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

Canadian Research Data Centre Network Conference

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Canada

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
Closing the Gap in a Generation: Health equity through action on the social determinants of health World Health Organization, Commission on Social Determinants of Health Final Report (2008)

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

* 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.

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
Cancer incidences during follow-up period (1969-2003)	338,085
Followed for mobility from tax summary files (1990-2006)	2,643,769

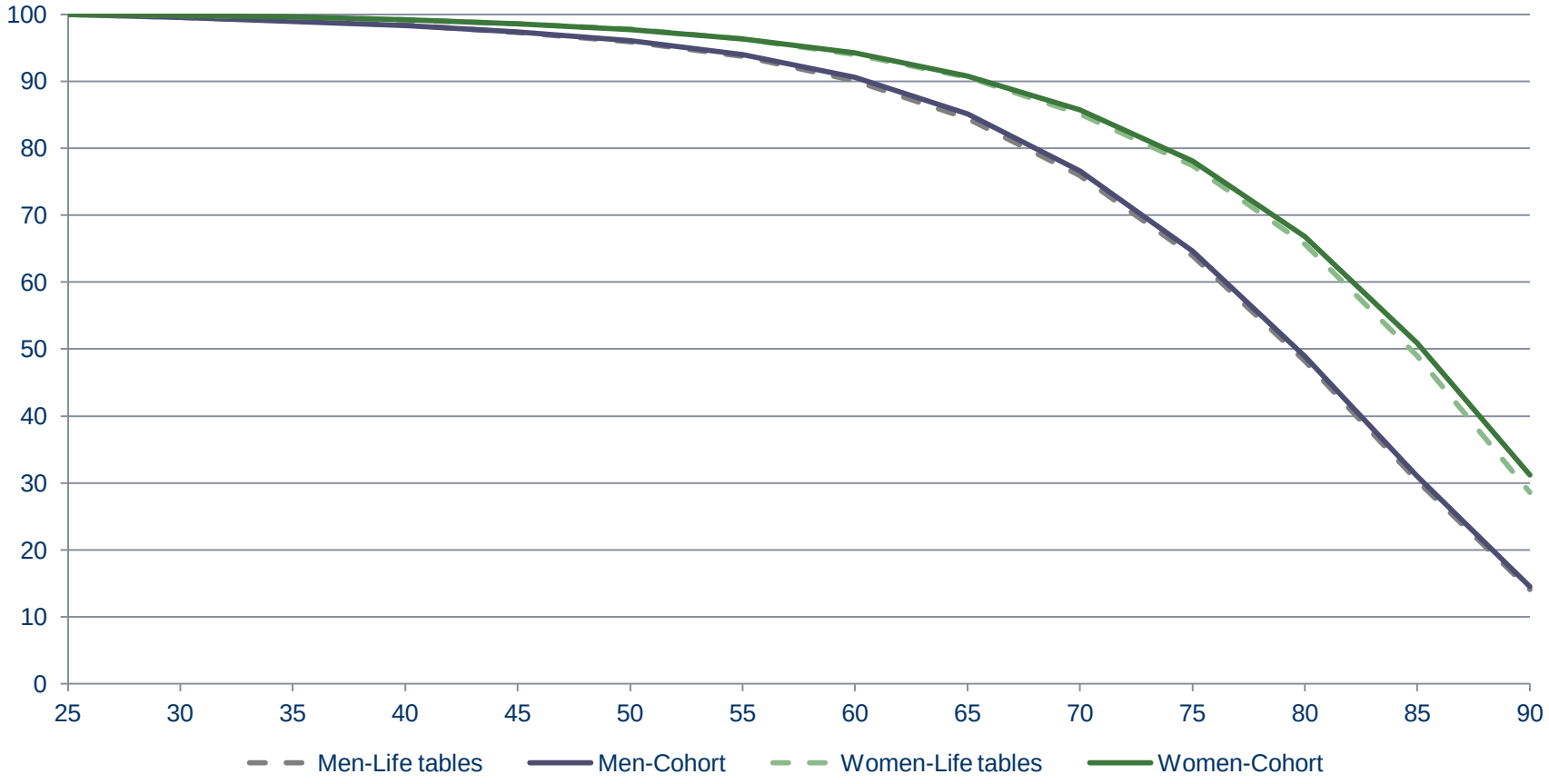
Linkage extension relevance

- 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

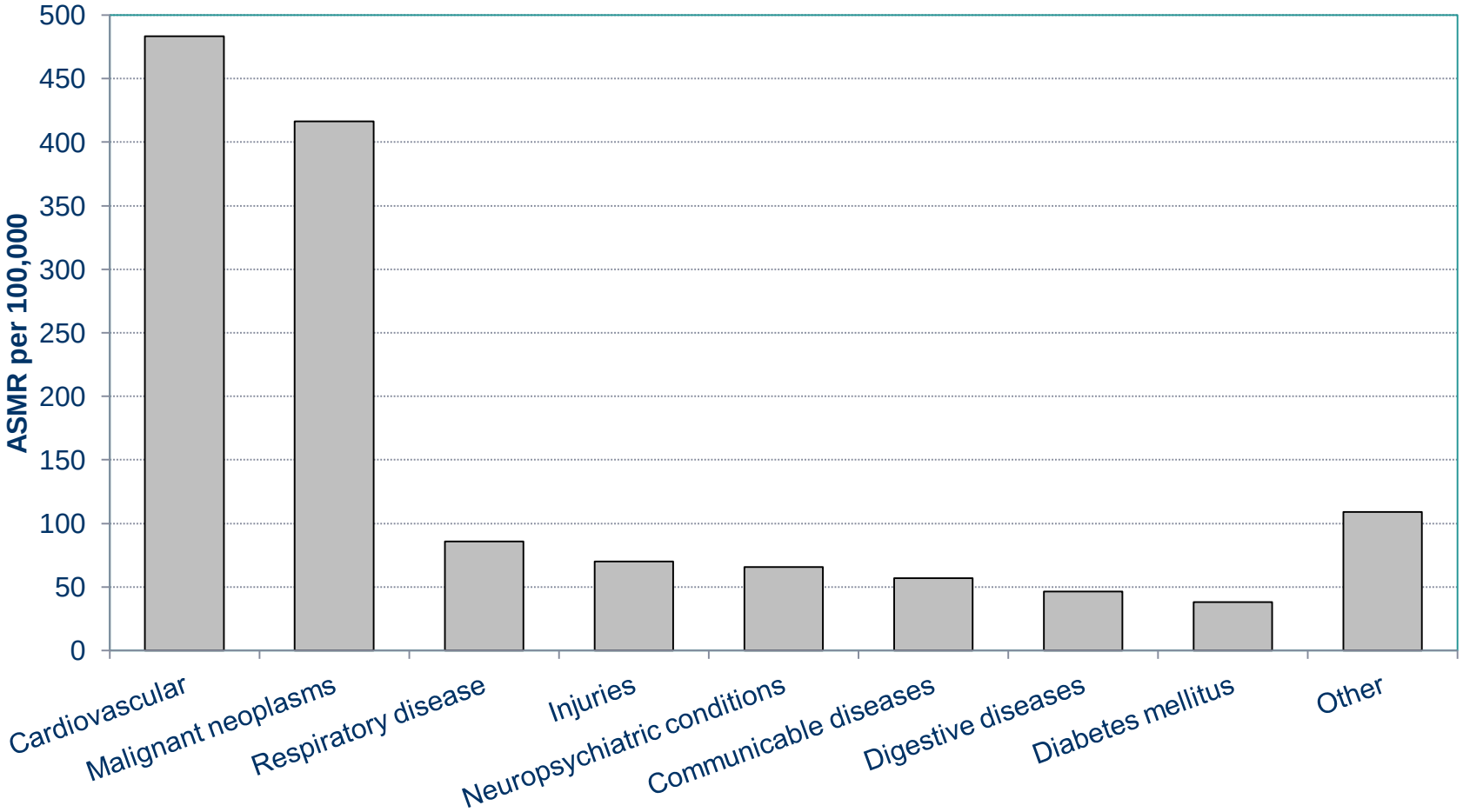
Selected Results

Results – survival

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

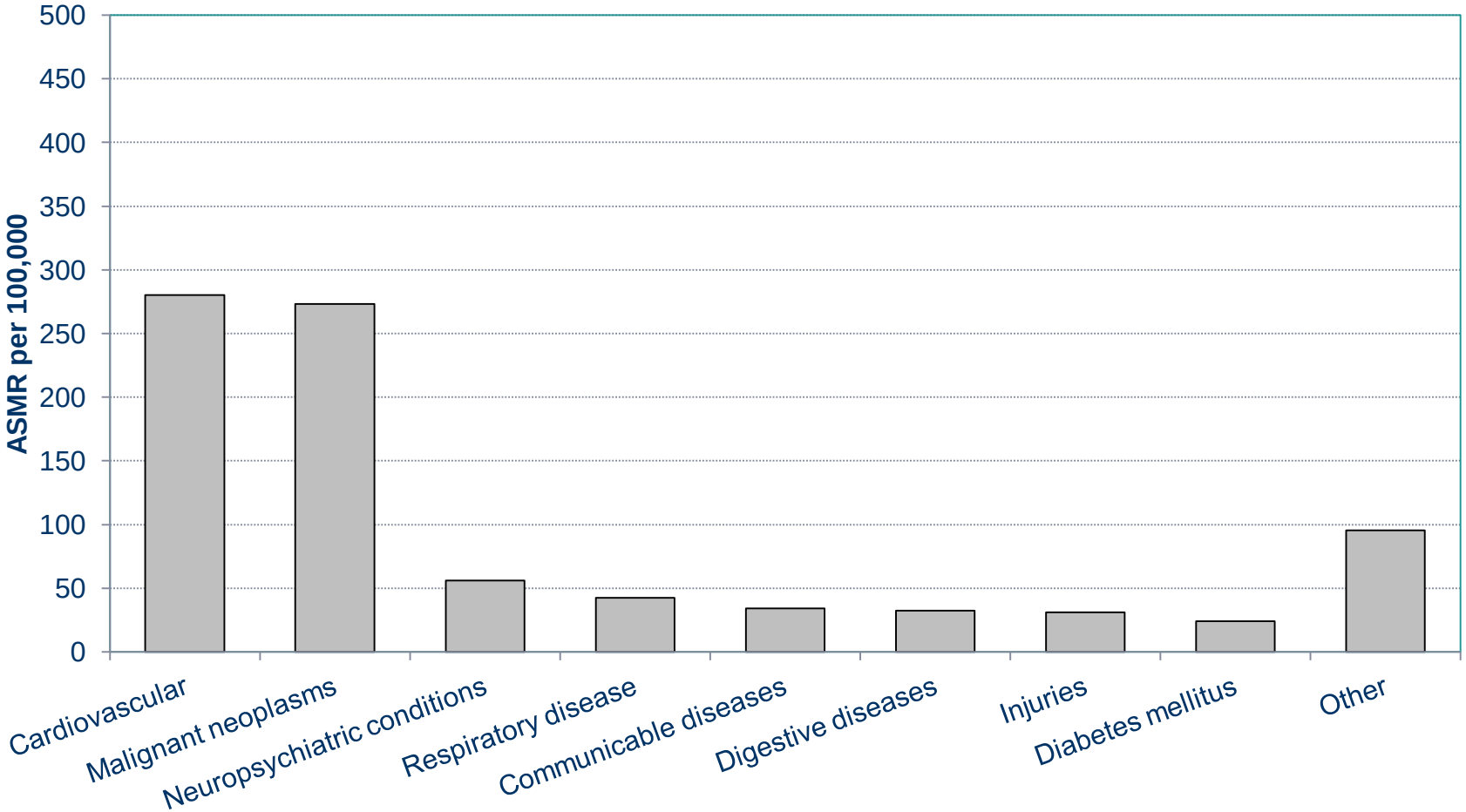


Mortality rates by cause of death, males 25+, 1991-2006



Source: Tjepkema M, Wilkins R, Long A. Cause-specific mortality by education in Canada: a 16 year follow-up study. *Health Reports* 2012;23(3): in press.

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



Source: Tjepkema M, Wilkins R, Long A. Cause-specific mortality by education in Canada: a 16 year follow-up study. *Health Reports* 2012;23(3): in press.

