Catalogue no. 82-003-X
ISSN 1209-1367

Health Reports

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Release date: February 15, 2023

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DOI: https://www.doi.org/10.25318/82-003-x202300200001-eng

ABSTRACT

Background

Mortality rates in Canada have been shown to vary by population group (e.g., Indigenous peoples, immigrants) and social economic status (e.g., income levels). Mortality patterns for some groups, including Black individuals, are not as well known. The objective of this study was to assess cause-specific mortality for Black adults living in Canada.

Methods

Mortality inequalities between Black and White cohort members were estimated by sex using Cox proportional hazard models, based on data from the 2001, 2006 and 2011 Canadian Census Health and Environment Cohorts (CanCHECs). The CanCHEC cycles were combined and followed for mortality between Census Day and December 31, 2016 or 2019, resulting in a follow-up period of 15.6, 13.6 or 8.6 years, depending on the CanCHEC cycle.

Results

Ischemic heart disease mortality was the leading cause of death among adult Black males (12.9%) and females (9.8%), as it is for adult White males (16.4%) and females (12.4%). Despite reduced risk of all-cause mortality among Black males and females, compared with White cohort members, there was notable increased risk for some cause-specific mortality. For instance, in the age-adjusted model, among the 25 causes of death examined, Black males had an increased risk of dying from four causes (HIV/AIDS, prostate cancer, diabetes mellitus and cerebrovascular disease), compared with White males. Similarly, Black females were at an increased risk for 6 causes of death (HIV/AIDS, stomach cancer, corpus uteri cancer, lymphomas and multiple myeloma, diabetes mellitus, and endocrine disorders) out of the 27 causes of death examined. These relative increased risks persisted for most causes of death after adjustment for differences in important social determinants of health.

Interpretation

Results showed substantial variability in the risk of dying by cause of death between Black and White cohort members. An important step in reducing health inequities is the routine identification and surveillance of different health outcomes by population groups. This study helps fill that information gap.

Keywords

Mortality, health equity, causes of death, cohort studies

AUTHORS

Michael Tjepkema, Tanya Christidis and Toyib Olaniyan are with the Health Analysis Division, Analytical Studies and Modelling Branch, at Statistics Canada. Jeremiah Hwee was formerly with the Health Analysis Division.

What is already known on this subject?

- Mortality rates in Canada have been shown to vary by population group.
- In Canada, not all sources of health data collect information on racialized identities.
- A self-reported survey showed Black individuals to be at increased risk for some health conditions, such as diabetes and hypertension, compared with White Canadians.

What does this study add?

- There was substantial variability in the risk of dying by cause of death between Black and White adults.
- The increased risk of dying persisted after accounting for some social determinants of health.

According to the 2016 Census, there were 1.2 million Black people in Canada, representing 3.5% of the total population.[1] Black people in Canada have diverse ethnic and cultural origins and places of birth. For example, Black immigrants who landed in the 1980s and 1990s were often sponsored by family members already living in Canada, with most coming from Jamaica and Haiti. Immigration patterns have changed more recently, with Black immigrants mostly arriving from African countries, coming to Canada under the economic program.[1] In 2016, immigrants from Africa accounted for 13.4% of new immigrants, second only to immigrants from Asia (including the Middle East), accounting for 61.8% of recent immigrants.[2]

In Canada, not all sources of health data collect information on racialized identities.[3] Because of this, health indicators such as disease prevalence, hospitalizations, cancer incidence and mortality are incomplete, including for Black individuals. Furthermore, data systems that can identify Black individuals often have small sample sizes,[3] limiting the types of analyses that can be performed. Hence, there is a recognized knowledge gap in the identification of potential health inequalities between groups of Canadians. The identification and surveillance of any inequalities are important steps that can inform public health priorities, policy development and planning intended to advance health equity.[4]

The Census of Population provides granular data for different population groups, including Black individuals, on a range of sociodemographic and economic indicators. For example, the 2016 Census highlighted that the Black population was at a greater disadvantage than the White population for many social determinants of health, including educational attainment, income level, employment status and housing.[3] The census, however, does not collect data on health indicators, with some exceptions. Studies based on the Canadian Community Health Survey have shown health inequalities between Black and White adults for some health conditions, such as diabetes and hypertension, but they are absent or reversed for other health conditions.[5] Another study[6] using the same data source showed that the Black population living in Ontario had more cardiometabolic risk factors (e.g., obesity, diabetes, smoking and hypertension) and other risk factors (lower physical activity, lower fruit and vegetable consumption, higher psychosocial stress, and higher alcohol consumption) compared with the White population.[6] Although the Canadian Community Health Survey collects a wealth of information on the health of the population, including health behaviours and health conditions, its sample size is not always sufficient to permit detailed analysis on all population groups in Canada. To address this limitation, an integrated dataset linking census data with health administrative data (the Canadian Census Health and Environment Cohort [CanCHEC]) was created.[7] A 2021 study[8] that used this integrated census and administrative dataset showed considerable variability in cancer incidence and mortality by ethnic origin. More recently, a study showed that risk of dying from COVID-19 was elevated for Black individuals, compared with White Canadians.[9]

The aim of this study is to compare the risk of mortality of Black adults with that of the adult White population for specific causes of death using the CanCHECs. First, mortality inequalities between the Black and White groups will be estimated to provide baseline measures. Second, the effect of including available demographic (e.g., marital status) and social determinants of health variables (e.g., educational attainment, income) and other population characteristics (e.g., region of birth) will be examined.

Methods

Data source

The CanCHECs consist of population-based integrated datasets that follow the non-institutional population at the time of census collection for different health outcomes, including mortality. In brief, all in-scope census records (i.e., those records with non-missing information for linking variables, such as full date of birth, sex and names) were probabilistically linked to mortality data using Statistics Canada's Social Data Linkage Environment. The Social Data Linkage Environment creates integrated population data files for social analysis through

linkage to the Derived Record Depository, a dynamic relational database containing only basic personal identifiers. The CanCHEC datasets were created by extracting data from responses to the long-form census questionnaire, which is administered to about one in five households, and mortality records that were both linked to the Derived Record Depository. Additional details on how the CanCHECs were created are available elsewhere.[7]

The linkage rate of the Canadian Vital Statistics Death Database to the Derived Record Depository exceeded 99% for all deaths that occurred from 2001 to 2019. For the census data, 78.6%, 90.8% and 96.7% of eligible records (i.e., records from the 2001 and 2006 long-form questionnaires and the 2011 National Household Survey) were linked to the Derived Record Depository and included in the 2001, 2006 and 2011 CanCHECs, respectively.

