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# Cardiovascular disease mortality among First Nations people in Canada, 1991–2001

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## Abstract

**Objective:** To compare cardiovascular disease mortality patterns between First Nations people and non-Aboriginal adults by sex and by income adequacy quintile and level of educational attainment.

**Methods:** A 15% sample of 1991 Canadian census respondents aged 25 years or older was previously linked to 11 years of mortality data. In this study, First Nations people were defined by North American Indian ethnic origin (ancestry), registration under the *Indian Act*, and/or membership in an Indian band or First Nation. The cohort included 62 400 First Nations people and 2 624 300 non-Aboriginal people.

**Results:** Compared to non-Aboriginal cohort members, the age-standardized cardiovascular disease mortality rate was 30% higher for First Nations men and 76% higher for First Nations women. This represented an excess of 58 deaths and 71 deaths per 100 000 person-years at risk, for First Nations men and women, respectively. Within each income adequacy quintile (adjusted for family size and region of residence) and level of educational attainment, the risk of dying from cardiovascular disease was higher for First Nations people compared to their non-Aboriginal counterparts.

**Conclusion:** First Nations people had higher rates of death from cardiovascular disease than non-Aboriginal Canadians within each income quintile and level of education. Income and education accounted for 67% and 25% of the excess mortality of First Nations men and women respectively.

**Keywords:** *indigenous, Registered Indian, non-status Indian, Aboriginal, income, education*

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## Introduction

Indigenous peoples worldwide experience a disproportionate burden of disease and illness.<sup>1,2</sup> Historically, infectious diseases were largely responsible for the poorer health of Aboriginal people.<sup>3</sup> However, since the 1960s the Aboriginal population has undergone an epidemiological transition during which the prevalence of non-communicable diseases such as diabetes and cardiovascular disease has increased while that of infectious diseases has decreased.<sup>4,5</sup>

Cardiovascular disease is a major cause of premature death, admissions to hospitals and disability,<sup>6</sup> and it imposes a large burden on the health care system.<sup>7</sup> Survey data have demonstrated that the prevalence of self-reported heart disease is higher among First Nations people residing on-reserve,<sup>8</sup> and similar for Aboriginal (including First Nations, Métis and Inuit) people residing off-reserve, compared to the non-Aboriginal population.<sup>9</sup> However, results based on self-reporting may not reflect the true extent of the disparities between First Nations

people and other Canadians.<sup>10</sup> A more fundamental indicator of disease burden and one which is more reliable for tracking trends over time could be based on mortality rates. In Canada, death registrations usually contain no First Nations identifiers, so either a record linkage or an area-based approach is required. Studies that have linked lists of Registered Indians (First Nations individuals who are registered under the *Indian Act of Canada*) to vital statistics death registrations have shown that Registered Indians had higher rates of cardiovascular disease mortality than other Canadians.<sup>5,11,12</sup> However, those studies excluded people who self-identify as First Nations but are not registered under the *Indian Act* (“non-Status Indians”) and provided no information on whether differences in socio-economic status played a role in explaining the disparities.

An estimated 80% of premature cardiovascular disease can be prevented,<sup>7</sup> so it should be possible to considerably reduce the burden of cardiovascular disease. A target for 2020 described as “ambitious but achievable” in the Canadian Heart Healthy Strategy and Action Plan<sup>7</sup> is to decrease the burden of cardiovascular diseases among Aboriginal people to the same level as that for other Canadians. To monitor progress towards that goal, it will be necessary to track cardiovascular disease mortality among all Aboriginal peoples, including First Nations, Inuit and Métis. The objective of this study is to assess the burden of cardiovascular disease mortality for First Nations people, including both Status and non-Status Indians, and to compare the rates to those of

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non-Aboriginal adults by sex and by income adequacy quintile and level of educational attainment.

## Methods

### Data source

This study is a secondary analysis of data from the 1991–2001 Canadian census mortality follow-up study.<sup>13</sup> Individuals were eligible to be in the original study cohort if they were aged 25 years or more and enumerated by the 1991 census long-form questionnaire, which excluded institutionalized residents. To be followed for mortality, in-scope census respondents first had to be linked to an encrypted name file abstracted from non-financial tax-filer data. About 80% of in-scope census records (n = 2 860 244) were linked to the name file. A random sample of respondents (n = 125 093) were then removed so that the final cohort (n = 2 735 152) would be a 15% sample of the Canadian population, as stipulated in the record linkage protocol. This cohort was then matched to the Canadian mortality database (4 June 1991 to 31 December 2001) using probabilistic record linkage methods primarily based on names and dates of birth.<sup>14,15</sup> Ascertainment of death was estimated to be slightly lower (95% to 96%) among First Nations cohort members, compared with the cohort as a whole (97%). Additional details of the construction and contents of the previously linked file are reported elsewhere.<sup>13</sup> In our study we compared cardiovascular disease mortality patterns between First Nations people and non-Aboriginal adults by sex and by income adequacy quintile and level of educational attainment.

