

# Income dynamics and adult mortality in Canada and the United States

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Institute for Work & Health  
Plenary series

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# Project history

- PhD Dissertation, Epidemiology, University of Toronto
- September 2009
- Supervisor: Cameron Mustard
- Committee: Doug Manuel & William Gnam

# Outline

- 1 Introduction
- 2 Study 1: Income drops and mortality in the US and Canada
- 3 Study 2: Income drops and mortality in Canada: evidence of causality
- 4 Summary

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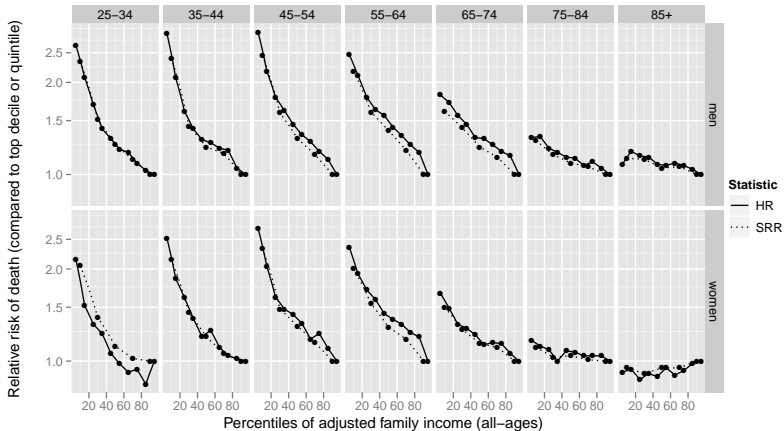
# Study aims

- Does income level determine adult mortality?
- Do income drops determine adult mortality?
- Are the effects of income level and income drops the same in Canada and the US?
- Who cares?
  - Income level: policies on distribution of income & health
  - Income drops: policies on labour market flexibility & income security
  - Canada v US: which country better protects the health and income security of its residents?

# What we know about income & adult mortality

- Greater income is associated with lower mortality.
  - True for men and women.
  - True throughout working life.
  - True in Canada and the US.
- Income drops may be associated with greater mortality.
  - Unemployment
    - Usually associated with increased mortality
  - Involuntary job loss
    - Often associated with increased mortality
  - Income drops
    - May increase mortality only at middle income levels

# Equivalized family income & mortality by age and sex



# What we *don't* know about income & adult mortality

- Income level
  - Role of health selection
  - Importance for mortality in Canada v US
- Income drops
  - Is the US finding statistically robust?
  - Is the US finding reproducible in Canada?
  - Elements of causal inference:
    - Strength of association?
    - Dose response?
    - Biologically plausible induction times?
    - Economically plausible dependency on income level?
    - Health selection?
    - Confounding?



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# Canada v USA: Introduction

- Replicating McDonough et al. 1997
  - Income drops increased mortality only at middle income levels
- Questions:
  - Does US finding depend on the statistical method?
  - Is effect of income level similar in Canada & US?
  - Is effect of income drops similar in Canada & US?
  - Does the effect of drops depend on level in Canada & US?

# Canada v USA: Methods

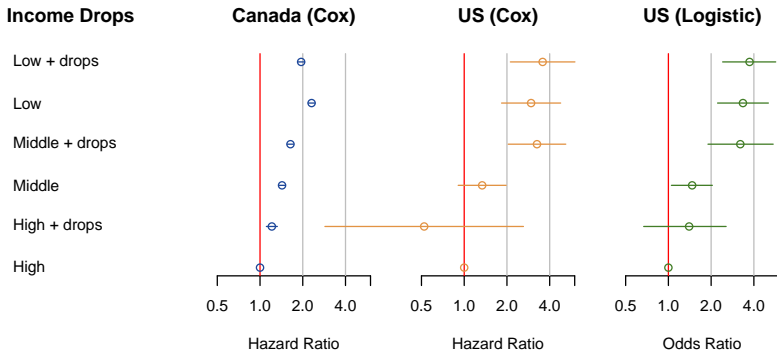
- Data:
  - Canada: tax data (1982-2005)
  - US: survey data (1968-1997)
  - Ages 45-64 at baseline
- Analysis:
  - McDonough et al.: logistic regression
  - New analyses: Cox regression
  - Adjusted for age, sex, family size & black v white (US only)

