Social Inequality in Mortality and Cancer Survival in Canada: 1991-2006 Census Cohort Study

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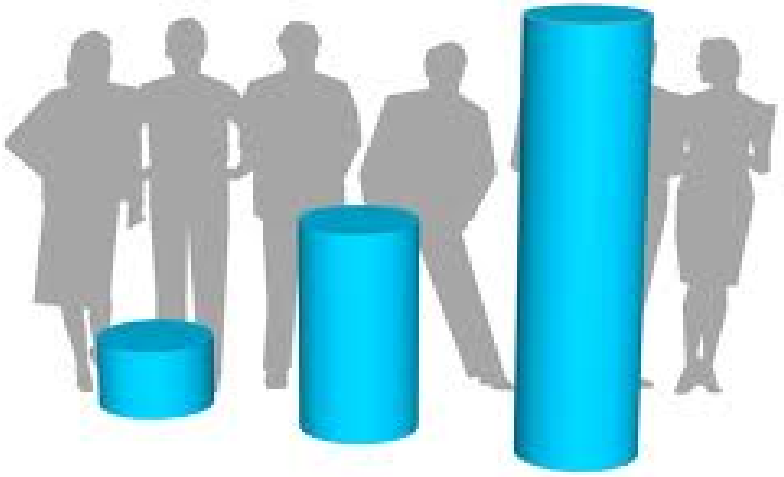
Why is the study of Social inequality important?

- By clearly identifying disadvantaged social groups, implementation of new policies can be targeted to those who most need them.
- Find causes of diseases and changes in mortality.
- Extend life expectancy by identifying beneficial conditions for longevity
- Achieving health equity has consistently been among the objectives of the health system in Canada.



Limitation of Previous Canadian Studies

- Canadian Vital Statistics or Canadian Cancer Registry does not contain information on Socioeconomic status (SES) or ethnicity. Historically, studies of mortality inequalities have used postal codes derived area-based measures of SES.
- Cancer inequality: major studies relied on the RCT or hospital-based cohort studies. Generalizability is limited by the scope of universe covered.
- First population level study (Wilkins et.al., 2008): 1991-2001 Canadian Census Mortality Follow-Up Study; descriptive analysis;

Wilkins R, Tjepkema M, Mustard CM, Choinière R. The Canadian census mortality follow-up study, 1991 through 2001. *Health Reports* 2008;19(3):25-43.

Research Questions

- To improve our understanding of the socioeconomic gradients in mortality from multivariate analysis - extend Wilkins et. Al.(2008)earlier work.

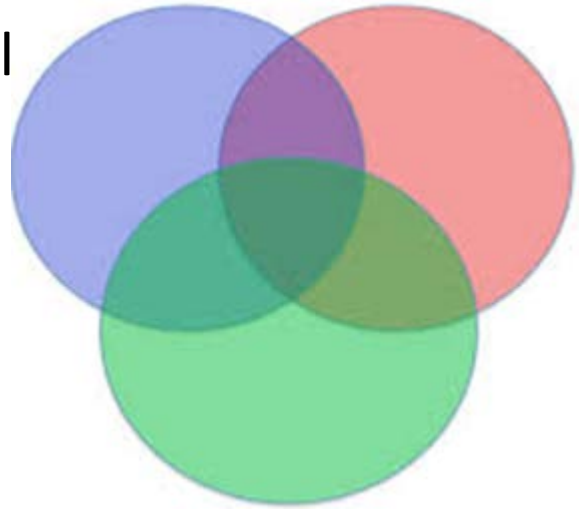
- To investigate the survival by socioeconomic status from all causes of cancer, as well as the most common cancers in Canada.

A national perspective

Three Key SES variables:

- education attainment
- household income
- occupational skill level

Age, period and birth cohort analysis



- aboriginal peoples
- immigration Status

Most common Cancers:

- Colorectal
- Lung
- Breast
- Prostate

Novel Opportunity: individual measures of SES in a large sample, representative of approximately 15% of Canadian adult population 25 years old and above

Component	Description	Number
Cohort	Respondents to 1991 Census long-form questionnaire, aged 25 and over	3,676,487
	Linked to tax summary file (bridge file between Census and mortality)[1]	2,860,244
	Respondents linked and followed for deaths	2,734,835
Mortality (CMDB)	Died during the follow up period (1991-2006)	426,979
Cancer (CCDB)	Individuals diagnosed with Cancer after census day 1991[2]	203,315

[1] Completed by Stats Canada

[2] Individuals can have more than 1 cancer incidence during follow-up period.

Statistical Method

Mortality Analysis

- Population: all cohorts

$$prob(y_{it} = 1) = f_{A,G}(SES_i, Z_i, T_{it})$$

Where

y_{it}: a measure of mortality at time t;

SES_i: education, income and occupation groups

Z_i: aboriginal and immigration status

T_{it}: binary time variable (dummy)

