

Catalogue no. 11-633-X — No. 013
ISSN 2371-3429
ISBN 978-0-660-24486-0

Analytical Studies: Methods and References

The 1996 CanCHEC: Canadian Census Health and Environment Cohort Profile

by Tanya Christidis, Félix Labrecque-Synnott, Lauren Pinault,
Abdelnasser Saidi and Michael Tjepkema

Release date: January 22, 2018



Statistics
Canada

Statistique
Canada

Canada

How to obtain more information

For information about this product or the wide range of services and data available from Statistics Canada, visit our website, www.statcan.gc.ca.

You can also contact us by

email at STATCAN.infostats-infostats.STATCAN@canada.ca

telephone, from Monday to Friday, 8:30 a.m. to 4:30 p.m., at the following numbers:

- | | |
|---|----------------|
| • Statistical Information Service | 1-800-263-1136 |
| • National telecommunications device for the hearing impaired | 1-800-363-7629 |
| • Fax line | 1-514-283-9350 |

Depository Services Program

- | | |
|------------------|----------------|
| • Inquiries line | 1-800-635-7943 |
| • Fax line | 1-800-565-7757 |

Standards of service to the public

Statistics Canada is committed to serving its clients in a prompt, reliable and courteous manner. To this end, Statistics Canada has developed standards of service that its employees observe. To obtain a copy of these service standards, please contact Statistics Canada toll-free at 1-800-263-1136. The service standards are also published on www.statcan.gc.ca under “Contact us” > “Standards of service to the public.”

Note of appreciation

Canada owes the success of its statistical system to a long-standing partnership between Statistics Canada, the citizens of Canada, its businesses, governments and other institutions. Accurate and timely statistical information could not be produced without their continued co-operation and goodwill.

Standard table symbols

The following symbols are used in Statistics Canada publications:

- . not available for any reference period
- .. not available for a specific reference period
- ... not applicable
- 0 true zero or a value rounded to zero
- 0^s value rounded to 0 (zero) where there is a meaningful distinction between true zero and the value that was rounded
- ^P preliminary
- ^r revised
- X suppressed to meet the confidentiality requirements of the *Statistics Act*
- ^E use with caution
- F too unreliable to be published
- * significantly different from reference category ($p < 0.05$)

Published by authority of the Minister responsible for Statistics Canada

© Minister of Industry, 2018

All rights reserved. Use of this publication is governed by the Statistics Canada [Open Licence Agreement](#).

An HTML version is also available.

Cette publication est aussi disponible en français.

The 1996 CanCHEC: Canadian Census Health and Environment Cohort Profile

by

**Tanya Christidis, Félix Labrecque-Synnott, Lauren Pinault,
Abdelnasser Saidi and Michael Tjepkema**

Health Analysis Division and Household Survey Methods Division
Statistics Canada

11-633-X No. 013
ISSN 2371-3429
ISBN 978-0-660-24486-0

January 2018

Analytical Studies: Methods and References

Papers in this series provide background discussions of the methods used to develop data for economic, health, and social analytical studies at Statistics Canada. They are intended to provide readers with information on the statistical methods, standards and definitions used to develop databases for research purposes. All papers in this series have undergone peer and institutional review to ensure that they conform to Statistics Canada's mandate and adhere to generally accepted standards of good professional practice.

The papers can be downloaded free at www.statcan.gc.ca.

Acknowledgements

The authors wish to acknowledge the contributions of H el ene Lamadeleine who assisted with manual review of census records, and of Jacques Dubois and Barry Zaid, who assisted in accessing census microfiche files for the manual validation.

Table of contents

Abstract	5
1 Introduction.....	6
2 Data	7
2.1 1996 Census of Population.....	7
2.2 Derived Record Depository.....	7
3 Methods	8
3.1 Linkage of 1996 Census to the Derived Record Depository	8
3.2 Re-weighting and bootstrap weights.....	9
3.3 Mortality analysis	9
3.4 Analytical file	10
4 Results.....	11
4.1 Cohort.....	11
4.2 Weighting.....	14
4.3 Mortality	16
5 Discussion.....	21
6 Conclusion	22
References.....	23

Abstract

This paper describes the creation of the 1996 Canadian Census Health and Environment Cohort (CanCHEC)—3.57 million respondents to the census long-form questionnaire who were retrospectively followed for mortality and mobility for 16.6 years from 1996 to 2012. The 1996 CanCHEC was limited to census respondents who were aged 19 or older on Census Day (May 14, 1996), were residents of Canada, were not residents of institutions, and had filed an income tax return. These respondents were linked to death records from the Canadian Mortality Database or to the T1 Personal Master File, and to a postal code history from a variety of sources. This is the third in a set of CanCHECs that, when combined, make it possible to examine mortality trends and environmental exposures by socioeconomic characteristics over three census cycles and 21 years of census, tax, and mortality data. This report describes linkage methodologies, validation and bias assessment, and the characteristics of the 1996 CanCHEC. Representativeness of the 1996 CanCHEC relative to the adult population of Canada is also assessed.

Keywords: Age-standardized mortality rate, census, cohort, data linkage, mortality, survival

1 Introduction

Since 2008, a number of population censuses have been linked to administrative health data (Bushnik et al. 2016; Rotermann et al. 2015; Withrow et al. 2017; Tjepkema, Wilkins and Long 2013) and to financial data (Jeon and Pohl 2016). These linked datasets have been instrumental in examining health inequalities and have been used in environmental health research (Crouse et al. 2012; Weichenthal et al. 2016).

In 2008, the 1991 Census was linked to 10 years of death records to study mortality by socioeconomic characteristics (Wilkins et al. 2008). In 2012, the dataset was enhanced by the addition of information about place of residence and cancer outcomes (Peters et al. 2013), and was named the Canadian Census Health and Environment Cohort (CanCHEC). This dataset was particularly useful for environmental health research because of its long follow-up period (20 years), large size (2.6 million people), approximate representativeness (it was census-based), broad geographic coverage, and information about where people lived over a 30-year period (via postal codes from 1981 to 2011). The same linkage methodology was applied to the 2001 Census to create the 2001 CanCHEC (Pinault et al. 2016).

With similar methodology, the 1996 CanCHEC was created by linking the 1996 Census (long form) to mortality and tax files, which makes it possible to examine mortality by ethnocultural and socioeconomic factors (as measured on the 1996 Census) and associations between environmental exposures and health. In conjunction with the 1991 and 2001 CanCHECs, temporal trends in mortality can be traced by socioeconomic characteristics. Environmental hazards (for example, air pollution) and neighbourhood characteristics (for example, green space) can be integrated into estimates of exposure because of the inclusion of annual residential location.

This report describes the deterministic and probabilistic linkage methodologies used to create the 1996 CanCHEC as well as the validation methods and bias assessment. It also describes the 1996 CanCHEC (or the Cohort) by demographic and socioeconomic factors, and mortality rates. Approval for the record linkage was provided by the Executive Management Board at Statistics Canada in 2016 (Record Linkage no. 047-2016) (Statistics Canada n.d.a).