The Canadian census mortality follow-up study was approved by the Statistics Canada Policy Committee after consultations with the Statistics Canada Confidentiality and Legislation Committee, the Data Access and Control Services Division, and the Federal Privacy Commissioner.

### Definitions

For the purposes of this study, we defined First Nations people as census respondents who either reported one ancestry, North American Indian, or indicated

being registered under the *Indian Act*, or indicated being a member of an Indian Band or First Nation. About three-quarters of the First Nations cohort members met all three criteria. About 9% of First Nations cohort members did not indicate being a Registered Indian.

Non-Aboriginal cohort members included anyone except those whose census responses indicated North American Indian, Métis or Inuit ancestry, Registered Indian status or membership in a North American Indian band or First Nation. Cohort members not defined as either First Nations or non-Aboriginal were excluded from this analysis.

A First Nations community (or Indian reserve) refers to land set aside by the Federal Government for the use and occupancy of an Indian group or band.

Level of education was grouped into two categories: less than high school diploma and high school diploma (or trades certificate) or higher.

Quintiles of population by income adequacy were constructed as follows. First, for each economic family or unattached individual, total pre-tax, post-transfer income from all sources was pooled across all family members, and the ratio of total income to the Statistics Canada low-income cut-off for the applicable family size and community size group was calculated.<sup>16</sup> Thus, all members of a given family were assigned the same ratio, which was calculated for all non-institutionalized people (the in-scope population), including people living on Indian reserves. The population was then ranked according to that ratio, and quintiles of population were constructed within each census metropolitan area, census agglomeration or total rural and small-town area within a given province or territory. The purpose of constructing the quintiles within each area was to take account of regional differences in housing costs, which were not reflected in the low income cut-offs. For this analysis, quintiles 4 and 5 were grouped due to the small number of First Nations respondents in those categories.

### Analytical techniques

For each member of the cohort, we calculated person-days of follow-up from the beginning of the study (4 June 1991) to the date of death, the date of emigration (which was only known for 1991), or to the end of study (31 December 2001). For each category of cardiovascular disease, we first calculated age- and sex-specific mortality rates by 5-year age groups (at baseline), and then, using the total Aboriginal cohort population structure (person-years at risk) as the standard population (an internal weighting scheme), we calculated age-standardized mortality rates (ASMRs) for each disease group, by sex and for subgroups of the population. Rate ratios (RRs) and rate differences (RDs) were calculated comparing the ASMRs for First Nations to those of non-Aboriginal cohort members. The rate difference was our measure of excess mortality. We calculated 95% confidence intervals (CIs) for the ASMRs, RRs and RDs based on a Poisson distribution.

Cox proportional hazard ratios for death by cardiovascular disease were calculated for First Nations compared to non-Aboriginal cohort members, by sex, first controlling for age (in years), then controlling for age and education (less than high school diploma versus high school diploma or higher), then controlling for age and income adequacy (quintiles 1, 2 and 3 compared to quintiles 4 and 5 combined). The final, fully adjusted model controlled for age, education and income adequacy (simultaneously). We interpreted differences in the hazard ratios between the age-adjusted model and the fully adjusted model as estimates of the effect of education and income on the extent of disparities between First Nations and non-Aboriginal adults. The proportion of excess mortality explained by differences in education and income was calculated as the difference between the age-adjusted and the fully adjusted hazard ratios, divided by the age-adjusted hazard ratio minus 1.

