

Estimated Prevalence of Stroke Survivors with Disability in Canada

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Estimated Prevalence of Stroke Survivors with Disability in Canada

Executive Summary

Stroke is the result of either a disruption in blood supply to the brain (ischemic stroke) or bleeding into the brain due to a ruptured blood vessel (hemorrhagic stroke). The effects of a stroke can range from mild to severe, including death. For those who survive their stroke, recovery can take months or even years, while many people never fully recover.

A transient ischemic attack (TIA) is a short-term reduction in the flow of blood to the brain. Most TIAs last less than 10 minutes, but can last as long as 24 hours. The majority of TIAs do not cause permanent brain damage and the symptoms may only last a short time, but a person who has experienced a TIA is at an increased risk of having another TIA or a full stroke.

Previous estimates of stroke prevalence have suggested that 315,000 Canadians are living with the effects of stroke. This value was estimated based off of the 2009/10 Canadian Community Health Survey (CCHS), which asked respondents, “Do you suffer from the effects of a stroke?” However, the CCHS, an annual survey of over 65,000 Canadians, does not capture children under the age of 12, or individuals living in institutions. In particular, there are much higher rates of stroke survivors among people living in institutions than those living in the community, suggesting that the estimate of 315,000 could underestimate the true prevalence of stroke survivors living with disability.

The purpose of this project is to provide an updated estimate of the prevalence of stroke survivors living with disability in Canada (and its regions) based on the analysis of data from multiple sources. In addition to deriving a current estimate of the number of stroke survivors living with disability, we provide trends in the prevalence of stroke in Canada since 2000, together with a forecast through to 2038.

A note on terminology: The focus throughout this report will be on stroke survivors living with disability (i.e., individuals living with the effects of stroke). More specifically, this refers to individuals who have been diagnosed by a health professional as having a stroke with cognitive or physical impairments lasting at least six months. Many individuals with a TIA or stroke have no such cognitive or physical and are thus excluded from our classification of “stroke survivors living with disability.” We use the more inclusive term of “stroke survivors” in this report to designate any individual who has survived a TIA or stroke, with or without longer term cognitive or physical impairments.

We considered four sources of data on stroke prevalence for estimating stroke in the Canadian population, and used three to compare estimates.¹

¹ The US Behavioural Risk Factors Surveillance System (BRFSS) uses a telephone-based survey to measure behavioural risk factors in American adults aged 18 and older living in households. While it does include a question regarding stroke diagnosis, based on the survey structure and the low response rate, we determined that the results would not be suitable for estimating stroke in the entire Canadian population.

The Survey of Disability, Ageing and Carers (SDAC) is a comprehensive national survey of disability in Australia, and includes individuals of all ages as well as individuals in private-dwellings, non-private dwellings, and cared-accommodation facilities. As such, it is able to capture a sample that well represents the entire Australian population. It includes questions that enable the calculation of both the number of stroke survivors, and those who have long-term effects of stroke that interfere with everyday activities. When we applied these age- and sex- specific prevalence rates to the Canadian population in 2013, we estimated that 455,000 Canadians were living with effects of stroke that interfere with everyday activities.

The Ontario Brain Institute (OBI) and Institute for Clinical Evaluative Sciences (ICES) estimated the prevalence of stroke or transient ischemic attack (TIA) survivors (regardless of disability) using administrative data, the results of which will be published in a forthcoming report. These estimates rely on individuals making health system contact and having a most responsible diagnosis code recorded in hospitalization data that indicates stroke. Survivorship was calculated following a nine-year run-in period. These estimates suggest that approximately 94,000 individuals living in Ontario have survived a stroke or TIA, which, when applied to the Canadian population, suggests an overall prevalence rate of 0.75%, or 264,000 people in 2013. However, due to the nature of the data collection, this is likely an underestimation of the true prevalence of stroke survivors.

The Canadian Community Health Survey (CCHS) is a telephone-based survey that collects information related to health status, health care utilization and health determinants for Canadians aged 12 years and older who live in private occupied dwellings. Based on responses to the survey from 2011/12, we were able to estimate the prevalence of stroke survivors living with disability, among those aged 12 and over living in the community. We then adjusted these rates to account for individuals living in homes for the aged (where the prevalence of stroke survivors is much higher than the general population) and among children aged 0-11. These adjustments were based on population-specific prevalence rates from the literature and Statistics Canada trends in residents of homes for the aged. Using these additional data, we estimated that there were 412,000 stroke survivors living with disability in Canada in 2013. Given that a population's risk for stroke can vary between regions due to underlying factors such as obesity and smoking rates, prevalence rates that are derived directly from the Canadian population are considered the most accurate estimate. For this reason, we have used adjusted region-specific CCHS prevalence rates for all subsequent calculations in this report.

Applying the adjusted region-, age- and sex-specific CCHS prevalence rates to the Atlantic provinces, Quebec, Ontario, the Prairie provinces, and British Columbia populations, we have estimated the number of stroke survivors living with disability in each region (see Table ES-1). When age-adjusted to the 2013 Canadian population, the prevalence rates ranged from a high of 1.29% in Ontario, to a low of 1.05% in Quebec.

ES-1: Estimated Prevalence of Stroke Survivors Living with Disability in Canada

By Region in 2013

Including residents of Homes for the Aged and Children ages 0-11

	Atlantic Provinces	Quebec	Ontario	Prairie Provinces	British Columbia	Canada
Prevalence of Stroke Survivors Living with Disability						
Males	1.40%	1.05%	1.20%	0.81%	1.24%	1.11%
Females	1.29%	1.17%	1.35%	1.04%	1.20%	1.23%
Total	1.35%	1.11%	1.28%	0.92%	1.22%	1.17%
Prevalence of Stroke Survivors Living with Disability (Age-Adjusted to the 2013 Canadian Population)						
Males	1.24%	1.01%	1.20%	0.96%	1.13%	1.11%
Females	1.18%	1.10%	1.36%	1.20%	1.16%	1.23%
Total	1.21%	1.05%	1.29%	1.08%	1.14%	1.17%
Estimated Number of Stroke Survivors Living with Disability						
Males	16,000	43,000	80,000	26,000	28,000	193,000
Females	16,000	48,000	93,000	33,000	28,000	219,000
Total	32,000	91,000	173,000	59,000	56,000	412,000

The CCHS survey has been conducted annually since 2007 (with data combined into two-year cycles), and biannually prior to that. Using age- and sex-specific data from the 2000/01, 2003, 2005, 2007/08 and 2009/10, and 2011/12 CCHS cycles, we estimated stroke prevalence for each region over the span of 12 years. While all regions demonstrated an overall decreasing trend in age-adjusted stroke prevalence, none of these trends were statistically significant. For Canada as a whole, age-adjusted stroke prevalence ranged from minimum of 1.16% in 2009/10, to a maximum of 1.25% in 2005. Despite the decreasing trend in prevalence over this period, the total number of stroke survivors living with disability increased by over 80,000, as a result of population growth and aging.