2 Data

2.1 1996 Census of Population

The 1996 Census of Population was conducted on May 14, 1996. Information about residents of enumerated households was collected with two questionnaires: the short-form questionnaire (80% of households) and long-form questionnaire (typically, 20% of households, except on Indian reserves and remote/northern areas, where 100% of households receive the long-form questionnaire). The short-form questionnaire gathered basic information: name, relationship to “person 1” (head of household), date of birth, sex, legal marital status, common-law status, and first language learned in childhood. The long-form questionnaire contained 55 questions, including the 7 listed above, on topics such as labour force activity, income, education, activity limitations, citizenship, housing, and ethnic origin.

Names were not used for analytical or linkage purposes, as digitization of the 1996 Census questionnaires did not include names of respondents. To perform the linkage with names would require a time- and labour-intensive review of the census questionnaires, which have been preserved in microfiche format. However, names of respondents were used to manually validate a sample of links and compute a rate of false positives (Subsection 3.1).

The census questionnaire was sent to approximately 98% of households; in the other 2% (typically in remote and northern areas, on most Indian reserves, and in special core areas of major cities), the questionnaire was completed by interview at the household. Some remote northern areas had been enumerated before Census Day, in February and March 1996.

The estimated population undercoverage rate (people not enumerated) of the 1996 Census was 3.18% (Statistics Canada 1999a). Undercoverage was higher for males (3.89%, versus 2.49% for females). Higher undercoverage rates by age were among 20- to 24-year-olds (men 9.48%; women 6.45%) and 25- to 34-year-olds (men 7.74%; women 3.94%). A total of 78 Indian reserves or Indian settlements were incompletely enumerated and not included in 1996 Census products, and so were not available for linkage.

2.2 Derived Record Depository

The Derived Record Depository (DRD) is a national relational database created by linking selected Statistics Canada source index files (for example, vital statistics registration records for births and deaths, tax records, and immigrant data) to produce a list of unique individuals. Each of these files linked only once to the DRD, and each individual in the DRD is assigned a unique Social Data Linkage Environment (SDLE) identifier (Statistics Canada n.d.b; St-Jean 2016). For the 1996 CanCHEC, version 4 of the DRD was used. To ensure consistent methodology with the 1991 and 2001 CanCHECs, a tax file was built from individual variable-specific tables prepared for the SDLE.

Historical residential postal codes were extracted from the DRD. These postal codes come from Canada Revenue Agency sources, such as the T1 Personal Master File, Canada Child Tax Benefit files, and dependant registries from 1981 to 2012. The postal codes reported on the T1 Personal Master File reflect the mailing address for that tax year, and are assumed to be broadly representative of where a person resides.

Mortality records that were previously linked to the DRD were deterministically linked to the Cohort using the DRD identifier. Deaths captured in the Canadian Mortality Database (CMDDB) (1970 to 2012) were probabilistically linked to the DRD using standard linkage methodology (St-Jean 2016). The linkage rate was estimated at 95% to 98% for deaths that occurred between 1996 and 2012. Deaths reported in the CMDDB included underlying cause of death and were coded using

the version of the International Classification of Diseases (ICD) in effect at the time of death. Deaths that occurred from 1996 to 1999 were coded according to the Ninth Revision of the ICD (ICD-9); deaths that occurred from 2000 to 2012 were coded according to the Tenth Revision (ICD-10). Deaths reported via tax filings did not include data on cause of death. For comparability in this paper, deaths previously coded by ICD-9 and ICD-10 were grouped according to the Global Burden of Disease coding (Mathers, Lòpez and Murray 2006).

3 Methods

3.1 Linkage of 1996 Census to the Derived Record Depository

Persons enumerated by the 1996 Census (respondents to both the long-form and short-form questionnaires, referred to herein as “respondents”) were linked to the DRD using deterministic and probabilistic methodology.

Data on sex and birth date were obtained from the DRD version 4. Records were retained if they had a birth date before Census Day, and either a death date after Census Day or no reported death date. Records missing a birth date or postal code were dropped. If sex was missing, two alternate records with options of both male and female were generated in place of the original record. Postal code history from the DRD address table was linked to the Cohort with a deterministic linkage.

In the first of four sequential groups of the deterministic linkage process, the keys used to link the census and the DRD were sex, date of birth, 1996 postal code, and marital status (names were not electronically available for the 1996 Census). The second group was identical to the first, except that it did not consider marital status. The third group used sex, date of birth, and 1995 postal code. Finally, the fourth group used sex, date of birth, and the closest available postal code before 1995 or after 1996 in cases where the 1995 and 1996 postal codes were both missing.

In each group, only records with unique keys on both the DRD and census files were retained in the Cohort; duplicates and non-matches were considered in subsequent linkage groups. Respondents to the census short-form questionnaire were included at this stage to reduce the number of records to be considered for probabilistic linkage and to reduce the number of false-positive matches, because records from the DRD linked to records of the short-form questionnaire at the deterministic step were not eligible for linkage in the subsequent probabilistic step.

Respondents to the census long-form questionnaire who were not matched during the deterministic linkage and who did not reside in an institutional collective dwelling were considered for probabilistic linkage. Several groups were formed, using linkage weights derived from a probabilistic linkage methodology influenced by the Fellegi-Sunter theory of record linkage (Fellegi and Sunter 1969). The following variables were used for probabilistic linkage: birth date, spousal birth date (if applicable), sex, marital status, postal code(s), and rural/urban status based on postal code. A total of six probabilistic linkage groups were considered for inclusion in the Cohort.

To determine the linkage threshold and the groups that would be included in the Cohort, linkage accuracy was estimated for all potential linkage groups by verifying a random sample of linked records against the original scanned census questionnaires, which contained respondents' names. Respondents for whom the name and birth dates were a match (allowing for minor spelling differences) to those on tax files were considered a successful match. Groups for which 90% of records were not successfully matched were excluded from the Cohort. Five out of the six groups were included in the final probabilistic linkage.

To be considered in scope, individuals had to meet the following criteria: they were enumerated by the 1996 Census long form; they were aged 19 or older on Census Day (May 14, 1996); they were enumerated as residents of Canada (overseas nationals were excluded); they were not institutional residents; and they had filed an income tax return.

3.2 Re-weighting and bootstrap weights

Sampling weights were created for the 1996 CanCHEC to (1) ensure that the Cohort represents the target population (non-institutional population aged 19 or older in 1996); and (2) reduce bias (for example, due to missed links between census and DRD). Weights for the census long-form questionnaire were adjusted by model parameters on the probability of linking to the DRD. These sampling weights were then calibrated according to the raking method (Kalton and Flores-Cervantes 2003) and incorporated trimming to prevent negative or excessively large weights (Izrael, Battaglia and Frankel 2009).

Generalized bootstrap weights were derived from the calibrated sampling weights using the Poisson bootstrap method proposed by Beaumont and Patak (2012). The same raking and trimming macro that was used to calibrate the sampling weights (after adjustment for missed links) was applied to each of the 500 bootstrap replicates. These weights were finally adjusted to take into account the high sampling fraction of the census, using a method proposed by Beaumont and Charest (2012).