The cause of death of those who died in the years 1991 to 1999 had been previously coded using the World Health Organization's *International Classification of Diseases, Ninth Revision* (ICD-9) codes, and that of those who died in 2000 or 2001

had been previously coded using the *Tenth Revision* (ICD-10) codes. We grouped the ICD codes as follows: all cardiovascular diseases (ICD-9 390–459; ICD-10 I00–I99), ischemic heart disease (ICD-9 410–414; ICD-10 I20–I25), acute myocardial infarction (ICD-9 410; ICD-10 I21–I22), cerebrovascular disease (ICD-9 430–438; ICD-10 I60–I69), stroke (ICD-9 430, 431, 434, 436; ICD-10 I60, I61, I63, I64), congestive heart failure (ICD-9 428.0; ICD-10 I50.0), inflammatory heart disease (ICD-9 420–422, 425; ICD-10 I30–I33, I38, I40, I42), rheumatic heart disease (ICD-9 390–398; ICD-10 I01–I09), and hypertensive heart disease (ICD-9 401–405; ICD-10 I10–I13).

## Results

The cohort follow-up tracked mortality for 27 300 First Nations men, 1 307 800 non-Aboriginal men, 35 100 First Nations women and 1 316 500 non-Aboriginal women. Compared to non-Aboriginal cohort members, First Nations cohort members tended to be younger, with a lower level of formal education, less income and more often lived in western Canada and the north (Table 1).

Cardiovascular disease deaths accounted for 29% and 27% of all deaths among First Nations men and women, respectively. Ischemic heart disease was the most common type of cardiovascular disease mortality (62% of all cardiovascular disease deaths for First Nations men; 45% for First Nations women), followed by cerebrovascular disease (14% for First Nations men; 25% for First Nations women). Compared to non-Aboriginal cohort members, the risk of dying from cardiovascular disease was 30% higher among First Nations men and 76% higher among First Nations women. This translates into an additional 58 deaths per 100 000 person-years at risk for First Nations men and an additional 71 deaths per 100 000 person-years at risk for First Nations women (Table 2).

Compared to non-Aboriginal cohort members, the relative risk of dying was particularly elevated among First Nations men and women for rheumatic heart disease (RR = 3.8 and 2.9, respectively), congestive heart failure (RR = 2.2 and 3.2,

**TABLE 1**  
Selected characteristics of First Nations and non-Aboriginal men and women, non-institutional cohort members aged 25 years or older at baseline, Canada, 1991

	First Nations		Non-Aboriginal	
	Men	Women	Men	Women
Number	27 300	35 100	1 307 800	1 316 500
Percentage	100	100	100	100
Age group (years), %				
25–34	41	44	27	28
35–44	28	28	26	26
45–54	16	15	18	17
55–64	9	8	14	12
65–74	5	4	10	10
75–84	2	2	4	5
85+	< 1	< 1	1	1
Province, region or territory of residence, %				
Atlantic Canada <sup>a</sup>	5	5	8	8
Quebec	12	13	26	26
Ontario	18	17	37	37
Manitoba	18	16	4	4
Saskatchewan	12	13	4	3
Alberta	9	11	9	9
British Columbia	20	19	12	12
Territories <sup>b</sup>	6	5	1	0
Residing in a First Nations community, %				
Yes	67	63	0	0
No	33	37	100	100
Educational attainment, %				
Less than high school graduation	59	55	34	34
High school graduation	33	29	38	35
Post-secondary diploma	7	13	13	19
University degree	2	3	15	12
Income adequacy quintile, %				
Quintile 1 – lowest	38	42	14	19
Quintile 2	26	25	19	19
Quintile 3	18	17	21	20
Quintile 4	12	11	23	20
Quintile 5 – highest	6	6	23	21

Source: 1991–2001 Canadian census mortality follow-up study.

Note: Counts have been rounded to the nearest 100.

<sup>a</sup> New Brunswick, Prince Edward Island, Nova Scotia and Newfoundland and Labrador.

<sup>b</sup> Yukon, Northwest Territories and Nunavut.

respectively), inflammatory heart disease (RR = 1.7 and 2.3, respectively), stroke (RR = 1.3 and 2.0, respectively) and hypertensive heart disease (RR = 2.1 for First Nations women) (Table 2).

RDs, a measure of absolute burden, indicate that ischemic heart disease accounted for

the majority of excess mortality due to cardiovascular disease (61% of the RD) for First Nations men whereas both ischemic heart disease (36% of the RD) and cerebrovascular disease (29% of the RD) were the largest contributors to such excess mortality for First Nations women (Table 2).