Using region-specific data from these six CCHS cycles and projections for the Canadian population, we forecasted the number of stroke survivors living with disability, up to 2038. CCHS data were adjusted to include residents of homes for the aged and children aged 0-11. We used four different methods in our forecasted estimates, three of which included weighted averages of various CCHS cycles. The fourth method used age- and sex-specific trends in stroke prevalence only if the trends were significant and had a high predictive value; otherwise we used a weighted average of all six CCHS cycles.

The number of stroke survivors living with disability in Canada is projected to increase from 412,000 in 2013, to between 666,000 and 738,000 in 2038. This represents an expected increase from 2013 ranging between 62% and 79%. In some regions, we expect that the prevalence of stroke survivors living with disability will as much as double by 2038. The largest increase was seen in the Prairie provinces, where we estimate that there will be between 118,000 and 134,000 stroke survivors living with disability in 2038. This represents an expected increase from 2013 ranging between 100% and 127%. The results for all regions are summarized in Table ES-2.

**Table ES-2: Estimated and Projected Number of Stroke Survivors
Living with Disability**

By Region in 2000/01, 2013 and 2039

Including residents of Homes for the Aged and Children ages 0-11

	<u>Number of Individuals in 2000/01</u>	<u>Estimated Number of Individuals in 2013</u>	<u>Projected Number of Individuals in 2038</u>
Atlantic Provinces	25,000	32,000	52,000 - 54,000
Quebec	64,000	91,000	135,000 - 139,000
Ontario	132,000	173,000	289,000 - 299,000
Prairie Provinces	51,000	59,000	118,000 - 134,000
British Columbia	43,000	56,000	105,000 - 119,000
Canada	315,000	412,000	666,000 - 738,000

The focus of this analysis and report is to provide an updated estimate of the prevalence of stroke survivors living with disability in Canada, rather than the prevalence of all stroke survivors. Data from Australia in 2012 suggest that 202,000 out of 551,000 (37%) stroke survivors in that country do not have an ongoing disability.

To be able to capture this level of information within the CCHS, it would require that the survey include children under the age of 12 and individuals living within institutions. Furthermore, the type of questions with respect to stroke in the CCHS would require enhancement. The current CCHS asks only the following question on stroke: “Do you suffer from the effects of a stroke?” Prior to asking the question, the interviewer is instructed to say: “Remember, we’re interested in conditions diagnosed by a health professional and that are expected to last or have already lasted 6 months or more.”² The Australian SDAC poses three questions with respect to stroke. All respondents are asked, “Have you ever had a stroke?” If the respondent answers “yes” they are asked the following question: “Do you have any long-term effects as a result of the stroke, that interfere with your doing everyday activities?” Finally, they are asked, “What are the long-term effects that the stroke has caused?”³

One of the only ways in which we could obtain an accurate estimate of the overall prevalence of stroke survivors in Canada is if a comprehensive national survey were to ask questions similar to those that were covered by the SDAC. Complete and inclusive data that reports on stroke survivorship and stroke disability among *all* Canadians is essential for agencies charged with planning for the provision of services to those who have experienced a stroke, as well as for monitoring improvements in treatment and prevention.

² Statistics Canada. *Canadian Community Health Survey Annual Component - 2012 Questionnaire*. 2013. Available at http://www23.statcan.gc.ca/imdb-bmdi/instrument/3226_Q1_V9-eng.pdf. Accessed December 2014.

³ Australian Bureau of Statistics. *Survey of Disability Ageing and Carers (SDAC): Household Survey Questionnaire*. 2012-2013. Available at [http://www.ausstats.abs.gov.au/ausstats/subscriber.nsf/0/F1079EC1FADE48B8CA257C21000D88C2/\\$File/44300do001_household_questionnaire.pdf](http://www.ausstats.abs.gov.au/ausstats/subscriber.nsf/0/F1079EC1FADE48B8CA257C21000D88C2/$File/44300do001_household_questionnaire.pdf). Accessed December 2014.

Introduction

Background and Purpose

Stroke is the result of either a disruption in blood supply to the brain (ischemic stroke) or bleeding into the brain due to a ruptured blood vessel (hemorrhagic stroke). The effects of a stroke can range from mild to severe, including death. For those who survive their stroke, recovery can take months or even years, while many people never fully recover.

A transient ischemic attack (TIA) is a short-term reduction in the flow of blood to the brain. Most TIAs last less than 10 minutes, but can last as long as 24 hours. The majority of TIAs do not cause permanent brain damage, and the symptoms may only last a short time, but a person who has experienced a TIA is at an increased risk of having another TIA or a full stroke.

The first attempt to estimate the prevalence of stroke in Canada using Canadian data was reported by Hodgson.⁴ A previous estimate had used American prevalence rates applied to the Canadian population.⁵ Hodgson's study used data from the 1994/95 National Population Health Survey (NPHS) that indicated 319 out of 58,439 (0.55%) respondents aged 12 and older living in the community answered "Yes" when asked, "Do you have the effects of a stroke as diagnosed by a health professional?" Based on this information, Hodgson estimated that 205,000 Canadians living in the community were suffering from the effects of stroke. Furthermore, she estimated that an additional 56,000 Canadians living in institutions were stroke survivors, for a total of 261,000 estimated stroke survivors living with disability in 1995.

The Heart and Stroke Foundation currently estimates that "about 315,000 Canadians are living with the effects of stroke."⁶ This estimate is drawn from the Public Health Agency of Canada's (PHAC) report *Tracking Heart Disease and Stroke in Canada*.⁷ PHAC, in turn, has based their estimate on the results from the 2009/10 Canadian Community Health Survey (CCHS) which estimated that 311,163 community-dwelling Canadians aged 12 or older were suffering the effects of a stroke. This estimate was based off of the weighted number of individuals who responded "yes" to the question: "Do you suffer from the effects of a stroke?" Prior to asking this question, the interviewer is instructed to say: "Remember, we're interested in conditions diagnosed by a health professional."⁸ An additional estimated 15,257 Canadians were coded as "don't know," 1,456 as "refusal" (to answer the question) and 4,282 as "not stated."⁹ The PHAC report includes the caveat that "this estimate [of 315,000]

⁴ Hodgson C. Prevalence and disabilities of community-living seniors who report the effects of stroke. *Canadian Medical Association Journal*. 1998; 159(6): S9-14.

⁵ Mayo N. Epidemiology and recovery. *Physical Medicine and Rehabilitation*. 1993; 7: 1-25.

⁶ Heart and Stroke Foundation. *Statistics: Stroke*. Available at <http://www.heartandstroke.com/site/c.iQlLcMWJtE/b.3483991/k.34A8/Statistics.htm>. Accessed December 2014.

⁷ Public Health Agency of Canada. *Tracking Heart Disease and Stroke in Canada*. 2011. Available at http://www.phac-aspc.gc.ca/cd-mc/cvd-mcv/sh-fs-2011/pdf/StrokeHighlights_EN.pdf. Accessed December 2014.

⁸ Statistics Canada. *Canadian Community Health Survey Annual Component - 2010 Questionnaire*. 2010. Available at http://www23.statcan.gc.ca/imdb-bmdi/pub/instrument/3226_Q1_V7-eng.pdf. Accessed December 2014.