3.3 Mortality analysis

Mortality was tracked for 16.6 years from May 14, 1996 (Census Day), to December 31, 2012. Based on records of death, person-years-at-risk (PYAR) were calculated for each respondent. Respondents who lived to the end of follow-up were assigned a PYAR of 16.6 years; those who died during follow-up were given a PYAR reflective of the length of time between Census Day and their death. PYAR was calculated starting at the beginning of the day on Census Day; that is, if someone died on May 14, 1996, their PYAR was equivalent to one day ($1/365.25 = 0.00273$ years at risk). To examine the comparability of the Cohort to the Canadian population, the years that each Cohort member survived during follow-up were compared with survival rates in the Canadian population over the same period.

Age-standardized mortality rates (ASMRs) and 95% confidence intervals were calculated using the PYAR value and the PROC RATIO procedure in SUDAAN version 11.0.1 (Research Triangle Institute 2013). The procedure used the balanced repeated replication design with calibrated sampling weights and calibrated bootstrap weights. ASMRs were calculated for population-standardized five-year age groups at Cohort inception (Table 1) for a variety of demographic and socioeconomic characteristics. Rate ratios (RRs) and 95% confidence intervals were calculated using ASMR standard errors that were calculated from PROC RATIO and the methodology of Carriere and Roos (1997).

Table 1
Standardized population percentages from the 1996
Census used for age-standardized mortality rates

Age group (years)	Population group weight
	percent
20 to 24	8.8
25 to 29	9.4
30 to 34	11.4
35 to 39	11.6
40 to 44	10.6
45 to 49	9.6
50 to 54	7.4
55 to 59	6.0
60 to 64	5.5
65 to 69	5.2
70 to 74	4.6
75 to 79	3.6
80 to 84	3.0
85 to 89	2.0
90 and older	1.4

Note: Percentages may not add up to 100% because of rounding.

Source: Statistics Canada, authors' calculations based on data from the 1996 Census of Population.

3.4 Analytical file

The analytical file contains nearly all the variables in the census long-form questionnaire, including marital status, household composition, languages, labour force activity, income, education, physical activity limitations, housing, Aboriginal identity, immigration, and ethnic origin. However, variables that were the result of write-in responses were removed. Details about the census variables are available elsewhere (Statistics Canada 1999*b*).

Variables were derived for the analytical file to simplify categorization of key concepts and comparisons between cohorts. For example, highest level of education was grouped into four categories: less than secondary graduation, secondary graduation, postsecondary diploma, and university degree. Documentation for the derived variables is available in the 1996 CanCHEC Technical Report (Christidis and Tjepkema 2017).

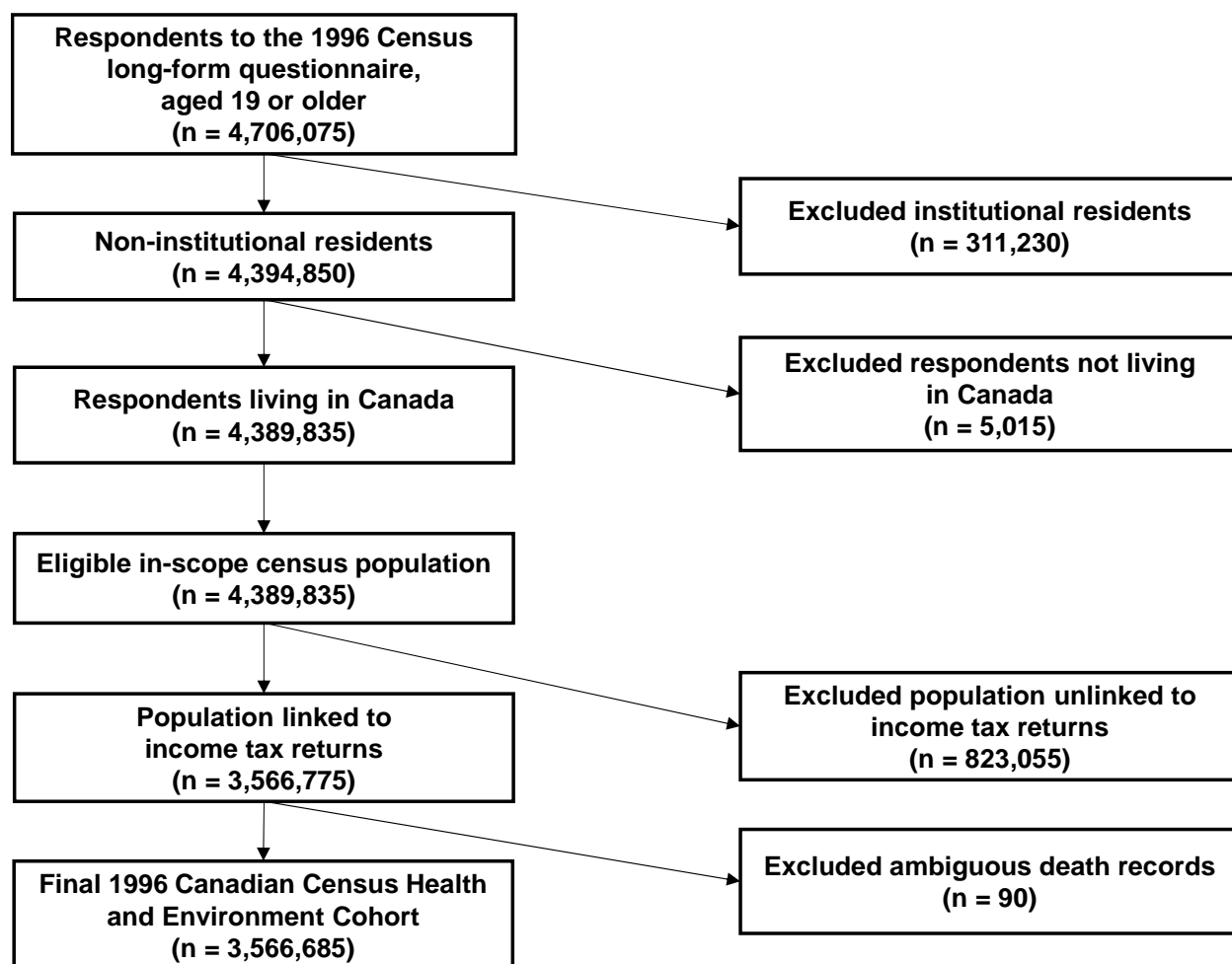
One of the derived variables ranked the population by income adequacy quintiles and deciles. For each economic family or unattached individual, total pre-tax, post-transfer income from all sources was pooled across all family members, and the ratio of total income to the Statistics Canada low-income cut-off (LICO) for the applicable family size and community size group was calculated (Statistics Canada 1999*b*). Thus, all members of an economic family were assigned the same LICO ratio, which was calculated for all non-institutionalized persons (the in-scope population), including people living on Indian reserves. This population was then ranked according to the LICO ratio, and quintiles and deciles were constructed, nationally and within each census metropolitan area or census agglomeration, or rural and small town area. The reason for constructing the quintiles within each area was to account for regional differences in housing costs, which are not reflected in the LICO, and to base comparisons across areas on comparable percentages of the population in each quintile.