## Canada v USA: Results

	LAD (Canada)		PSID (US)	
	Mean	SD	Mean	SD
Age (baseline, t-5)	49.1	6.1	49	4.7
Family size (5y mean) <sup>1</sup>	2.8	1.2	3.4	1.4
	Freq	%	Freq	%
Died	40,180	6.9	341	13.8
Male	311,795	53.3	805	46.3
Black	NA	NA	168	9.7
Drops (5y cum. incidence) <sup>1</sup>	160,950	31.2	227	13.4
Income Level (5y mean, 1993 USD) <sup>1</sup>				
< 20,000 (low)	113,130	21.9	287	16.9
20,000-70,000 (middle)	317,230	61.4	1067	62.9
> 70,000 (high)	86,295	16.7	342	20.2

<sup>1</sup> During first 5y period.

# Interaction of income drops & income level



# Under-ascertainment of deaths in Canadian tax data

- Mortality rates in tax data are 73% of official estimates
- Under-ascertainment could be differential by income level

Under-ascertainment		
Rich	Poor	RR
0.7	0.7	4.0
0.8	0.6	3.0
0.9	0.5	2.2
1.0	0.4	1.6

# Under-ascertainment of deaths in Canadian tax data

- 1991 Census mortality follow-up allows comparison
- Under-ascertainment may not be differential by income level

Sample	Age	Sex	RR: Q5/Q1
Low	45-64	M+F	2.3
Low + Drops	45-64	M+F	1.9
Census	45-54	M	2.5
Census	45-54	F	2.3
Census	55-64	M	2.2
Census	55-64	F	2.0

# Canada v USA: Discussion

- Findings:
  - Does US finding depend on the statistical method?
    - No.
  - Is effect of income level similar in Canada & US?
    - No, the effect is greater in the US.
  - Is effect of income drops similar in Canada & US?
    - No, effects are smaller in Canada.
  - Does the effect of drops depend on level in Canada & US?
    - Yes. In Canada effect protective for poor. In US limited to middle incomes.



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## Study 2: Introduction

- Canada only
- Questions on income level:
  - Health selection?
- Questions on income drops:
  - Strength of association?
  - Dose response?
  - Biologically plausible induction times?
  - Economically plausible dependency on income level?
  - Health selection?
  - Confounding?
    - Family structure changes
    - Retirement
    - Family death
    - Self-employment

## Study 2: Methods

- Data:
  - Canada: tax data (1982-2005)
  - Ages 40-55 at exposure
  - Lag 1-18 years between exposure and death
  - Deaths at age 41-73
- Analysis:
  - Cox regression
  - Adjusted for age
  - Exclusion: recent immigrants, missing income data
  - Models with and without work disability and other confounding variables
  - Separate models for each lag, sex, family type combination
    - lag (18)  $\times$  sex (2)  $\times$  family type (2)  $\times$  subsets (7)  $\times$  drops (2) = 1008 regressions
    - also main effects, additive, interactions
    - also full data and 1992+ data

## Study 2: Results

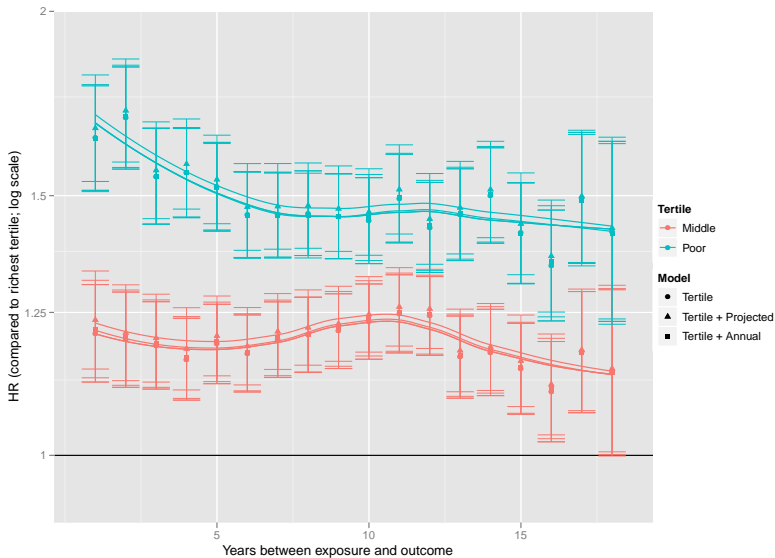
- Results for men in couple families
- Deaths/model: range = 1,390 to 16,980