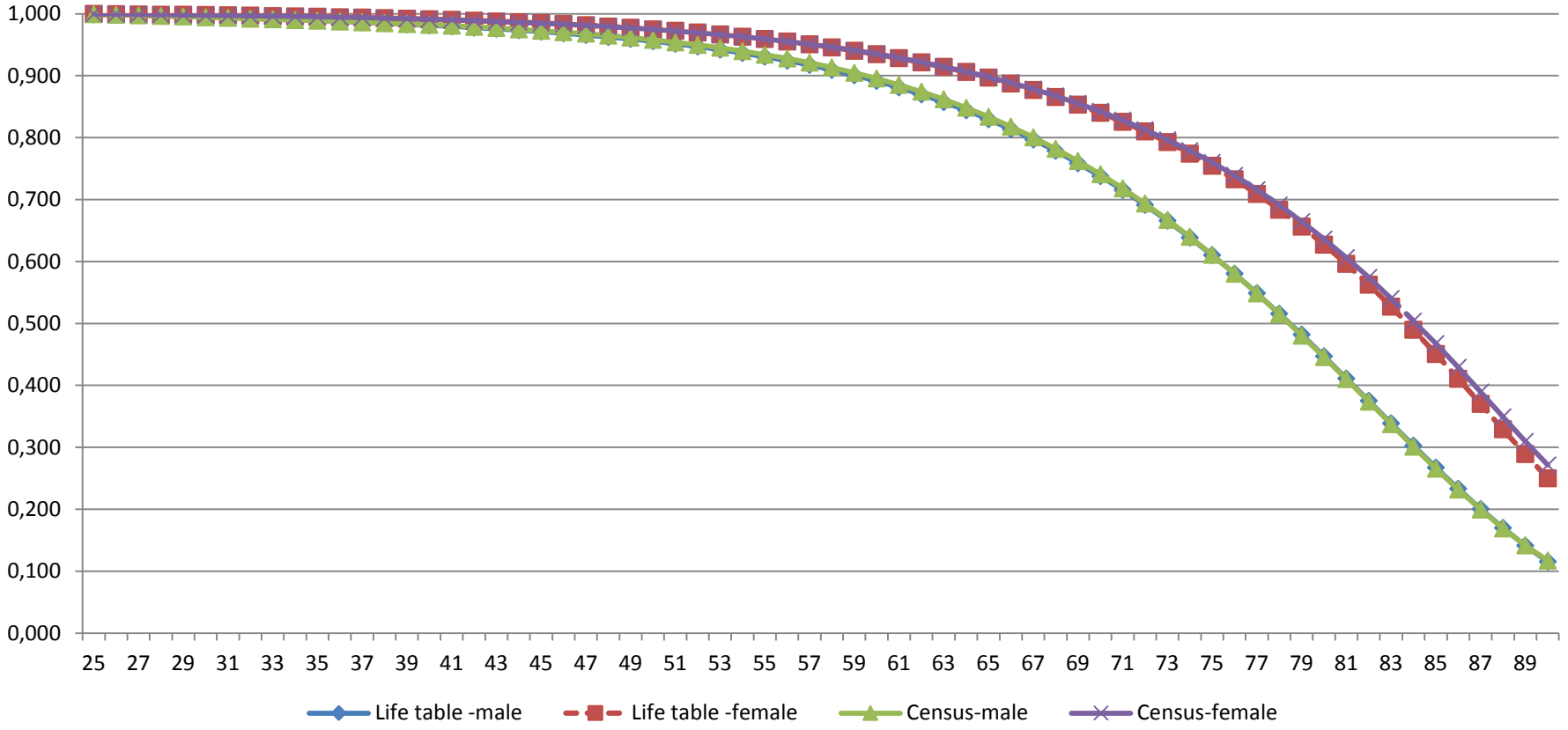
f : logistic regression model

A, G: cohort age and gender groups - 5 year interval age groups

Estimators: Odds ratio

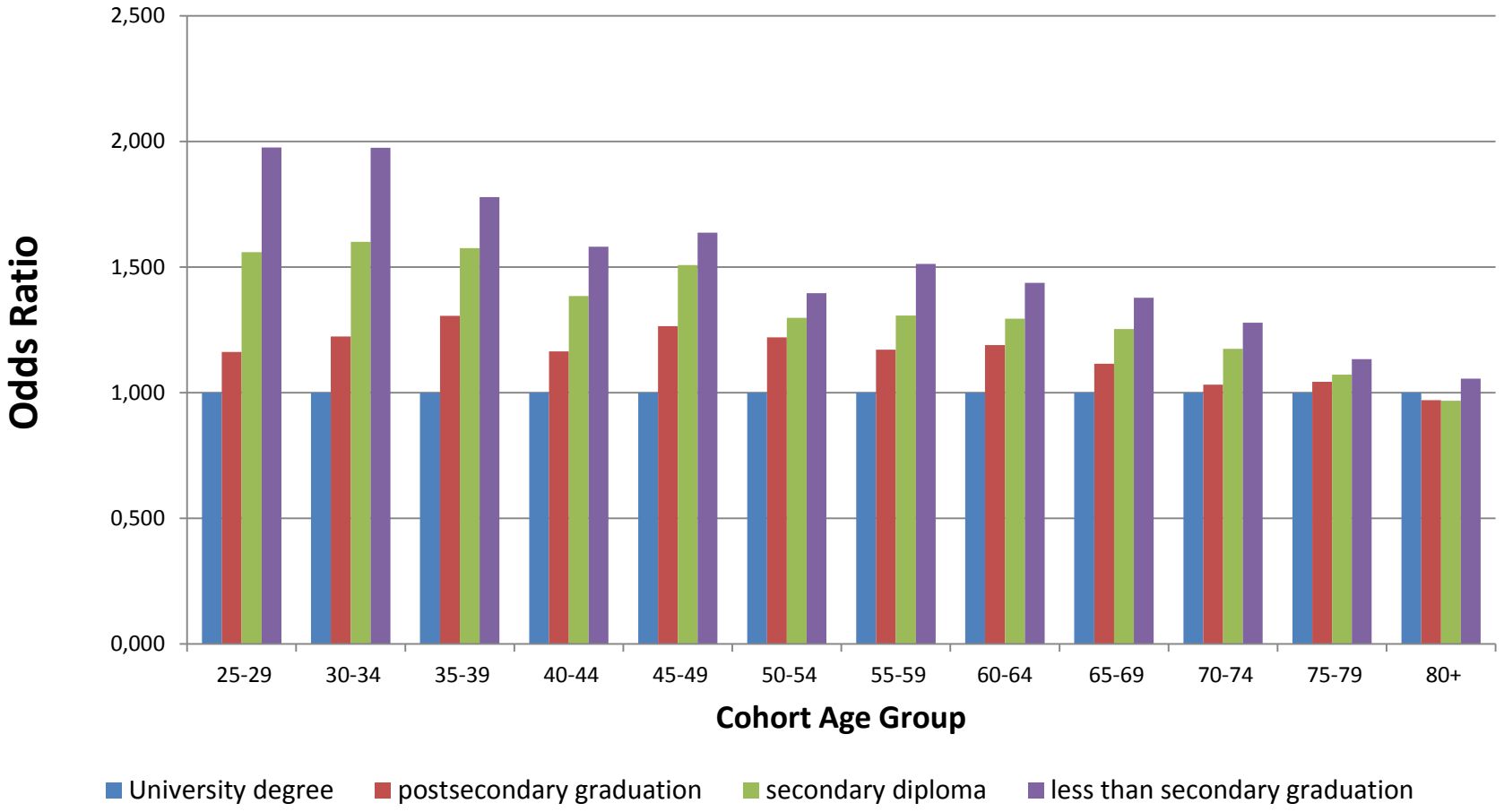
Age Profile of Mortality in Canada

Survival rate by age for 1995-1997 and 2002 (average) compared to census cohort 1991-2006



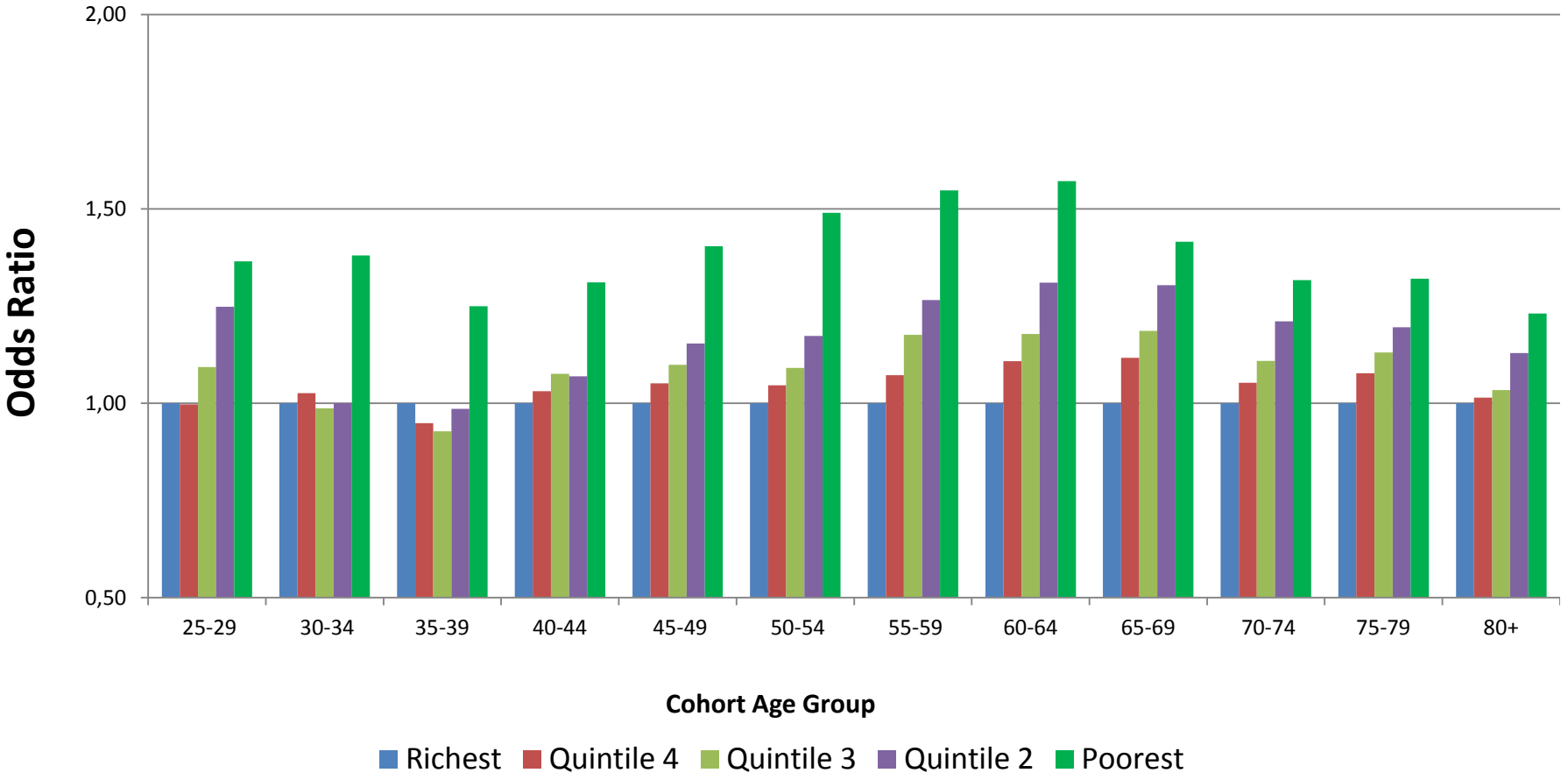
The Cohort survival estimates closely follow those of official Canadian life tables for both men and women. Slight overestimate at older ages, especially for females, likely due to a selection effect (institutional residents are excluded from the cohort).