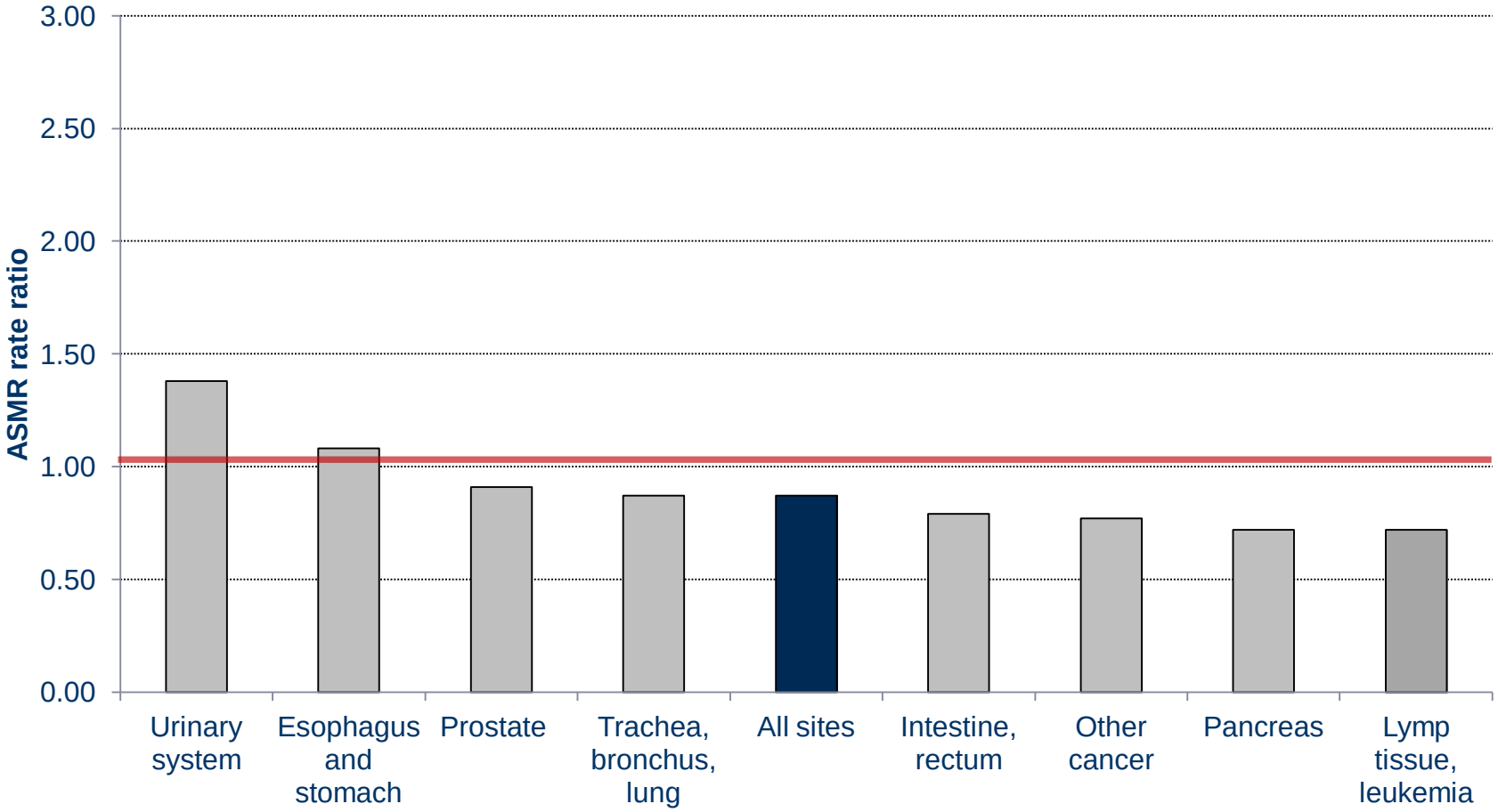
Sub-population analysis

- 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

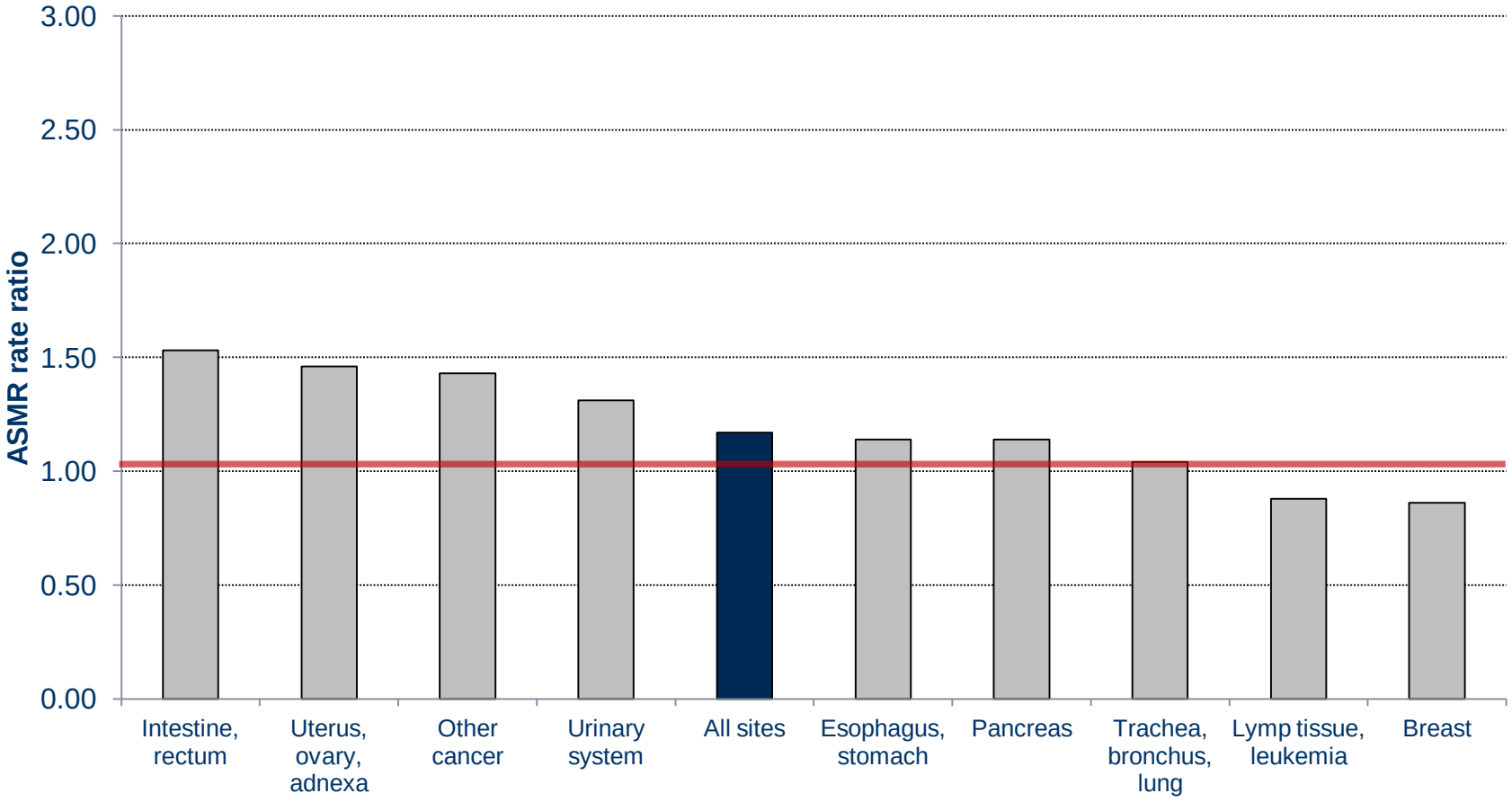


Source: Tjepkema M, Wilkins R, Senécal S, Guimond É. Mortality of Métis and Registered Indian adults in Canada: An 11-year follow-up study. *Health Reports* 2009;20(4):31-51

Cancer mortality

Registered Indians: women aged 25+ at baseline, 1991-2001 follow-up

- ASMR compared to non-Aboriginal female cohort members



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Cancer mortality

Métis: men aged 25+ at baseline, 1991-2001 follow-up

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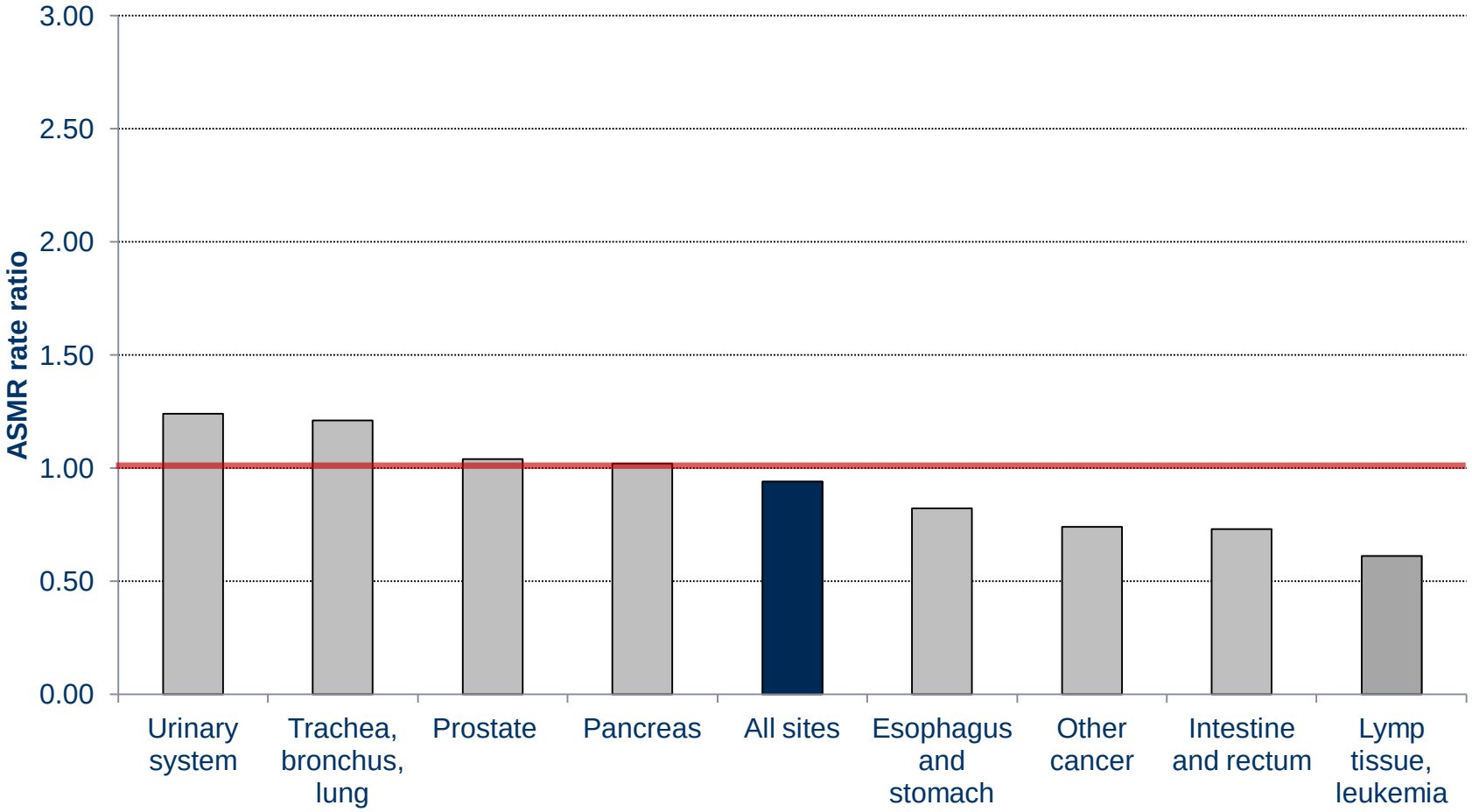

