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The 1991-2001 Canadian Census-Mortality Follow-up Study

A new resource for the study of socioeconomic disparities in health expectancies

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Statistics Canada Statistique Canada

Health Information and Research Division HIRD

Division de l'information et de la recherche sur la santé DIRS

Canada

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Canadian Population Health Initiative, part of the Canadian Institute for Health Information

Principal investigators for the original study

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Ethics and peer review

Statistics Canada (STC) Policy Committee

STC Confidentiality and Legislation Committee

STC Data Access and Control Services Division

Privacy Commissioner of Canada

University of Toronto Research Ethics Committee

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Institute for Work and Health (IWH)

STC Health Statistics Division (HSD)

STC Health Information and Research Division (HIRD)

Overview of presentation

- Objectives
- Methods (data sources, linkages, analyses)
- Some results to date (including HALE)
- Work ahead

STC objectives:
Produce indicators of mortality for monitoring health disparities in Canada

- **Education**
- **Labour force status**
- **Occupation (and occupation-based SES levels)**
- **Income**
- **Visible minority status and Aboriginal identity**
- **Period of immigration and region of birth**
- **Disability status**

Overview of the data

Data sources

- 1991 census+post-censal disability survey (HALS)
- 1991-2001 death records (CMDB)

15% sample of non-inst population aged 25+

- ≈ 3 out of 4 long-form census questionnaires
- ≈ 2.7 million records for individuals

Follow-up for deaths 1991-2001

- ≈ 28 million person-years at risk
- ≈ 260 000 deaths

Linkage strategy

Objective: census => mortality (CMDB)

Problem: not enough common variables to link

Solution: get names of tax filers as "bridge"

- using postal code, dates of birth, sex, marital status
- to obtain encrypted names needed for link to CMDB

Method: census => names => mortality

1991 1990-1991 tax 1991-2001

by probabilistic matching

Linkage in the absence of names (or unique identifiers) on the electronic census files for 1991

Postal codes: 750,000 (30 persons per code urban, 1200 per code rural), at census and 1990, 1991 tax

Birthdays at ages 25-85 (60 y * 365 days): 21,900

Birthdays of spouse ± 5 y (10 y * 365): 3,650

Sex: 2.

Marital status (in couple, not in couple): 2

Also matched with partial agreement on postal code (or higher levels of geography) and dates of birth

The first stages of the linkage

Combine 1990 and 1991 name files, with spousal information and alternate postal codes, etc. Pre-process names, then encrypt.

Impute postal codes for short-form census records.

Pre-match from full census (including short forms) to full 1990-1991 name file to eliminate names matching best to short form records.

Match from the "in-scope" census records to the remaining names from the tax filer data: approximately 80% linked, with estimated 99% accuracy (based on stratified sample manually checked against census microfilms).

- **"in-scope" = non-institutional long-form census records for persons aged 25+ , with full DOB or at least year of birth (unimputed)**

The second stages of linkage

Only census records which could be "bridged" to the name file (from non-financial tax filer data) could be followed for mortality.

However, the numbers and full-socioeconomic characteristics of the "un-bridged" census records have been tabulated to describe the completeness of this initial linkage and the socioeconomic characteristics of the unlinked records.

Except for encryption, and the large size of the cohort, the methods of probabilistic record linkage for the mortality follow-up are nearly the same as those routinely employed for mortality follow-up studies at Statistics Canada.

The mortality of the cohort has also been compared against that of the total population of Canada.

Derivation of the cohort

In-scope census records	3,575,487
- Not linked to name file	716,243
Linked to name file	2,860,244
- Linked but not followed*	125,092
Linked and followed	2,735,152