⁹ Statistics Canada. *Canadian Community Health Survey Annual Component: Public Use Microdata Files*. 2009-2010.

excludes people living in institutions, and it is known that many stroke survivors who require rehabilitative care live in complex continuing care facilities.”¹⁰

Stroke is a leading cause of disability in Canada.¹¹ A variety of therapies, including physical, occupational, speech and psychological, may be required to help a stroke survivor regain some or all of their functions damaged by stroke. An updated estimate of the number of stroke survivors living with disability is important for agencies charged with planning for the provision of these services.

The purpose of this project is to provide an updated estimate of the prevalence of stroke survivors living with disability in Canada (and its regions) based on the analysis of data from multiple sources. In addition to deriving a current estimate of the number of stroke survivors living with disability, we calculate trends in Canada since 2000, together with a forecast through to 2038. We considered the United States Behavioural Risk Factor Surveillance System (BRFSS), the Australian Survey of Disability, Ageing and Carers (SDAC), population-based linked health administrative data files for the province of Ontario compiled by the Institute for Clinical Evaluative Sciences (ICES), as well as the CCHS as potential data sources.

A note on terminology: The focus throughout this report will be on stroke survivors living with disability. More specifically, this refers to individuals who have been diagnosed by a health professional as having a stroke with cognitive or physical impairments lasting at least six months. Many individuals with a TIA or stroke have no such cognitive or physical and are thus excluded from our classification of “stroke survivors living with disability”. We use the more inclusive term of “stroke survivors” in this report to designate any individual who has survived a TIA or stroke, with or without longer term cognitive or physical impairments.

Data Sources

United States – Behavioral Risk Factor Surveillance System

In the United States, the Behavioral Risk Factor Surveillance System (BRFSS) is a collaborative project between the Centers for Disease Control and Prevention (CDC) and the U.S. states and territories.¹² The annual survey, initiated in 1984, is designed to measure behavioural risk factors among the adult population aged 18 and older and living in households, by means of a telephone-based survey. Excluded from the survey are persons living in institutions, long-term care facilities, nursing homes, correctional institutions and members of the military. Since 2011, the surveys have been conducted by both landline and cellular phone. Median response rates for the survey tend to be the 50-55%.¹³ In 2012, the

¹⁰ Public Health Agency of Canada. *Tracking Heart Disease and Stroke in Canada*. 2011. Available at http://www.phac-aspc.gc.ca/cd-mc/cvd-mcv/sh-fs-2011/pdf/StrokeHighlights_EN.pdf. Accessed December 2014.

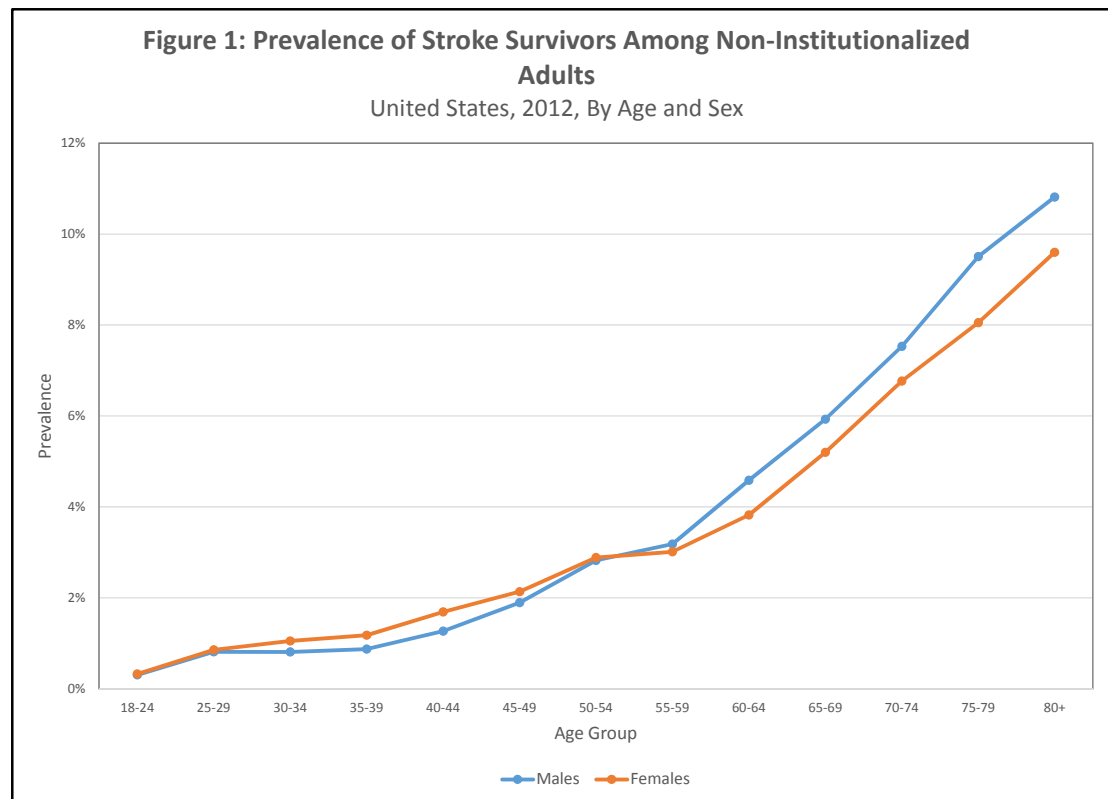
¹¹ Public Health Agency of Canada. *Tracking Heart Disease and Stroke in Canada*. 2011. Available at http://www.phac-aspc.gc.ca/cd-mc/cvd-mcv/sh-fs-2011/pdf/StrokeHighlights_EN.pdf. Accessed December 2014.

¹² Behavioural Risk Factor Surveillance System. *Overview: BRFSS 2012*. 2013. Available at http://www.cdc.gov/brfss/annual_data/2012/pdf/Overview_2012.pdf. Accessed December 2014.

¹³ Centers for Disease Control and Prevention. Prevalence of stroke--United States, 2006-2010. *Morbidity and Mortality Weekly Report*. 2012; 61(20): 379-82.

median response rate was 45.2%, with a 49.1% rate for landline responses and 35.3% rate for cellular responses.¹⁴

The survey consists of a core component and optional CDC modules. Since 2005, the core component has included a section on cardiovascular disease with one question related to stroke: “Has a doctor, nurse, or other health professional ever told you that you have a stroke?”^{15,16} Figure 1 provides a summary of the proportion of the U.S. respondents (by age group and sex) in the 2012 BRFSS who responded “yes” to this question.¹⁷ This self-reported prevalence of stroke survivors among non-institutionalized adults suggests that rates increase as the population ages, starting at 0.3% for ages 18-24 and increasing to 10.0% after age 80. Age-specific rates are modestly higher for males than females from age 60 and older.