**TABLE 2**  
**All cardiovascular disease deaths by sub-type, age-standardized mortality rate per 100 000 person-years at risk, rate ratios and rate differences per 100 000 persons-years at risk for First Nations men and women compared to non-Aboriginal men and women, by age groups, non-institutional cohort members aged 25 years or older at baseline, Canada, 1991–2001**

	First Nations				Non-Aboriginal				First Nations compared to non-Aboriginal			
	Deaths	% of all CVD deaths	ASMR	95% CI	Deaths	% CVD deaths	ASMR	95% CI	RR	95% CI	RD	95% CI
<b>Men</b>												
All causes	2 633	—	885.7	852.4, 920.3	149 335	—	566.7	563.4, 569.9	1.56	1.50, 1.62	319.0	284.9, 353.1
All cardiovascular disease	763	100.0	250.2	233.0, 268.6	55 514	100.0	192.5	190.8, 194.3	1.30	1.21, 1.40	57.7	39.8, 75.6
Ischemic heart disease	476	62.4	156.7	143.2, 171.5	34 383	61.9	121.4	120.0, 122.8	1.29	1.18, 1.41	35.3	21.2, 49.5
Acute myocardial infarction	250	32.8	82.2	72.6, 93.1	18 270	32.9	65.9	64.9, 67.0	1.25	1.10, 1.41	16.3	6.0, 26.6
Cerebrovascular disease	109	14.3	35.3	29.3, 42.7	8 638	15.6	28.2	27.5, 28.8	1.25	1.04, 1.52	7.2	0.5, 13.9
Stroke	95	12.5	30.7	25.1, 37.6	7 209	13.0	23.7	23.1, 24.3	1.30	1.06, 1.59	7.1	0.8, 13.3
Other cardiovascular diseases	178	23.3	58.1	50.2, 67.4	12 493	22.5	43.0	42.1, 43.8	1.35	1.17, 1.57	15.2	6.6, 23.8
Congestive heart failure	34	4.5	10.8	7.7, 15.1	1 670	3.0	5.0	4.7, 5.2	2.18	1.55, 3.06	5.8	2.2, 9.5
Inflammatory heart diseases	23	3.0	7.6	5.0, 11.4	1 033	1.9	4.5	4.2, 4.8	1.68	1.11, 2.55	3.1	0.0, 6.2
Rheumatic heart disease	9	1.2	3.1	1.6, 5.9	216	0.4	0.8	0.7, 0.9	3.83	1.96, 7.49	2.3	0.3, 4.3
Hypertensive heart disease	8	1.0	2.5	1.3, 5.1	731	1.3	2.5	2.3, 2.7	1.04	0.52, 2.08	0.1	-1.7, 1.9
<b>Women</b>												
All causes	2 317	—	622.3	597.4, 648.2	103 890	—	318.9	316.5, 321.2	1.95	1.87, 2.03	303.4	277.9, 328.9
All cardiovascular disease	628	100.0	164.9	152.5, 178.4	39 066	100.0	94.0	92.9, 95.1	1.76	1.62, 1.90	71.0	58.0, 84.0
Ischemic heart disease	280	44.6	73.5	65.3, 82.6	20 098	51.4	48.1	47.3, 48.8	1.53	1.36, 1.72	25.4	16.7, 34.1
Acute myocardial infarction	147	23.4	38.8	33.0, 45.6	10 009	25.6	25.1	24.6, 25.7	1.54	1.31, 1.82	13.6	7.3, 19.9
Cerebrovascular disease	157	25.0	41.7	35.6, 48.7	8 835	22.6	21.4	20.9, 21.9	1.95	1.66, 2.28	20.3	13.7, 26.8
Stroke	139	22.1	37.0	31.3, 43.7	7 611	19.5	18.7	18.2, 19.2	1.98	1.67, 2.34	18.3	12.1, 24.4
Other cardiovascular diseases	81	12.9	49.8	43.2, 57.4	10 133	25.9	24.5	23.9, 25.1	2.03	1.76, 2.35	25.3	18.2, 32.4
Congestive heart failure	41	6.5	10.3	7.6, 14.0	1 714	4.4	3.2	3.0, 3.4	3.23	2.36, 4.40	7.1	3.9, 10.3
Inflammatory heart diseases	13	2.1	3.5	2.1, 6.1	439	1.1	1.6	1.4, 1.7	2.27	1.30, 3.96	2.0	0.0, 3.9
Rheumatic heart disease	12	1.9	3.2	1.8, 5.7	389	1.0	1.1	1.0, 1.3	2.88	1.62, 5.14	2.1	0.3, 4.0
Hypertensive heart disease	15	2.4	4.0	2.4, 6.7	862	2.2	1.9	1.8, 2.1	2.07	1.24, 3.46	2.1	0.0, 4.1

Source: 1991 to 2001 Canadian census mortality follow-up study.