Study cohort

For this analysis, individuals who were aged 19 and older at the time of the census (2001, 2006 or 2011), were Canadian citizens or permanent residents, and were living in a private household were included. Consistent with other research,[10] non-permanent or temporary residents (who represented about 4% of the total Black population in the 2011 National Household Survey), such as those with study or work permits, were excluded because of the heterogeneity of this group and because of potential overestimation of the denominator—some of these individuals may have left Canada during the follow-up period but would not be known, as the CanCHEC dataset does not have information on whether someone has left Canada. Because of the high sampling fraction of the long-form questionnaire, about 15% of CanCHEC members are in two or more CanCHEC cycles (2001, 2006 and 2011). For these individuals, the first CanCHEC record was kept. People younger than 19 were excluded from all cohorts, as the 2001 CanCHEC included only individuals aged 19 or older. The number of deaths in this age range is low, especially for the Black group.

The analytical sample by CanCHEC cycle was as follows: 3,020,600 for the 2001 CanCHEC, 3,120,640 for the 2006 CanCHEC and 2,804,265 for the 2011 CanCHEC. The mortality follow-up period for this study cohort was as follows: 2001 CanCHEC (May 14, 2001, to December 31, 2016), 2006 CanCHEC (May 15, 2006, to December 31, 2019) and 2011 CanCHEC (May 10, 2011, to December 31, 2019).

Definitions

The Black adult group was defined based on responses to the following census question (multiple responses were allowed) that was completed by the individual or individuals living in the household:

> Is this person: White; Chinese; South Asian (e.g., East Indian, Pakistani, Sri Lankan, etc.); Black; Filipino; Latin American; Southeast Asian (e.g., Cambodian, Indonesian, Malaysian, Laotian, Vietnamese, etc.); Arab; West Asian (e.g., Afghan, Iranian, etc.); Japanese; Korean; Other—specify.

There are many different ways to define and measure the Black population. For this study, CanCHEC respondents who self-identified as "Black" in the above question, with no other identities, were considered the Black group. Because of a small sample size, mortality rates could not be reliably estimated for individuals who self-identified as "Black" and "White." Appendices B and C provide a description of these individuals by census characteristics and cause of death, where feasible. The White adult group was defined as those who self-identified as "White" with no other identities. Note that individuals who self-identified as Indigenous (e.g., First Nations, Métis or Inuit) were not asked this question and were thus not in scope for this study.

The Global Burden of Disease cause of death classification was used to retain the top 25 cause-of-death groups (both sexes combined) for both the full CanCHEC sample and Black cohort members, resulting in a total of 28 cause-of-death groups examined in this study (25 for males, 27 for females). See Appendix A for a list of International Classification of Diseases 10th Revision codes.

Statistical analysis

The following census variables (i.e., demographic and social determinants of health) were included in the models because of known associations with mortality:

- marital status: never married (single), married or common-law, separated or divorced, or widowed
- census family structure: common-law or married with or without children, lone parent with children, or single person (no partner or children)
- number of people in household (one, two, three, four, or five or more)
- educational attainment: less than a high school diploma; high school diploma or equivalency; trades, college university credential below bachelor's; or bachelor's degree or higher
- labour force status: employed, unemployed or not in the labour force
- income quintile: total household income divided by weighted household size
- immigrant status: non-immigrant, immigrated to Canada within last 10 years at time of census or immigrated to Canada more than 10 years ago at time of census
- generation status: first, second or third

- region of birth: Canada; Caribbean, Bermuda and Guyana; Western Africa; Eastern Africa; Northern Africa; Central Africa; Southern Africa; or other regions
- census metropolitan area (CMA) or census agglomeration (CA).

Cox proportional hazard regression models were run using Stata version 17.0 to compute the hazard risk for all-cause mortality, including the 28 cause-specific mortalities using their respective survival time. Cohort members were followed from the respective census date to either the death date or the cohort-specific date for which follow-up was assumed to be complete—whichever occurred first. The White population was chosen as a reference point[11] with which the Black group was compared, since it is the largest social group, and this approach is similar to those taken in Canadian health inequalities studies.[12]

Table 1
Cohort size and characteristics of Black and White adults at time of cohort entry

	Black		White	
	Females	Males	Females	Males
		number		
Cohort participants	**106,640**	**92,245**	**4,493,030**	**4,253,590**
		%		
Age group (years)				
19 to 24	13.4	14.2	9.3	10.0
25 to 34	23.9	22.5	15.7	15.9
35 to 44	24.3	25.2	19.3	19.7
45 to 54	17.3	18.4	20.4	21.0
55 to 64	11.4	11.6	15.7	16.2
65 to 74	6.3	5.9	10.7	10.5
75 to 84	2.6	1.8	6.9	5.6
85 and older	0.7	0.3	2.1	1.2
Place of residence				
In a CMA/CA	98.4	97.7	79.0	77.9
Outside a CMA/CA	1.6	2.3	21.0	22.1
Marital status				
Never married (single)	36.4	33.1	18.0	22.5
Married or common-law	41.6	55.9	63.4	68.6
Separated or divorced	17.4	9.9	9.6	6.8
Widowed	4.6	1.0	9.0	2.1
Census family structure				
Common-law/married with or without children	39.5	52.9	62.8	68.0
Lone parent with children	25.0	3.5	7.9	2.1
Single person (no partner or children)	35.5	43.6	29.3	29.9
Educational attainment				
No high school diploma	16.6	15.6	20.6	21.4
High school diploma or equivalency	35.4	39.3	35.2	40.9
Trades, college or university credential below bachelor's	30.8	23.9	25.6	19.5
Bachelor's degree or higher	17.1	21.2	18.7	18.3
Labour force status				
Employed	62.4	71.2	59.5	69.6
Unemployed	8.2	8.4	3.6	4.6
Not in the labour force	29.4	20.5	36.9	25.8
Income quintile				
1 (lowest)	34.0	27.1	19.4	15.3
2	22.9	22.7	20.1	19.1
3	18.0	19.9	20.1	20.8
4	15.0	17.6	20.2	21.9
5 (highest)	10.0	12.7	20.2	22.9
Immigrant status and period of immigration				
Non-immigrant	23.7	27.0	86.8	86.8
Immigrated within last 10 years before census	25.0	25.5	2.0	1.9
Immigrated more than 10 years before census	51.4	47.5	11.3	11.3
Place of birth (region)				
Canada	20.2	21.9	86.5	86.5
Caribbean, Bermuda and Guyana	50.6	42.6	0.1	0.1
Western Africa	7.7	10.2	0.0	0.0
Eastern Africa	10.7	10.9	0.0	0.0
Northern Africa	0.9	1.5	0.2	0.2
Central Africa	3.1	3.8	0.0	0.0
Southern Africa	0.3	0.3	0.1	0.2
Other region	6.6	8.9	13.0	13.1
CanCHEC cycle				
2001	26.6	24.8	33.9	34.0
2006	35.9	36.9	34.9	34.8
2011	37.5	38.3	31.2	31.2