4 Results

4.1 Cohort

The Cohort was formed in several steps (Figure 1), first by combining the deterministic links of respondents to the census long-form questionnaire who did not reside in institutional collective dwellings with the probabilistic links. Of the original 4,706,075 respondents to the 1996 Census long-form questionnaire, 4,389,835 (93.3%) were “in-scope.” The number linked to tax records was 3,566,775 (81.3% of the in-scope population); 99.5% of records were estimated to be true links (less than 0.5% false positive error rate). The majority of these Cohort members (93.5%) were linked via deterministic linkage, for which 99.5% of records were considered to be true links (based on a manual review of 266 records). Fewer Cohort members (6.5%) were linked through the probabilistic linkage, for which 99.4% of links were considered to be true links (based on a manual review of 450 records). After mortality records were linked to the Cohort, 90 respondents were removed because of ambiguous death records, resulting in a final Cohort of 3,566,685 census respondents.

Figure 1
Flow chart of the creation of the in-scope census population and the final 1996 Canadian Census Health and Environment Cohort, showing respondent exclusions



Sources: Statistics Canada, Derived Record Depository and authors' calculations based on data from the 1996 Census of Population.

Table 2
In-scope and in-cohort men, by selected census characteristics, 1996

	Included in the Cohort			Cohort as a percentage of total ²	Not included in the Cohort			Deaths ¹
	In-scope census respondents ¹	In-cohort ¹	In category		Not linked ¹	In category	Ratio ³	
	Column 1	Column 2	Column 3		Column 4	Column 5	Column 6		Column 7	Column 8
	number	number	percent	percent	number	percent	ratio	number
Total men	2,135,970	1,728,260	100	81	407,710	100	1.00	300,340
Age group (years)								
19 to 24	243,440	164,130	11	67	79,310	19	1.71	2,440
25 to 44	964,300	769,585	45	80	194,710	48	1.06	26,755
45 to 64	636,515	547,455	30	86	89,060	22	0.73	98,590
65 to 84	275,835	235,400	13	85	40,435	10	0.77	161,055
85 and older	15,880	11,685	1	74	4,195	1	1.38	11,505
Marital status								
Not married or common-law	681,190	450,890	32	66	230,300	56	1.77	66,825
Married or common-law	1,454,780	1,277,370	68	88	177,410	44	0.64	233,515
Highest level of education								
Less than secondary diploma	690,965	542,585	32	79	148,375	36	1.12	163,380
Secondary diploma or higher	1,445,010	1,185,675	68	82	259,335	64	0.94	136,960
Labour force participation								
Employed	1,429,330	1,181,155	67	83	248,180	61	0.91	88,825
Unemployed	169,610	124,190	8	73	45,415	11	1.40	11,620
Not in labour force	537,030	422,915	25	79	114,115	28	1.11	199,895
Visible minority status								
Not visible minority	1,925,550	1,569,600	90	82	355,950	87	0.97	287,075
Visible minority	210,420	158,660	10	75	51,760	13	1.29	13,265
Mobility in past year								
Did not move	1,787,535	1,510,635	84	85	276,900	68	0.81	280,515
Moved	348,435	217,625	16	62	130,815	32	1.97	19,825
Rural or urban								
Rural	546,495	448,455	26	82	98,040	24	0.94	82,320
Urban	1,589,475	1,279,805	74	81	309,670	76	1.02	218,020

1. Because figures are randomly rounded to base 5, they may not add up to totals.

2. Column 2 divided by Column 1.

3. Column 3 divided by Column 6.

Note: The 1996 Canadian Census Health and Environment Cohort is derived from the 1996 Census of Population and the Derived Record Depository.

Source: Statistics Canada, 1996 Canadian Census Health and Environment Cohort.

Table 3
In-scope and in-cohort women, by selected census characteristics, 1996

	Included in the Cohort			Cohort as a percentage of total ²	Not included in the Cohort			Deaths ¹
	In-scope census respondents ¹	In-cohort ¹	In category		Not linked ¹	In category	Ratio ³	
	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7		Column 8
	number	number	percent	percent	number	percent	ratio	number
Total women	2,253,865	1,838,425	100	82	415,435	100	1.00	265,275
Age group (years)								
19 to 24	240,775	165,040	11	69	75,740	18	1.71	1,250
25 to 44	984,050	813,580	44	83	170,465	41	0.94	18,390
45 to 64	642,940	554,765	29	86	88,175	21	0.74	66,015
65 to 84	353,510	283,660	16	80	69,850	17	1.07	158,940
85 and older	32,585	21,385	1	66	11,205	3	1.87	20,685
Marital status								
Not married or common-law	787,370	565,535	35	72	221,835	53	1.53	131,415
Married or common-law	1,466,490	1,272,890	65	87	193,600	47	0.72	133,860
Highest level of education								
Less than secondary diploma	736,700	581,850	33	79	154,850	37	1.14	156,725
Secondary diploma or higher	1,517,160	1,256,575	67	83	260,590	63	0.93	108,550
Labour force participation								
Employed	1,210,660	1,015,625	54	84	195,040	47	0.87	40,925
Unemployed	132,750	101,665	6	77	31,085	7	1.27	4,620
Not in labour force	910,450	721,140	40	79	189,310	46	1.13	219,730
Visible minority status								
Not visible minority	2,026,075	1,666,120	90	82	359,955	87	0.96	254,295
Visible minority	227,790	172,305	10	76	55,485	13	1.32	10,980
Mobility in past year								
Did not move	1,905,525	1,607,665	85	84	297,860	72	0.85	248,440
Moved	348,340	230,760	15	66	117,575	28	1.83	16,835
Rural or urban								
Rural	524,310	433,885	23	83	90,425	22	0.94	57,630
Urban	1,729,550	1,404,540	77	81	325,010	78	1.02	207,645

1. Because figures are randomly rounded to base 5, they may not add up to totals.

2. Column 2 divided by Column 1.

3. Column 3 divided by Column 6.

Note: The 1996 Canadian Census Health and Environment Cohort is derived from the 1996 Census of Population and the Derived Record Depository.

Source: Statistics Canada, 1996 Canadian Census Health and Environment Cohort.

Overall, 81.3% of the in-scope population was linked to the DRD—3,566,685 non-institutional individuals aged 19 or older (Tables 2 and 3). Linkage rates were below 70% among 19- to 24-year-olds (69% women, 67% men) and women aged 85 or older (66%). Men and women who had moved in the last year had low linkage rates (62%, 66%), as did men who were not married or in a common-law relationship (66%).

4.2 Weighting

The characteristics of the weighted in-scope respondents (using original census sampling weights) and weighted Cohort respondents (using calibrated weights for missed links) were compared to assess how well the Cohort sampling weights reflect the target population and reduce bias (Table 4). Proportions were estimated by selected characteristics and compared between the Cohort and the original census (using a ratio measure). Ratios close to 1.00 indicate that the Cohort sampling weights adequately addressed differences in the in-scope and Cohort groups. After re-weighting, the Cohort slightly underrepresented unmarried men and women (0.98, 0.99), men in urban areas (0.99), men who moved in the year before the census (0.98), and unemployed women (0.99). The Cohort slightly overrepresented men and women who were married or in a common-law relationship (1.01, 1.01), men and women in rural communities (1.02, 1.01), and women who had moved in the year before the census (1.01).