Abbreviations: ASMR, age-standardized mortality rate; CI, confidence interval; CVD, cardiovascular disease; RD, rate difference; RR, rate ratio.

Note: Reference population (person-years at risk) for age standardization was taken from the Aboriginal age distribution (5-year age groups).

ASMRs for cardiovascular disease mortality were highest for First Nations people residing in the Atlantic region (New Brunswick, Prince Edward Island, Nova Scotia, Newfoundland and Labrador) and Manitoba, and lowest for those residing in Quebec and the territories (Yukon, Northwest Territories, Nunavut) (Table 3). The ASMRs for cardiovascular disease were similar among First Nations people regardless of residence on- or off-reserve (Table 3).

The relative risk of dying from cardiovascular disease (compared to non-Aboriginal cohort members) was highest in the younger age

groups and diminished with age (Figure 1). For First Nations people aged 25 to 34 years at baseline, the risk of dying from cardiovascular disease was 62% higher for men and 217% higher for women compared to their non-Aboriginal counterparts. By contrast the relative risk of dying from cardiovascular disease was slightly lower for First Nations men aged 75 years or older and similar for First Nations women aged 85 years or older.

For both First Nations and non-Aboriginal cohort members, ASMRs for cardiovascular disease were higher for those with less than a high school diploma compared to

those with a high school diploma or higher (Table 4). Higher relative risks (First Nations compared to non-Aboriginal) were evident within both levels of education for both sexes. For First Nations compared to non-Aboriginal men, relatively higher RRs and RDs were observed for those with a high school diploma or higher. For First Nations compared to non-Aboriginal women, RRs and RDs were similarly elevated regardless of level of educational attainment (Table 4).

By income adequacy quintile, cardiovascular disease mortality rates showed a stair-stepped gradient (with the lowest

TABLE 3

All cardiovascular disease deaths, age-standardized mortality rates per 100 000 person-years at risk, rate ratios and rate differences per 100 000 person-years at risk comparing First Nations men and women to non-Aboriginal men and women, by selected geographic areas, non-institutional cohort members age 25 years or older at baseline, Canada, 1991–2001

Residence in June 1991	First Nations			Non-Aboriginal			First Nations compared to non-Aboriginal			
	Deaths	ASMR	95% CI	Deaths	ASMR	95% CI	RR	95% CI	RD	95% CI
<b>Men</b>										
<b>Canada</b>	763	250.2	233.0, 268.6	55 514	192.5	190.8, 194.3	1.30	1.21, 1.40	57.7	39.8, 75.6
Atlantic Canada <sup>a</sup>	39	396.4	270.0, 581.8	4 956	214.1	207.7, 220.7	1.85	1.26, 2.72	182.3	30.0, 334.5
Quebec	57	164.4	126.5, 213.5	13 527	200.0	196.4, 203.6	0.82	0.63, 1.07	-35.6	-78.8, 7.6
Ontario	146	264.8	224.9, 311.8	20 854	192.5	189.6, 195.4	1.38	1.17, 1.62	72.3	29.0, 115.7
Manitoba	195	337.1	292.5, 388.4	2 681	201.6	193.1, 210.6	1.67	1.44, 1.94	135.4	86.8, 184.0
Saskatchewan	87	252.1	204.1, 311.5	2 437	188.2	179.6, 197.3	1.34	1.08, 1.66	63.9	9.9, 117.9
Alberta	67	277.9	217.2, 355.7	4 090	181.7	175.9, 187.7	1.53	1.19, 1.96	96.2	27.4, 165.1
British Columbia	152	233.2	198.7, 273.6	6 877	169.4	165.0, 173.9	1.38	1.17, 1.62	63.8	26.2, 101.3
Territories <sup>b</sup>	20	98.8	63.3, 154.2	92	167.8	133.0, 211.7	0.59	0.36, 0.97	-69.0	-127.9, -10.2
<b>Residing in a First Nations community</b>										
Yes	550	257.6	236.9, 280.2	—	—	—	1.34	1.23, 1.46	65.2	43.4, 86.9
No	213	232.9	203.4, 266.6	55 393	192.5	190.7, 194.2	1.21	1.06, 1.39	40.4	8.9, 71.9
<b>Women</b>										
<b>Canada</b>	628	164.9	152.5, 178.4	39 066	94.0	92.9, 95.1	1.76	1.62, 1.90	71.0	58.0, 84.0
Atlantic Canada	36	244.5	174.0, 343.6	3 521	108.8	104.6, 113.2	2.25	1.60, 3.16	135.7	52.4, 219.0
Quebec	57	117.4	90.4, 152.4	9 064	83.7	81.7, 85.8	1.40	1.08, 1.82	33.6	2.9, 64.4
Ontario	121	182.6	152.7, 218.5	15 100	98.6	96.8, 100.4	1.85	1.55, 2.22	84.1	51.3, 116.8
Manitoba	132	212.7	178.9, 252.8	2 073	102.4	96.9, 108.3	2.08	1.73, 2.49	110.2	73.1, 147.4
Saskatchewan	71	143.6	113.7, 181.4	1 619	94.0	88.3, 100.1	1.53	1.20, 1.95	49.6	15.5, 83.7
Alberta	57	141.3	108.9, 183.4	2 762	94.7	90.9, 98.7	1.49	1.15, 1.94	46.6	9.6, 83.7
British Columbia	138	183.7	155.0, 217.8	4 905	90.4	87.5, 93.4	2.03	1.71, 2.42	93.3	61.9, 124.7
Territories <sup>b</sup>	16	73.7	43.6, 124.8	22	147.2	48.1, 450.6	0.50	0.15, 1.72	-73.5	-242.6, 95.7
<b>Residing in a First Nations community</b>										
Yes	424	167.3	152.0, 184.2	—	—	—	1.78	1.62, 1.96	73.4	57.3, 89.5
No	204	162.9	142.0, 186.9	39 013	93.9	92.8, 95.0	1.73	1.51, 1.99	69.0	46.5, 91.4