* Simple random sample 4.4% of linked

Limitations

80% linkage to name file, 99% accuracy

Census non-respondents excluded

Follow-up restricted to tax filers

Limited to 25+ yrs, non-institutionalized

SES characteristics only known at baseline

Lack of behavioural risk factors

Non-lethal outcomes unknown

Some loss to follow-up from emigration

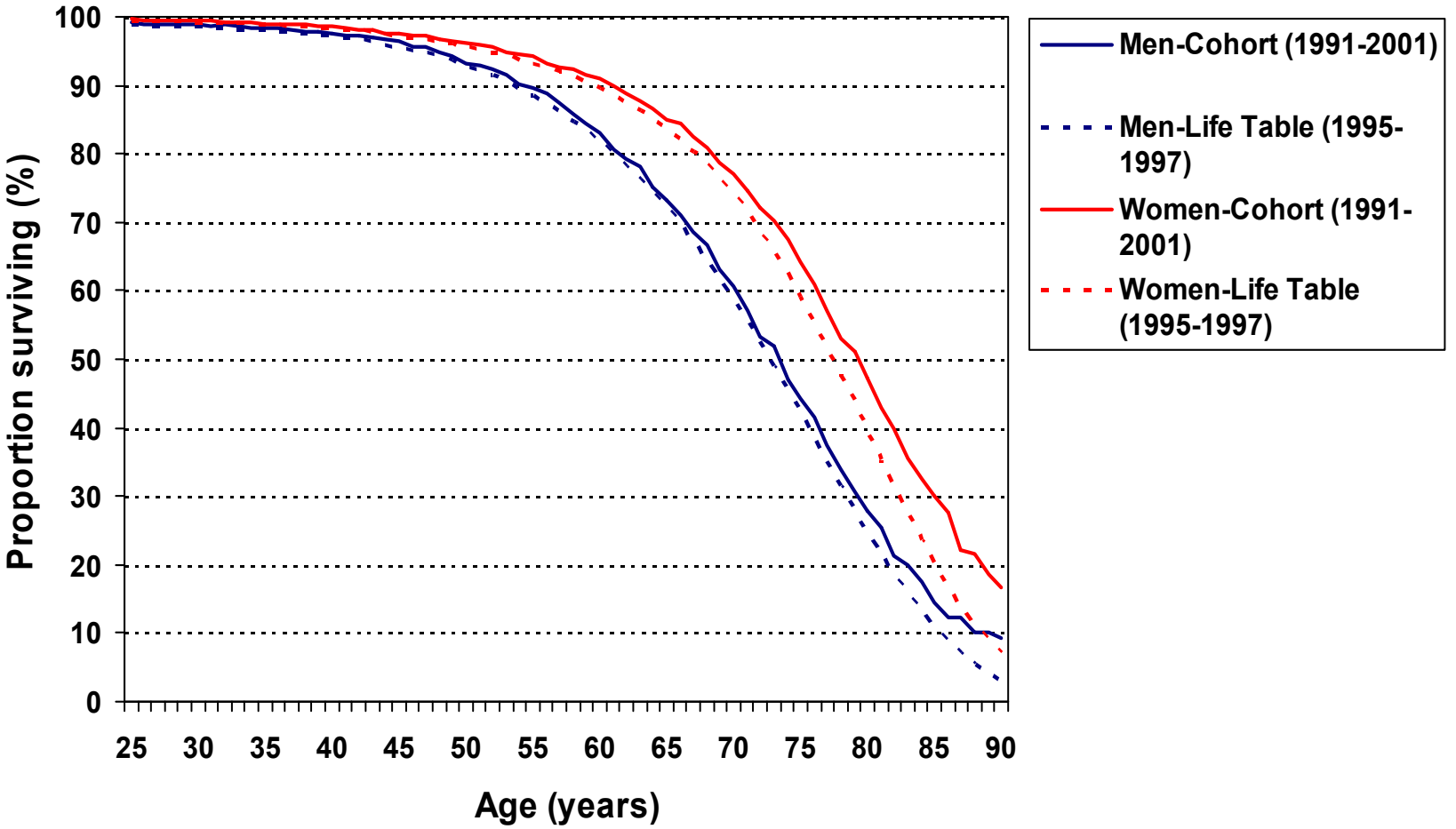
Cohort followed and deaths ascertained

Category	Persons in cohort	% of in-scope*	Deaths	Ratio **
Total	**2,735,152**	**76**	**260,820**	**1.00**
Not in labour force	779,507	67	192,226	1.66
Not married	704,689	68	106307	1.59
Education <hs grad	953,466	71	155598	1.42
60+ yrs	592,059	70	198624	1.44
Females	1,276,773	75	107268	1.11
Mover in last year	392,619	65	26495	1.87
Rural	598,846	74	56098	1.17

*In-scope = census long-form respondents (non-institutional) age 25+ at baseline (4 June, 1991)

** Ratio = % unmatched / % in cohort (>1 is more likely to be unmatched)

Proportion surviving 10.6 years



Mortality analyses by sex and baseline socioeconomic characteristics

Age-specific mortality rates

Age-standardized mortality rates

Potential years of life lost (<75 y), excess PYLL

Period life tables

- **by age at beginning of each year of follow-up**
- **probability of survival to age x**
- **remaining life expectancy at age x**

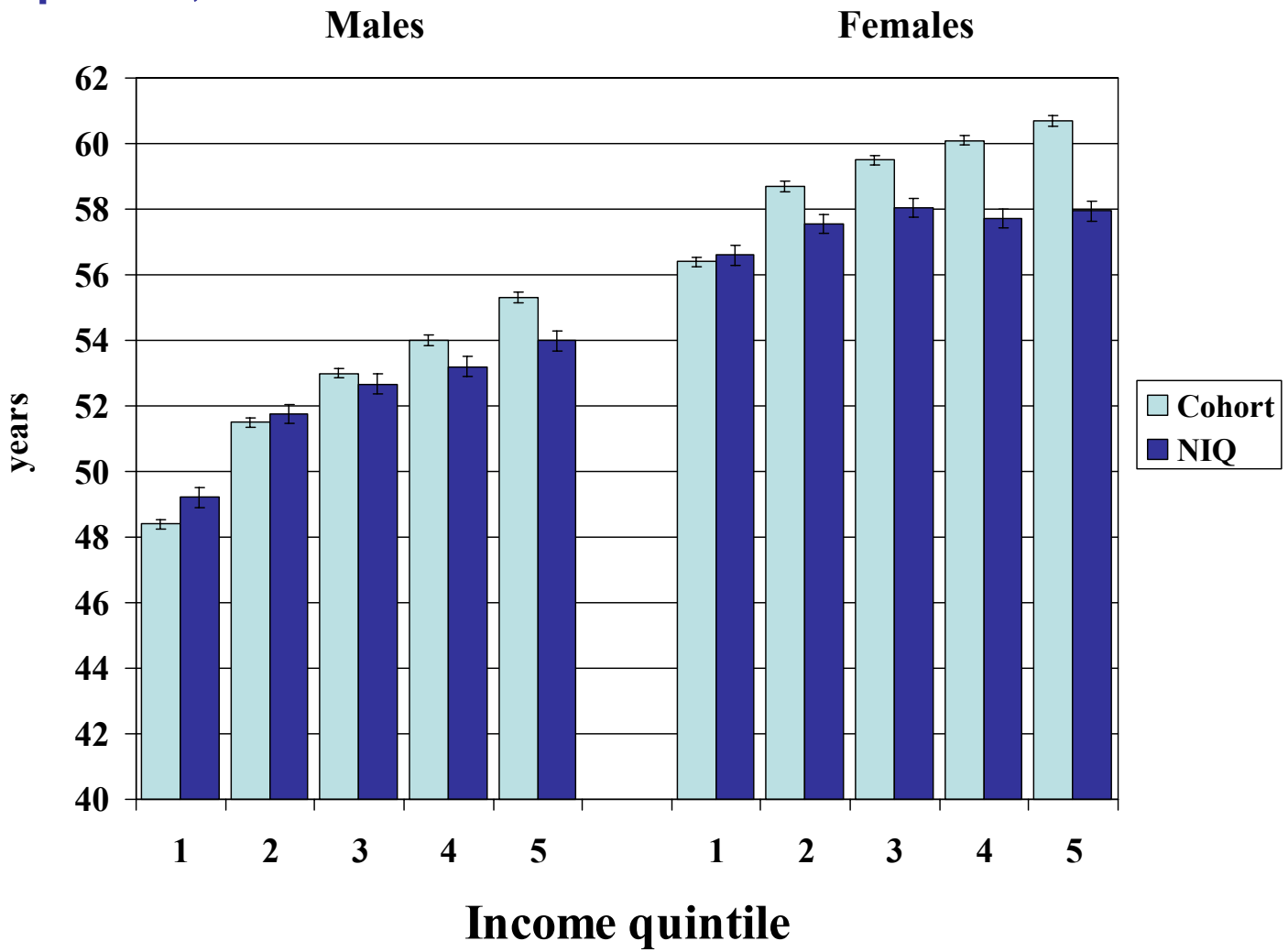
Hazard ratios (PHREG)

- **by age group, or adjusted for age (yrs) – in exponent**
- **indicator (0,1) variables for each SES category**