Logistic regression on mortality – Education Attainment (male)



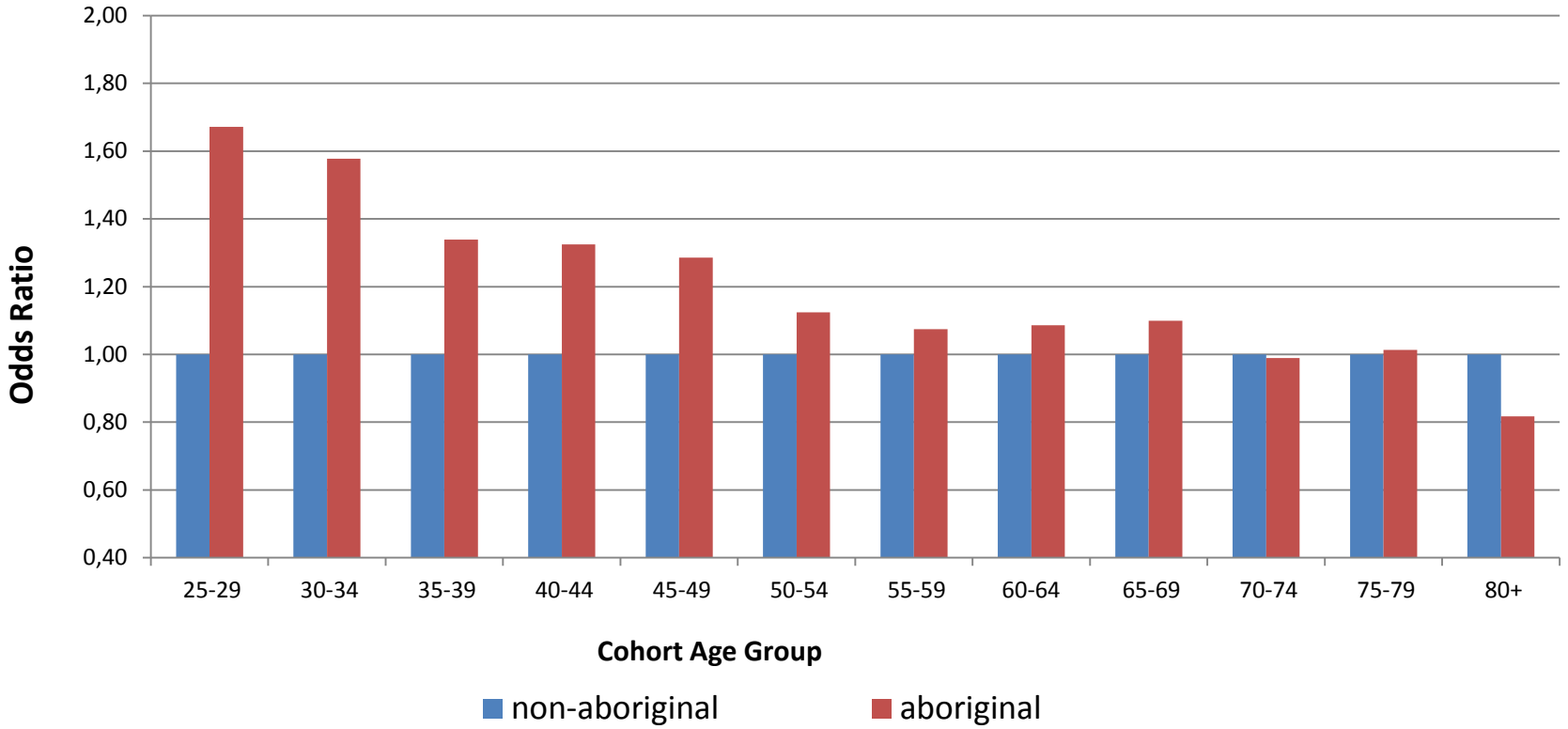
Higher education attainment was associated with low mortality rate. The magnitude is decreasing with the age. Educational disparity for male is significantly larger than for female.

Logistic regression on mortality - income (male)



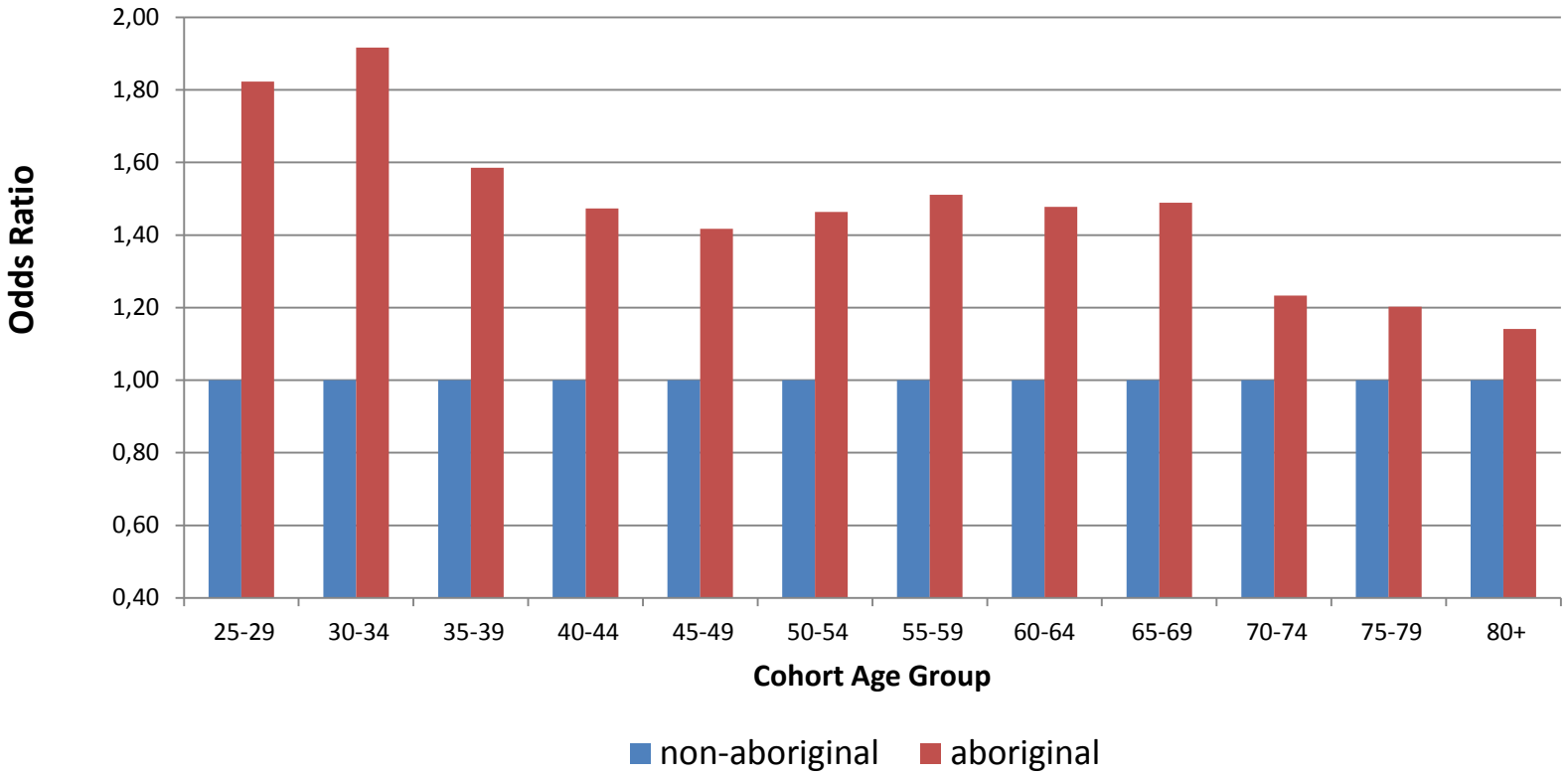
Compared with the richest, the poorer always were more likely to die (OR=1.231 to 1.548 for men, OR=1.095 to 1.717 for women), where the steepest disparity occurred for cohorts aged 60-64 among men and aged 50-54 among women. The odds of the 2nd and 3rd poorest were not significant in the cohorts aged under 45 in men and under 40 in women.