Notes: CMA: census metropolitan area; CA: census agglomeration; CanCHEC: Canadian Census Health and Environment Cohort.
Sources: 2001, 2006 and 2011 CanCHECs.

Table 2
Number of deaths in analytic cohort for Black and White adults, Canada, 2001 to 2019

	Black				White			
	Females		Males		Females		Males	
	n	%	n	%	n	%	n	%
All causes	5,120	100.0	5,020	100.0	528,040	100.0	581,160	100.0
Communicable								
HIV/AIDS	50	1.0	60	1.2	90	0.0	620	0.1
Lower respiratory infections	80	1.6	75	1.5	13,510	2.6	12,540	2.2
Malignant neoplasms								
Mouth and oropharynx cancer	25	0.5	40	0.8	2,030	0.4	7,290	1.3
Stomach cancer	85	1.7	80	1.6	3,240	0.6	5,690	1.0
Colon and rectal cancers	210	4.1	200	4.0	17,930	3.4	22,085	3.8
Liver cancer	50	1.0	95	1.9	3,800	0.7	6,650	1.1
Pancreas cancer	140	2.7	130	2.6	10,370	2.0	10,920	1.9
Trachea, bronchus and lung cancers	190	3.7	305	6.1	43,870	8.3	53,145	9.1
Breast cancer (women)	390	7.6	…	…	24,040	4.6	…	…
Corpus uteri cancer (women)	130	2.5	…	…	4,590	0.9	…	…
Ovarian cancer (women)	85	1.7	…	…	8,450	1.6	…	…
Prostate cancer (men)	…	…	295	5.9	…	…	19,915	3.4
Bladder cancer	20	0.4	25	0.5	2,855	0.5	7,520	1.3
Lymphomas and multiple myeloma	160	3.1	155	3.1	9,300	1.8	12,025	2.1
Leukemia	50	1.0	70	1.4	5,205	1.0	7,465	1.3
Diabetes mellitus	245	4.8	265	5.3	12,655	2.4	16,550	2.8
Endocrine disorders	110	2.1	100	2.0	6,460	1.2	6,470	1.1
Neuro-psychiatric conditions								
Alzheimer's disease and other dementias	440	8.6	255	5.1	49,610	9.4	31,810	5.5
Parkinson's disease	25	0.5	45	0.9	3,520	0.7	6,220	1.1
Cardiovascular diseases								
Hypertensive heart disease	100	2.0	75	1.5	7,165	1.4	5,260	0.9
Ischemic heart disease	500	9.8	650	12.9	65,435	12.4	95,170	16.4
Cerebrovascular disease	325	6.3	325	6.5	32,735	6.2	25,525	4.4
Inflammatory heart diseases	30	0.6	60	1.2	3,180	0.6	4,470	0.8
Respiratory diseases								
Chronic obstructive pulmonary disease	80	1.6	100	2.0	24,060	4.6	26,650	4.6
Digestive diseases								
Cirrhosis of the liver	40	0.8	40	0.8	4,230	0.8	8,180	1.4
Genitourinary diseases								
Nephritis and nephrosis	95	1.9	95	1.9	7,430	1.4	8,210	1.4
Injuries								
Falls	35	0.7	50	1.0	9,840	1.9	9,020	1.6
Self-inflicted injuries	30	0.6	100	2.0	3,345	0.6	10,715	1.8

… not applicable

Notes: Because of rounding, percentages may not add up to 100%. The 2001 Canadian Census Health and Environment Cohort (CanCHEC) was followed for mortality to 2016, while the 2006 and 2011 CanCHECs were followed to 2019.
Sources: 2001, 2006 and 2011 CanCHECs.

A series of sex-specific models were run, with each model accounting for groups of important covariates in a stepwise methodological approach. Model 1 stratified by 10-year age group and CanCHEC year. Model 2 also stratified by immigrant status (three categories), in addition to the strata in Model 1, and added generation status and region of birth as covariates. Model 3 added marital status, census family structure and household size as covariates, in addition to those of Model 2. Model 4 added educational attainment, labour status and income quintile as covariates, in addition to those of Model 3. Model 5 added place of residence (CMA or CA) as a covariate, in addition to those of Model 4.

Results

The study cohort consisted of 92,245 male and 106,640 female Black adults aged 19 or older, who were enumerated in either the 2001, 2006 or 2011 CanCHEC (Table 1). Of these individuals, 5,020 males and 5,120 females died between the time of cohort entry and December 31, 2016, or December 31, 2019, depending on the CanCHEC (Table 2).

Each group differed in terms of sociodemographic and economic characteristics (Table 1). The average age of the Black cohort was significantly younger (41.6 years ± 15.2 standard deviation [SD]) vs. White cohort members (47.8 years ± 17.2 SD). Compared with White members, Black cohort members predominantly resided in a CMA or CA; were single (never married), separated or divorced (particularly for Black females, at 17.4% vs. 9.6%); and had double unemployment rate as of the respective census date. Observable among Black female cohort members was a high proportion of lone-parent family structures (25.0%), compared with their White cohort counterparts (7.9%). Nonetheless, the proportion with a university degree was significantly higher among Black male cohort members (21.2%), compared with their White counterparts (18.3%), while Black female cohort members reported significantly higher levels of postsecondary training as their highest level of education attained (e.g., trades, college or

Table 3
Mortality hazard ratios for Black male cohort members compared with White male cohort members