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Cancer mortality

Métis: women aged 25+ at baseline, 1991-2001 follow-up

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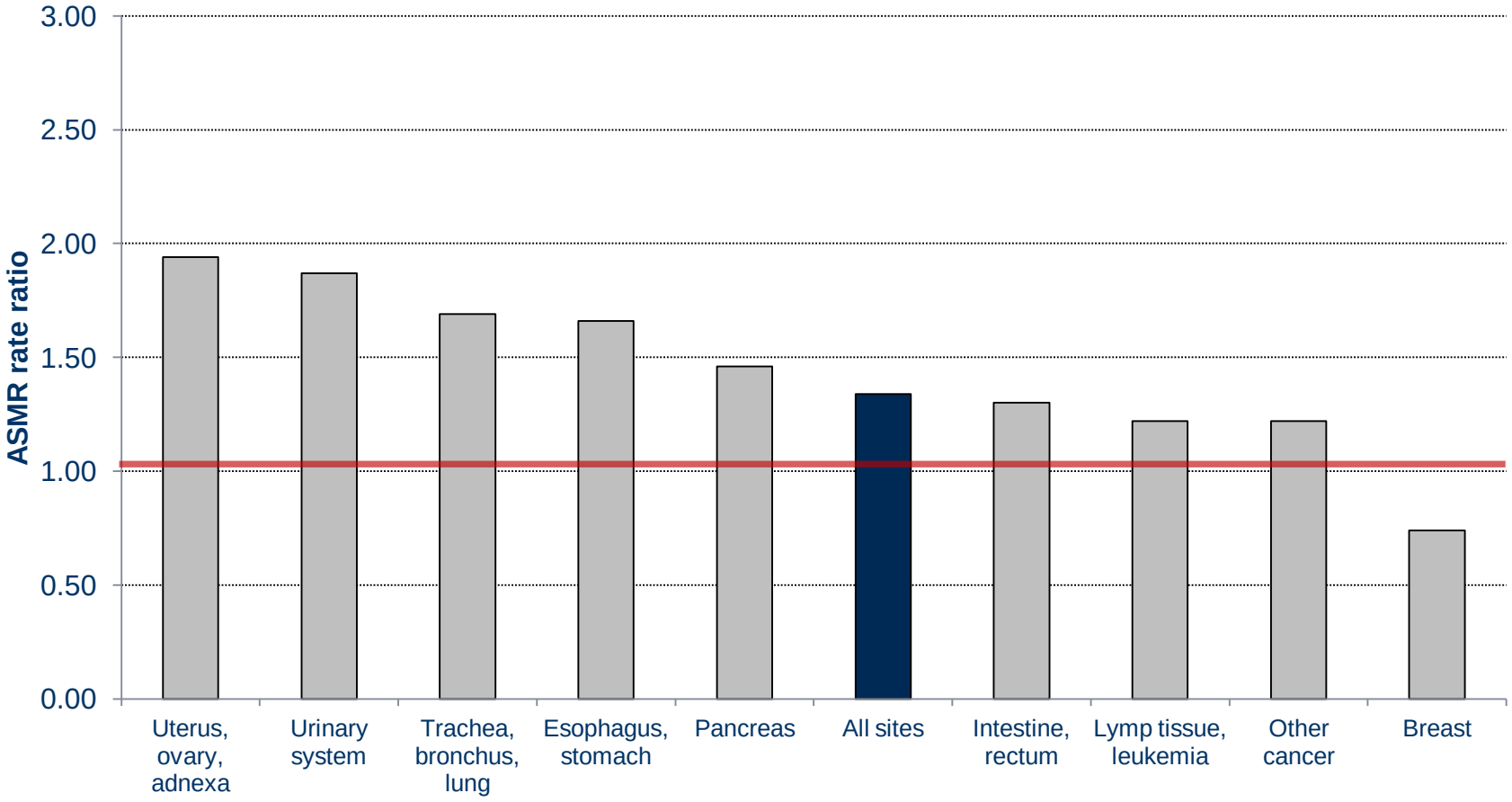
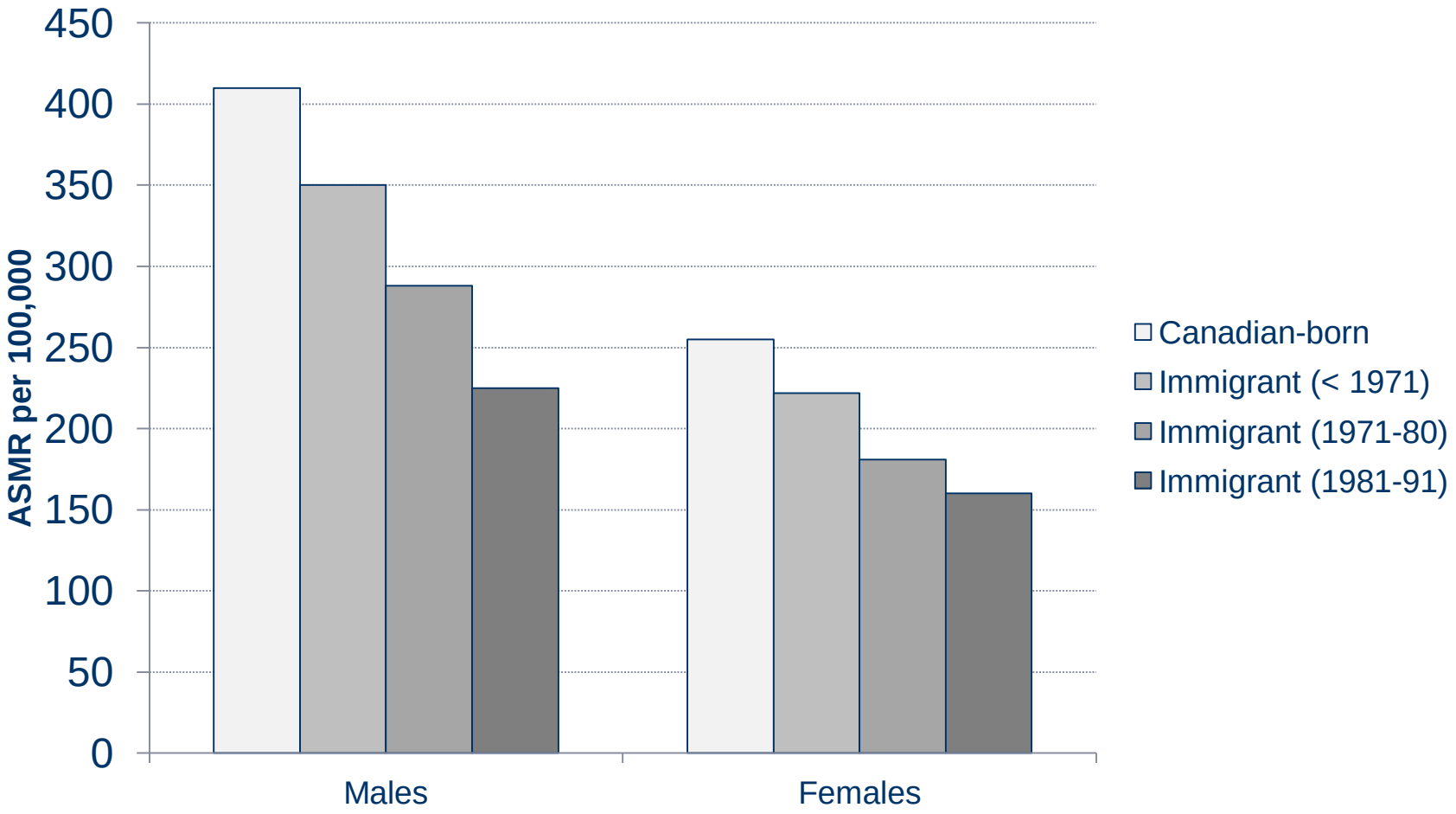


Source: Tjepkema M, Wilkins R, Senécal S, Guimond É. Mortality of Métis and Registered Indian adults in Canada: An 11-year follow-up study. *Health Reports* 2009;20(4):31-51

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



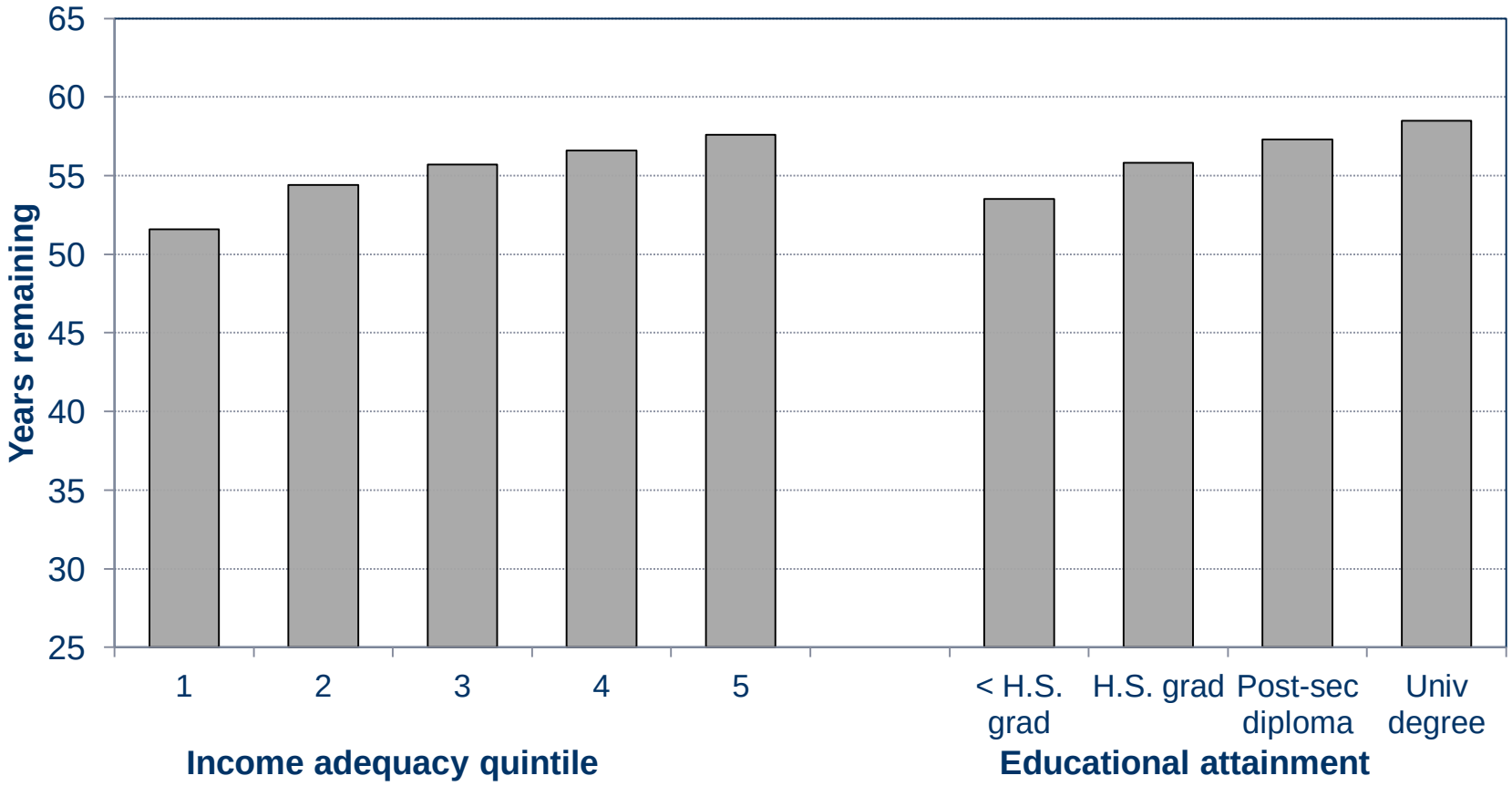
Source: Ng E and the Longitudinal Health and Administrative Data Research Team. *Insights into the healthy immigrant effect: Mortality by period of immigration and birthplace*. Health Analysis Division Working Paper Series. Catalogue no. 820622-X, No. 8. Ottawa: Statistics Canada, 2010 September. 16 pp.