Logistic regression on mortality – Aboriginal (male)



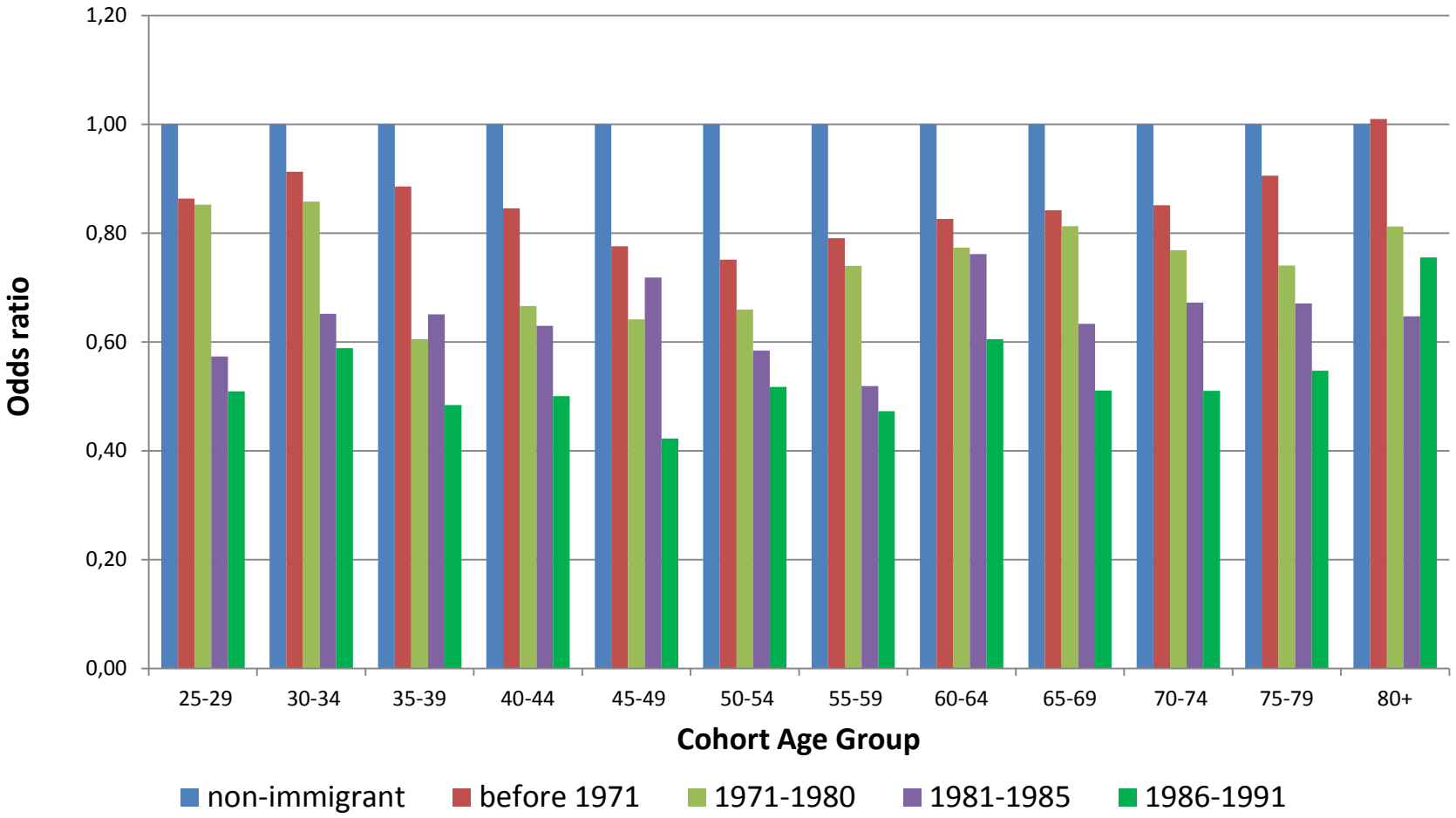
Aboriginals were significantly more likely to die compared with non-Aboriginals for cohorts under 70. The gradient decreased with the cohort age. There was a **selection effect** in the oldest group (80+ year), where selected aboriginals were robust and less likely to die.

Logistic regression on mortality – Aboriginal (female)

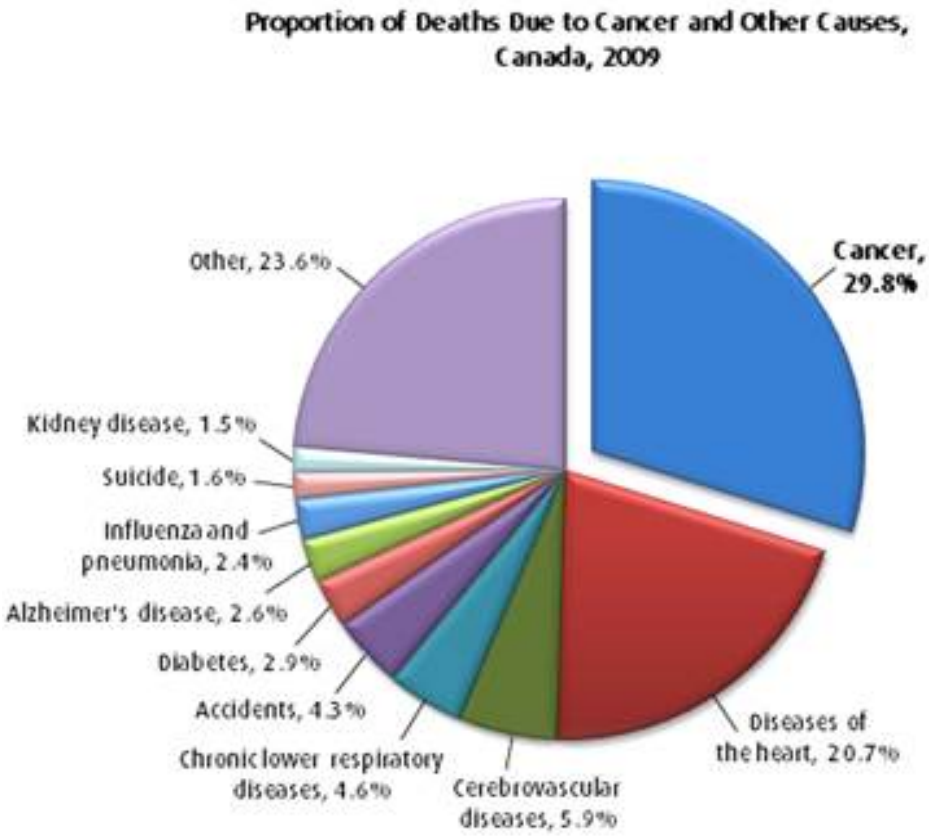


Female aboriginals were significantly more likely to die compared with non-Aboriginals across all cohort groups. The magnitudes for the older cohorts is smaller than younger cohorts. There was no selection effect in the oldest group.