Source: 1991 to 2001 Canadian census mortality follow-up study.

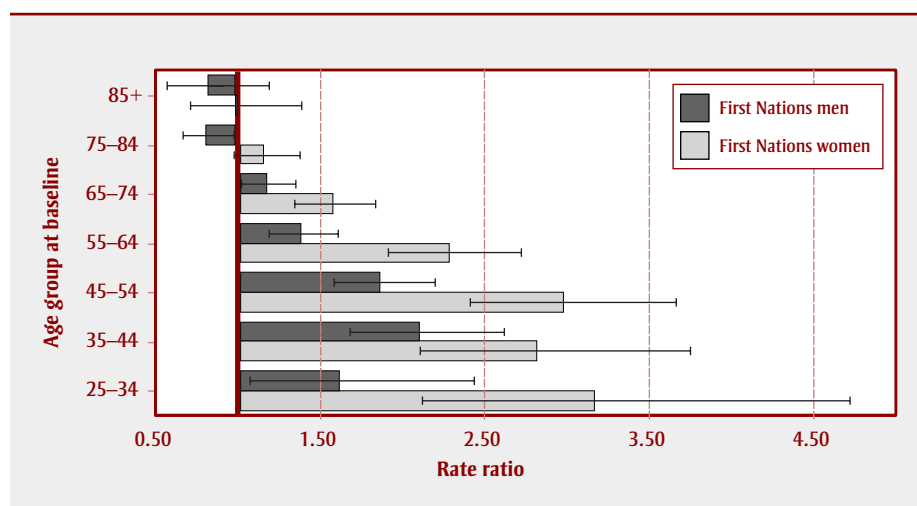
Abbreviations: ASMR, age-standardized mortality rate; CI, confidence interval; CVD, cardiovascular disease; RD, rate difference; RR, rate ratio.

Note: Reference population (person-years at risk) for age standardization was taken from the Aboriginal age distribution (5-year age groups).

<sup>a</sup> New Brunswick, Prince Edward Island, Nova Scotia and Newfoundland and Labrador.

<sup>b</sup> Yukon, Northwest Territories and Nunavut.

**FIGURE 1**  
Cardiovascular disease mortality rate ratios comparing First Nations to non-Aboriginal cohort members



income quintile having the highest mortality) for both First Nations and non-Aboriginal cohort members (Table 4). The mortality gradient was steeper for non-Aboriginal cohort members than for First Nations cohort members. Higher relative risks (First Nations compared to non-Aboriginal) were evident within each income strata, with the highest ratios in the highest income quintile (RR = 1.29 for First Nations men; RR = 1.91 for First Nations women).