¹⁴ Behavioural Risk Factor Surveillance System. *2012 Summary Data Quality Report* 2013. Available at http://www.cdc.gov/brfss/annual_data/2012/pdf/summarydataqualityreport2012_20130712.pdf. Accessed December 2014.

¹⁵ Centers for Disease Control and Prevention. Prevalence of stroke--United States, 2006-2010. *Morbidity and Mortality Weekly Report*. 2012; 61(20): 379-82.

¹⁶ Behavioural Risk Factor Surveillance System. *2012 Behavioural Risk Factor Surveillance System Questionnaire*. 2012. Available at http://www.cdc.gov/brfss/questionnaires/pdf-ques/2012_BRFSS.pdf. Accessed December 2014.

¹⁷ The denominator in calculating the proportion was the total of respondents who answered ‘Yes’ combined with the total of respondents who answered ‘No’. Participants who answered ‘Don’t Know’ or refused to answer this question were thus excluded. We used the detailed data available online at http://www.cdc.gov/brfss/annual_data/annual_2012.html adjusted to reflect weighted age-specific prevalence rates available online at <http://apps.nccd.cdc.gov/brfss/age.asp?cat=CH&yr=2012&qkey=8111&state=UB>.

Australia – Survey of Disability, Ageing and Carers

The 2012 Survey of Disability, Ageing and Carers (SDAC) was conducted throughout Australia from August of 2012 to March of 2013. It is the seventh comprehensive national survey conducted by the Australian Bureau of Statistics (ABS) to measure disability, following similar surveys in 1981, 1988, 1993, 1998, 2003 and 2009.¹⁸

The 2012 SDAC included the survey of 27,401 private dwellings, 518 non-private dwellings and 999 cared-accommodation facilities. The cared-accommodation facilities included hospitals, nursing homes and hostels. Response rates were 89.8%, 80.4% and 87.5% for private dwellings, non-private dwellings, and cared-accommodation dwellings, respectively. The final combined sample was 79,164 persons, comprised of 68,802 persons from the household component and 10,362 persons from the cared-accommodation component.¹⁹

Whenever possible, a personal interview was conducted. Proxy interviews were conducted for children aged younger than 15 years, those aged 15 to 17 years whose parent or guardian did not consent to them being personally interviewed, and those incapable of answering for themselves due to illness, impairment, injury or language problems. The results of the SDAC are therefore based on a comprehensive overview of the Australian population.²⁰

The 2012 SDAC posed three questions with respect to stroke. All respondents were asked, “Have you ever had a stroke?” If the respondent answers “yes” they were asked the following question: “Do you have any long-term effects as a result of the stroke, that interfere with your doing everyday activities?” Finally, they were asked, “What are the long-term effects that the stroke has caused?”²¹

Deloitte Access Economics has used the results of the 2012 SDAC to estimate the prevalence and number of stroke survivors in Australia, with or without disability.²² Figure 2 provides a summary, which includes all individuals who responded “yes” to the question “Have you ever had a stroke?” Based on these results, the self-reported prevalence of stroke survivors increases as the population ages, particularly after age 60. As observed in the U.S. data, age-specific rates for males are higher than females among those aged 60 and older.

¹⁸ Australian Bureau of Statistics. *Disability, Ageing and Carers, Australia: Summary of Findings, 2012* 2013. Available at <http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/4430.0Explanatory%20Notes5002012?OpenDocument>. Accessed December 2014.

¹⁹ Australian Bureau of Statistics. *Disability, Ageing and Carers, Australia: Summary of Findings, 2012* 2013. Available at <http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/4430.0Explanatory%20Notes5002012?OpenDocument>. Accessed December 2014.

²⁰ Exclusions consist of diplomatic personnel of overseas governments, persons whose usual residence was outside Australia, members of non-Australian defence forces (and their dependents) stationed in Australia and persons living in very remote areas.

²¹ Australian Bureau of Statistics. *Survey of Disability Ageing and Carers (SDAC): Household Survey Questionnaire, 2012-2013*. Available at [http://www.ausstats.abs.gov.au/ausstats/subscriber.nsf/0/F1079EC1FADE48B8CA257C21000D88C2/\\$File/44300do001_household_questionnaire.pdf](http://www.ausstats.abs.gov.au/ausstats/subscriber.nsf/0/F1079EC1FADE48B8CA257C21000D88C2/$File/44300do001_household_questionnaire.pdf). Accessed December 2014.

²² Deloitte Access Economics. *The Economic Impact of Stroke in Australia*. 2013. National Stroke Foundation. Available at <http://strokefoundation.com.au/site/media/Final-Deloitte-Stroke-Report-14-Mar-13.pdf>. Accessed December 2014.