Logistic regression on mortality – Immigration Status (male)



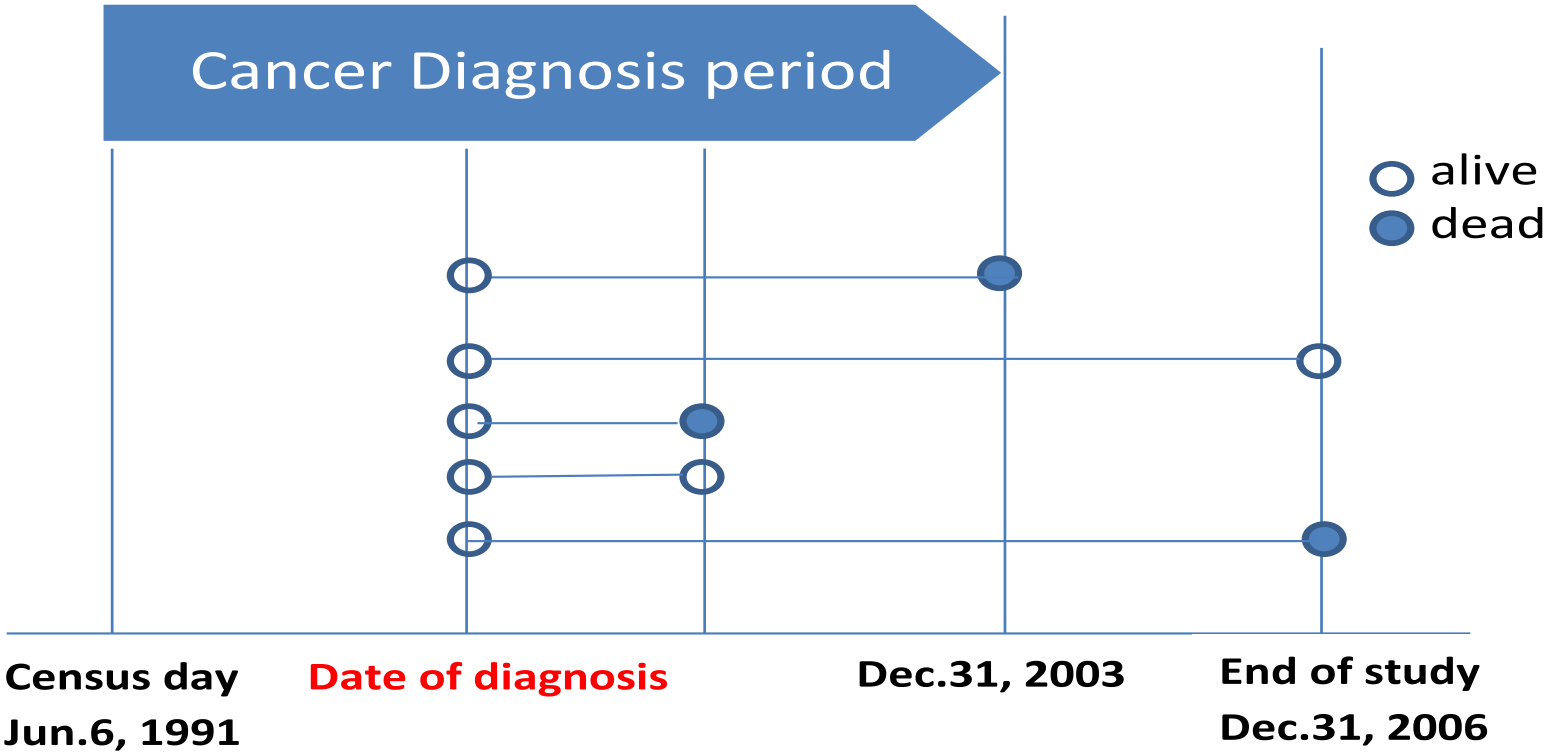
"healthy immigrant" effect : immigrants' health is generally better than that of the Canadian-born but diminishes with years since immigration to Canada.



Cancer Survival?

SES Differences

Cancer Survival Analysis: Cox Proportional Hazard Model

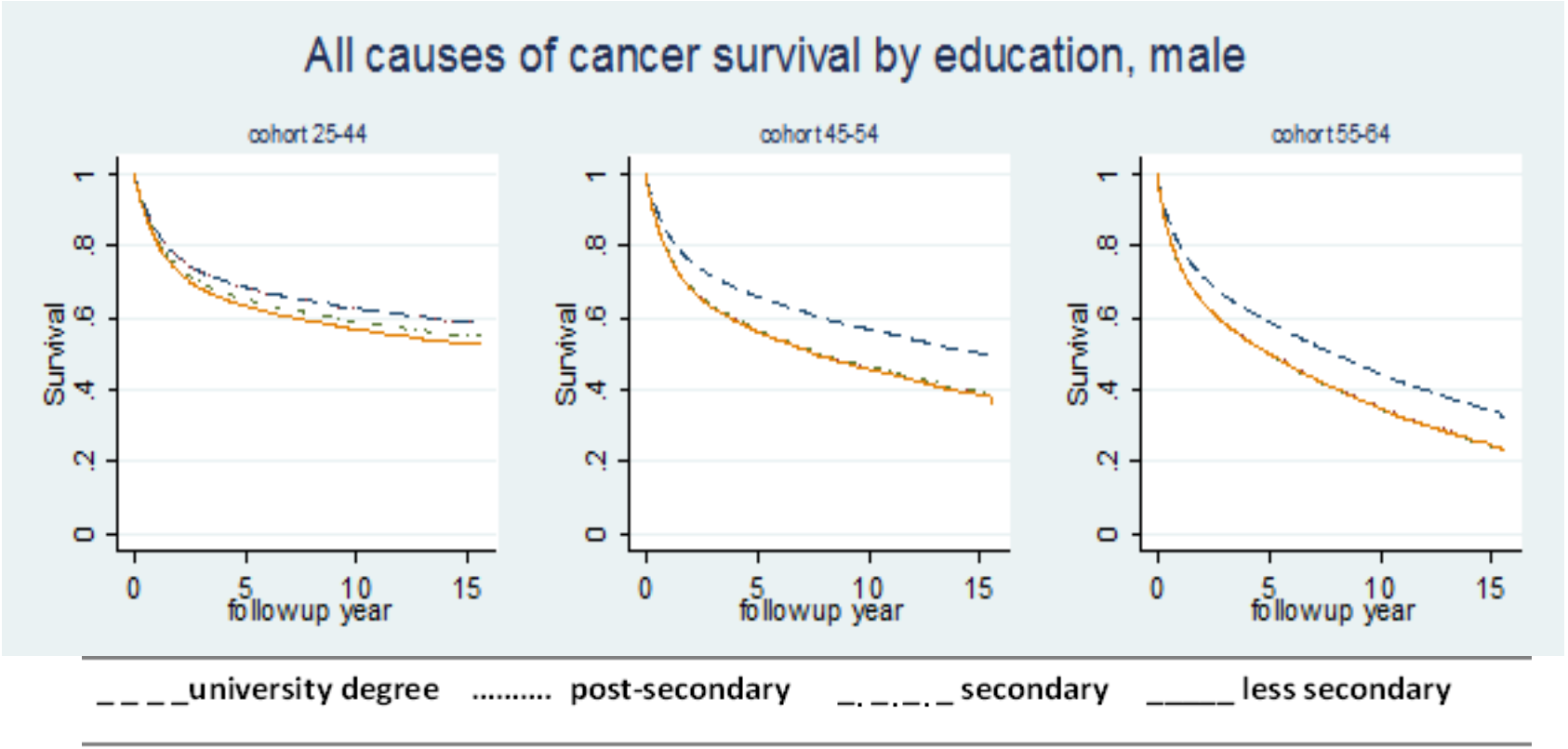


Survival time: from the date of diagnosis of the first primary cancer to the date of death

Covariates: SES, immigration status, aboriginal, age at diagnosis and types of cancer