	Model 1			Model 2			Model 3			Model 4			Model 5		
		95% Confidence interval			95% Confidence interval			95% Confidence interval			95% Confidence interval			95% Confidence interval	
	Hazard ratio	from	to	Hazard ratio	from	to	Hazard ratio	from	to	Hazard ratio	from	to	Hazard ratio	from	to
All causes	0.66	0.65	0.68	0.82	0.79	0.86	0.80	0.77	0.83	0.76	0.73	0.78	0.75	0.72	0.78
Communicable															
HIV/AIDS	4.78 ‡	3.67	6.24	4.00 ‡	2.43	6.61	3.02 ‡	1.84	4.95	2.59 ‡	1.57	4.28	2.37 ‡	1.44	3.92
Lower respiratory infections	0.53	0.42	0.66	0.65	0.49	0.87	0.63	0.47	0.85	0.60	0.45	0.80	0.59	0.44	0.79
Malignant neoplasms															
Mouth and oropharynx cancer	0.35	0.25	0.49	0.46	0.30	0.71	0.47	0.31	0.72	0.45	0.30	0.69	0.45	0.29	0.68
Stomach cancer	1.06	0.85	1.32	0.96	0.70	1.31	0.96	0.70	1.31	0.92	0.68	1.26	0.92	0.68	1.26
Colon and rectal cancers	0.67	0.59	0.78	0.93	0.76	1.13	0.92	0.75	1.11	0.88	0.72	1.07	0.87	0.72	1.06
Liver cancer	0.99	0.81	1.22	1.41 ‡	1.07	1.86	1.38 ‡	1.05	1.82	1.33 ‡	1.01	1.76	1.30	0.99	1.71
Pancreas cancer	0.87	0.73	1.03	1.45 ‡	1.13	1.86	1.46 ‡	1.14	1.86	1.43 ‡	1.12	1.83	1.42 ‡	1.11	1.82
Trachea, bronchus and lung cancers	0.43	0.39	0.49	0.80	0.69	0.93	0.78	0.67	0.91	0.72	0.62	0.83	0.71	0.61	0.82
Breast cancer	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
Corpus uteri cancer	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
Ovarian cancer	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
Prostate cancer	1.33 ‡	1.18	1.49	1.18	0.99	1.42	1.20 ‡	1.00	1.44	1.18	0.99	1.42	1.19 ‡	1.00	1.43
Bladder cancer	0.29	0.20	0.42	0.43	0.27	0.70	0.44	0.27	0.72	0.43	0.27	0.69	0.43	0.26	0.69
Lymphomas and multiple myeloma	0.96	0.82	1.13	1.11	0.88	1.40	1.13	0.89	1.42	1.11	0.88	1.39	1.11	0.88	1.39
Leukemia	0.69	0.54	0.87	0.78	0.56	1.09	0.79	0.57	1.10	0.78	0.56	1.08	0.78	0.56	1.08
Diabetes mellitus	1.25 ‡	1.11	1.41	1.25 ‡	1.05	1.49	1.18 ‡	1.00	1.41	1.10	0.92	1.30	1.10	0.93	1.31
Endocrine disorders	1.12	0.91	1.36	1.09	0.81	1.46	1.06	0.79	1.41	1.00	0.75	1.33	0.99	0.74	1.32
Neuro-psychiatric conditions															
Alzheimer's disease and other dementias	0.74	0.66	0.84	0.91	0.77	1.08	0.92	0.78	1.10	0.90	0.76	1.07	0.88	0.75	1.05
Parkinson's disease	0.63	0.46	0.84	0.65	0.44	0.96	0.65	0.44	0.96	0.64	0.43	0.95	0.63	0.43	0.94
Cardiovascular diseases															
Hypertensive heart disease	1.09	0.87	1.38	1.26	0.90	1.77	1.21	0.87	1.69	1.15	0.83	1.61	1.18	0.84	1.64
Ischemic heart disease	0.55	0.51	0.60	0.58	0.53	0.65	0.57	0.51	0.63	0.54	0.49	0.59	0.54	0.48	0.59
Cerebrovascular disease	1.11 ‡	1.00	1.24	1.16	0.99	1.35	1.13	0.97	1.32	1.08	0.92	1.26	1.09	0.93	1.27
Inflammatory heart diseases	0.94	0.73	1.21	1.05	0.73	1.52	1.00	0.69	1.43	0.94	0.66	1.35	0.93	0.65	1.34
Respiratory diseases															
Chronic obstructive pulmonary disease	0.32	0.27	0.40	0.89	0.70	1.14	0.83	0.65	1.06	0.74	0.58	0.94	0.74	0.58	0.94
Digestive diseases															
Cirrhosis of the liver	0.32	0.24	0.43	0.37	0.26	0.54	0.34	0.24	0.50	0.32	0.22	0.46	0.31	0.21	0.44
Genitourinary diseases															
Nephritis and nephrosis	1.04	0.85	1.27	1.23	0.92	1.63	1.20	0.91	1.59	1.13	0.85	1.50	1.13	0.85	1.50
Injuries															
Falls	0.48	0.36	0.63	0.51	0.36	0.71	0.50	0.36	0.71	0.49	0.35	0.69	0.49	0.35	0.68
Self-inflicted injuries	0.43	0.36	0.53	0.71	0.56	0.90	0.66	0.52	0.84	0.60	0.47	0.76	0.61	0.48	0.78

… not applicable

‡ significantly elevated mortality risk compared with White male cohort members ($p < 0.05$)

Notes: CI: confidence interval. Model 1 stratified for 10-year age group and cohort year. Model 2 also stratified for immigrant status, including adjustment for generation and region of birth. Model 3, in addition to all variables from Model 2, adjusted for marital status, census family structure and household size. Model 4 included all variables from Model 3, as well as educational attainment, labour force status and income quintile. Model 5 included all variables in Model 4, as well as residence in a census metropolitan area or census agglomeration.

Sources: 2001, 2006 and 2011 Canadian Census Health and Environment Cohorts.

university credential below bachelor's; 30.8% vs. 25.6% among White females). Furthermore, the proportion of Black males and females in the lowest income quintile was approximately 1.75 times higher, compared with their respective White counterparts.

Irrespective of sex, about three-quarters of Black adults in the study cohort were immigrants, compared with 13.3% for White cohort members. Nearly half of Black adults immigrated more than 10 years before the relevant census, and one-quarter immigrated in the 10 years before the census. By region of birth, nearly half (46.9%) of the Black cohort members were born in the Caribbean, Bermuda or Guyana, followed by Canada (21.0%), Eastern Africa (10.8%) and Western Africa (8.8%).