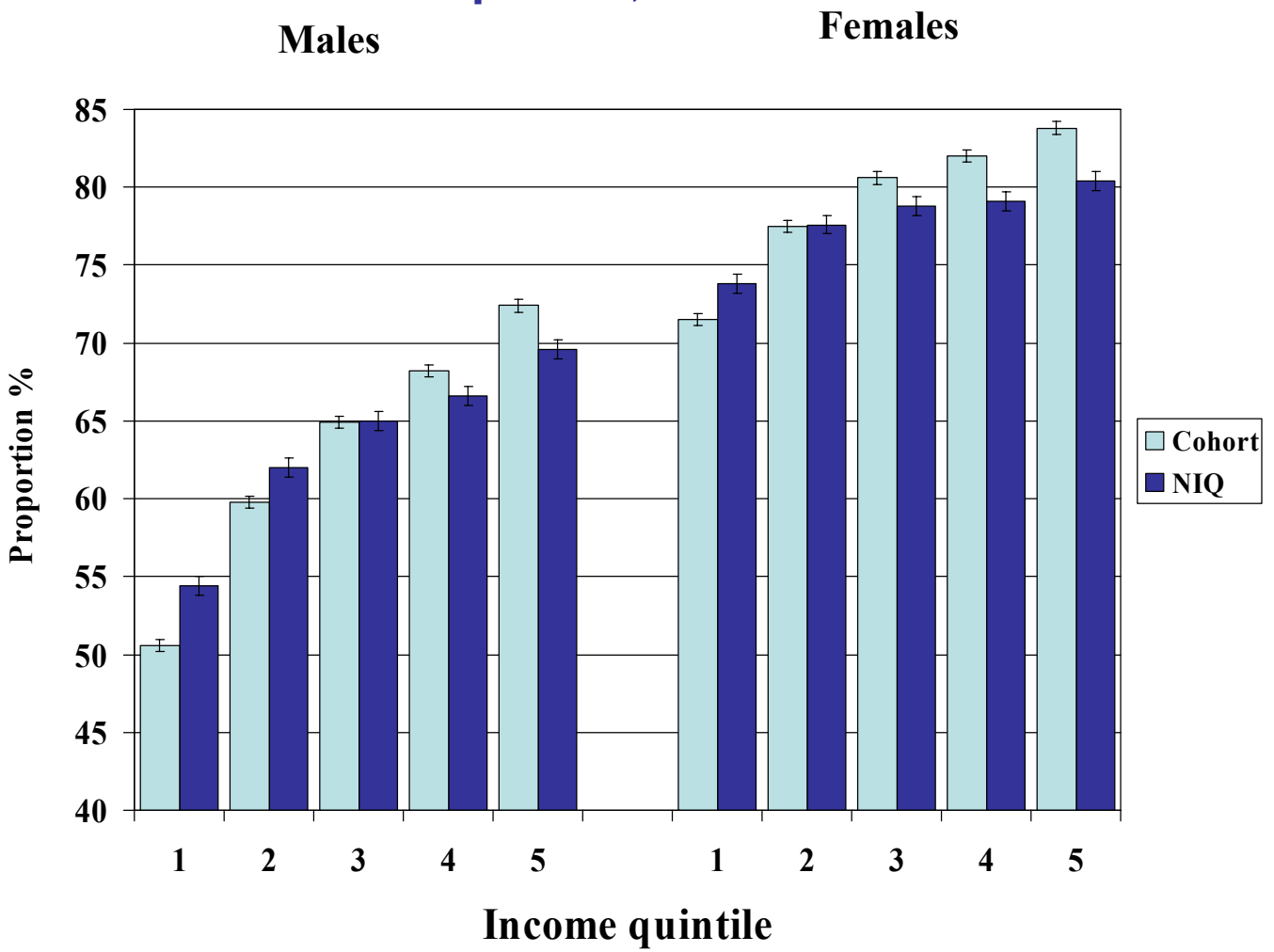
Some results to date: Important findings – new for Canada

- Mortality of individuals ranked by family income *versus* neighbourhood income
- Mortality by educational attainment, and by educational attainment *within* each income quintile
- Importance of labour force participation as well as occupation-based socioeconomic status category
- Differential mortality across many other socio-economic and socio-demographic categories
- Causes of death responsible for these differences
- Health-adjusted life expectancy by income and education

Remaining life expectancy at age 25, by income adequacy quintile, Canada, 1991-2001, compared to urban Canada by neighbourhood income quintile, 1996