Figure 2: Prevalence of Stroke
Australia, 2012, By Age and Sex

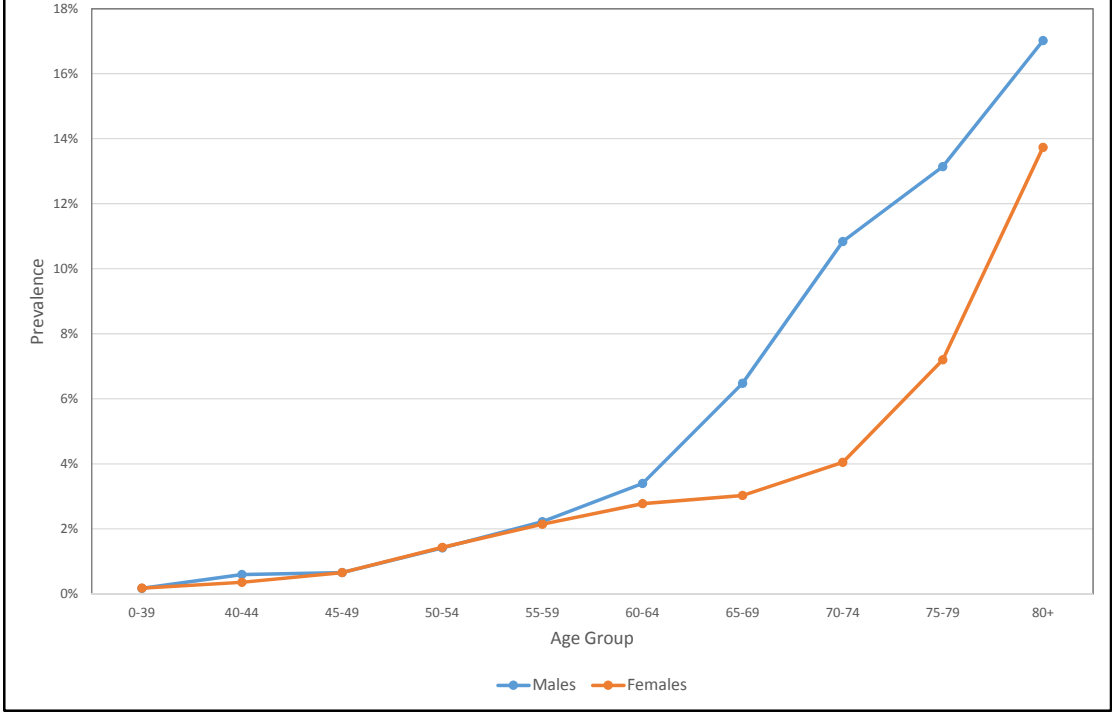
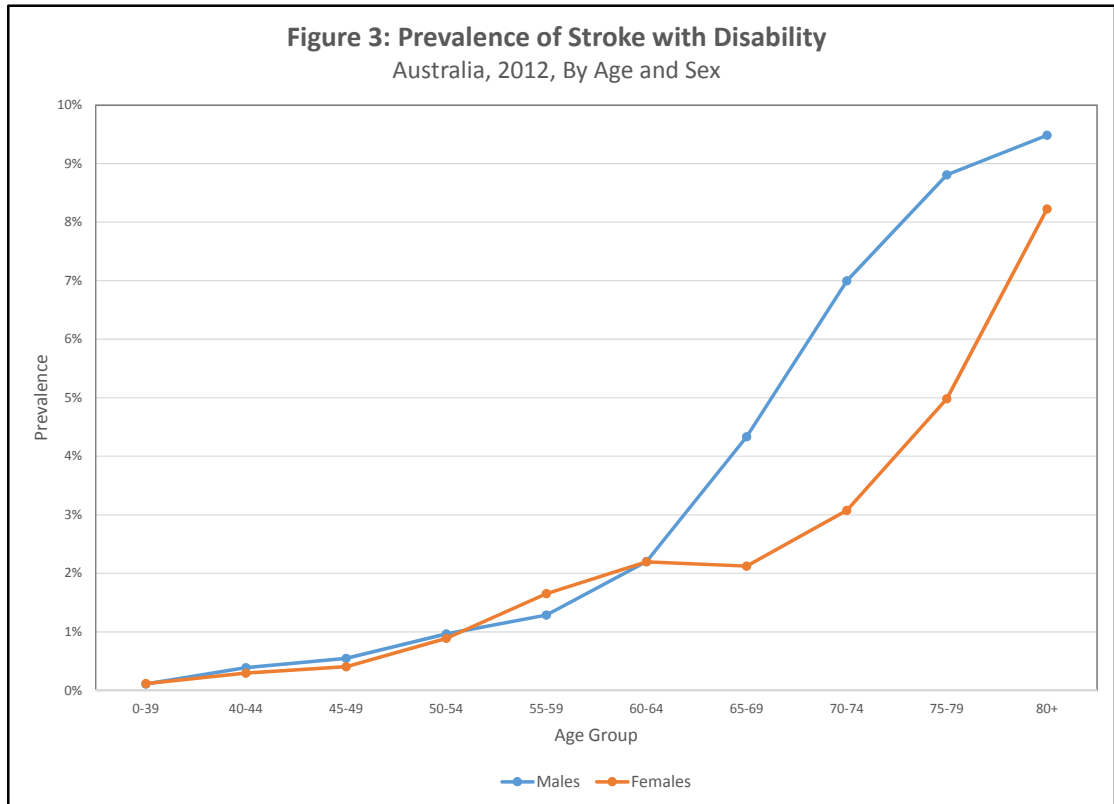


Figure 3 provides a summary of all individuals who responded “yes” to the question “Have you ever had a stroke?” and responded “yes” to the follow-up question “Do you have any long-term effects as a result of the stroke, that interfere with your doing everyday activities?” these results, the self-reported prevalence of stroke survivors with disability increases as the population ages, particularly after age 65. Prevalence tends to peak at age 80-84, when 10.2% of males and 8.1% of females have had a stroke that interferes with their ability to do everyday activities.



Ontario – Ontario Brain Institute and Institute for Clinical Evaluative Sciences

The Ontario Brain Institute (OBI) and the Institute for Clinical Evaluative Sciences (ICES) have recently collaborated on a forthcoming project to estimate the burden of brain disorders in Ontario. One of the brain disorders considered is stroke. Cases of incident stroke were identified based on an administrative data algorithm in which historical hospitalizations for stroke or transient ischemic attack (TIA) were identified based on the presence of a specific set of International Classification of Diseases codes in the Discharge Abstract Database (DAD). The codes used in this identification from the International Classification of Diseases, 9th Revision (ICD-9) are as follows:

- 362.3 – Retinal vascular occlusion NOS
- 430 – Subarachnoid hemorrhage
- 431 – Intracerebral hemorrhage
- 433.01 – Basilar artery w/cerebral infarction
- 433.11 – Carotid artery w/cerebral infarction
- 433.21 – Vertebral artery w/cerebral infarction
- 433.31 – Multiple and bilateral w/cerebral infarction
- 433.81 – Other specified precerebral artery w/cerebral infarction

- 433.91 – Unspecified precerebral artery w/cerebral infarction
- 434 – Occlusion of cerebral arteries
- 435 – Transient cerebral ischemia
- 436 – Acute, but ill-defined, cerebrovascular disease

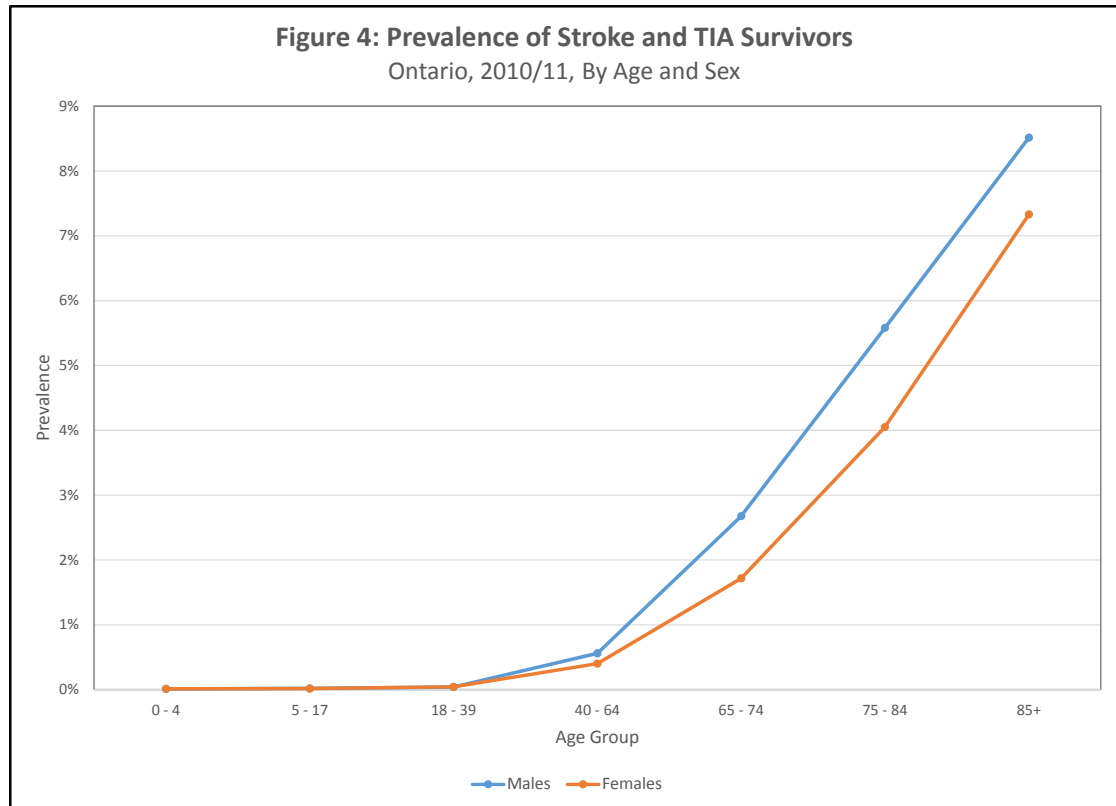
The codes from the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Canada (ICD-10-CA) are as follows:

- G45.0 – Vertebro-basilar artery syndrome
- G45.1 – Carotid artery syndrome (hemispheric)
- G45.2 – Multiple and bilateral precerebral artery syndromes
- G45.3 – Amaurosis fugax
- G45.8 – Other transient cerebral ischaemic attacks and related syndromes
- G45.9 – Transient cerebral ischaemic attack, unspecified
- H34.0 – Transient retinal artery occlusion
- H34.1 – Central retinal artery occlusion
- I60 – Subarachnoid haemorrhage
- I61 – Intracerebral haemorrhage
- I63 – Cerebral infarction
- I64 – Stroke, not specified as haemorrhage or infarction

Cases were only counted if the above codes were for the most responsible diagnosis. Cases were excluded if they had invalid Ontario health insurance numbers, missing data on age and/or sex, were dead before detection or were a non-Ontario resident. Cases were accrued from April 1, 1995 until March 31, 2011. A nine-year run-in period (from April 1, 1995 until March 31, 2004) was used to allow estimates to stabilize. All living cases residing in Ontario were used to calculate survivor rates and reported from 2004/05 through 2010/11 by age and sex.

The estimated number and prevalence of stroke and TIA survivors in Ontario in 2010/11 are shown in Table 1 and Figure 4.

Table 1: Stroke or TIA Survivors								
Ontario, By Age and Sex								
2010/11								
	Age Group							Total
	0 - 4	5 - 17	18 - 39	40 - 64	65 - 74	75 - 84	85+	
Males								
Estimated Population	363,636	1,040,000	2,021,951	2,314,973	460,441	269,229	81,689	6,551,920
# with Stroke or TIA	40	208	829	12,987	12,326	15,023	6,955	48,368
% of Population	0.011%	0.020%	0.041%	0.561%	2.677%	5.580%	8.514%	0.742%
Females								
Estimated Population	350,000	1,000,000	2,018,182	2,350,250	510,076	352,937	167,340	6,748,784
# with Stroke or TIA	42	150	888	9,401	8,758	14,301	12,266	45,806
% of Population	0.012%	0.015%	0.044%	0.400%	1.717%	4.052%	7.330%	0.683%
Total								
Estimated Population	713,636	2,040,000	4,040,133	4,665,223	970,517	622,166	249,029	13,300,704
# with Stroke or TIA	82	358	1,717	22,388	21,084	29,324	19,221	94,174
% of Population	0.012%	0.018%	0.043%	0.480%	2.172%	4.713%	7.718%	0.708%



Canada – Canadian Community Health Survey

The Canadian Community Health Survey (CCHS) is a cross-sectional telephone-based survey that collects information related to health status, health care utilization and health determinants for the Canadian population aged 12 years and older who live in private occupied dwellings in all provinces and territories. Excluded from the survey's coverage are persons living on reserves and other Aboriginal settlements in the provinces, full-time members of the Canadian Forces, the institutionalized population and persons living in the Quebec health regions of Région du Nunavik and Région des Terres-Cries-de-la-Baie-James. Altogether, these exclusions represent less than 3% of the target population.²³

Prior to 2007, data collection occurred every two years for an annual period. Data are available for the 2001, 2003 and 2005 periods based on a sample of approximately 130,000 respondents who were interviewed during the reference period. In 2007, major changes were made to the survey design, resulting in yearly data collection based on a sample of approximately 65,000 respondents who were interviewed during the reference period.

The CCHS has three content components: the common content, the optional content and the rapid response content. The common content is collected from all survey respondents and has remained relatively unchanged over time.

The CCHS produces a Public Use Microdata File (PUMF) including annual and/or combined data for two years which are available to researchers.

²³ Statistics Canada. *Canadian Community Health Survey - Annual Component (CCHS)*. 2014. Available at <http://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&SDDS=3226>. Accessed December 2015.

For the 2011/12 CCHS, a total of 144,000 households accepted the invitation to participate, out of 183,721 households that were approached (yielding a household-level response rate of 78.4%). One individual from each of the 144,000 households was selected to be interviewed with 125,645 accepting, yielding a person-level response rate of 87.3%. The combined response rate for Canada was 68.4%. This combined response rate by province ranged from 64.9% to 71.8%.²⁴

The 2011 and 2012 surveys included one question on stroke: “Do you suffer from the effects of a stroke?” Prior to asking the question, the interviewer was instructed to say: “Remember, we’re interested in conditions diagnosed by a health professional and that are expected to last or have already lasted 6 months or more.”²⁵