The total number of deaths in the cohort by population group is shown in Table 2. Ischemic heart disease was the most common cause of death among all cohort groups: Black males (12.9%), White males (16.4%), Black females (9.8%) and White females (12.4%). The next two most common causes of death were cerebrovascular disease (6.5%), and trachea, bronchus and lung cancer (6.1%) for Black males; trachea, bronchus and lung cancer (9.1%), and Alzheimer's disease and other dementias (5.5%) for White males; Alzheimer's disease and other dementias (8.6%), and breast cancer (7.6%) for Black females; and Alzheimer's disease and other dementias (9.4%), and trachea, bronchus and lung cancer (8.3%) for White females.

Tables 3 and 4 show the risk of death from various Cox models for Black males and females, respectively, compared with their

White counterparts. Age-adjusted all-cause mortality risk was reduced among Black males (hazard ratio [HR]: 0.66; 95% confidence interval [CI]: 0.65 to 0.68) and Black females (HR: 0.72; 95% CI: 0.70 to 0.74), compared with their respective White counterparts. These reduced risks persisted for Black males (HR: 0.75; 95% CI: 0.72 to 0.78) and Black females (HR: 0.78; 95% CI: 0.75 to 0.82) after accounting for important social determinants of health in the respective fully adjusted models (Table 3 and Table 4).

In contrast to the reduced risk of all-cause mortality among Black males and females, there were notable increased risks for some cause-specific mortality, compared with their respective White counterparts. For instance, among the causes of death examined in the age-adjusted model, Black males had an increased risk of dying from four causes (HIV/AIDS [HR: 4.78; 95% CI: 3.67 to 6.24], prostate cancer [HR: 1.33; 95% CI: 1.18 to 1.49], diabetes mellitus [HR: 1.25; 95% CI: 1.11 to 1.41] and cerebrovascular disease [HR: 1.11; 95% CI: 1.00 to 1.24]), compared with their White counterparts. Similarly, Black females were at an increased risk for six causes of death (HIV/AIDS [HR: 21.65; 95% CI: 15.16 to 30.91], stomach cancer [HR: 1.76; 95% CI: 1.41 to 2.19], corpus uteri cancer [HR: 1.78; 95% CI: 1.49 to 2.12], lymphomas and multiple myeloma [HR: 1.21; 95% CI: 1.03 to 1.41], diabetes mellitus [HR: 1.48; 95% CI: 1.31 to 1.68], and endocrine disorders [HR: 1.26; 95% CI: 1.04 to 1.51]). All these relative increased risks persisted, following adjustment for differences in important social determinants of health.

By contrast, Black male cohort members had a decreased risk of dying, compared with their White counterparts, for 13 of the 25 causes of death examined (Table 3). Observed reduced risk was as low as 26% for death related to Alzheimer's disease and other dementias, and as high as 71% for bladder cancer death. Similarly, Black female cohort members had a decreased risk of dying, compared with their reference group, for 15 of the 27 causes of death examined (Table 4). These reduced risks ranged from 17% for deaths related to cerebrovascular disease to 75% for chronic obstructive pulmonary disease mortality.

Discussion

To the authors' knowledge, this is the first national Canadian study to estimate mortality differentials for Black adults for a variety of causes of death, while taking into account differences in some demographic and social determinants of health factors between the Black and White cohort members. Overall, there was a reduced all-cause mortality risk in the age-adjusted models for Black males (34% lower) and Black females (28% lower), compared with their respective White cohort members. By cause of death, age-adjusted HRs were statistically higher for Black males (compared with the reference group) for 4 of the 25 causes of death examined (HIV/AIDS, prostate cancer, diabetes mellitus and cerebrovascular disease) and were statistically lower for 13 of the 25 causes of death examined. For Black females, the age-adjusted HRs were statistically higher for 6 causes of death examined (HIV/AIDS, stomach cancer, corpus uteri cancer, lymphomas and multiple myeloma, diabetes mellitus, and endocrine disorders) and were statistically lower for 13 of the 27 causes of death examined.

The root causes of both the inequities and social determinants of health are complex and include the underlying social advantage or disadvantage of a population group.[13] In general, Black Canadians are disadvantaged according to many of the social determinants of health, such as education, income, employment and housing, compared with the White population.[1,3] Results from this study showed that mortality inequalities by selected cause of death persisted or were unchanged after taking into account some important social determinants of health as covariates (i.e., the reduced all-cause mortality HRs persisted between the age-adjusted and fully adjusted models for Black cohort members). This finding was similar to those of other studies,[5,14,15] reinforcing the fact that differences in socioeconomic status alone do not fully explain the mortality disparities between Black and White Canadians. An important health determinant that was not available in the dataset, and is difficult to measure, was respondents' experience with discrimination. Daily lived experience is both a precursor to and an outcome of the social determinants of health and poor health outcomes. Other research has shown that Black people are the most likely to experience discrimination, compared with other groups, and that this discrimination is associated with chronic conditions and chronic condition risk factors, such as smoking, binge drinking and infrequent physical activity.[16]

A notable mortality difference observed in this study was that related to HIV/AIDS, with an increased risk of nearly 5 times and 21 times greater among Black males and females, respectively, compared with their respective White counterparts. These increased risks persisted despite accounting for important covariates (Black males [HR: 2.37; 95% CI: 1.44 to 3.92] and Black females [HR: 6.05; 95% CI: 2.56 to 14.30]). The presence of such increased risk, when all other important social determinants of health were held constant between the two groups, demonstrates the presence of other factors beyond what was accounted for in the fully adjusted model. With no known genetic marker responsible for the decreased survival time observed in Black cohort members with HIV/AIDS, it is possible that this mortality inequality may stem from health inequities, differential antiretroviral therapy (ART) adherence and treatment delays. For example, in a recent scoping systematic review,[17] barriers to specialized care were found in HIV care delivery to Francophone Black people in Canada. In a collaborative study[18] that included 19 studies from Canada, Europe and the United States, which followed HIV-positive patients from time of ART initiation, comparable AIDS-related death rates were observed among Black patients of Sub-Saharan African ancestry (HR: 0.97; 95% CI: 0.74 to 1.27), compared with patients of European origin in a pool of European cohorts; an increased risk was observed for African Americans (HR: 2.37; 95% CI: 1.44 to 3.92), compared with their White

Table 4
Mortality hazard ratios for Black female cohort members compared with White female cohort members