## Study 2: Distribution of projected income drops

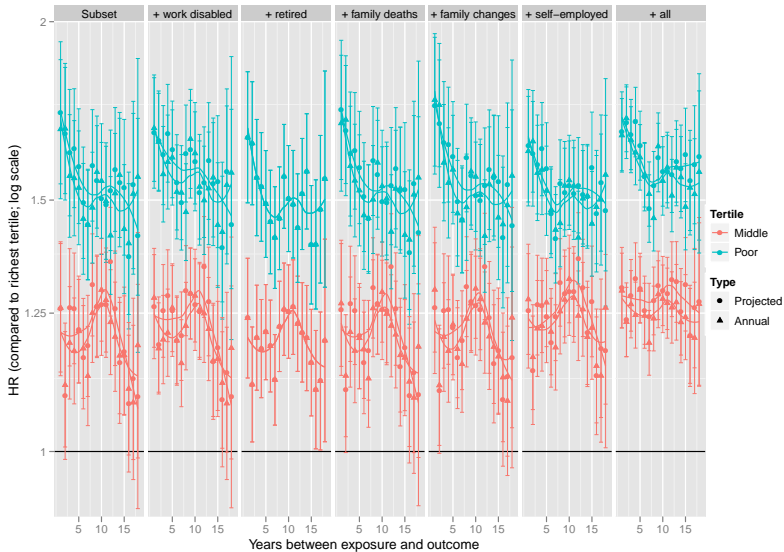
- Projected drops more common than annual drops (not shown)
- Some “regression to mean:” small drops for rich
- But poor more likely to experience largest drops

Income Drops	Income level		
	Poor	Middle	Rich
None	57.9	55.0	44.9
(0-15%]	18.9	25.8	31.1
(15-50%]	17.1	16.3	20.5
(50-100%]	6.1	2.9	3.5
TOTAL	100	100	100

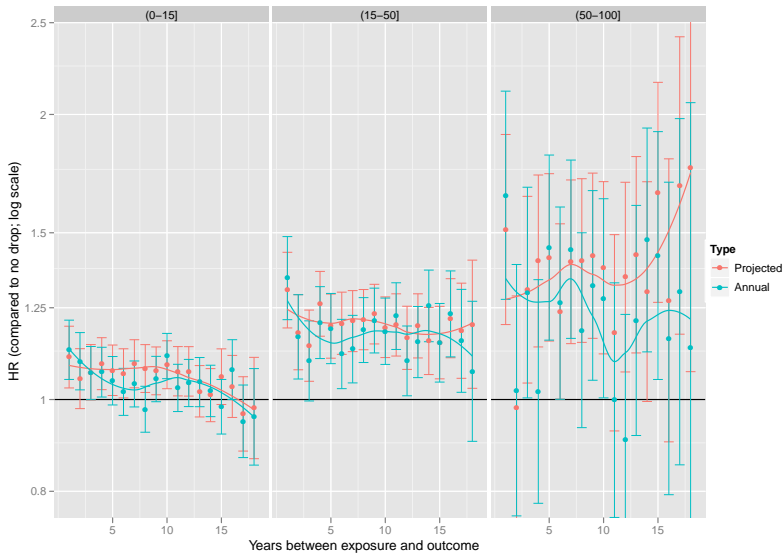
# Study 2: Effect of income level adjusting for income drops