Table 4
Selected characteristics of weighted in-scope and weighted cohort, by sex, 1996

	Men					Women				
	Cohort		In-scope		Ratio ²	Cohort		In-scope		Ratio ²
	number ¹	percent	number ¹	percent		number ¹	percent	number ¹	percent	
Total	10,206,510	100.0	10,206,710	100.0	1.00	10,842,115	100.0	10,842,365	100.0	1.00
Age group (years)										
19 to 24	1,141,795	11.2	1,141,995	11.2	1.00	1,131,940	10.4	1,131,885	10.4	1.00
25 to 44	4,593,575	45.0	4,593,895	45.0	1.00	4,727,645	43.6	4,727,545	43.6	1.00
45 to 64	3,053,565	29.9	3,053,435	29.9	1.00	3,120,510	28.8	3,120,590	28.8	1.00
65 to 84	1,342,960	13.2	1,342,775	13.2	1.00	1,712,415	15.8	1,712,690	15.8	1.00
85 and older	74,620	0.7	74,615	0.7	1.00	149,605	1.4	149,655	1.4	1.00
Marital status										
Not married or common-law	3,120,945	30.6	3,199,100	31.3	0.98	3,712,885	34.2	3,758,655	34.7	0.99
Married or common-law	7,085,565	69.4	7,007,610	68.7	1.01	7,129,230	65.8	7,083,715	65.3	1.01
Highest level of education										
Less than secondary diploma	3,176,250	31.1	3,176,275	31.1	1.00	3,452,265	31.8	3,452,445	31.8	1.00
Secondary diploma or higher	7,030,260	68.9	7,030,435	68.9	1.00	7,389,850	68.2	7,389,920	68.2	1.00
Labour force participation										
Employed	6,939,605	68.0	6,940,800	68.0	1.00	5,884,020	54.3	5,892,415	54.3	1.00
Unemployed	754,980	7.4	757,865	7.4	1.00	621,255	5.7	624,980	5.8	0.99
Not in labour force	2,511,925	24.6	2,508,045	24.6	1.00	4,336,840	40.0	4,324,975	39.9	1.00
Visible minority status										
Not a visible minority	9,148,165	89.6	9,147,425	89.6	1.00	9,692,110	89.4	9,691,025	89.4	1.00
Visible Minority	1,058,345	10.4	1,059,285	10.4	1.00	1,150,005	10.6	1,151,340	10.6	1.00
Mobility in the past year										
Did not move	8,617,990	84.4	8,580,945	84.1	1.00	9,177,530	84.6	9,188,810	84.7	1.00
Moved	1,588,520	15.6	1,625,760	15.9	0.98	1,664,585	15.4	1,653,560	15.3	1.01
Rural or urban										
Rural	2,332,320	22.9	2,288,305	22.4	1.02	2,236,520	20.6	2,206,110	20.3	1.01
Urban	7,874,190	77.1	7,918,400	77.6	0.99	8,605,600	79.4	8,636,255	79.7	1.00

1. Because figures are randomly rounded to base 5, they may not add up to totals.

2. Ratio is cohort percent divided by in-scope percent.

Note: The 1996 Canadian Census Health and Environment Cohort is derived from the 1996 Census of Population and the Derived Record Depository.

Source: Statistics Canada, 1996 Canadian Census Health and Environment Cohort.

4.3 Mortality

Of the 3,566,685 Cohort members, 565,615 (15.9%) died during the 16.6-year follow-up. The annual number of deaths rose each calendar year, reaching 40,640 in 2012 (Table 5). About 98% of deaths were ascertained by linkage to the CMDB, which indicates cause of death. The remaining 2% were ascertained from the T1 tax file, which provides only the date of death. In general, the percentages of deaths that were identified from tax files did not vary greatly by socioeconomic and demographic characteristics. The exceptions were visible minority and immigrant Cohort members, among whom 7.2% and 3.5% of deaths, respectively, were ascertained from tax files (data not shown).

Table 5
Number of Cohort deaths, by year, data source and sex

Year of death	Data source		Sex	
	Canadian mortality		Men ¹	Women ¹
	database ¹	T1 tax files ¹		
	number	number	number	number
1996	15,520	280	9,545	6,290
1997	25,785	545	15,550	10,780
1998	27,285	550	16,205	11,630
1999	28,600	690	16,725	12,565
2000	29,410	630	16,730	13,310
2001	30,545	635	17,035	14,140
2002	31,600	665	17,325	14,940
2003	32,315	710	17,455	15,565
2004	32,670	705	17,605	15,765
2005	33,950	675	18,030	16,590
2006	36,005	750	18,965	17,795
2007	37,080	685	19,385	18,385
2008	37,705	700	19,685	18,725
2009	38,095	735	19,825	19,010
2010	38,575	835	19,870	19,535
2011	39,240	770	20,075	19,935
2012	39,705	935	20,320	20,315

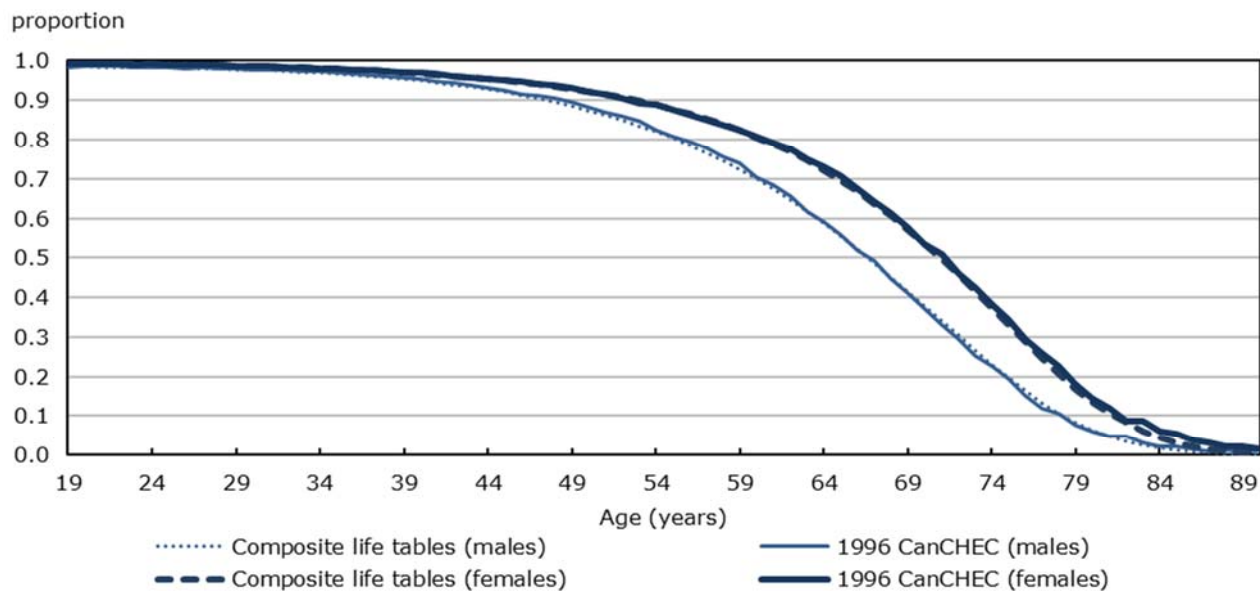
1. Randomly rounded to base 5.