	Model 1			Model 2			Model 3			Model 4			Model 5		
	Hazard ratio	95% Confidence interval from	to	Hazard ratio	95% Confidence interval from	to	Hazard ratio	95% Confidence interval from	to	Hazard ratio	95% Confidence interval from	to	Hazard ratio	95% Confidence interval from	to
All causes	0.72	0.70	0.74	0.88	0.85	0.92	0.83	0.80	0.87	0.79	0.76	0.82	0.78	0.75	0.82
Communicable															
HIV/AIDS	21.65 ‡	15.16	30.91	10.52 ‡	4.58	24.20	7.73 ‡	3.36	17.79	6.45 ‡	2.73	15.23	6.05 ‡	2.56	14.30
Lower respiratory infections	0.50	0.41	0.63	0.55	0.42	0.74	0.50	0.38	0.67	0.47	0.35	0.62	0.46	0.35	0.62
Malignant neoplasms															
Mouth and oropharynx cancer	0.81	0.54	1.21	2.11 ‡	1.21	3.70	2.03 ‡	1.16	3.52	2.00 ‡	1.15	3.47	1.98 ‡	1.14	3.45
Stomach cancer	1.76 ‡	1.41	2.19	1.75 ‡	1.25	2.45	1.65 ‡	1.18	2.31	1.55 ‡	1.11	2.18	1.56 ‡	1.11	2.19
Colon and rectal cancers	0.82	0.71	0.94	1.18	0.96	1.44	1.13	0.92	1.38	1.08	0.89	1.33	1.08	0.88	1.32
Liver cancer	0.84	0.63	1.12	1.35	0.91	2.00	1.32	0.90	1.96	1.27	0.86	1.88	1.27	0.86	1.88
Pancreas cancer	0.92	0.78	1.08	1.11	0.87	1.43	1.10	0.86	1.41	1.08	0.84	1.39	1.08	0.84	1.39
Trachea, bronchus and lung cancers	0.28	0.25	0.33	0.76	0.63	0.91	0.74	0.62	0.89	0.69	0.58	0.83	0.69	0.57	0.82
Breast cancer	1.00	0.90	1.10	1.06	0.91	1.24	1.02	0.87	1.19	1.00	0.86	1.17	1.00	0.85	1.16
Corpus uteri cancer	1.78 ‡	1.49	2.12	1.15	0.86	1.53	1.06	0.79	1.41	1.05	0.79	1.41	1.05	0.79	1.41
Ovarian cancer	0.63	0.51	0.78	0.52	0.39	0.70	0.53	0.39	0.71	0.53	0.40	0.71	0.53	0.40	0.71
Prostate cancer	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
Bladder cancer	0.45	0.28	0.72	0.71	0.37	1.36	0.70	0.37	1.35	0.68	0.35	1.30	0.67	0.35	1.28
Lymphomas and multiple myeloma	1.21 ‡	1.03	1.41	1.27	0.99	1.63	1.27	0.99	1.63	1.25	0.98	1.60	1.25	0.97	1.60
Leukemia	0.68	0.51	0.89	0.77	0.51	1.14	0.76	0.51	1.14	0.75	0.50	1.12	0.75	0.50	1.12
Diabetes mellitus	1.48 ‡	1.31	1.68	1.30 ‡	1.08	1.58	1.15	0.95	1.40	1.05	0.87	1.27	1.06	0.88	1.29
Endocrine disorders	1.26 ‡	1.04	1.51	1.80 ‡	1.35	2.40	1.60 ‡	1.20	2.14	1.49 ‡	1.12	1.99	1.48 ‡	1.11	1.98
Neuro-psychiatric conditions															
Alzheimer's disease and other dementias	0.76	0.69	0.84	0.81	0.70	0.92	0.77	0.67	0.88	0.75	0.65	0.86	0.74	0.65	0.85
Parkinson's disease	0.56	0.37	0.83	0.59	0.35	1.00	0.56	0.33	0.95	0.56	0.33	0.95	0.56	0.33	0.96
Cardiovascular diseases															
Hypertensive heart disease	1.20	0.99	1.46	1.56 ‡	1.15	2.11	1.47 ‡	1.08	1.98	1.39 ‡	1.02	1.88	1.42 ‡	1.05	1.92
Ischemic heart disease	0.64	0.59	0.70	0.67	0.59	0.75	0.62	0.55	0.70	0.57	0.51	0.65	0.57	0.51	0.65
Cerebrovascular disease	0.83	0.75	0.93	0.96	0.83	1.12	0.92	0.79	1.08	0.88	0.75	1.03	0.89	0.76	1.03
Inflammatory heart diseases	0.68	0.48	0.97	0.62	0.38	1.03	0.60	0.37	0.99	0.57	0.35	0.94	0.57	0.35	0.93
Respiratory diseases															
Chronic obstructive pulmonary disease	0.25	0.20	0.31	0.72	0.55	0.96	0.66	0.50	0.87	0.59	0.44	0.78	0.59	0.44	0.78
Digestive diseases															
Cirrhosis of the liver	0.49	0.36	0.68	0.70	0.45	1.11	0.67	0.42	1.05	0.61	0.39	0.96	0.61	0.39	0.96
Genitourinary diseases															
Nephritis and nephrosis	1.06	0.86	1.30	1.26	0.94	1.70	1.16	0.86	1.56	1.06	0.79	1.42	1.06	0.79	1.43
Injuries															
Falls	0.30	0.21	0.41	0.34	0.22	0.50	0.34	0.22	0.51	0.33	0.22	0.50	0.33	0.22	0.50
Self-inflicted injuries	0.35	0.25	0.51	0.72	0.46	1.12	0.64	0.41	0.99	0.57	0.37	0.89	0.57	0.36	0.88

… not applicable

‡ significantly elevated mortality risk compared with White male cohort members ($p < 0.05$)

Notes: CI: confidence interval. Model 1 stratified for 10-year age group and cohort year. Model 2 also stratified for immigrant status, including adjustment for generation and region of birth. Model 3, in addition to all variables from Model 2, adjusted for marital status, census family structure and household size. Model 4 included all variables from Model 3, as well as educational attainment, labour force status and income quintile. Model 5 included all variables in Model 4, as well as residence in a census metropolitan area or census agglomeration.

