The 1991 Canadian census cohort: mortality and cancer follow-up
A research opportunity

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Outline

- Rationale & purpose
- Analytic results
- Potential for health data linkage
- Data access, publications, & contacts
Rationale

- Romanow & Kirby commissions
- 2010 Conference of FPT Ministers of Health
  - The health of the population is an important measure of - and an important contributor to - the overall well-being of society.
  - Led to a federal focus on health inequalities
- International (World Health Organization 2008)
  - ...there needs to be an active research programme on the social determinants of health

Commission on the Future of Health Care in Canada (Romanow Commission), 2002-2002
Standing Senate Committee on Social Affairs, Science and Technology Study on the State of the Health Care System in Canada (Kirby Committee) 1999-2002
A Declaration on Prevention and Promotion from Canada's Ministers of Health and Health Promotion / Healthy Living 2010 Conference of the FPT Ministers of Health
Rationale

- Identification of differences in mortality across socio-economic characteristics for a number of populations
  - Immigrants, ethnic origins, First Nations, Métis, and Inuit
- Produce baseline indicators of mortality for monitoring health disparities
  - Life expectancy & mortality by detailed population groups
  - Incl. by occupation, education, income groups

Data gaps

- Death certificates and cancer registry lack individual identifiers (ethnicity, Aboriginal identity) or characteristics
  - Inability to compare mortality/cancer differentials

Data approaches

- Area-based approach
  - Geozones: Inuit, Aboriginal, Foreign-born, income

- Record linkage approach
  - Census mortality (+ cancer & mobility extension)
Benefits of census linkage

- Expanded knowledge base
  - Improved understanding of social determinants
  - Identification of multiple dimensions of social disadvantage
  - Allow for multi-variable & multi-level analysis

- Large cohort size
  - Analyse population by sub-groups (Foreign-born, housing)
  - Examine rare outcomes (kidney diseases, amenable causes)
  - Allow for cross-classification (urban - Aboriginal)
Creation of 1991 census cohort

- 1991 Census long form (2B/2D) respondents
  - Aged 25+
  - Non-institutional residents
  - Variables: demography, labour market, income, education, language, disabilities, housing, immigration, ethno-cultural

- Follow-up for deaths
  - 1991-2001 mortality database (CMDB)
  - Variables: Cause of death (ICD), age at death, place of residence
Initial limitations of 1991 census cohort

- SES measures only at baseline
- No information on health behaviours
- Place of residence only at baseline and death
- Follow-up period short for some purposes
- Does not include cancer incidence
Linkage extension

- Extension of mortality follow-up to 2011
- Linkage to cancer incidence (1969-2011)
- Linkage to annual mobility (1985-2011)

**Linkage results from first linkage extension**

Linked to name file and followed for deaths (the cohort) 2,734,835
Died during the follow-up period (1991-2006) 426,979
Followed for mobility from tax summary files (1990-2006) 2,643,769
Linkage extension relevance

- Improves statistical power via additional deaths
  - 260,000 → 427,000 (1991 – 2006)
- Includes cancer incidence
  - 1969 – 2003, cancer-free cohort at baseline
- Follows for mobility
  - Postal code of residence for each year of follow-up
  - Allows for improved link to environmental variables
Selected Results
Results – survival

Percentage surviving to various ages in Canada for 1995-1997 and 2002 (average) compared to cohort for 1991-2006

Mortality rates by cause of death, females 25+, 1991-2006

Sub-population analysis

- Examine outcomes by different population groupings
  - First Nations (Registered Indians, non-Status Indians)
  - Métis
  - Immigrants (year of immigration)
  - Place of birth
  - Ethnic origin
Cancer mortality
Registered Indians: men aged 25+ at baseline, 1991-2001 follow-up
- ASMR compared to non-Aboriginal male cohort members

Cancer mortality
Registered Indians: women aged 25+ at baseline, 1991-2001 follow-up
- ASMR compared to non-Aboriginal female cohort members

Cancer mortality
Métis: men aged 25+ at baseline, 1991-2001 follow-up
- ASMR compared to non-Aboriginal male cohort members

Cancer mortality
Métis: women aged 25+ at baseline, 1991-2001 follow-up
- ASMR compared to non-Aboriginal female cohort members