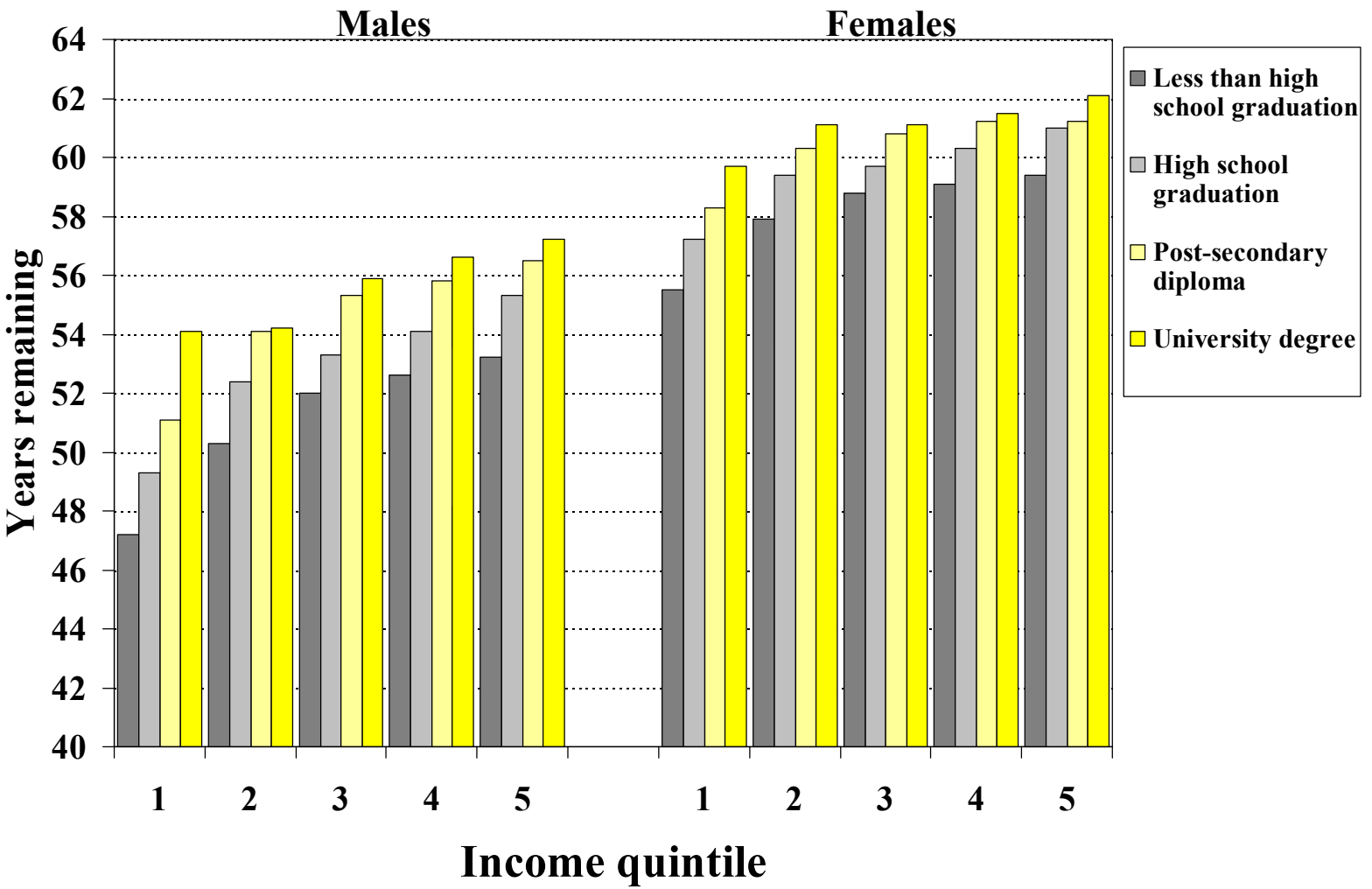


Expected probability of survival from ages 25 to 75, by income adequacy quintile, Canada, 1991-2001, compared to urban Canada by neighbourhood income quintile, 1996



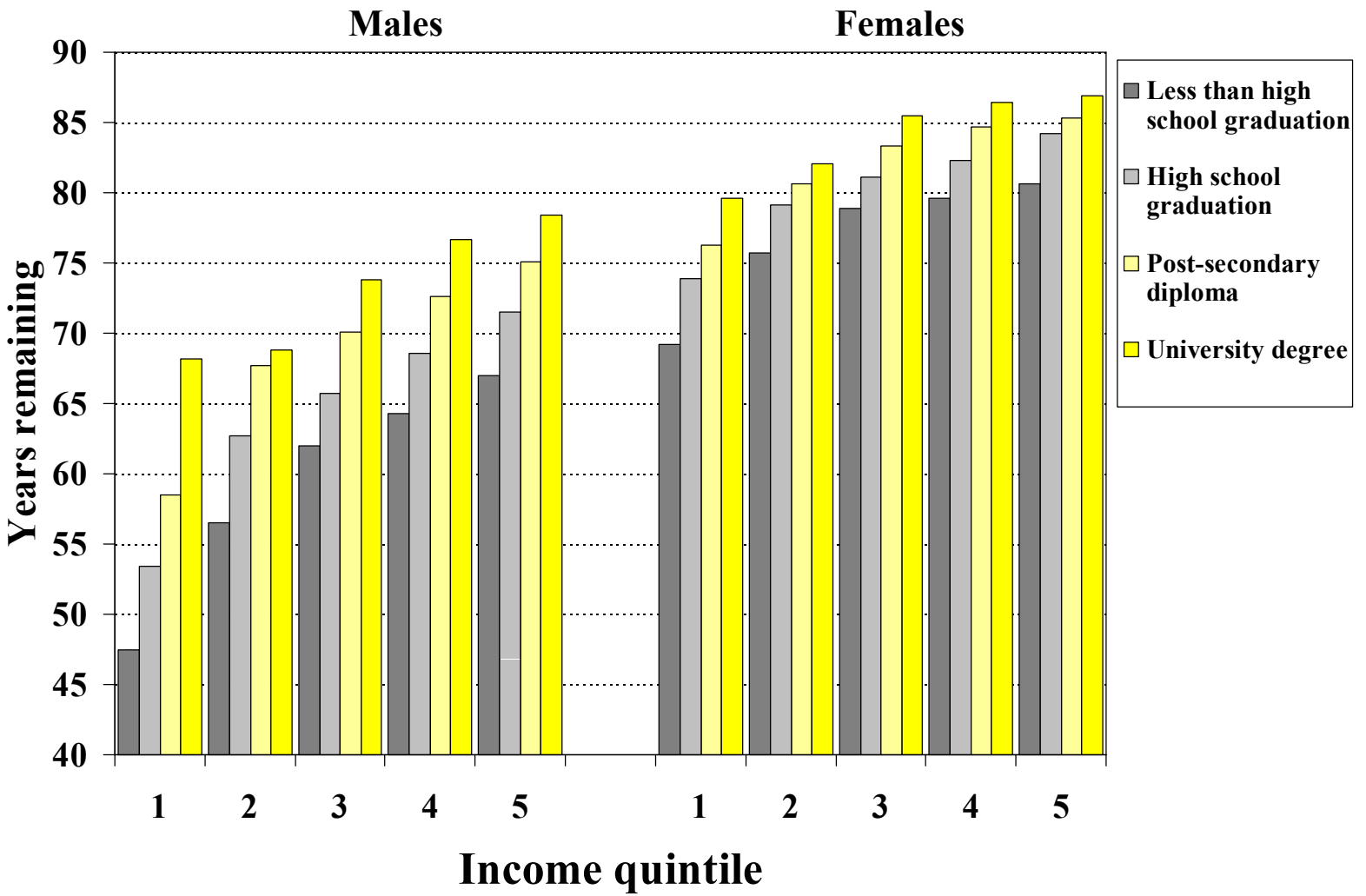
Educational attainment and income

Remaining life expectancy by educational attainment within each income adequacy quintile



Educational attainment and income

Probability of survival to age 75, by educational attainment within each income adequacy quintile, Canada, 1991-2001



Skill-based occupational groupings

Mortality hazard ratios*

Category	Men	Women
Professional (ref)	1.00	1.00
Managerial	1.12	1.19
Skilled, technical, supervisory	1.34	1.26
Semi-skilled	1.53	1.28
Unskilled	1.72	1.45
No occupation	2.29	1.85