Note: The 1996 Canadian Census Health and Environment Cohort is derived from the 1996 Census of Population and the Derived Record Depository.

Source: Statistics Canada, 1996 Canadian Census Health and Environment Cohort.

Chart 1 shows the proportion of the Cohort who survived during the 16.6-year period (from 1996 to 2012), by age and sex, along with composite life tables (1995–1997 to 2010–2012). The trend in the proportion who survived was similar in each data source. At older ages (80 or older), the proportion surviving was slightly greater in the Cohort than in the life tables, perhaps the result of excluding the institutional population from the Cohort.

Chart 1
Proportion of respondents surviving the 16.6-year follow-up period (1996 to 2012), by age and sex, compared with Canada life tables



Note: The 1996 Canadian Census Health and Environment Cohort (CanCHEC) is derived from the 1996 Census of Population and the Derived Record Depository.

Sources: Statistics Canada, 1996 Canadian Census Health and Environment Cohort, and authors' calculations based on data from Canada life tables.

Detailed mortality statistics (ASMRs, RRs) were calculated for the population by various socioeconomic and demographic characteristics (Tables 6 and 7). Mortality rates were higher among people who were not in the labour force, compared with those who were employed. A clear gradient by educational attainment was apparent, with the highest ASMRs among people with less than secondary graduation. A gradient was also evident by income adequacy quintile, with ASMRs highest among the lowest quintile. Mortality rates also varied by community size, mobility, Aboriginal identity, and visibility minority status. RRs reflect the relative differences between the ASMRs in each subgroup, with one group (reference group) held at 1.00 and other RRs calculated as a ratio relative to the reference group.

Table 6
Number of deaths, age-standardized mortality rate (ASMR) per 100,000 person-years at risk and rate ratios (RRs), men, Canada, 1996 to 2012

	Deaths ¹ number	ASMR rate	95% CI ²		RR ratio	95% CI ²	
			From rate	To rate		From rate	To rate
Highest level of education							
Less than secondary graduation	163,365	2,724	2,701	2,746	1.38	1.34	1.42
Secondary graduation	87,425	2,417	2,381	2,453	1.23	1.19	1.27
Postsecondary diploma	24,735	2,248	2,163	2,333	1.14	1.09	1.20
University degree	24,795	1,969	1,914	2,025	1.00	...	...
Labour force participation							
Employed	88,820	1,888	1,796	1,980	1.00	...	...
Unemployed	11,625	2,053	1,731	2,375	1.09	0.92	1.28
Not in labour force	199,875	2,877	2,856	2,897	1.52	1.45	1.60
Occupation: skill-based categories							
Professional	11,535	1,638	1,413	1,862	1.00	...	...
Management	12,315	1,969	1,699	2,239	1.20	0.99	1.46
Skilled, technical, supervisory	37,920	2,051	1,939	2,163	1.25	1.08	1.45
Semi-skilled	32,740	1,987	1,684	2,289	1.21	0.99	1.49
Unskilled	15,015	2,063	1,813	2,313	1.26	1.05	1.51
No occupation	190,790	2,957	2,936	2,978	1.81	1.57	2.07
Visible minority status							
Not visible minority	274,255	2,525	2,506	2,543	1.00	...	...
Visible minority	13,265	1,796	1,715	1,878	0.71	0.68	0.74
Not applicable (Aboriginal)	12,795	3,122	2,914	3,329	1.22	1.17	1.27
Mobility in past year							
Did not move	280,495	2,471	2,453	2,489	1.00	...	...
Moved	19,825	2,634	2,530	2,737	1.07	1.02	1.11
Community size							
Less than 10,000	82,315	2,541	2,501	2,581	1.07	1.05	1.09
10,000 to 99,999	44,635	2,641	2,601	2,682	1.11	1.09	1.13
100,000 to 499,999	28,790	2,552	2,503	2,601	1.07	1.05	1.10
500,000 to 999,999	32,990	2,493	2,439	2,546	1.05	1.02	1.07
1,000,000 or more	111,585	2,380	2,351	2,409	1.00	...	...
Income adequacy quintile							
1 (lowest)	51,500	2,979	2,937	3,020	1.39	1.35	1.43
2	83,995	2,645	2,615	2,675	1.23	1.20	1.27
3	63,380	2,442	2,403	2,481	1.14	1.10	1.18
4	52,845	2,302	2,251	2,354	1.07	1.04	1.11
5 (highest)	48,595	2,145	2,085	2,204	1.00	...	...
Aboriginal identity³							
First Nations	9,600	3,060	2,911	3,209	1.26	1.20	1.33
Métis	2,095	3,096	2,708	3,485	1.28	1.13	1.45
Inuit	1,050	3,519	2,726	4,313	1.45	1.16	1.82
No Aboriginal identity	287,520	2,420	2,407	2,434	1.00	...	...

... not applicable

1. Randomly rounded to base 5.

2. Confidence interval (CI) based on cohort sample weights and bootstrap weights.

3. Excludes those reporting multiple Aboriginal identities; rates calculated for 14 age groups (oldest was 85 years or older).

Notes: The 1996 Canadian Census Health and Environment Cohort is derived from the 1996 Census of Population and the Derived Record Depository.

Source: Statistics Canada, 1996 Canadian Census Health and Environment Cohort.

Table 7

Number of deaths, age-standardized mortality rate (ASMR) per 100,000 person-years at risk and rate ratios (RRs), women, Canada, 1996 to 2012

	Deaths ¹ number	ASMR rate	95% CI ²		RR ratio	95% CI ²	
			From rate	To rate		From rate	To rate
Highest level of education							
Less than secondary graduation	156,720	1,875	1,864	1,886	1.31	1.26	1.35
Secondary graduation	65,455	1,689	1,667	1,710	1.18	1.13	1.22
Postsecondary diploma	31,035	1,544	1,517	1,570	1.08	1.04	1.12
University degree	12,050	1,436	1,387	1,485	1.00	...	...
Labour force participation							
Employed	40,925	1,287	1,212	1,362	1.00	...	...
Unemployed	4,615	1,507	1,291	1,723	1.17	1.00	1.37
Not in labour force	219,720	1,854	1,844	1,863	1.44	1.36	1.53
Occupation: skill-based categories							
Professional	7,000	1,285	1,137	1,433	1.00	...	...
Management	3,310	1,561	1,034	2,088	1.21	0.85	1.73
Skilled, technical, supervisory	13,365	1,401	1,292	1,509	1.09	0.95	1.25
Semi-skilled	20,250	1,278	1,171	1,385	0.99	0.86	1.15
Unskilled	7,340	1,580	1,398	1,763	1.23	1.04	1.45
No occupation	214,000	1,875	1,865	1,885	1.46	1.30	1.64
Visible minority status							
Not a visible minority	244,190	1,759	1,749	1,768	1.00	...	...
Visible minority	10,980	1,318	1,269	1,366	0.75	0.72	0.78
Not applicable (Aboriginal)	10,095	2,409	2,300	2,518	1.37	1.31	1.43
Mobility in past year							
Did not move	248,425	1,730	1,721	1,739	1.00	...	...
Moved	16,835	1,858	1,813	1,904	1.07	1.05	1.10
Community size							
Less than 10,000	57,630	1,793	1,771	1,816	1.07	1.05	1.09
10,000 to 99,999	41,910	1,826	1,803	1,849	1.09	1.07	1.10
100,000 to 499,999	27,645	1,800	1,773	1,828	1.07	1.05	1.09
500,000 to 999,999	31,715	1,735	1,711	1,760	1.03	1.02	1.05
1,000,000 or more	106,365	1,677	1,664	1,691	1.00	...	...
Income adequacy quintile							
1 (lowest)	68,515	1,968	1,952	1,984	1.26	1.23	1.28
2	78,810	1,777	1,760	1,794	1.14	1.11	1.16
3	48,355	1,721	1,697	1,744	1.10	1.07	1.13
4	37,695	1,651	1,622	1,680	1.06	1.03	1.08
5 (highest)	31,890	1,564	1,535	1,593	1.00	...	...
Aboriginal identity³							
First Nations	7,700	2,446	2,338	2,554	1.45	1.39	1.52
Metis	1,570	2,155	1,944	2,366	1.28	1.16	1.41
Inuit	780	2,483	2,052	2,914	1.47	1.24	1.75
No Aboriginal identity	255,165	1,684	1,677	1,692	1.00	...	...