Cancer mortality rates by year of immigration, 1991-2001 follow-up

Analysis by socioeconomic status

- Able to examining outcomes by different SES dimensions
  - Income (source, household, individual)
  - Education (years, qualifications)
  - Occupation
  - Industry
  - Type of housing
  - Marital status
Life expectancy

Remaining life expectancy at age 25, by income adequacy quintile, and by education level, Canada, both sexes, 1991-2006 follow-up

Housing

Homeless and marginally-housed cohort members, probability of survival, conditional on survival to age 25, both sexes

Malignant neoplasms by different SES dimensions, 1991-2006 follow-up

ASMR rate ratio

Educational attainment  Income adequacy quintile  Occupation rank*

Men

Educational attainment  Income adequacy quintile  Occupation rank*

Women

* Ages 25-64 at baseline

Type of cancer by income adequacy quintile, 1991-2006 follow-up

Multi-dimensional analysis

- Able to examining the effect of several indicators (such as income, education, occupation) simultaneously on mortality and cancer incidence
- Cross-tabulations
- Cox regression modeling
Remaining life expectancy by educational attainment within each income adequacy quintile, 1991-2006 follow-up

Education and place of birth, 1991-2001 follow-up

Probability of survival to age 75 by education, conditional on survival to age 25

- University graduation
- Post-secondary diploma
- High school graduation
- Less than high school diploma

Adjusted hazard ratios by educational attainment, ages 25-64 at baseline, 1991-2006 follow-up

Hazard ratios for dying from CVD for First Nations compared to non-Aboriginal cohort members, 1991-2001 follow-up

<table>
<thead>
<tr>
<th>Adjusted for:</th>
<th>Men</th>
<th></th>
<th></th>
<th>Women</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hazard ratio</td>
<td>95% CI</td>
<td></td>
<td>Hazard ratio</td>
<td>95% CI</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>1.24</td>
<td>1.16</td>
<td>1.34</td>
<td>1.67</td>
<td>1.54</td>
<td>1.80</td>
</tr>
<tr>
<td>Age + education</td>
<td>1.15</td>
<td>1.07</td>
<td>1.24</td>
<td>1.55</td>
<td>1.44</td>
<td>1.68</td>
</tr>
<tr>
<td>Age + education + income</td>
<td>1.08</td>
<td>1.00</td>
<td>1.16</td>
<td>1.50</td>
<td>1.39</td>
<td>1.63</td>
</tr>
</tbody>
</table>

Exposure analysis

- Ability to examine outcomes by ambient exposures
  - Geographically assign air pollution estimates to cohort members via postal code representative points
Mean satellite-derived estimates of PM$_{2.5}$ across Canada, 2001-2006

Risk of mortality in relation to PM$_{2.5}$ exposure

There are positive and significant associations between non-accidental mortality and estimates of PM$_{2.5}$

These associations are present with exposure to concentrations as low as a few μg/m$^3$

<table>
<thead>
<tr>
<th>Cause of death</th>
<th>Hazard ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Accidental</td>
<td>1.10 (1.05-1.15)</td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>1.15 (1.07-1.24)</td>
</tr>
<tr>
<td>Circulatory</td>
<td>1.14 (1.06-1.22)</td>
</tr>
<tr>
<td>Ischemic Heart Disease</td>
<td>1.30 (1.18-1.43)</td>
</tr>
<tr>
<td>Cerebrovascular</td>
<td>1.04 (0.93-1.16)</td>
</tr>
</tbody>
</table>
Data access

- Approved research projects, those enabling Health Analysis Division to better assess the accuracy of the file

- Goal is to increase access to this dataset
  - Research Data Centre pilot project (2012-2014)
Next links...

- CCHS – mortality – hospitalization
  - 4 cycles of CHS
  - Followed for mortality, hospitalization, place of residence

- Perinatal outcomes study
  - Births 2-years previous to 1996 & 2006 census (by mother)
  - Linked to birth, death, & stillbirth database

- Future census periods
  - 2001 census follow-up (planning phase)
  - ? 2011 NHS follow-up ?
Funding and research partners

- Canadian Population Health Initiative, part of Canadian Institute of Health Information (CIHI)
- Health Canada, Healthy Environment and Consumer Safety Branch (Rick Burnett)
- Current research projects with:
  - Health Canada
  - Cancer Care Ontario
  - McGill University
  - University of Ottawa
  - Institut nationale de la santé publique du Québec
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Publications (I)


Publications (II)


