- Others: Tony Blakely, June Atkinson, Andrew Sporle, Alan Lee
**References**

**Accumulation hypothesis**

**Critical period**

**Mobility hypothesis**

**Instability hypothesis**

**Social and cultural factors**

**Ethnic associations**
Blakely T, et al. (2006). What is the contribution of smoking and socioeconomic status to ethnic inequalities in mortality in New Zealand? Lancet, 368, 44-52

**Sibling Analyses**