... not applicable

1. Randomly rounded to base 5.

2. Confidence interval (CI) based on cohort sample weights and bootstrap weights.

3. Excludes those reporting multiple Aboriginal identities; rates calculated for 14 age groups (oldest was 85 years or older).

Note: The 1996 Canadian Census Health and Environment Cohort is derived from the 1996 Census of Population and the Derived Record Depository.

Source: Statistics Canada, 1996 Canadian Census Health and Environment Cohort.

Table 8 shows the number of Cohort members who died, by cause. Most deaths were the result of non-communicable diseases (90% of male deaths, 80% of female deaths), specifically, neoplasms (34% of male deaths, 29% of female deaths) and cardiovascular diseases (33% of male deaths, 28% of female deaths). Within these groups, the most frequently reported causes were ischemic heart disease (20% of male deaths, 14% of female deaths) and cancer of the trachea, bronchus or lung (10% of male deaths, 7% of female deaths).

Table 8
Number of deaths (among CMDB deaths) for selected causes of death, by Global Burden of Disease cause of death groups² and sex, 1996 to 2012

	Male ¹	Female ¹
	number	
Communicable, maternal, perinatal, and nutritional conditions (U001)	11,755	11,525
Infectious and parasitic diseases (U002)	4,820	4,515
Respiratory infections (U038)	6,455	6,255
Other communicable, maternal, perinatal, and nutritional conditions (U042, U049, U053)	480	755
Non-communicable diseases (U059)	262,255	234,065
Neoplasms (U060)	98,595	83,835
Mouth and oropharynx cancers (U061)	1,840	865
Esophageal cancer (U062)	3,200	1,000
Stomach cancer (U063)	3,265	1,945
Colon and rectal cancers (U064)	10,610	8,770
Liver cancer (U065)	2,735	1,585
Pancreas cancer (U066)	4,840	4,770
Trachea, bronchus, and lung cancers (U067)	28,020	19,640
Melanoma and other skin cancers (U068)	1,900	1,125
Breast cancer (U069)	120	12,805
Ovarian cancer (U072)	...	4,125
Prostate cancer (U073)	10,320	...
Bladder cancer (U074)	3,180	1,260
Lymphomas and multiple myeloma (U075)	5,880	4,670
Leukemia (U076)	3,460	2,430
Other neoplasms and malignant neoplasms (U070, U071, U077, U078)	19,225	18,845
Diabetes (U079)	9,405	7,980
Endocrine disorders (U080)	2,880	3,035
Neuropsychiatric disorders (U081)	17,745	23,220
Cardiovascular diseases (U104)	95,170	81,650
Ischemic heart disease (U107)	57,090	39,490
Cerebrovascular disease (U108)	15,290	18,510
Other cardiovascular diseases (U105, U106, U109, U110)	22,790	23,650
Respiratory diseases (U111)	38,460	34,345
Chronic obstructive pulmonary disease (U112)	13,655	10,305
Other respiratory diseases (U113, U114)	5,680	4,655
All other non-communicable diseases³ (U098, U115, U120, U124, U125, U131, U143)	19,125	19,385
Injuries (U148)	17,830	10,330
Unintentional injuries (U149)	11,670	8,375
Self-inflicted injuries (U157)	5,690	1,710
All other injuries (U158, U159, U160)	470	245
Other		
Ill-defined death⁴	3,220	3,095

... not applicable

1. Randomly rounded to base 5.

2. Coding from the ninth revision (ICD-9) and the tenth revision (ICD-10) of the International Classification of Diseases (as cited in Mathers, López and Murray 2006) to coding from the Global Burden of Disease from C.D. Mathers, A.D. López, and C.J. Murray, 2006, "The burden of disease and mortality by conditions: Data, methods and results for 2001," in *Global Burden of Disease and Risk Factors*, ed. A.D. Lopez, C.D. Mathers, M. Ezzati, D.T. Jamison, and C.J.L. Murray, Chapter 3, Annex table 3A.2.

3. Other: sense organ diseases, skin diseases, musculoskeletal, congenital abnormalities, oral conditions, digestive diseases, genitourinary diseases

4. "Symptoms, signs, and ill-defined conditions" or "Injury deaths where the intent is not determined."

Note: The 1996 Canadian Census Health and Environment Cohort is derived from the 1996 Census of Population and the Derived Record Depository.

Source: Statistics Canada, 1996 Canadian Census Health and Environment Cohort.

5 Discussion

The 1996 CanCHEC is a retrospective cohort that followed a sample of nearly one-fifth of Canadians 19 years of age or older to determine mortality over a follow-up period of 16.6 years. With this, the third CanCHEC, it is now possible to examine mortality trends spanning three census cycles and 21 years of data.

The 1996 CanCHEC was constructed by linking 81% of respondents to the census long-form questionnaire to the DRD through probabilistic and deterministic linkages. The false positive error rate was less than 0.5%, indicating that most links were true links. This is comparable to the 2001 CanCHEC, which linked 78.6% of in-scope census respondents to tax files and followed them for mortality (3,537,520 of 4,500,245), and to the original linkage results for the 1991 Census Cohort, where 80.0% of in-scope census respondents were linked to tax files and followed for mortality (2,860,240 of 3,576,485) (Pinault et al. 2016; Peters et al. 2013).

Linkage rates of the 1996 Cohort to the DRD differed by census characteristics. Rates were relatively low for respondents who were in the youngest or oldest age groups, not married, or of low income; who had moved in the past year; and who reported Aboriginal identity. These findings are consistent with those of the 1991 and 2001 Cohorts. The 2001 Cohort had lower linkage rates for respondents who were younger, Aboriginal, and movers in the previous year. The 1991 Cohort had lower linkage rates for respondents who were unmarried, were not working, had low income, or reported Aboriginal ancestry. In weighted analysis, the linkage bias was addressed and representativeness of the Cohort was improved.

The survival curve for the Cohort indicated strong concordance with national life tables. The curves diverged slightly at older ages (particularly at age 80) and among women, likely because of smaller sample sizes in these older age groups, and the exclusion of institutionalized residents from the Cohort. Higher survival rates for older women, compared with life table estimates, was also reported for the 1991 and 2001 Cohorts.