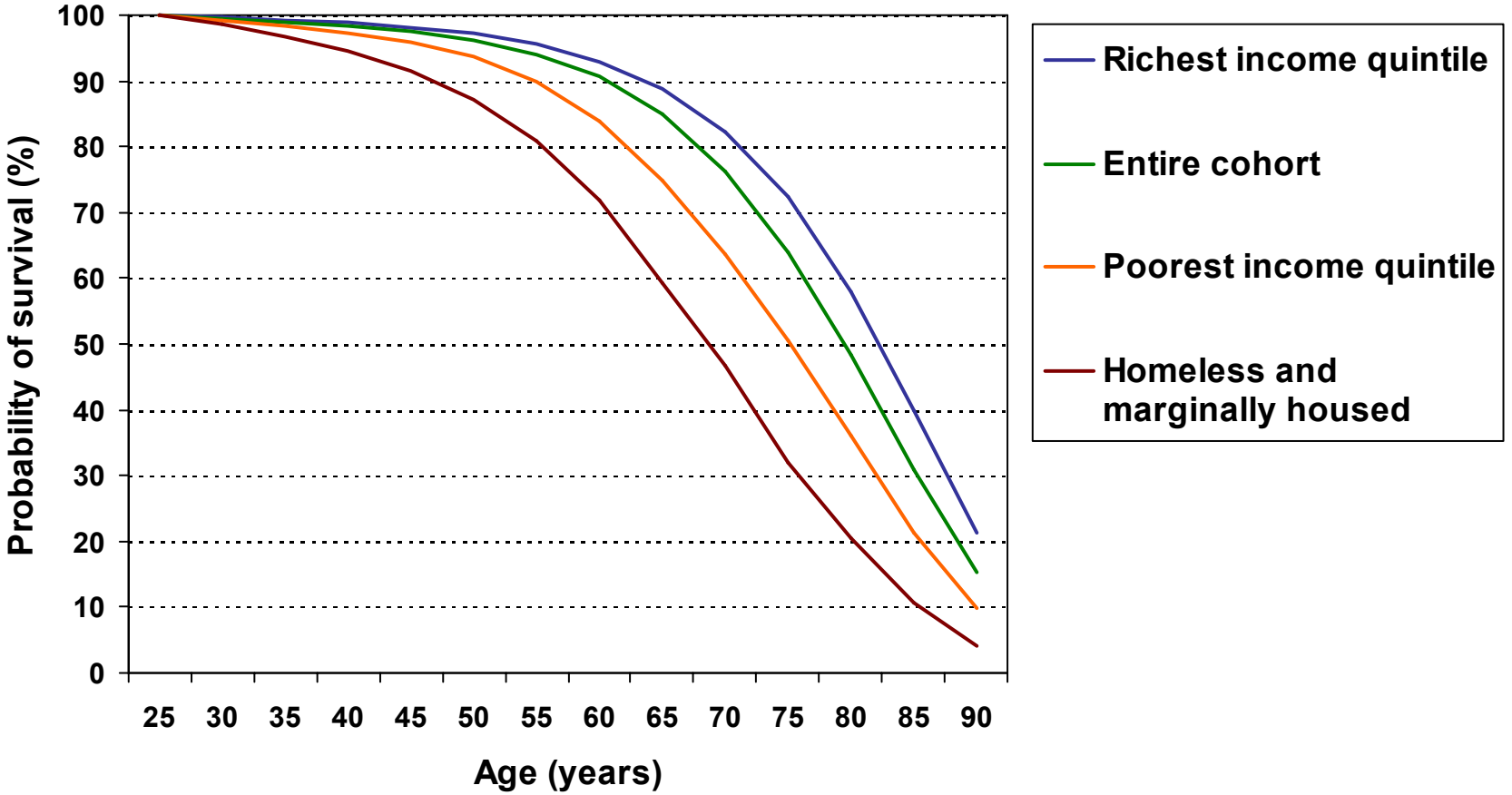
* controlled for age.

NOC5-EIC

Homeless and marginally-housed men

living in shelters, rooming houses and hotels

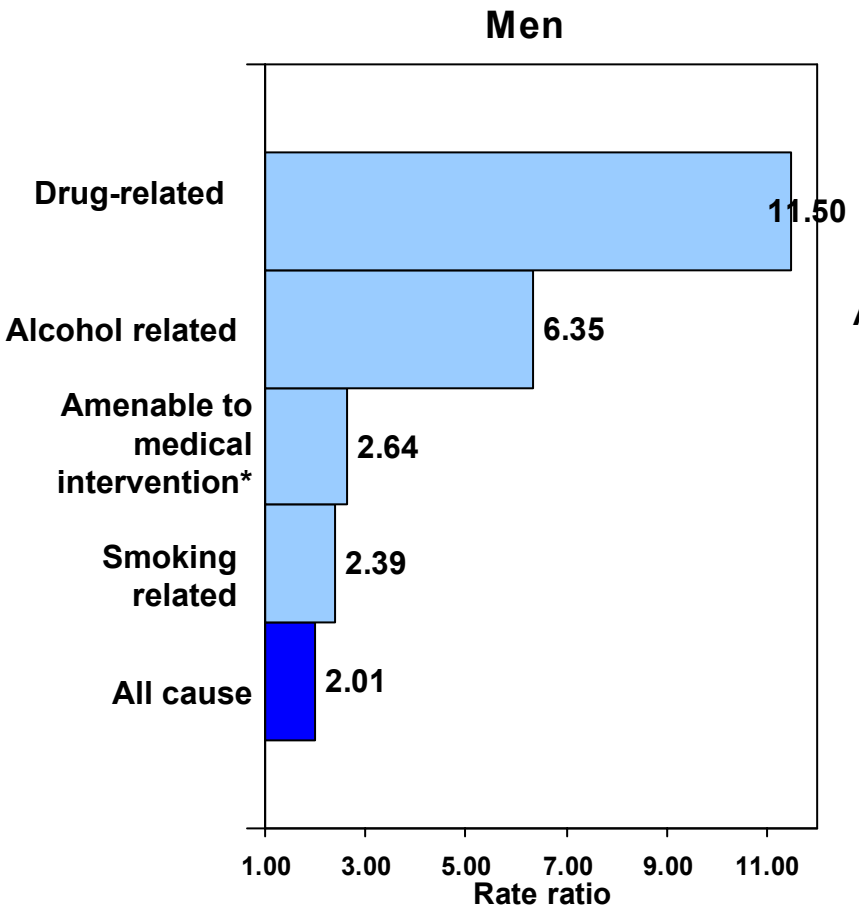
Probability of survival, conditional on survival to age 25