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

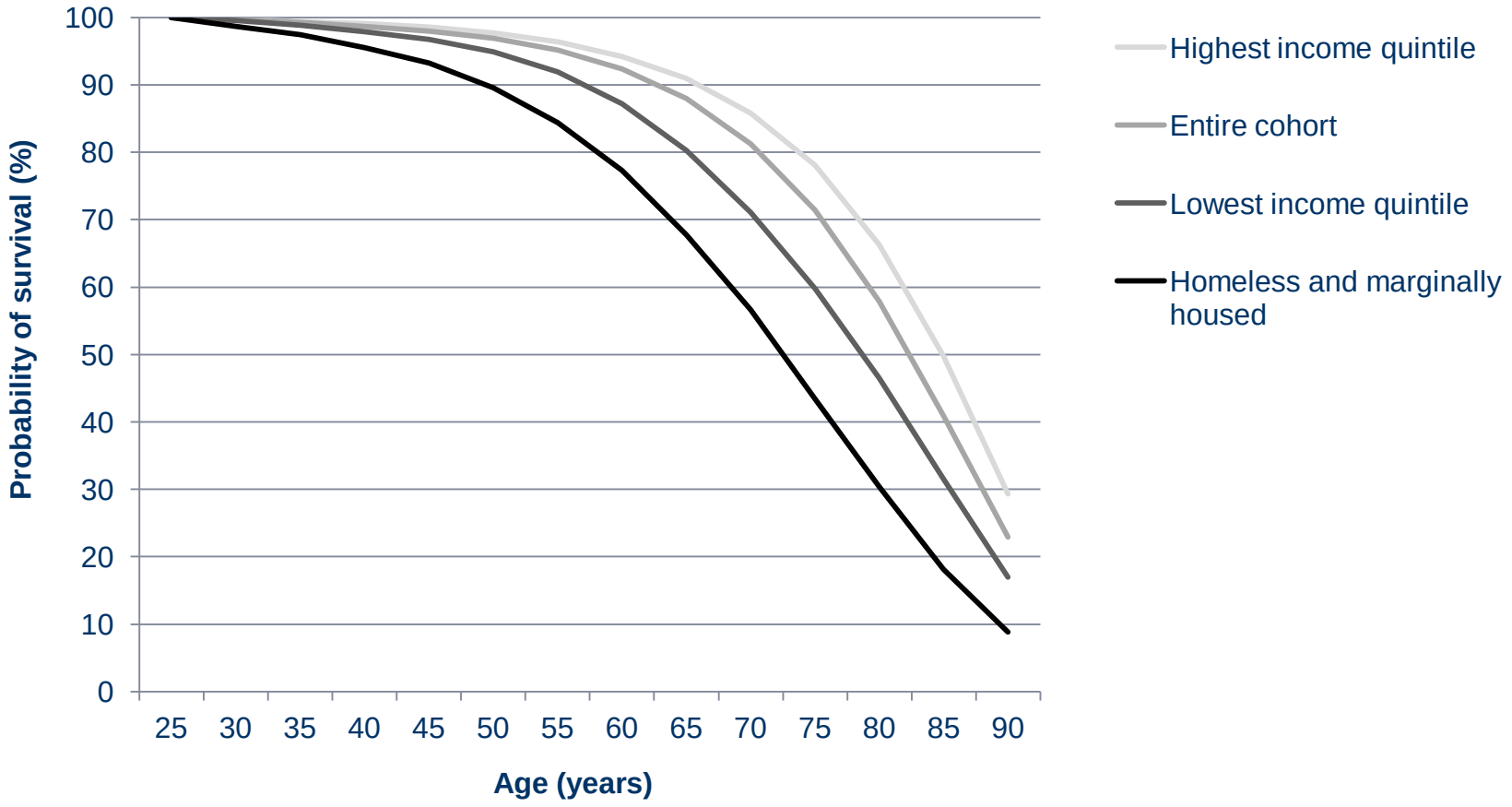
Remaining life expectancy at age 25, by income adequacy quintile, and by education level, Canada, both sexes, 1991-2006 follow-up



Source: Tjepkema M, Wilkins R. Remaining life expectancy at age 25 and probability of survival to age 75 by socio-economic status and Aboriginal ancestry. *Health Reports* 2011;22(4): 1-6. See also CANSIM tables 109-5401 and 109-5402 on the Statistics Canada website.