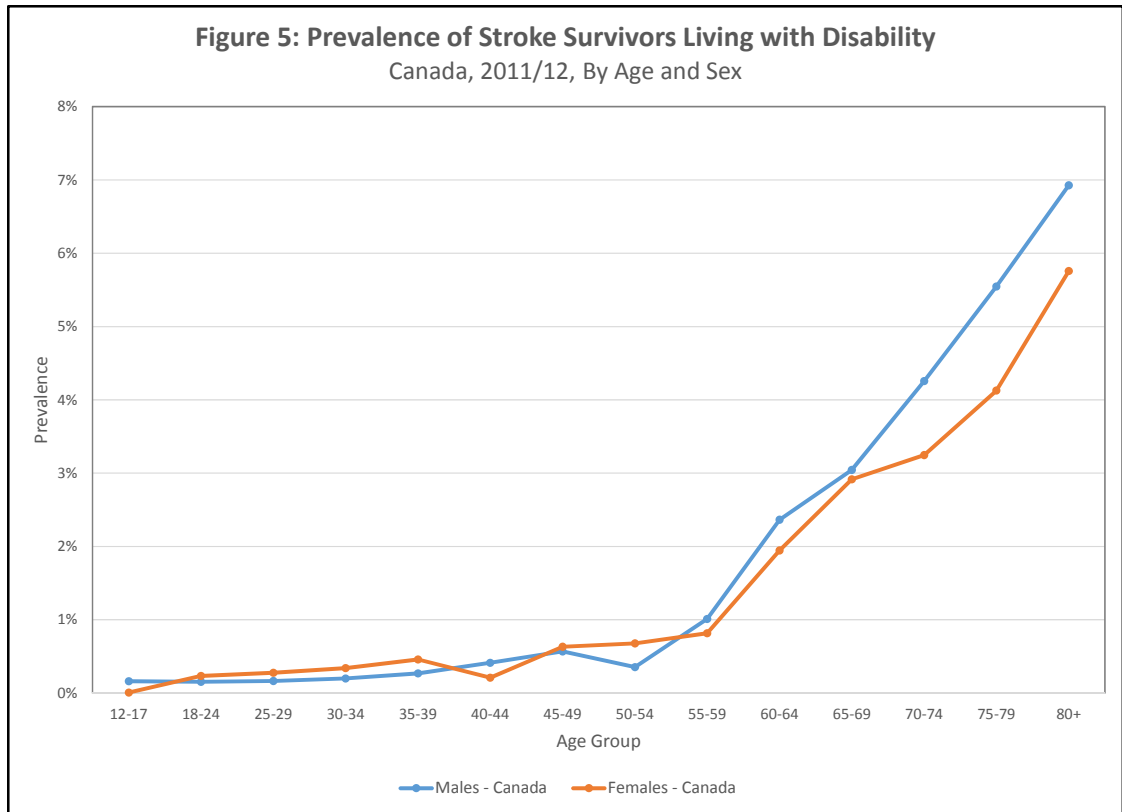
For this analysis, we utilized the combined 2011/12 PUMF data.²⁶ Figure 5 provides a summary of the weighted proportion of the respondents (by age group and sex) in the 2011/12 CCHS who responded “yes” to the question: “Do you suffer from the effects of a stroke?”²⁷ Respondents who were categorized as “don’t know,” “refusal” or “not stated” were excluded from this calculation, and assumed to have comparable stroke prevalence as the rest of the population. Based on this self-reported prevalence of individuals living with the effects of a stroke among non-institutionalized persons aged 12 and older, rates appear to increase as the population ages, starting at 0.09% for ages 12-17 and increasing to 6.2% after age 80. As observed in the U.S., Australian and Ontario data, age-specific rates are modestly higher for males than females for ages 60 and older.

²⁴ Statistics Canada. *Canadian Community Health Survey Annual Component - User Guide 2012 and 2011-2012 Microdata Files*. 2013. Available at Accessed December 2014.

²⁵ Statistics Canada. *Canadian Community Health Survey Annual Component - 2012 Questionnaire*. 2013. Available at http://www23.statcan.gc.ca/imdb-bmdi/instrument/3226_Q1_V9-eng.pdf. Accessed December 2014.

²⁶ This analysis is based on the Statistics Canada Canadian Community Health Survey 2011-12 and 2012 Public Use Microdata file (Catalogue number 82M0013XVB-2013001). All computations, use and interpretation of these data are entirely that of H. Krueger & Associates Inc.

²⁷ The denominator in calculating the proportion was the total of respondents who answered ‘Yes’ combined with the total of respondents who answered ‘No’. Participants who answered ‘Don’t Know’ or refused to answer this question were thus excluded.



Approach and Limitations of each Data Source

Each of the three publically available data sources described above use somewhat different approaches, which may in turn influence the way we can interpret and use the survey data. The BRFSS includes ages 18 and older, the CCHS includes ages 12 and older, and the SDAC includes all ages.

The Australian SDAC surveyed a large number of individuals living in institutions (including nursing homes), while the BRFSS and CCHS both exclude individuals living in institutions. From the perspective of estimating the prevalence of stroke survivors, this is an important difference. We expect that a much higher proportion of individuals living in nursing homes or continuing care facilities would have had a stroke compared to those of a similar age living in their own homes.

The question(s) each survey asked about respondents' experiences with stroke were also quite different. The SDAC included a set of questions that allowed us to estimate the prevalence of stroke survivors living with or without disability. The CCHS clearly attempted to include only those whose stroke had resulted in disability ("Do you suffer from the effects of a stroke...that [has] lasted 6 months or more?"). The BRFSS question was more generic ("Has a doctor, nurse, or other health professional ever told you that you have a stroke?").

The response rates for the three data sources also vary. The BRFSS had the lowest response rate in 2012, at 45%. The response rate for the CCHS in 2011/12 was 68%, while the combined response rate for the SDAC in 2012 was approximately 89%. A higher response

rate is usually considered to be a better indicator that the responses of the sample surveyed reflect what is truly occurring within the population.²⁸

Of the three data sources, the SDAC is arguably the best with respect to estimating the stroke survivor prevalence, based on its high response rate together with comprehensive coverage of the population, including individuals living in nursing homes. Of course, the age- and sex-specific rates for a given country also reflect the underlying risk factors for stroke within that population, which may vary considerably from Canada.

The approach used by OBI/ICES differs from the other three in that it used coded health administrative rather than survey data, and these data are not publically available. This approach makes it possible to capture all stroke survivors in a region (i.e., Ontario), provided they made contact with the health care system (in this case, were hospitalized) in that region. The strength of the approach depends on the accuracy of the case coding data included in the DAD. The use of a nine-year run-in period will help to stabilize rates, but will not identify younger stroke patients who were hospitalized for stroke prior to April 1, 1995 but who have not been hospitalized (for stroke) since then. This approach will affect rates in older populations to a smaller degree, as it is less likely for an older person who suffered a stroke before April 1, 1995 to survive beyond the end of the run-in period. Furthermore, the sole use of the most responsible diagnosis code will miss individuals who were hospitalized but for whom the stroke was a secondary diagnosis, as well as those who suffered a minor stroke and were discharged directly from the emergency department.

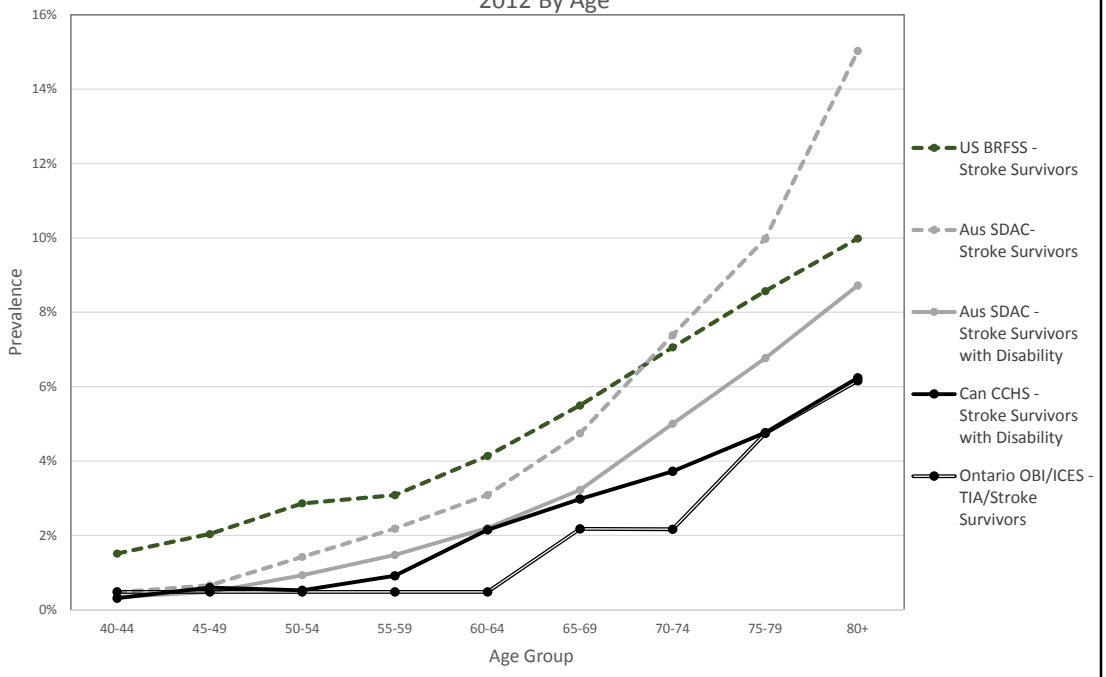
Figure 6 provides a comparison of the age-specific prevalence of stroke based on these three surveys, as well as from the Ontario administrative data. The results from the Australian SDAC include prevalence rates for all stroke survivors and stroke survivors living with disability. Results from the US BRFSS are presented as the prevalence of all stroke survivors, while results from the Canadian CCHS are presented as the prevalence of stroke survivors living with disability. The age-specific prevalence rates tend to be the highest for the U.S. from ages 40 through 69, with rates even higher than the overall stroke survivor rates for Australia. The results for Australia tend to increase rapidly after age 80, likely due to the inclusion of individuals living in nursing homes. This increase after age 80 is observed for all stroke survivors and stroke survivors living with disability. The Australian results for stroke survivors living with disability approximate the Canadian results until age 80, at which point the Australian results increase sharply, again reflecting the inclusion of individuals living in nursing home (or alternatively, the *exclusion* of these individuals in the Canadian survey results).