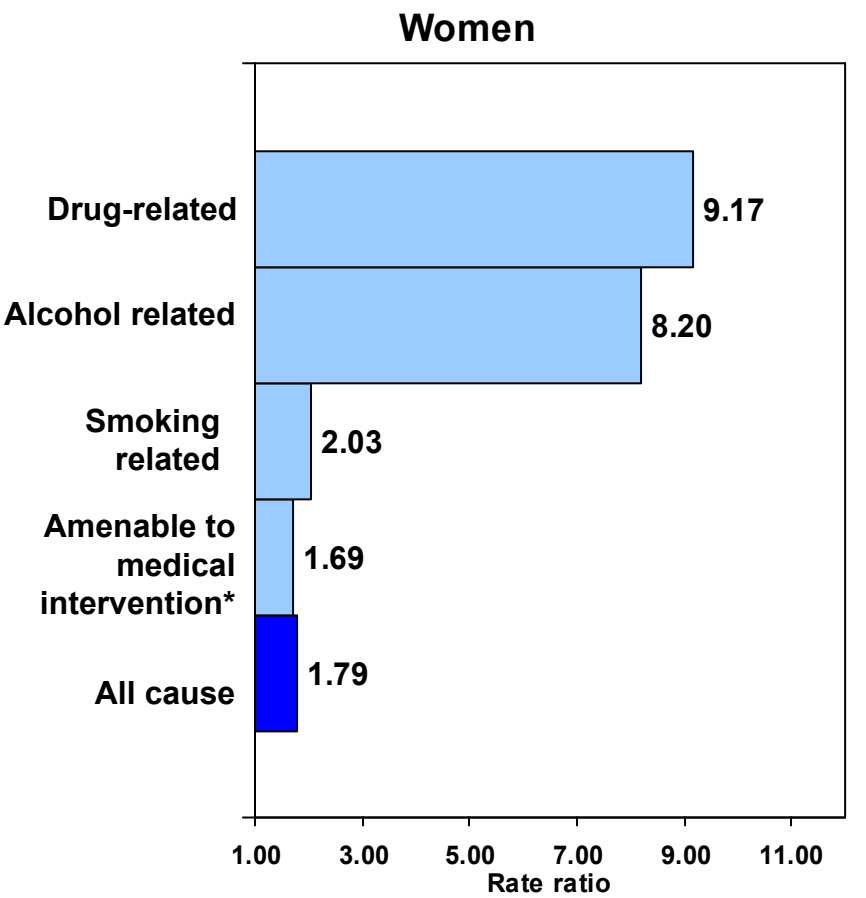


Homeless and marginally-housed adults

living in shelters, rooming houses and hotels

Selected rate ratios (compared to entire cohort)