Housing

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



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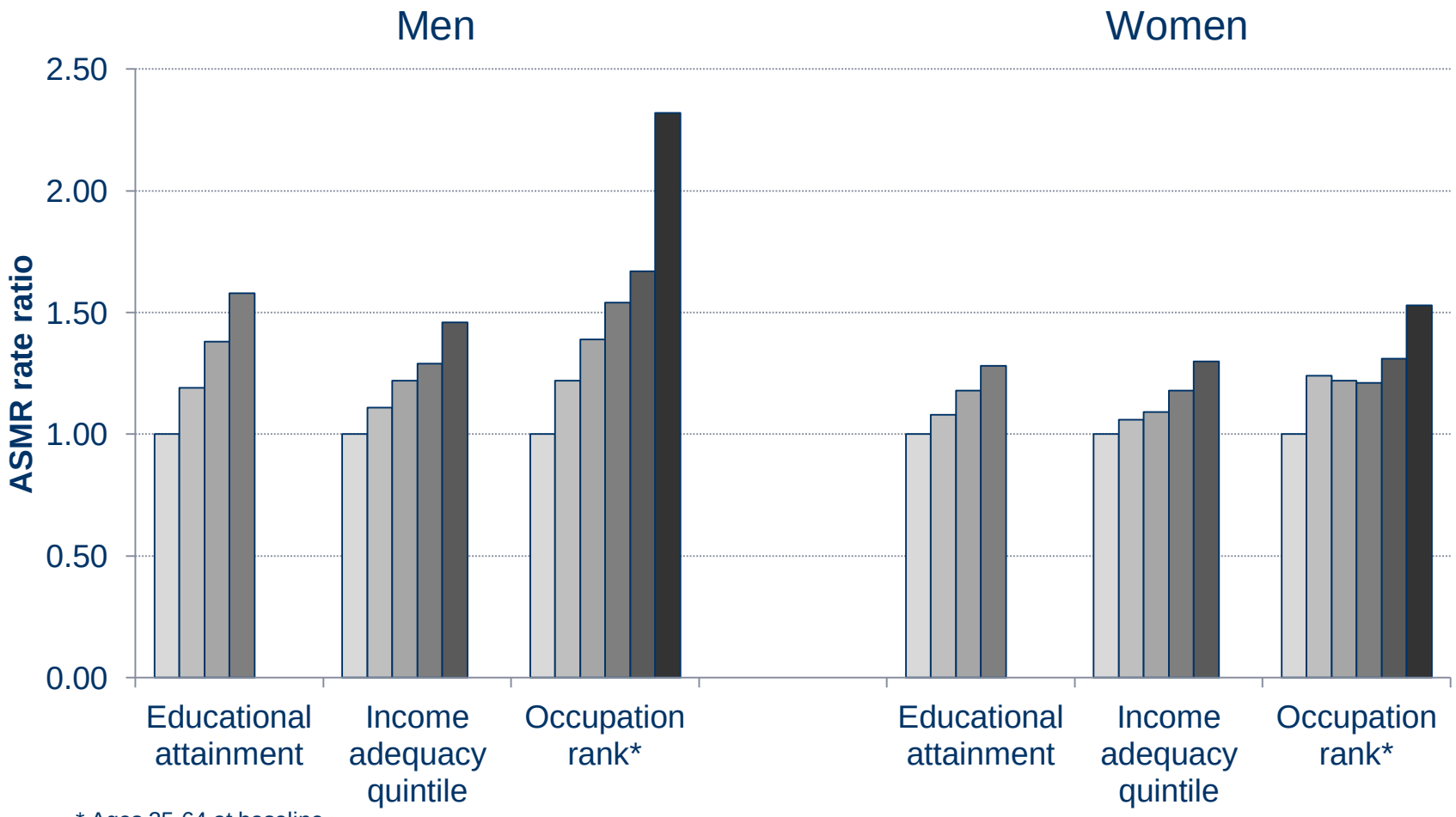
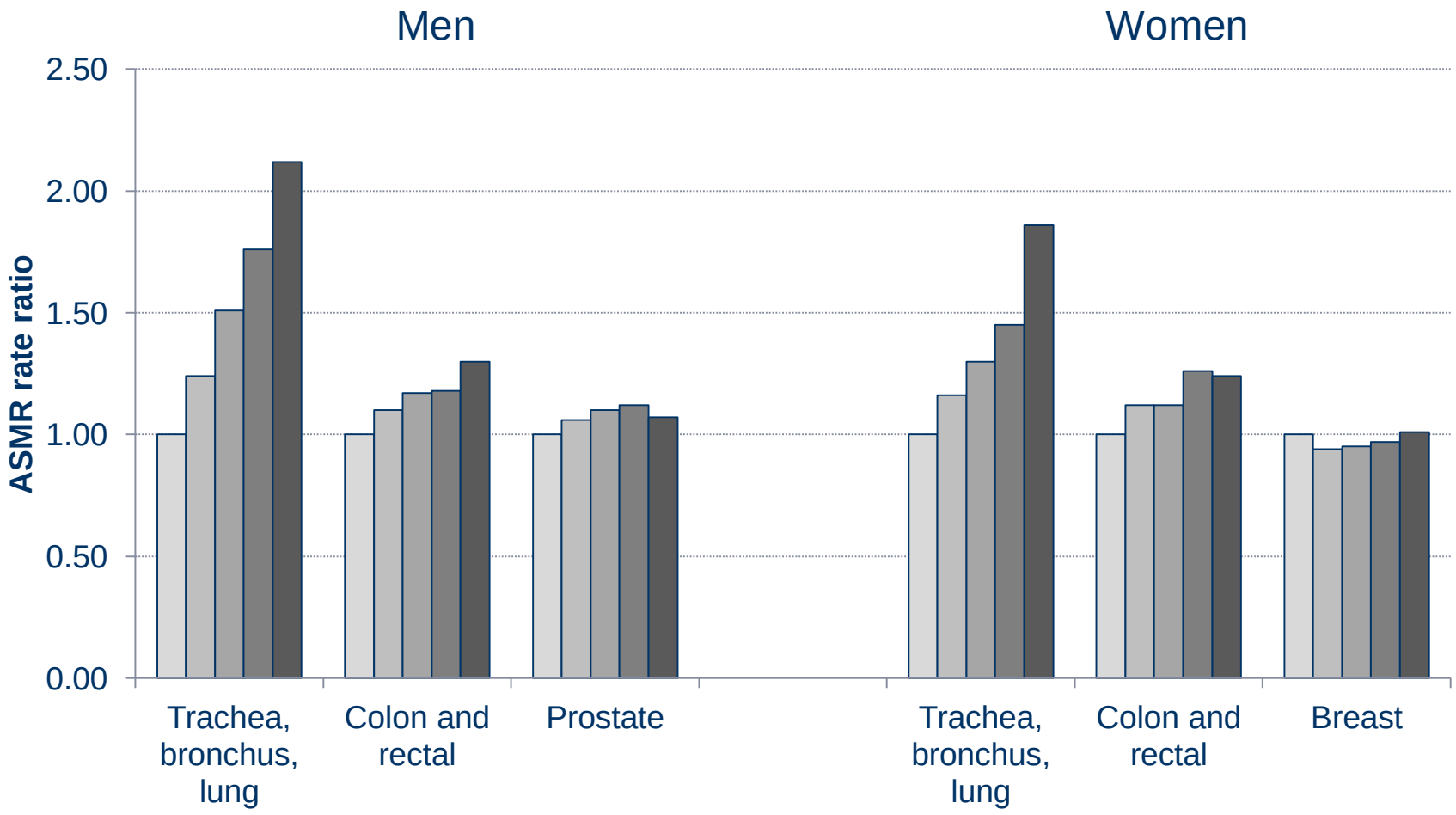
Malignant neoplasms by different SES dimensions, 1991-2006 follow-up



* Ages 25-64 at baseline

Source: 1991 Canadian census cohort: mortality and cancer follow-up study (1991-2006)

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

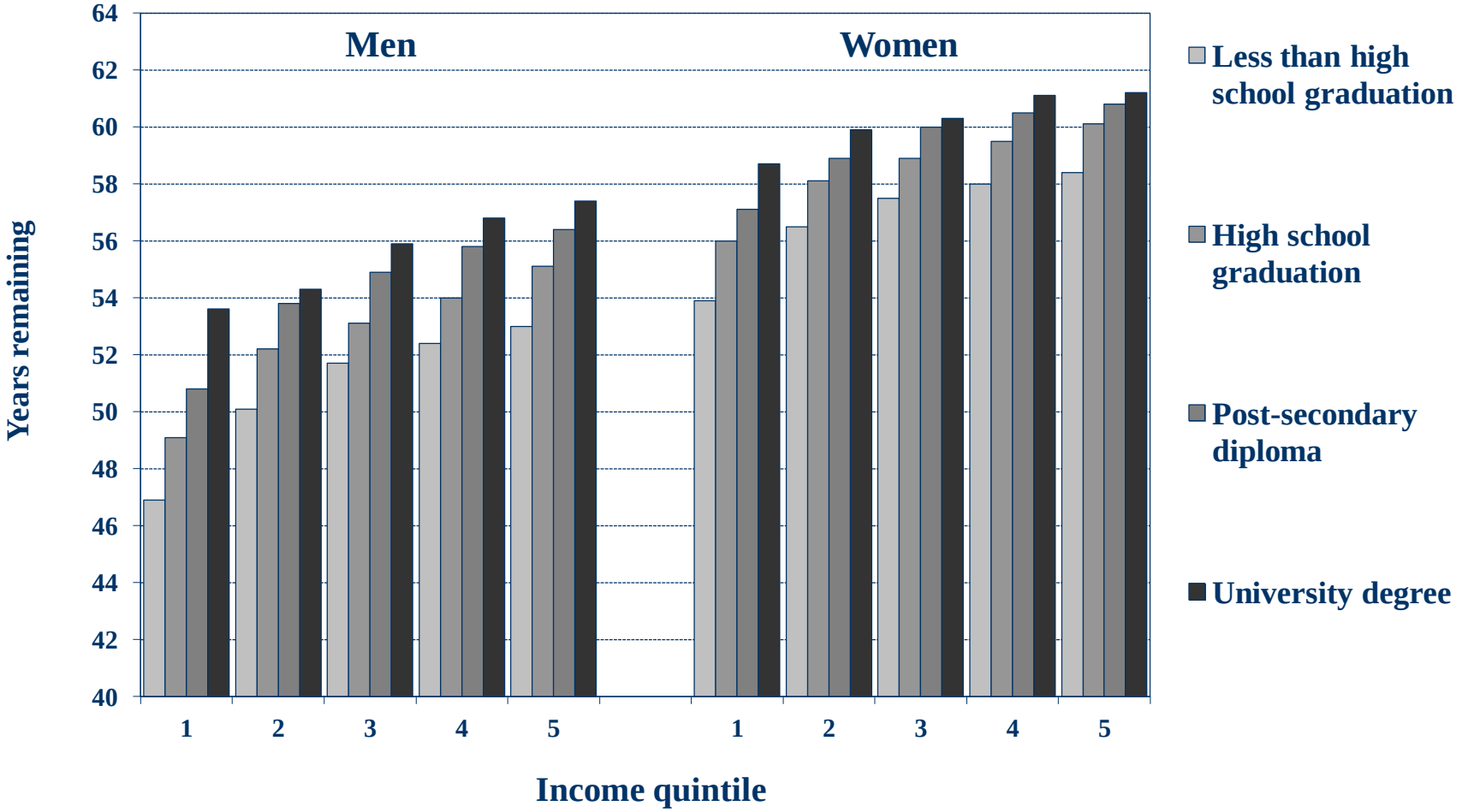


Source: 1991 Canadian census cohort: mortality and cancer follow-up study (1991-2006)