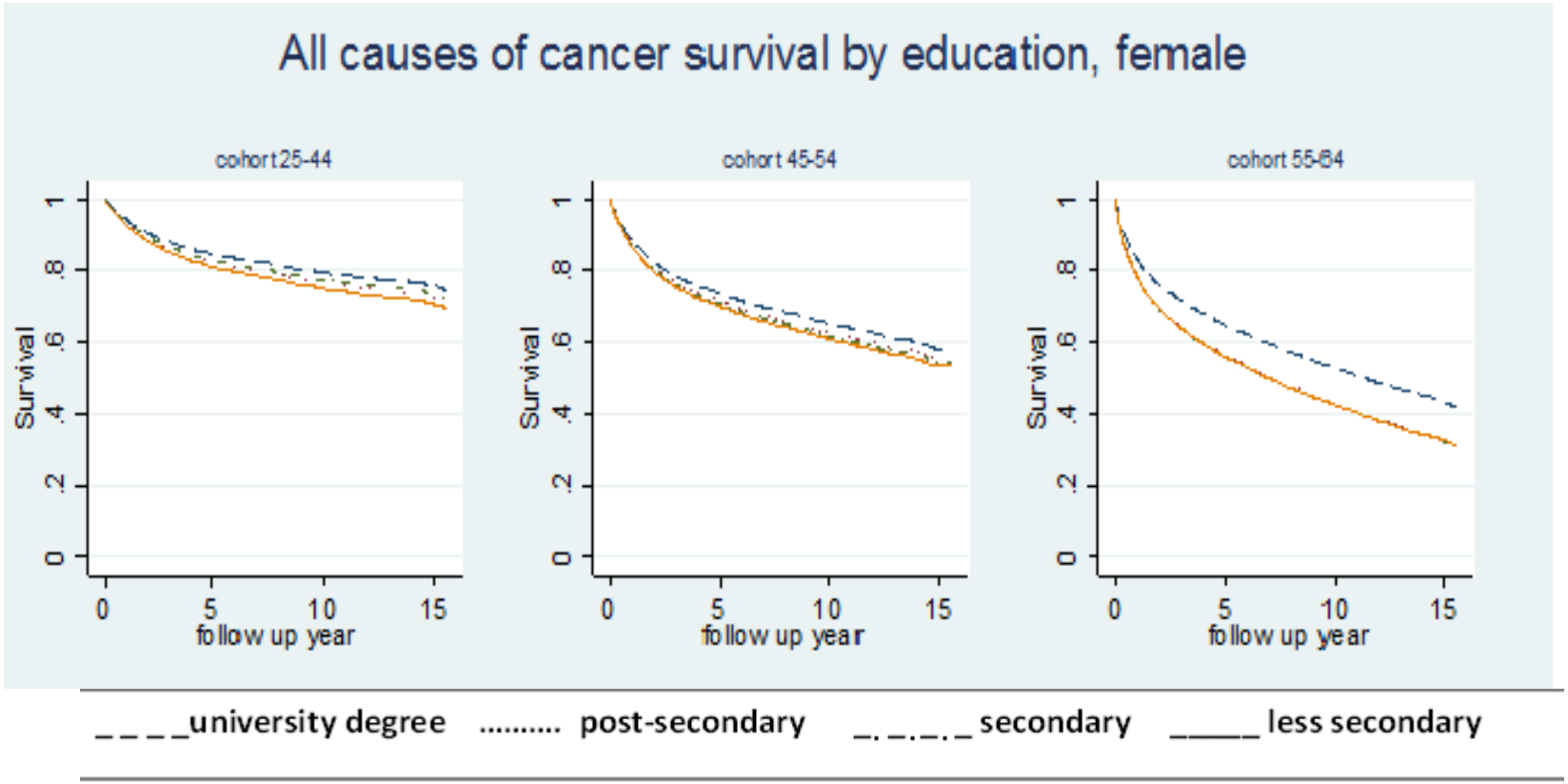
Estimator: hazard ratio, survival/hazard function

SES Disparity in All Causes of Cancer Survival- education attainment



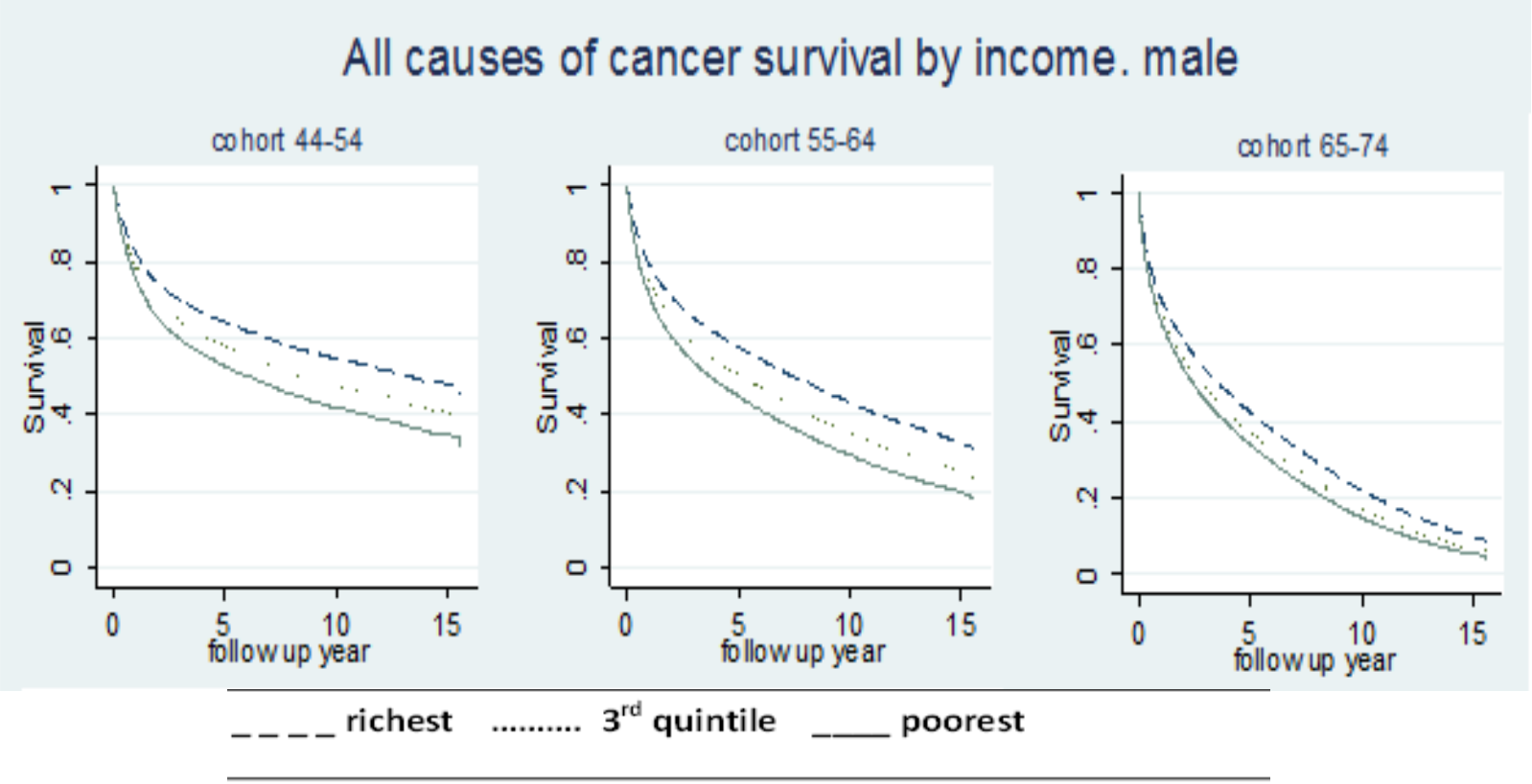
Cancer patients with less than secondary education increased the expected hazard by around 14% - 26% across cohort age groups, compared with those with university degree. The largest educational disparity in all causes of cancer survival occurred in the cohort aged 45-54 for men.