Sources: 2001, 2006 and 2011 Canadian Census Health and Environment Cohorts.

counterparts in the American cohorts. Although death rates among Black patients were suppressed in the Canadian cohorts because of a low number of deaths, the absence of differential AIDS-related deaths in the European cohorts—which have universal health care systems similar to Canada—suggests that other factors might be at play in the current study.

Among the cancer-related deaths examined, Black females had approximately an 80% increased risk for stomach and corpus uteri cancers, and about a 21% increased risk for lymphomas and multiple myeloma, compared with their White counterparts. Although adjusted hazard risk was not reported, a previous study on the 2006 CanCHEC (including age groups from 0 years) reported approximately twice as many stomach and corpus uteri cancers among females with African and Caribbean ethnic or cultural origins, compared with those of European ancestry.[8] Similarly, results from the current study showed a significant 33% (95% CI: 18% to 49%) increased risk of dying from prostate cancer among Black males, compared with their White counterparts. Although slightly reduced (i.e., compared with the age-adjusted model), a significant increased risk of 19% (95% CI: 0% to 43%) persisted when the social determinants of health were held constant between the two groups. This result is consistent with most research[19,20,21] but is contrary to another Canadian study that was based on the 1991 CanCHEC. That study showed that Black males had a lower risk of prostate cancer mortality (HR: 0.83; 95% CI: 0.87 to 1.02) than White males.[22] The lack of agreement with the earlier CanCHEC study may be related to the differences in cohort year (1991 vs. 2001, 2006 and 2011 combined data), mortality follow-up period (1991 to 2010 vs. 2001 to 2019) or sample size (95 prostate cancer deaths vs. 295 in the current study). However, a 2021 study[8] that used the 2006 CanCHEC (including age groups from 0 years) also found a higher rate of

prostate cancer mortality among those with Caribbean and African ethnic or cultural origins.

The risk of diabetes mellitus mortality was approximately 25% higher for Black males and 48% higher for Black females, compared with their respective White counterparts in the age-adjusted models. This is consistent with findings from the 2017 pan-Canadian Health Inequalities Data Tool.[23] The observed risk was attenuated in the fully adjusted model, which included important social determinants of health. The absence of differential mortality when all these covariates were held constant between Black and White cohort members suggests the possible role of these factors in the mortality disparity observed in the age-adjusted model. Overall, this study's mortality results are consistent with known elevated diabetes prevalence in the Canadian Black population.[5,6]

Compared with White females, Black females had an elevated risk of dying from endocrine disorders, with a 26% increased risk in the age-adjusted model and a 48% increased risk in the fully adjusted model. This group of diseases includes blood-related conditions, such as sickle cell anemia, which are known to be more prevalent in the Black population.[24] Although the physiopathology of increased endocrine complications among sickle cell individuals is not fully understood, iron overload resulting from chronic transfusions, damage to the ischemic vessels and vaso-occlusive crises caused by the inflammatory state have been implicated.[25] Additional investigation into the cause of this elevated risk, including genetic studies for hereditary disorders, would prove useful.

Results showed that mortality inequalities between White and Black adults differ by cause of death. Differences in societal context and other factors specific to each population group and sex would need to be considered when interpreting the findings. However, this study did demonstrate that grouping Black males and females together would mask important differences in mortality. For example, stomach cancer and endocrine disorder mortality were elevated only for Black females and not for Black males.

The results of this study contrasted with those of American studies that showed higher all-cause mortality rates for African Americans, compared with their White counterparts,[26-29] and were similar to results from the United Kingdom, where the Black population in England and Wales had a lower mortality rate, compared with the White population.[30] An American study[31] found a 16% increased risk of death for the Black population, compared with White Americans, for all-cause mortality, although the increased risk was evident only for those younger than 65 years. The reasons for these differing results between the Black populations across Canada, the United States and the United Kingdom are complex, and the societal context in each country is important to understand these differences.[13] Other important differences between the three countries include health care systems (i.e., universal access) and immigration patterns. For example, the proportion of immigrants in the Black population is quite different between the United States and Canada. In the CanCHEC study, 73% of Black male cohort members and 76% of Black females were born outside Canada, compared with 15% of African Americans who were born outside the United States.[31] The difference in the proportion of immigrants and the importance of the healthy immigrant effect, especially when one considers the economic immigrant category in Canada,[32] need to be considered when comparing results across countries. The healthy immigrant effect in Canada is related to the medical examinations performed on immigration candidates, which exclude medically inadmissible candidates. Thus, medically inadmissible candidates are denied the chance to immigrate to Canada based on three possible reasons: danger to public health, danger to public safety, or excessive demand on health or social services.[33]

The strengths of this study include a relatively large sample size that allowed for the examination of mortality outcomes for 28 different causes of death. Another strength is the inclusion of many important social determinants of health in the analyses, which helped account for key contextual factors. However, there are limitations in the current study. First, the results are not generalizable to the entire Black population in Canada, as the study excluded people living in collective dwellings (both institutional and non-institutional) at the time of cohort entry, the homeless population, and non-permanent residents such as study and work permit holders. Second, combining the 2001, 2006 and 2011 CanCHECs meant that survey weights could not be used and the results are thus reflective of the cohort. The study was unable to disaggregate to Black sub-communities (e.g., historical Black communities vs. immigrant Black communities) because of small sample sizes, so important differences between Black communities may have been masked. Third, important confounders, such as health risk behaviours like smoking, and life experiences, such as discrimination, were also not available in the census data. In addition, all covariates were measured at a single point in time (i.e., Census Day) and may have changed during the follow-up period. This is an important consideration, as research has shown that mortality risk is an accumulation of multiple influences over the life course.[34] Finally, this study is based on data prior to the start of the COVID-19 pandemic. How the pandemic affects these results is not entirely known, but recent research has found that the Black population was at increased risk of dying from COVID-19 in 2020.[9]

Conclusions

This study examined mortality outcomes for Black adults in Canada across several leading causes of death. Results showed that the risk of mortality between Black and White cohort members differed by cause of death and sex, where some causes of death showed an elevated risk for Black cohort members, while other causes showed a reduced risk. This study highlights the importance of measuring health inequalities for the Black population using linked census data, such as the CanCHEC.

Acknowledgements

The authors would like to thank members (Drs. Ntonghanwah Forcheh, Jude Kong, Jenese Nugent, Tafadzwa Machipisa and Tolulope Sajobi) of the Health Analytical working group of the Canadian Black Scientists Network and Dr. Kwame McKenzie, co-chair of the Health Committee at BlackNorth Initiative and CEO of the Wellesley Institute, for their insightful comments and suggestions on the analytical plan and earlier drafts of the manuscript. The authors also thank Evelyne Bougie, a former employee of the Health Analysis Division, for earlier contributions.