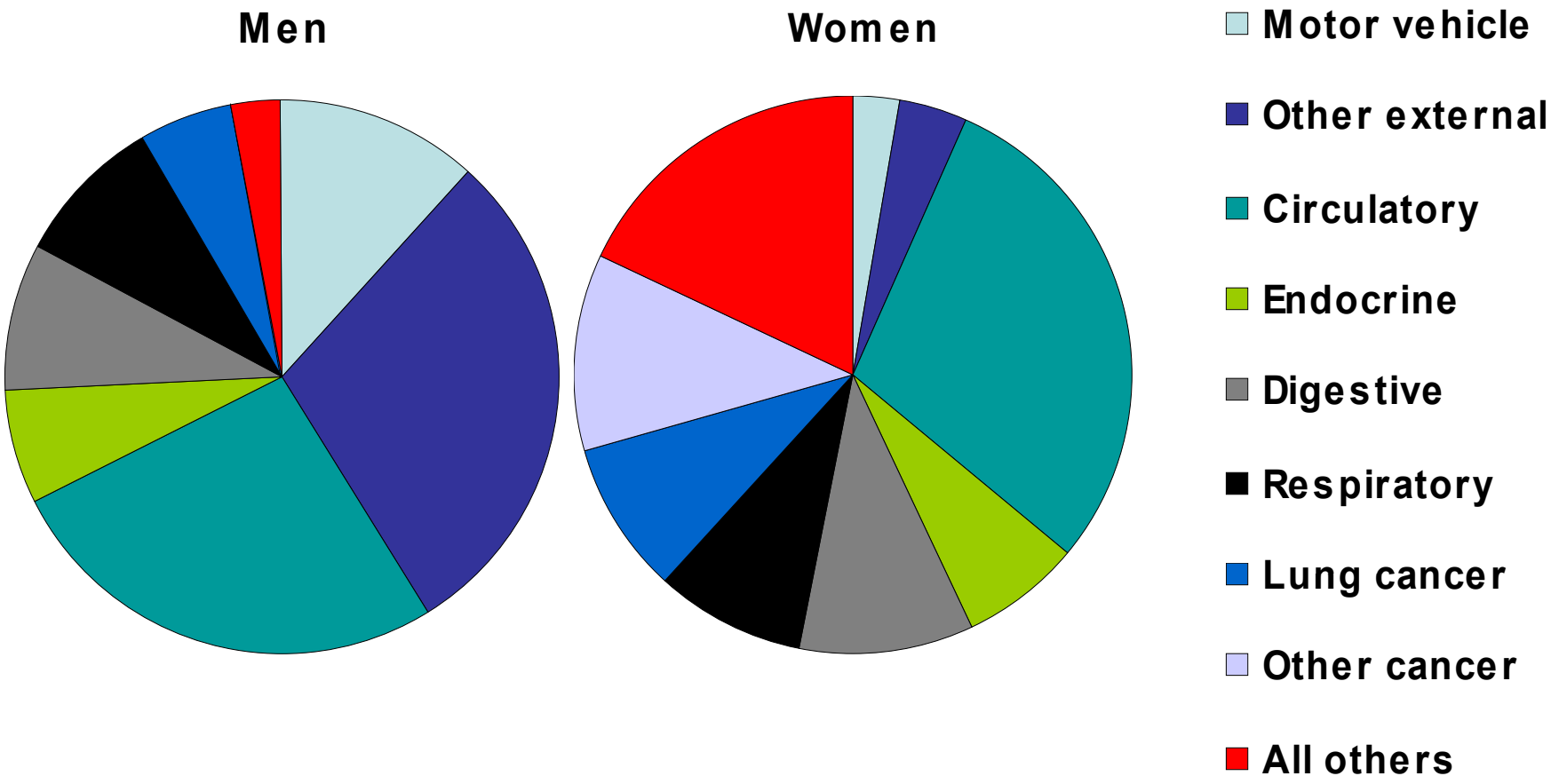




* < 75 years

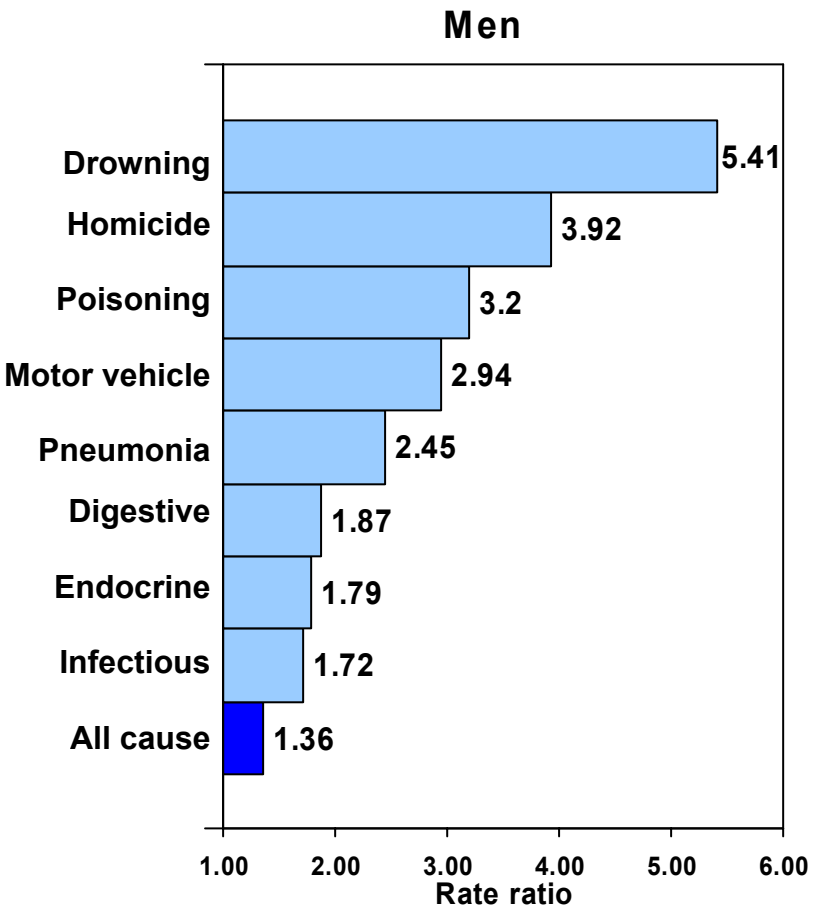
Métis adults

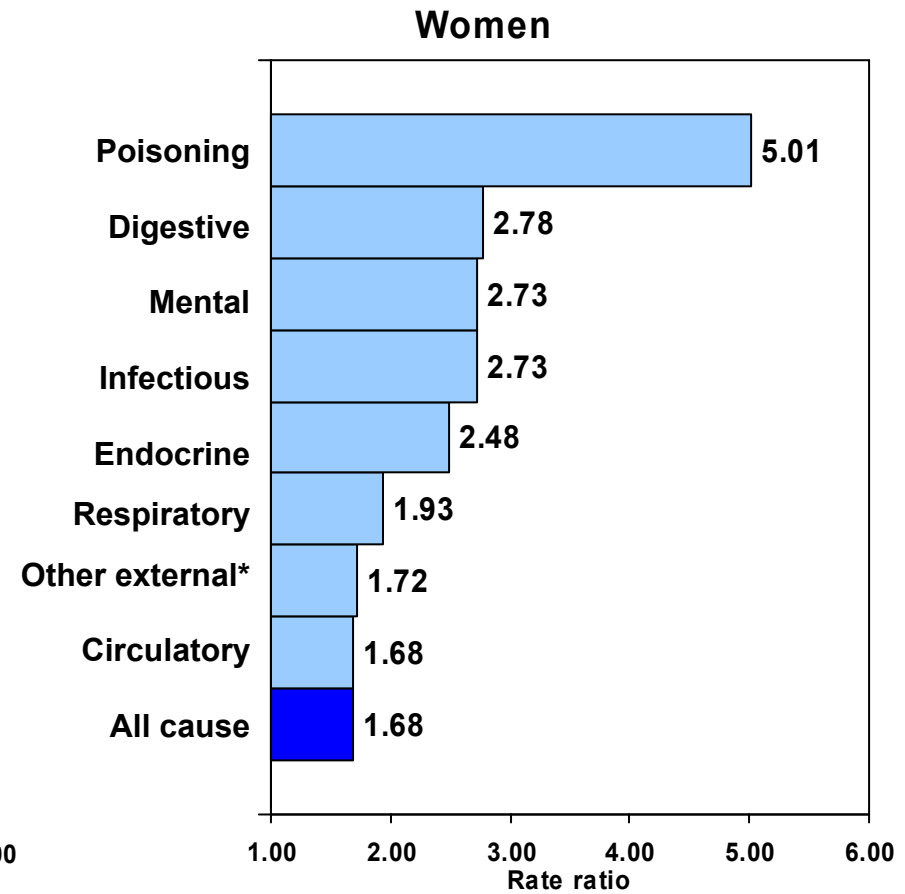
Excess mortality by cause of death (compared to entire cohort)



Métis adults

Selected rate ratios (compared to entire cohort)





Initial calculations of health-adjusted life expectancy (HALE) by income decile and sex, and by educational attainment and sex

Period life tables by sex for each category

- **from 1991-2001 census mortality follow-up study**

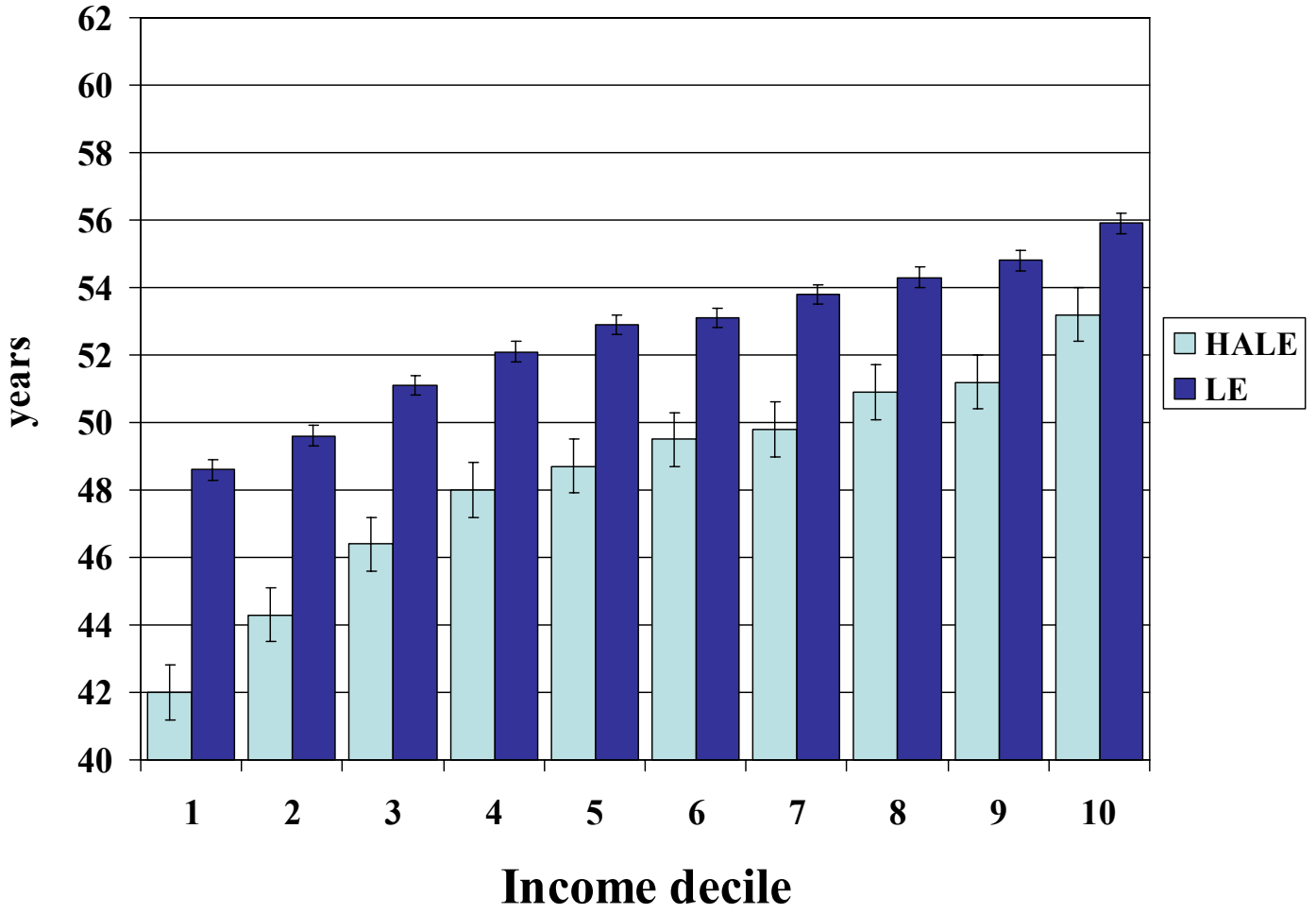
Average health utilities index scores by age and sex for each income/education category