SES Disparity in All Causes of Cancer Survival – education attainment



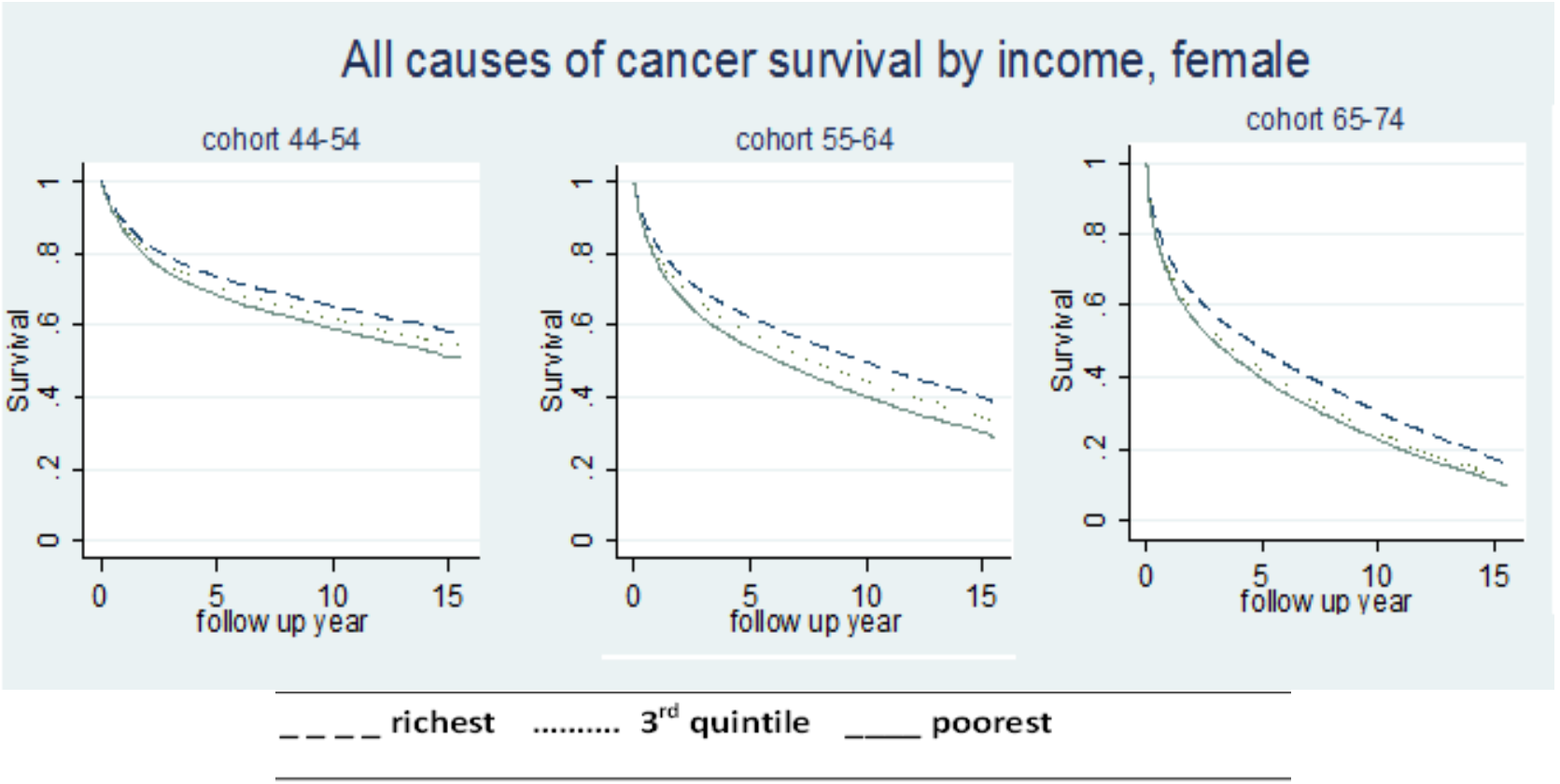
Magnitude of educational difference in cancer survival for female was smaller than for male. The largest educational disparity occurred in the cohort aged 55-64 for female.

SES Disparity in All Causes of Cancer Survival- income



The poorest cancer patients increased the expected hazard by 7%-37% for male compared with the richest cancer patients, in which the largest survival differences occurred in the cohort aged 45-54 for male.

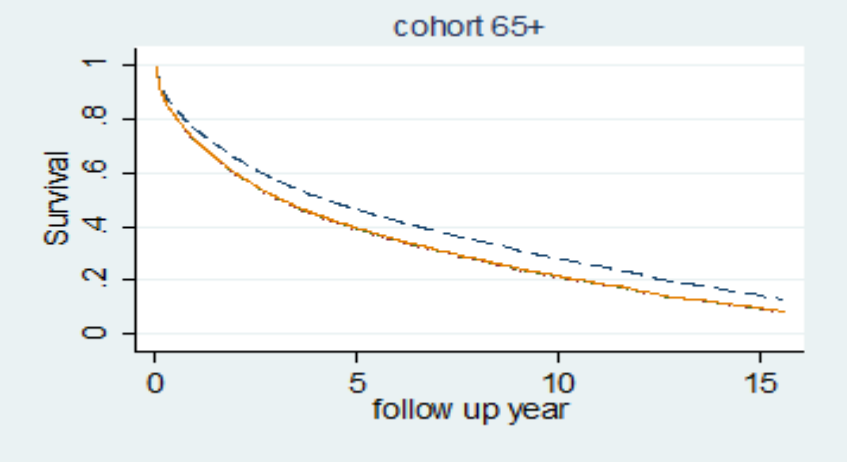
SES Disparity in All Causes of Cancer Survival



The poorest cancer patients increased the expected hazard by 7% -26% compared with the richest cancer patients, in which the largest survival differences occurred in the cohort aged 55-64.

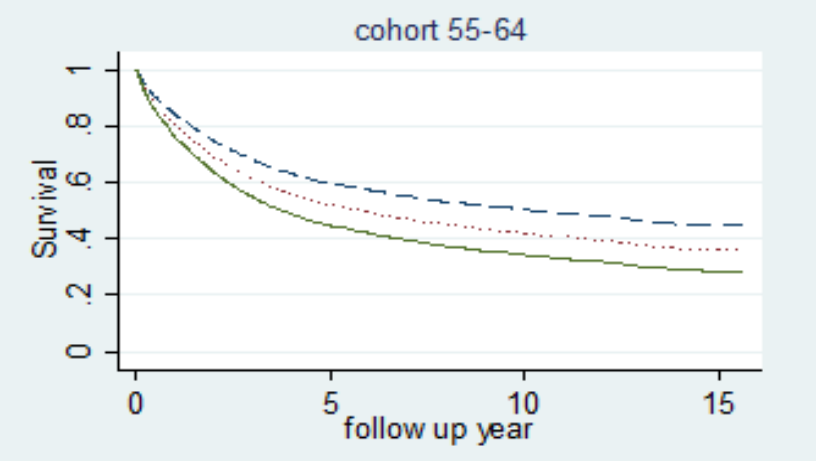
SES Disparity in Colorectal Cancer Survival

EDUCATION



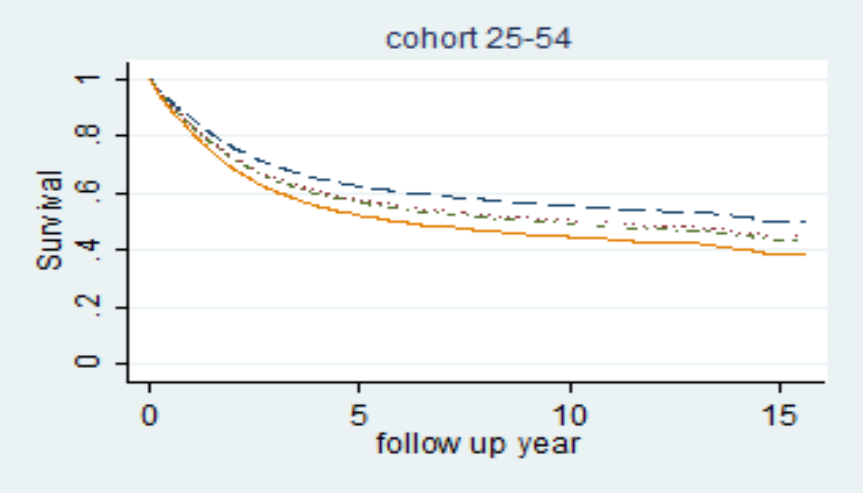
____university degree ..... post-secondary _.-.-._ secondary ____ less secondary