After adjusting for educational attainment and income adequacy, the risk of dying from cardiovascular disease was 8% higher for First Nations men and 50% higher for First Nations women (compared to non-Aboriginal cohort members)



(Table 5). Compared to the age-adjusted hazard ratios, the relative risk of dying from cardiovascular disease (after adjusting for education and income) was reduced by 67% (from 1.24 to 1.08) for First Nations men and by 25% for First Nations women (from 1.67 to 1.50).

## Discussion

This study was the first to estimate cardiovascular disease mortality rates for First Nations people by level of educational attainment and income adequacy in Canada. Our results show that First Nations adults were at higher risk of

dying from cardiovascular disease compared to non-Aboriginal adults, both overall and within subgroups classified by education and income. This study included First Nations people who were not registered under the *Indian Act* (non-Status Indians), and included data from all provinces and territories of Canada.

The burden of cardiovascular disease has increased among Aboriginal peoples in Canada over the past several decades.<sup>5,7,17</sup> However, results from British Columbia indicate that ASMRs for cardiovascular disease among Status Indians decreased

between 1993 and 2006, but the rate remained 25% higher compared to that of other residents of British Columbia.<sup>12</sup>

Research has demonstrated that the prevalence of traditional cardiovascular disease risk factors is more common among First Nations than among non-Aboriginal people. These include higher rates of smoking,<sup>8,9,18,19</sup> high blood pressure,<sup>8,9</sup> obesity,<sup>8,20</sup> diabetes,<sup>21,22</sup> and poor diet.<sup>22-24</sup>

In addition to those well-known cardiovascular disease risk factors, it has been argued that social factors such as education and income are fundamental determinants

**TABLE 4**  
All cardiovascular disease deaths, age-standardized mortality rates per 100 000 person-years at risk, rate ratios and rate differences per 100 000 person-years at risk comparing First Nations men and women to non-Aboriginal men and women, by selected socio-economic indicators, non-institutional cohort members aged 25 years or older at baseline, Canada, 1991–2001

Characteristic measured in 1991	First Nations			Non-Aboriginal			First Nations compared to non-Aboriginal			
	Deaths	ASMR	95% CI	Deaths	ASMR	95% CI	RR	95% CI	RD	95% CI
<b>Educational attainment</b>										
<b>Men</b>										
Less than high school diploma	606	256.7	236.3, 278.8	33 776	227.8	224.5, 231.1	1.13	1.04, 1.23	28.9	7.4, 50.4
High school diploma or higher	157	231.4	190.6, 281.0	21 738	166.4	164.2, 168.7	1.39	1.14, 1.69	65.0	20.0, 110.0
<b>Women</b>										
Less than high school diploma	530	176.3	161.3, 192.6	25 307	110.6	108.6, 112.7	1.59	1.46, 1.74	65.7	49.9, 81.4
High school diploma or higher	98	141.8	108.5, 185.4	13 759	79.7	78.3, 81.1	1.78	1.36, 2.33	62.1	24.1, 100.2
<b>Income adequacy quintile</b>										
<b>Men</b>										
Quintile 1 – lowest	309	298.4	266.4, 334.3	13 053	273.1	267.3, 279.1	1.09	0.97, 1.23	25.3	–9.1, 59.7
Quintile 2	239	257.3	225.0, 294.4	15 476	213.4	209.1, 217.8	1.21	1.05, 1.38	44.0	9.1, 78.9
Quintile 3	116	222.4	185.2, 267.2	10 088	185.0	181.2, 189.0	1.20	1.00, 1.45	37.4	–3.5, 78.3
Quintiles 4,5 – highest	99	208.0	169.0, 256.0	16 897	161.1	158.6, 163.6	1.29	1.05, 1.59	46.9	3.7, 90.2
<b>Women</b>										
Quintile 1 – lowest	275	185.5	164.7, 209.0	15 918	127.7	124.5, 131.0	1.45	1.29, 1.64	57.8	35.5, 80.2
Quintile 2	211	172.6	149.8, 198.8	9 346	98.6	96.0, 101.3	1.75	1.51, 2.02	74.0	49.4, 98.6
Quintile 3	81	142.2	113.6, 178.1	5 559	88.9	86.4, 91.5	1.60	1.28, 2.01	53.3	21.2, 85.4
Quintiles 4,5 – highest	61	146.7	112.1, 192.0	8 243	76.7	75.1, 78.5	1.91	1.46, 2.50	70.0	30.5, 109.4

Source: 1991 to 2001 Canadian census mortality follow-up study.