Mortality patterns were broadly consistent with the previous CanCHECs—ASMRs were higher among people who were not in the labour force, in the lowest income quintile, or reported Aboriginal identity (or ancestry in the 1991 Census).

6 Conclusion

This paper describes linkage of respondents to the 1996 Census long-form questionnaire to tax and mortality records to create the 1996 Canadian Census Health and Environment Cohort (CanCHEC), an analytical dataset that can be used to examine mortality trends by demographic and socioeconomic characteristics and for environmental health research. This is the third in a set of similar cohorts, which offers the potential to study trends over three census cycles and 21 years of mortality follow-up. Validation revealed a slight bias which increased the probability of respondents to be included in the 1996 CanCHEC and linked to mortality databases, relative to the Canadian population. However, cohort weights were created to allow researchers to reduce the effect of this bias.

References

- Beaumont, J.F., and A.S. Charest. 2012. "Bootstrap variance estimation with survey data when estimating model parameters." *Computational Statistics & Data Analysis* 56 (12): 4450–4461.
- Beaumont, J.F., and Z. Patak. 2012. "On the generalized bootstrap for sample surveys with special attention to poisson sampling." *International Statistical Review* 80 (1): 127–148.
- Bushnik, T., S. Yang, M.S. Kramer, J.S. Kaufman, A.J. Sheppard and R. Wilkins. 2016. "The 2006 Canadian Birth-Census Cohort." *Health Reports* 27 (1): 11–19. Statistics Canada Catalogue no. 82-003-X.
- Carriere, K.C., and L.L. Roos. 1997. "A method of comparison for standardized rates of low-incidence events." *Medical Care* 35 (1): 57–69.
- Christidis, T., and M. Tjepkema. 2017. *1996 Canadian Census Health and Environment Cohort (CanCHEC): Technical Report*. Ottawa: Statistics Canada. Unpublished.
- Crouse, D.L., P.A. Peters, A. van Donkelaar, M.S. Goldberg, P.J. Villeneuve, O. Brion, S. Khan, D.O. Atari, M. Jerrett, C.A. Pope, III, M. Brauer, J.R. Brook, R.V. Martin, D. Stieb, and T. Burnett. 2012. "Risk of nonaccidental and cardiovascular mortality in relation to long-term exposure to low concentrations of fine particulate matter: A Canadian national-level cohort study." *Environmental Health Perspectives* 120 (5): 708–714.
- Fellegi, I.P., and A.B. Sunter. 1969. "A theory for record linkage." *Journal of the American Statistical Association* 64 (328): 1183–1210.
- Jeon, S.H., and R.V. Pohl. 2016. *Health and Work in the Family: Evidence from Spouses' Cancer Diagnoses*. Analytical Studies Branch Research Paper Series, no. 381. Statistics Canada Catalogue no. 11F0019M. Ottawa: Statistics Canada.
- Izrael, D., M.P. Battaglia, and M.R. Frankel. *Extreme survey weight adjustment as a component of sample balancing (a.k.a. raking)*. Paper presented at the SAS Global Forum, Washington, D.C., 2009.
- Kalton, G., and I. Flores-Cervantes. 2003. "Weighting methods." *Journal of Official Statistics* 19 (2): 81–97.
- Mathers C.D., A.D. López, and C.J. Murray. 2006. "The burden of disease and mortality by conditions: Data, methods and results for 2001." In *Global Burden of Disease and Risk Factors*, ed. A.D. Lopez, C.D. Mathers, M. Ezzati, D.T. Jamison, and C.J.L. Murray, Chapter 3, Annex table 3A.2. New York: Oxford University Press. Available at: <https://www.ncbi.nlm.nih.gov/books/NBK11808/> (accessed November 9, 2017).
- Peters, P.A., M. Tjepkema, R. Wilkins, P. Finès, D.L. Crouse, P.C.W. Chan, and R.T. Burnett. 2013. "Data resource profile: 1991 Canadian census cohort." *International Journal of Epidemiology* 42 (5): 1319–1326.
- Pinault, L., P. Finès, M. Tjepkema, F. Labrecque-Synnott, and A. Saidi. 2016. *The 2001 Canadian Census–Tax–Mortality Cohort: A 10-Year Follow-up*. Analytical Studies: Methods and References, no. 003. Statistics Canada Catalogue no. 11-633-X. Ottawa: Statistics Canada.
- Research Triangle Institute. 2013. *SUDAAN (software), Release 11.0.1*. Research Triangle Park, North Carolina: Research Triangle Institute.

Rotermann, M., C. Sanmartin, R. Trudeau, and H. St-Jean. 2015. "Linking 2006 Census and hospital data in Canada." *Health Reports* 26 (10): 10–20. Statistics Canada Catalogue no. 82-003-X.

St-Jean, H. 2016. *Social Data Linkage Environment (SDLE) Methodology Report: External linkage between the Canadian Mortality Database (CMDDB 1970 to 2011 and CMDDB 2012) and the SDLE Derived Record Depository (version 4)*. Ottawa: Statistics Canada. Unpublished.

Statistics Canada. n.d.a. "2016 submissions," "Approved microdata linkages," *Microdata linkage at Statistics Canada*. Last updated June 14, 2017. Available at: <http://www.statcan.gc.ca/eng/record/2016> (accessed November 2, 2017).

Statistics Canada. n.d.b. *Social Data Linkage Environment (SDLE)*. Last updated July 7, 2017. Available at: <http://www.statcan.gc.ca/eng/sdle/index> (accessed October 19, 2017).

Statistics Canada. 1999a. *Coverage 1996 Census Technical Reports*. Statistics Canada Catalogue No. 92-370-XIE. Ottawa: Statistics Canada.

Statistics Canada 1999b. *1996 Census Dictionary Final Edition Reference*. Statistics Canada Catalogue No. 92-351-UIE. Ottawa: Statistics Canada.

Tjepkema, M., R. Wilkins, and A. Long. 2013. "Socio-economic inequalities in cause-specific mortality: A 16-year follow-up study." *Canadian Journal of Public Health* 104 (7): 472–478.

Weichenthal, S., D.L. Crouse, L., Pinault, K. Godri-Pollitt, E.Lavigne, G. Evans, A. van Donkelaar, R.V. Martin, and R.T. Burnett. 2016. "Oxidative burden of fine particulate air pollution and risk of cause-specific mortality in the Canadian Census Health and Environment Cohort (CanCHEC)." *Environmental Research* 146: 92–99.

Wilkins, R., M. Tjepkema, C. Mustard, and R. Choinière. 2008. "The Canadian census mortality follow-up study, 1991 through 2001." *Health Reports* 19 (3): 25–43. Statistics Canada Catalogue no. 82-003-X.

Withrow, D.R., J.D. Pole, E.D. Nishri, M. Tjepkema, and L.D. Marrett. 2017. "Cancer survival disparities between First Nations and non-Aboriginal adults in Canada: Follow-up of the 1991 Census Mortality Cohort." *Cancer Epidemiology, Biomarkers & Prevention* 26 (1): 145–151. DOI: 10.1158/1055-9965.EPI-16-0706.