Appendix Table A
Global Burden of Disease cause of death categories and International Classification of Diseases 10th Revision codes

Global Burden of Disease cause of death name	International Classification of Diseases 10th Revision codes
All causes	
Communicable	
HIV/AIDS	B20–B24
Lower respiratory infections	J10–J18, J20–J22
Malignant neoplasms	
Mouth and oropharynx cancer	C00–C14
Stomach cancer	C16
Colon and rectal cancers	C18–C21
Liver cancer	C22
Pancreas cancer	C25
Trachea, bronchus and lung cancers	C33–C34
Breast cancer	C50
Corpus uteri cancer	C54–C55
Ovarian cancer	C56
Prostate cancer	C61
Bladder cancer	C67
Lymphomas and multiple myeloma	C81–C90, C96
Leukemia	C91–C95
Diabetes mellitus	E10–E14
Endocrine disorders	D55–D64 (minus D64.9), D65–D89, E03–E07, E15–E16, E20–E34, E65–E88
Neuro-psychiatric conditions	
Alzheimer's disease and other dementias	F01, F03, G30–G31
Parkinson's disease	G20–G21
Cardiovascular diseases	
Hypertensive heart disease	I10–I13
Ischemic heart disease	I20–I25
Cerebrovascular disease	I60–I69
Inflammatory heart diseases	I30–I33, I38, I40, I42
Respiratory diseases	
Chronic obstructive pulmonary disease	J40–J44
Digestive diseases	
Cirrhosis of the liver	K70, K74
Genitourinary diseases	
Nephritis and nephrosis	N00–N19
Injuries	
Falls	W00–W19
Self-inflicted injuries	X60–X84, Y870

Source: World Health Organization. Global Burden of Disease: 2004 Update. Geneva: World Health Organization, 2008.

Appendix Table B
Cohort size and characteristics of both Black and White cohort members at time of cohort entry

	Females	Males
	number	
Cohort participants	**7,700**	**6,410**
	%	
Age group (years)		
19 to 24	27.0	28.3
25 to 34	29.3	28.6
35 to 44	20.2	20.9
45 to 54	11.4	11.0
55 to 64	6.2	6.2
65 to 74	3.9	3.2
75 to 84	1.5	1.5
85 and older	0.6	0.3
Place of residence		
In a CMA/CA	93.1	93.1
Outside a CMA/CA	6.9	6.9
Marital status		
Never married (single)	46.3	47.7
Married or common-law	40.1	47.0
Separated or divorced	10.5	4.6
Widowed	2.7	0.7
Census family structure		
Common-law/married with or without children	39.9	46.3
Lone parent with children	16.5	2.0
Single person (no partner or children)	43.5	51.6
Educational attainment		
No high school diploma	12.8	16.9
High school diploma or equivalency	37.4	44.1
Trades, college or university credential below bachelor's	29.4	22.4
Bachelor's degree or higher	20.4	16.6
Labour force status		
Employed	67.5	73.7
Unemployed	7.3	8.8
Not in the labour force	25.2	17.6
Income quintile		
1 (lowest)	26.4	20.3
2	20.3	19.4
3	18.5	19.7
4	18.6	21.4
5 (highest)	16.2	19.2
Immigrant status and period of immigration		
Non-immigrant	77.2	79.3
Immigrated within last 10 years before census	4.1	3.8
Immigrated more than 10 years before census	18.8	16.9
Place of birth (region)		
Canada	76.2	78.3
Caribbean, Bermuda and Guyana	12.4	10.6
Western Africa	0.6	0.3
Eastern Africa	1.3	1.4
Northern Africa	0.1	0.0
Central Africa	0.6	0.5
Southern Africa	1.4	1.3
Other region	7.4	7.6
CanCHEC cycle		
2001	23.4	20.2
2006	35.7	35.3
2011	40.8	44.5

Notes: CMA: census metropolitan area; CA: census agglomeration; CanCHEC: Canadian Census Health and Environment Cohort.
Sources: 2001, 2006 and 2011 CanCHECs.

Appendix Table C
Number of deaths in analytic cohort for both Black and White cohort members, Canada, 2001 to 2019

	Females		Males	
	n	%	n	%
All causes	300	100	270	100.0
Communicable				
HIV/AIDS	x	x	x	x
Lower respiratory infections	x	x	5	1.9
Malignant neoplasms				
Mouth and oropharynx cancer	x	x	x	x
Stomach cancer	x	x	x	x
Colon and rectal cancers	5	1.7	10	3.0
Liver cancer	x	x	x	x
Pancreas cancer	10	2.7	10	3.0
Trachea, bronchus and lung cancers	20	6.7	15	5.2
Breast cancer (women)	20	6.7	...	...
Corpus uteri cancer (women)	x	x	...	...
Ovarian cancer (women)	x	x	...	...
Prostate cancer (men)	...	...	5	1.9
Bladder cancer	x	x	x	x
Lymphomas and multiple myeloma	x	x	10	3.0
Leukemia	x	x	10	3.0
Diabetes mellitus	10	2.7	10	3.0
Endocrine disorders	x	x	5	1.9
Neuro-psychiatric conditions				
Alzheimer's disease and other dementias	20	6.7	10	3.0
Parkinson's disease	x	x	x	x
Cardiovascular diseases				
Hypertensive heart disease	x	x	10	3.0
Ischemic heart disease	35	10.8	40	13.7
Cerebrovascular disease	20	6.7	15	5.2
Inflammatory heart diseases	x	x	x	x
Respiratory diseases				
Chronic obstructive pulmonary disease	5	1.7	15	5.2
Digestive diseases				
Cirrhosis of the liver	x	x	5	1.9
Genitourinary diseases				
Nephritis and nephrosis	5	1.7	x	x
Injuries				
Falls	x	x	x	x
Self-inflicted injuries	10	2.7	20	6.7

... not applicable

x suppressed to meet the confidentiality requirements of the *Statistics Act*

Notes: Because of rounding, percentages may not add up to 100%. The 2001 Canadian Census Health and Environment Cohort (CanCHEC) was followed for mortality to 2016, while the 2006 and 2011 CanCHECs were followed to 2019.

Sources: 2001, 2006 and 2011 CanCHECs.

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