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

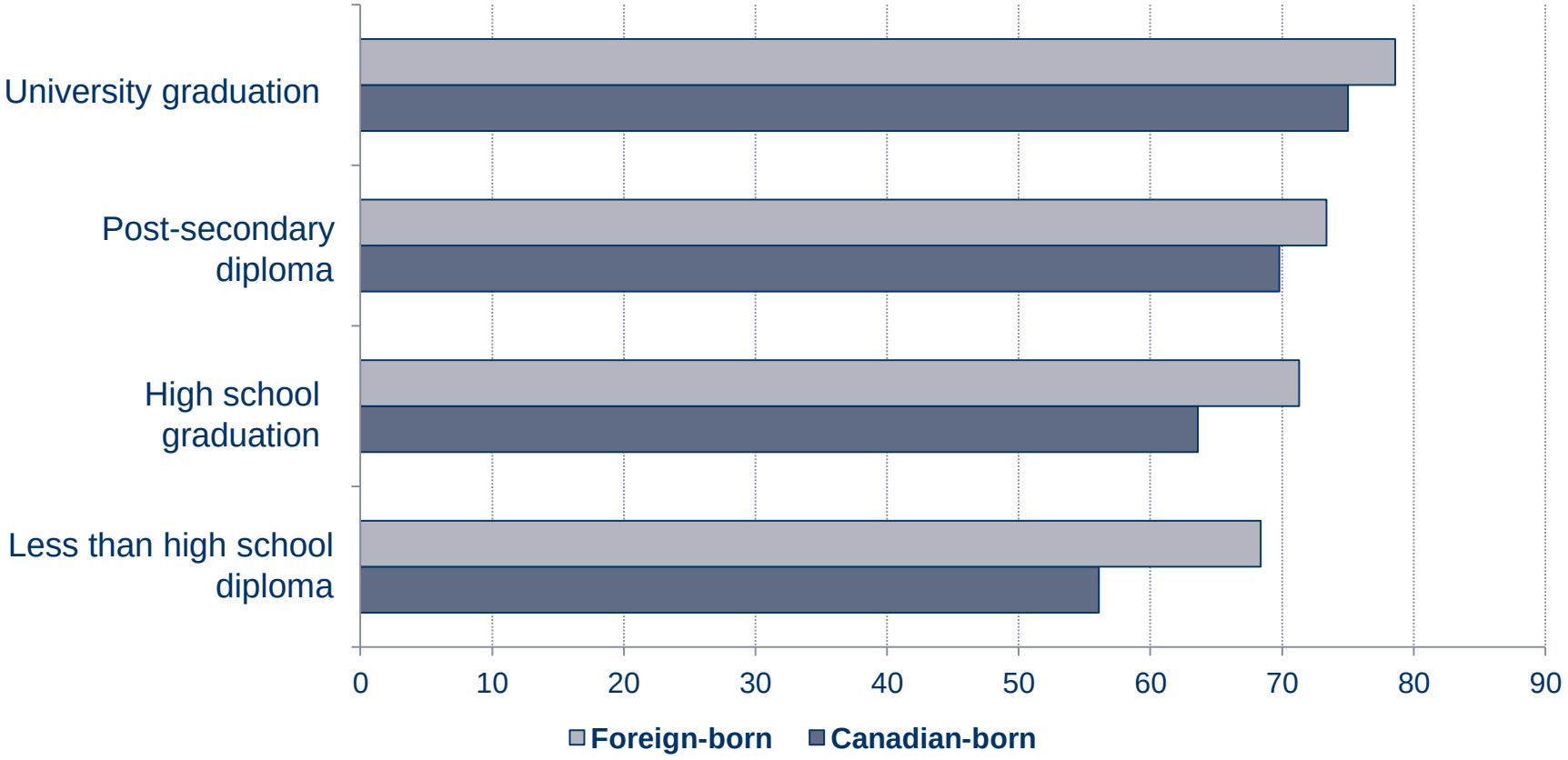
Remaining life expectancy by educational attainment within each income adequacy quintile, 1991-2006 follow-up



Source: 1991 Canadian census cohort: mortality and cancer follow-up study (1991-2006)

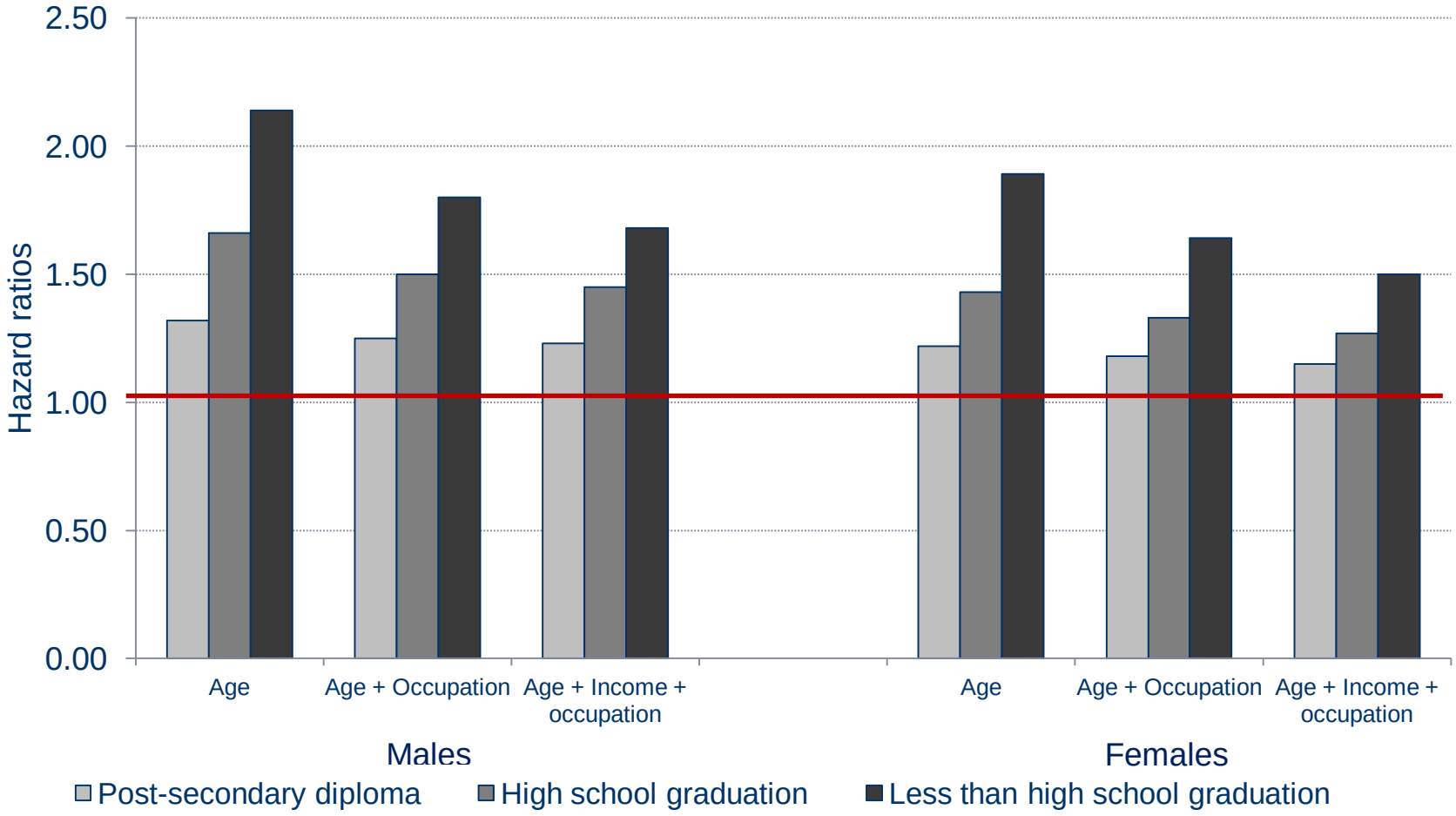
Education and place of birth, 1991-2001 follow-up

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



Source: Wilkins R, Tjepkema M. *Mortality by income, education and causes of death among Canadian adults.* Paper presented at the Annual Meeting of the Canadian Public Health Association (CPHA), Winnipeg MB, 2009.