Abbreviations: ASMR, age-standardized mortality rate; CI, confidence interval; CVD, cardiovascular disease; RD, rate difference; RR, rate ratio.

Note: Note: Reference population (person-years at risk) for age standardization was taken from the Aboriginal age distribution (5-year age groups).

**TABLE 5**  
Hazard ratios for dying from cardiovascular disease for First Nations compared to non-Aboriginal cohort members, controlling for selected socio-economic indicators, non-institutionalized persons aged 25 years or older at baseline, Canada, 1991–2001

Adjusted for:	Men		Women	
	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 + income adequacy	1.13	1.05, 1.21	1.58	1.46, 1.71
Age + education + income adequacy	1.08	1.00, 1.16	1.50	1.39, 1.63

Source: 1991 to 2001 Canadian census mortality follow-up study.

Abbreviation: CI, confidence interval.

Note: Models controlled for age in years (continuous), education (high school diploma or higher versus less than high school diploma) and income adequacy quintiles (1, 2, or 3 versus 4 + 5 combined).

of illness and disease.<sup>25</sup> First Nations people have lower levels of educational attainment and income compared to other Canadians.<sup>8,26</sup> We examined the relationship of education and income adequacy to inequalities in cardiovascular disease mortality comparing First Nations and non-Aboriginal cohort members. Differences remained when mortality rates were calculated within each level of educational attainment and income adequacy, indicating that these factors alone do not explain the disparity. In Cox models that controlled for income and education simultaneously, hazard ratios were attenuated by 67% for men and 25% for women, suggesting that these factors are important in explaining some but not all of the disparity. Research that examined the impact of socio-economic status on inequalities in self-rated health and chronic conditions—comparing First Nations people living off-reserve and other Canadians—demonstrated that factors such as income and education minimize but do not eliminate those health disparities.<sup>27</sup> This research also showed that factors often associated with health in the general population do not always act in the same way for First Nations people.<sup>27</sup> For example, among non-Aboriginal adults, men were less likely than women to report being in excellent or very good health whereas among First Nations adults, men and women were equally likely to report being in excellent or very good health. Although our results showed that cardiovascular disease mortality was higher among men than women for both First Nations and non-Aboriginal cohort members, the rate difference between men and women was smaller for First Nations than for non-Aboriginal cohort members. Thus, in terms of sex differences in cardiovascular disease mortality, First Nations women appeared to have less of an advantage compared to non-Aboriginal women. Determining why that is true would require additional study.

### Limitations

Our data excluded people who were not enumerated by the 1991 census long-form questionnaire, that is, people residing in long-term care facilities, seniors' residences or prisons, as well as people not enumerated by the census (about 3.4% of Canadian residents of all ages). The missed individuals

were more likely to be young, mobile, living in low income, of Aboriginal ancestry,<sup>28</sup> homeless and residents of Indian reserves.<sup>29</sup> In addition, since it was necessary to obtain encrypted names from tax filer data, only tax filers could be followed for mortality. Linkage rates to the name file abstracted from tax filer data were lower for First Nations (54%) compared with non-Aboriginal census respondents (77%). However, the socio-economic profile of First Nations cohort members was similar to that of all First Nations long-form census respondents, suggesting that there was little bias in the first linkage (data not shown).

This study defined First Nations people by ancestry, Registration under the *Indian Act*, or membership in an Indian band or First Nation, because questions on self-perceived Aboriginal identity were not included in the 1991 census. Our definition of First Nations excluded many people of mixed Aboriginal and non-Aboriginal origin whose census characteristics (data not shown) were closer to those of non-Aboriginal people than to First Nations people as defined for this study.

Our study examined cardiovascular disease mortality and not morbidity. Since mortality is the final outcome of a disease progression, the full burden of cardiovascular disease was not assessed.

Place of residence, education level and income were measured only at baseline (4 June 1991) and do not necessarily reflect the situation later in the follow-up period.

### Conclusion

The higher burden of cardiovascular disease among Aboriginal peoples is increasingly recognized in Canada.<sup>4,7</sup> Our results show that cardiovascular disease mortality was higher for First Nations people overall and by level of education and income adequacy. Since up to 80% of premature cardiovascular disease is said to be preventable, it may be possible to substantially reduce the burden of cardiovascular disease among Aboriginal peoples in Canada.<sup>7</sup> Results from this study show that both income adequacy

and educational attainment were important factors that help to explain the differences in cardiovascular disease mortality rates between First Nations people and non-Aboriginal Canadians.

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