- **from 2001 Canadian Community Health Survey**

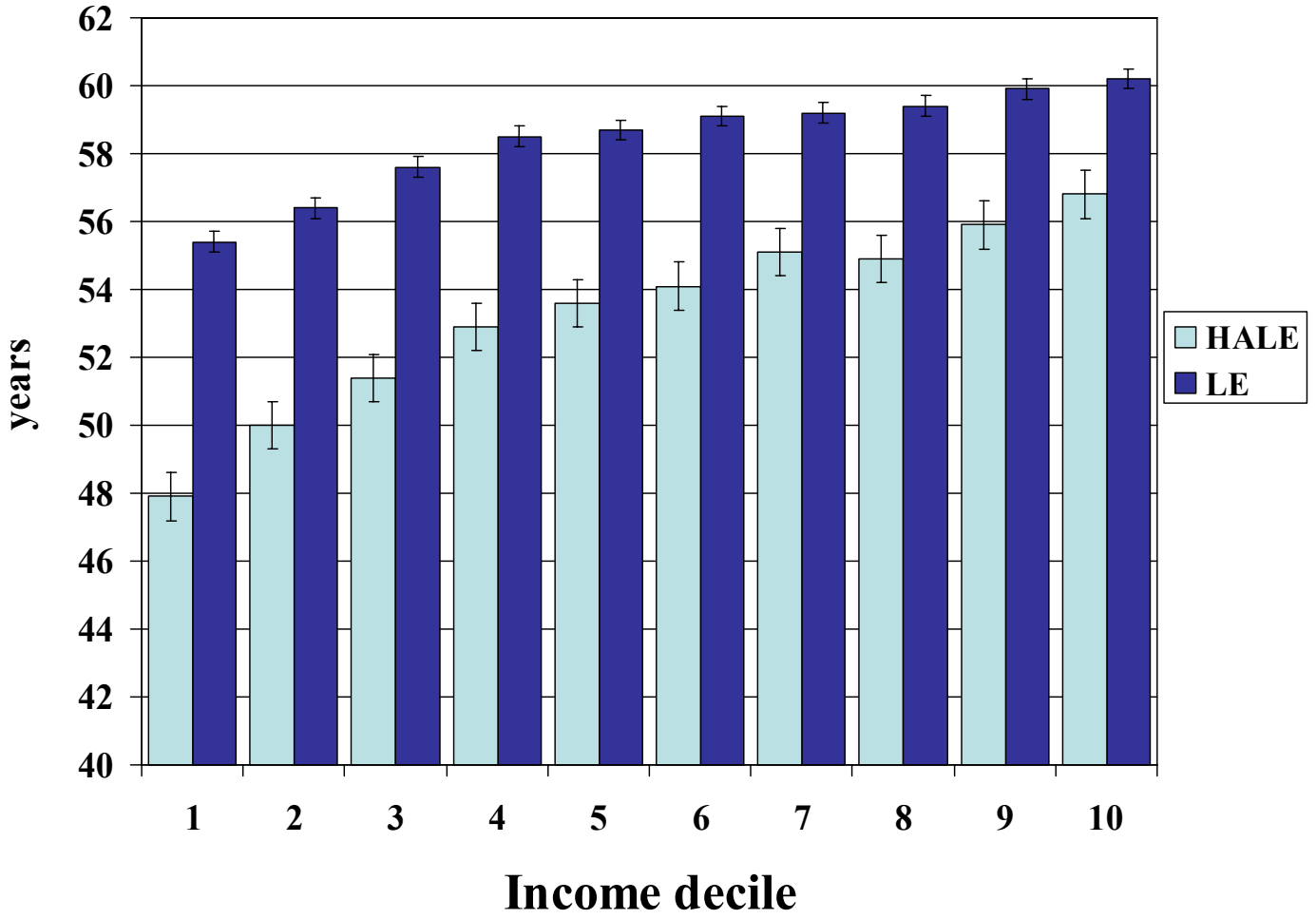
Sullivan-inspired method

- **but using average scores instead of proportions**

Remaining life expectancy and health-adjusted life expectancy at age 25, by income quintile, men, Canada, 1991-2001



Remaining life expectancy and health-adjusted life expectancy at age 25, by income quintile, women, Canada, 1991-2001



Differences in LE+HALE remaining at age 25:

	Men	Women
Top - bottom family income deciles:		
LE	7.3 (7.0, 7.6)	4.8 (4.5, 5.1)
HALE	11.2 (9.6, 12.8)	8.8 (7.5, 10.1)
University degree - less than hs graduation:		
LE	5.5 (5.3, 5.7)	3.4 (3.2, 3.7)
HALE	9.2 (8.6, 9.8)	9.3 (8.6, 10.1)

Other work ahead

Ambient air pollution and mortality

Ambient air pollution and cancer incidence (if additional linkage approved)

Mortality of linguistic minorities

“Well-informed” imputations to help control for confounding by unmeasured variables

"Well-informed" imputations to help control for confounding, based on multiple characteristics in both source and target datasets

To help control for occupational exposures in the context of environmental health studies:

- Occupational exposures to be estimated for specific occupations within each industry, based on measured exposure matrix data (Semiaticki)

To help control for behavioural risk factors:

- Probability of smoking and obesity to be estimated from 1996 National Population Health Survey data

  by age, sex, educational attainment and region for Canadian-born non-Aboriginal persons

  by age, sex, Aboriginal group and two education levels for Canadian-born Aboriginal persons

  by age, sex, world region, and two education levels for immigrants

Other work ahead (if approved)

Extend mortality follow-up to 21 years (add deaths for 2002-2006, then for 2007-2011)

Add linkage to cancer incidence data

Include alive follow-up from tax filer data

- **to detect emigration, additional deaths, other loss to follow-up, and changes of residence (for better estimation of ambient air pollution)**

For sub-sample, use disability data from post-censal Health and Activity Limitations Study (already approved)

References to reports from the Canadian census-mortality follow-up study

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