# Study 2: Effect of income level & confounding

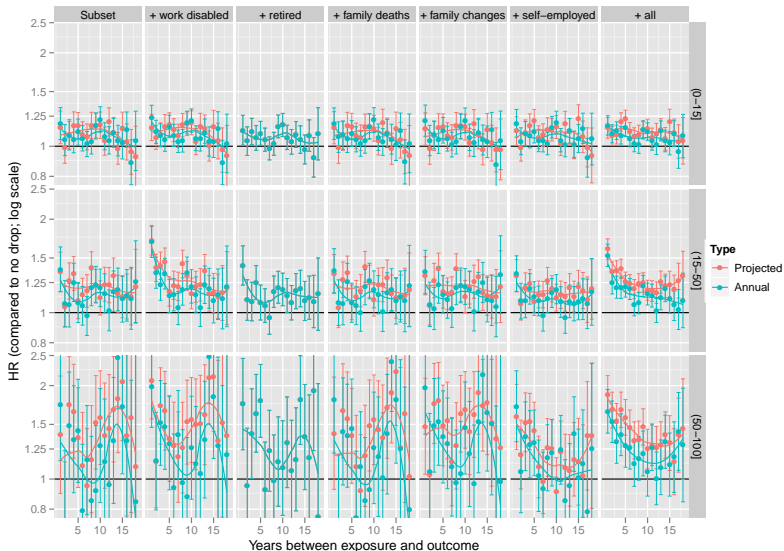


# Study 2: Effect of income drops (all exclusions)



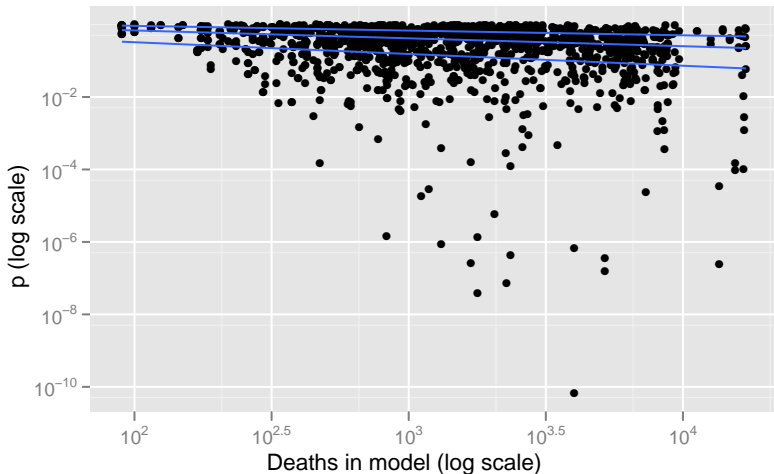


# Study 2: Effect of income drops & confounding



# Study 2: Interaction between income drops & income level

TYPE3 tests for PROC TPHREG effect of interaction term



## Study 2: Discussion: income level

- Questions on income level:
  - Is health selection the principle pathway?
    - No. Little decay in effect argues against health selection.
    - No. Effect of income level not greater among those with income drops, regardless of induction times.

## Study 2: Discussion: income drops

- Questions on income drops:
  - Strength of association?
    - Small for causal inference. Substantial for population burden.
  - Dose response?
    - Yes, for men in couple families.
  - Biologically plausible induction times?
    - Maybe not: enduring effect of acute exposure.
  - Economically plausible dependency on income level?
    - No.
  - Health selection?
    - Effect persists, but residual confounding possible.
  - Confounding by family structure changes, retirement, family death, self-employment
    - Effect persists.

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# What these studies add

- Income level is a strong determinant of mortality, and the effect is primarily causal.
- Income drops are associated with increased mortality, but evidence for causality is mixed.
- Income level likely has a stronger effect on mortality in the US than in Canada.
- Income drops have not been shown to have a similar effect in the US and Canada.

# Study strengths

- LAD: generalizability, sample size, longitudinal, low loss to follow-up
- LAD/PSID: death as outcome
- LAD/PSID: high quality annual family income data by component
- LAD/PSID: spans several business cycles
- LAD: examination of relevant induction times
- LAD: differences by sex & family type
- LAD: control for important sources of confounding
- PSID: survey follow-up of death events

# Study weaknesses

- LAD: underascertainment of death events
  - more likely at lower income
  - misclassification bias (to null)
- LAD: no data on occupation, education, health status (confounding bias)
- LAD: no data on cause of death
- PSID: sample size
- PSID: sample pre-dates recent Hispanic immigration
- LAD v PSID: samples not entirely comparable
- LAD v PSID: uncontrolled confounding



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