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



Source: 1991 Canadian census cohort: mortality and cancer follow-up study (1991-2006)

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

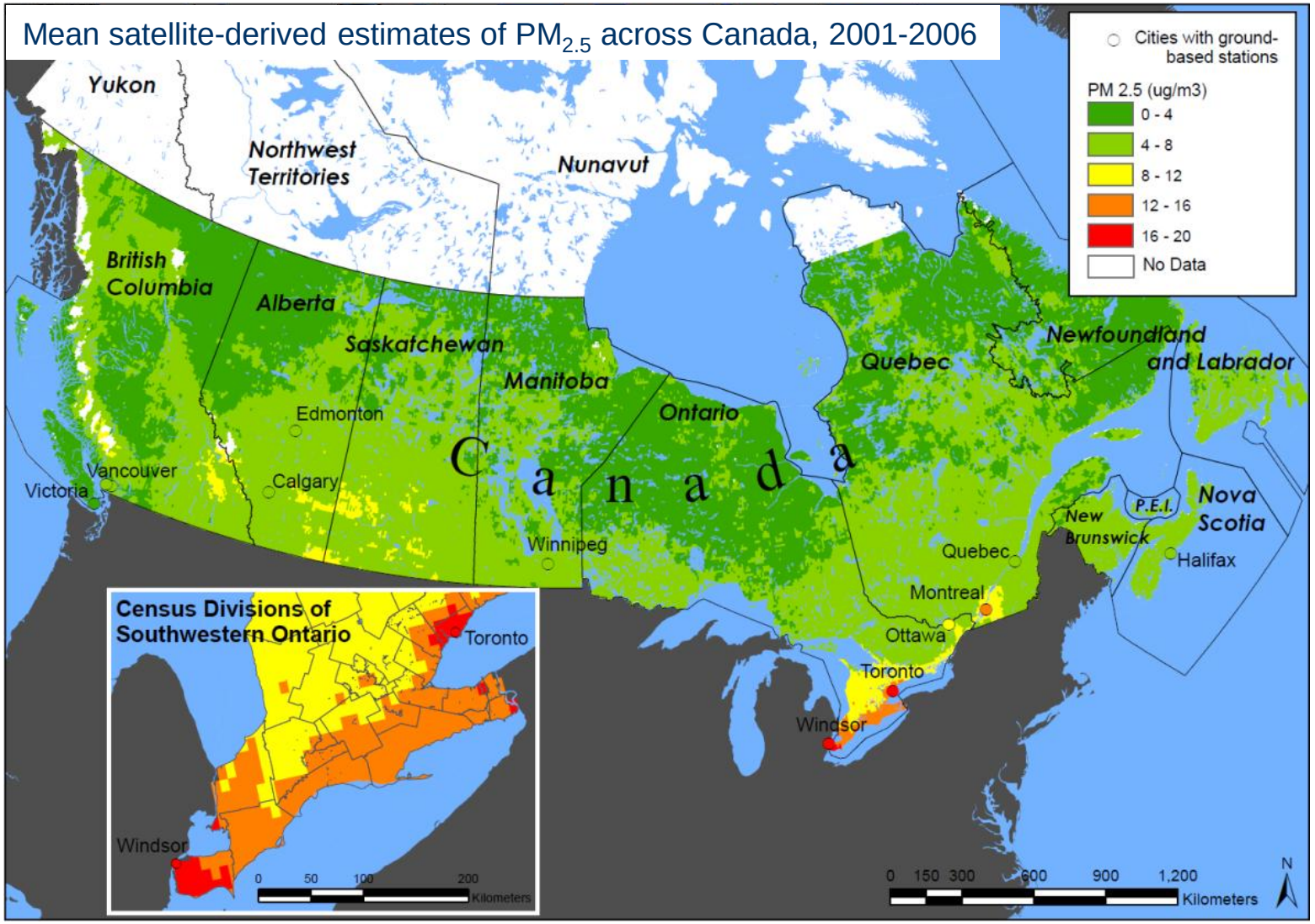
	Men				Women		
Adjusted for:	Hazard ratio	95% CI			Hazard ratio	95% CI	
Age	1.24	1.16	1.34		1.67	1.54	1.80
Age + education	1.15	1.07	1.24		1.55	1.44	1.68
Age + education + income	1.08	1.00	1.16		1.50	1.39	1.63

Source: Tjepkema, Wilkins RW, Goedhuis N, Pennock J. Cardiovascular disease mortality among First Nations people in Canada from 1991 through 2001 *Chronic Diseases in Canada* 2012;32(4): in press.

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



Source: Crouse DL, Peters, PA, van Donkelaar A, et. al. (2012) Risk of Non-accidental and Cardiovascular Mortality in Relation to Longterm Exposure to Low Concentrations of Fine Particulate Matter: A Canadian National-level Cohort Study. *Environmental Health Perspectives* DOI: http://dx.doi.org/10.1289/ehp.1104049

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 $\mu g/m^3$

Cause of death	Hazard ratio
Non-Accidental	1.10 (1.05-1.15)
Cardiovascular	1.15 (1.07-1.24)
Circulatory	1.14 (1.06-1.22)
Ischemic Heart Disease	1.30 (1.18-1.43)
Cerebrovascular	1.04 (0.93-1.16)

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 sante publique du Québec

Contact

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    michael.tjepkema@statcan.gc.ca

Publications (I)

- 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
- Hwang SW, Wilkins R, Tjepkema M, O'Campo PJ, Dunn JR. Mortality among residents of shelters, rooming houses and hotels in Canada: An 11-year follow-up study. *BMJ* 2009;339:b4036.
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- Pampalon R, Hamel D, Gamache P. A comparison of individual and area-based socio-economic data for monitoring social inequalities in health. Health Reports 2009;20(4):85-94.
- Mustard CA, Bielecky A, Etches J, Wilkins R, Tjepkema M, Gnam W, Amick BC, Smith PM, Aronson KJ. Suicide mortality by occupation in Canada, 1991-2001. *Canadian Journal of Psychiatry* 2010 June; 55(6):369-76.
- Mustard CA, Bielecky A, Etches J, Wilkins R, Tjepkema M, Amick BC, Smith PM, Gnam WH, Aronson KJ. Avoidable mortality for causes amenable to medical care, by occupation in Canada, 1991-2001. *Canadian Journal of Public Health* 2010 Nov-Dec;101(6):500-6.
- Pampalon R, Hamel D, Gamache P. Health inequalities, deprivation, immigration and Aboriginality in Canada: a geographic perspective. *Canadian Journal of Public Health* 2010; 101(6):470-474.
- Ng E and the Longitudinal Health and Administrative Data Research Team. *Insights into the healthy immigrant effect: Mortality by period of immigration and birthplace.* Health Analysis Division Working Paper Series. Catalogue no. 820622-X, No. 8. Ottawa: Statistics Canada, 2010 September. 16 pp.
- Tjepkema M, Wilkins R, Senécal S, Guimond É, Penney C. Mortality of urban Aboriginal adults in Canada, 1991-2001. *Chronic Diseases in Canada* 2010 Dec; 31(1):4-21.
- Tjepkema M, Wilkins R, Senécal S, Guimond É, Penney C. Potential years of life lost at ages 25 to 74) among Métis and non-Status Indians, 1991 to 2001. *Health Reports* 2011 Mar; 22(1): 37-46.

Publications (II)

- 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
- Tjepkema M, Wilkins, Pennock J, Goedhuis N. Potential years of life lost at ages 25 to 74 among Status Indians, 1991 to 2001. *Health Reports* 2011 Mar; 22(1): 25-36.
- Auger N, Hamel D, Martinez J, Ross NA. Mitigating effect of immigration on the relation between income inequality and mortality: a prospective study of 2 million Canadians. *J Epidemiol Community Health* 2011. doi:10.1136/jech.2010.12977. Online first. 7 pp.
- Peters PA, Tjepkema M. 1991-2011 Canadian census mortality and cancer follow-up study. *Proceedings of Statistics Canada Symposium 2010. Social Statistics: The Interplay among Censuses, Surveys and Administrative Data.* Catalogue no. 11-522-XCB. Ottawa: Statistics Canada, 2011:150-156.
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- Tjepkema M, Wilkins R, Long A. Cause-specific mortality by education in Canada: a 16 year follow-up study. *Health Reports* 2012;23(3): in press.
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