INCOME



____ richest ..... 3rd quintile ____ poorest

OCCUPATION



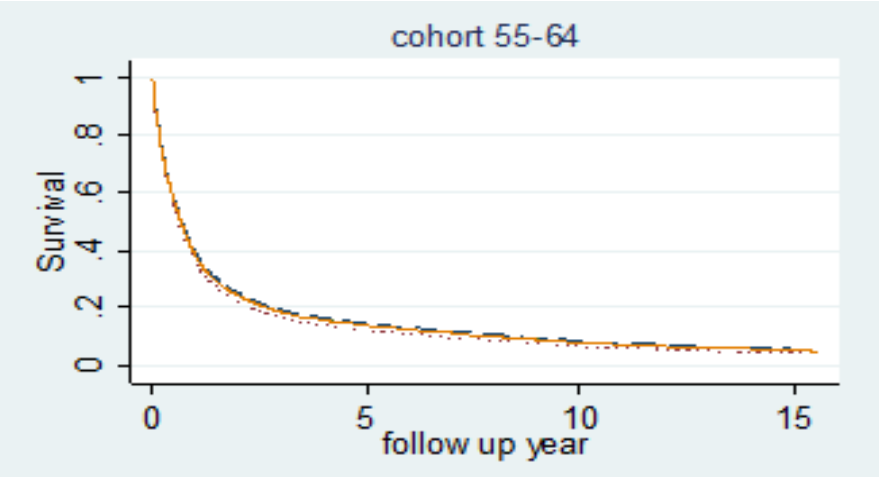
____ profession ..... skilled _.-.-._ unskilled _____ no occupation

GENDER

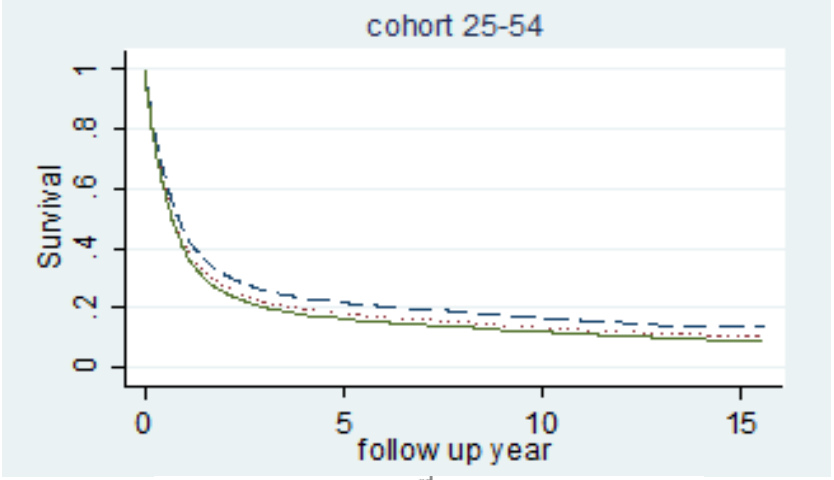
__ __ male ____ Female

SES Disparity in Lung Cancer Survival

EDUCATION



INCOME



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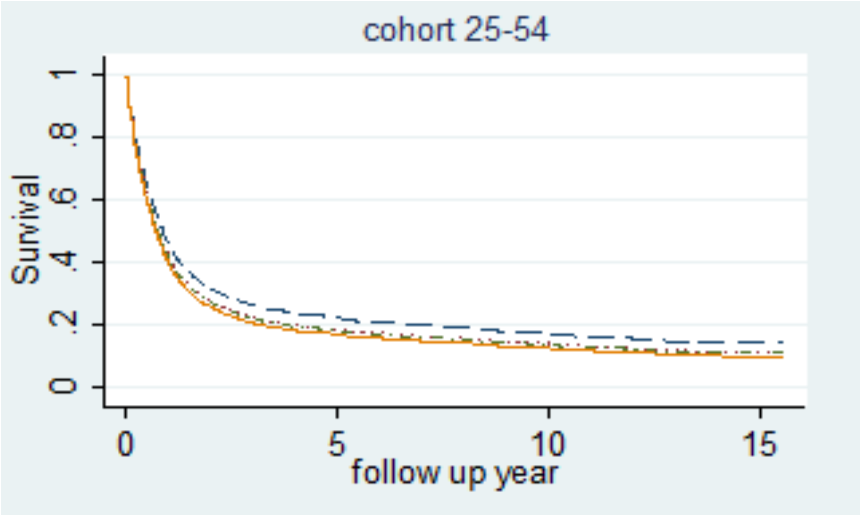
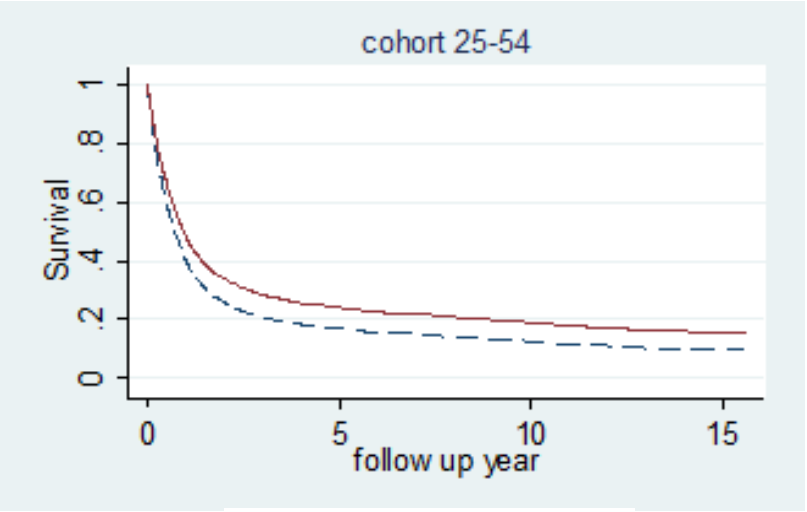


GENDER



SES Disparity in Female Breast Cancer Survival

	Hazard Ratio							
	Cohort 25-54		Cohort 55-64		Cohort 65-74		Cohort 75+	
Income								
Richest	1.000		1.000		1.000		1.000	
Quintile 4	1.202	**	0.961		1.108		1.109	**
Quintile 3	1.007		0.931		0.998		1.162	**
Quintile 2	1.270	***	1.042		1.112		1.289	***
Poorest	1.542	***	1.198	*	1.256	**	1.263	***
Occupation								
professional	1.000		1.000		1.000		1.000	
management	0.891		1.331	**	1.307		1.259	
skilled	1.119		1.175		0.973		1.222	
Semi-skilled	1.036		1.233	*	1.074		1.071	
unskilled	1.049		1.405	**	1.120		1.314	
No occupation	1.121		1.393	**	1.259	*	1.374	*

SES Disparity in Male Prostate Cancer Survival

	Hazard Ratio							
	Cohort 25-54		Cohort 54-64		Cohort 65-74		Cohort 75+	
Education								
University degree	1.000		1.000		1.000		1.000	
postsecondary graduation	1.375		0.986		1.072		1.037	
secondary diploma	1.699	**	1.192	**	1.135	**	1.211	**
< secondary graduation	2.015	***	1.375	***	1.24	***	1.28	***
Income								
Richest	1.000		1.000		1.000		1.000	
Quintile 4	0.933		1.041		1.038		1.086	
Quintile 3	0.992		1.169	**	1.105	**	1.089	
Quintile 2	1.046		1.327	***	1.209	***	1.179	**
Poorest	1.439	***	1.551	***	1.437	***	1.178	**
Aboriginal	1.688	**	1.382	**	1.231	*	1.445	***

Conclusion (1)

- There is a strong negative association between SES and overall mortality .
- There is a bigger convergence of educational mortality difference with age for men and women, but stronger among men.
- Largest increase in overall mortality inequalities between the poorest and the richest occurred in the cohort aged 60-64 for men aged 50-55.
- Aboriginals had higher mortality risk than the non-aboriginals but slowed down with age. There was a selection effect in the oldest male cohorts aged 80+.
- Immigrants had lower mortality risk than Canadian born , especially for recent immigrants.

Conclusion (2)

- The estimates of cancer survival show a significantly increased risk by decreasing level of education and income.
- The association and magnitude between SES and cancer survival varies by the tumor sites and gender.
- There was no SES disparity in the lung cancer survival.
- Education and income are significant positively associated with colorectal and male prostate cancer survival across cohort groups.
- Among female breast cancer patients, the poorest increased the hazard risk by 54% in the cohorts aged 25-54.


Thank You!