It is also apparent in Figure 6 that data from the OBI/ICES have the lowest age-specific prevalence estimates of the four sources. While the prevalence rates are similar to those of the CCHS for ages 75 and older, rates are much lower for ages below that. As discussed previously, this may be due, at least in part, to the limited ability of the approach used in capturing younger individuals who suffered a stroke prior to the start of the data collection period as well as limiting case identification to hospitalizations, i.e., inpatients only.

²⁸ Groves RM. Nonresponse rates and nonresponse bias in household surveys. *Public Opinion Quarterly*. 2006; 70(5): 646-75.

Figure 6: Prevalence of Stroke Survivors Living With and Without Disability

United States, Australia, Ontario and Canada
2012 By Age



Applying Age- and Sex Specific Rates to the 2013 Canadian Population

We report the age and sex-specific prevalence of stroke survivors/stroke survivors living with disability in Canada based on estimates derived from the above data sources, and the most appropriate estimate was selected for further analysis.

US BFRSS

We have determined, based on the nature of the survey and the low response rate (45.2%), that results from the US BFRSS are not appropriate for application to the Canadian population. In addition, the BFRSS question that was used to estimate stroke prevalence captures all survivors of stroke, not just those living with disability as a result of their stroke.

Australian SDAC

The results of the 2012 SDAC suggest that 348,810 Australians have had a stroke that interferes with their ability to do everyday activities. This represents 1.48% of their population of 23.6 million.

We have applied the age- and sex-specific rates from Australia to the 2013 Canadian population with the results summarized in Table 2. Using this approach, we estimate that there would be 455,000 stroke survivors with disability in Canada in 2013, or 1.29% of the Canadian population (35.2 million).

Table 2: Estimated Number of Stroke Survivors Living with Disability in Canada

Based on Age and Sex-Specific Australian Prevalence Rates

2013

	Estimated Canadian Population										
	0-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80+	Total
Males	8,859,809	1,187,072	1,290,603	1,382,386	1,248,641	1,042,864	851,866	593,923	430,807	542,256	17,430,227
Females	8,607,621	1,184,038	1,277,798	1,372,059	1,253,221	1,067,306	895,133	662,496	515,412	888,968	17,724,052
Total	17,467,430	2,371,110	2,568,401	2,754,445	2,501,862	2,110,170	1,746,999	1,256,419	946,219	1,431,224	35,154,279
<i>Source: CANSIM Table 051-0001 Estimates of population, by age group and sex for July 1, Canada, provinces and territories, annual</i>											
Prevalence of Stroke Survivors Living with Disability in Australia in 2012											
Males	0.11%	0.39%	0.55%	0.97%	1.29%	2.20%	4.33%	7.00%	8.81%	9.49%	1.39%
Females	0.12%	0.30%	0.40%	0.89%	1.65%	2.20%	2.12%	3.07%	4.98%	8.22%	1.20%
Total	0.11%	0.34%	0.47%	0.93%	1.47%	2.20%	3.20%	4.93%	6.72%	8.70%	1.29%
Estimated Number of Stroke Survivors Living with Disability in Canada											
Males	9,724	4,592	7,044	13,346	16,074	22,960	36,897	41,559	37,943	51,434	241,573
Females	10,108	3,512	5,150	12,213	20,691	23,429	19,008	20,370	25,676	73,095	213,252
Total	19,833	8,104	12,194	25,559	36,764	46,389	55,905	61,929	63,619	124,529	454,825

Ontario OBI and ICES

The data from the Ontario Brain Institute and the Institute for Clinical Evaluative Sciences suggest there were 94,174 stroke or TIA survivors living in Ontario in 2010/11. We have applied these age- and sex-specific rates to the 2013 Canadian population with the results summarized in Table 3. Using this approach, we estimate that there would be 264,000 stroke survivors in Canada in 2013, or 0.75% of the Canadian population.

Table 3: Stroke or TIA Survivors in Canada, based on OBI/ICES Ontario Prevalence
By Age and Sex
2013

	Age Group							Total
	0 - 4	5 - 17	18 - 39	40 - 64	65 - 74	75 - 84	85+	
Males								
Estimated Population	983,523	2,569,119	5,307,167	6,151,566	1,445,789	739,172	233,891	17,430,227
# with Stroke or TIA	108	514	2,176	34,510	38,704	41,246	19,913	137,171
% of Population	0.011%	0.020%	0.041%	0.561%	2.677%	5.580%	8.514%	0.787%
Females								
Estimated Population	935,648	2,436,051	5,235,922	6,154,422	1,557,629	935,558	468,822	17,724,052
# with Stroke or TIA	112	365	2,304	24,618	26,744	37,909	34,365	126,417
% of Population	0.012%	0.015%	0.044%	0.400%	1.717%	4.052%	7.330%	0.713%
Total								
Estimated Population	1,919,171	5,005,170	10,543,089	12,305,988	3,003,418	1,674,730	702,713	35,154,279
# with Stroke or TIA	220	879	4,480	59,128	65,448	79,155	54,278	263,588
% of Population	0.011%	0.018%	0.042%	0.480%	2.179%	4.726%	7.724%	0.750%

Canadian CCHS

We have applied the age- and sex-specific rates from the 2011/12 CCHS to the 2013 Canadian population aged 12 and over, with the results summarized in Table 4. Based on this approach, we estimate that there would be 367,000 stroke survivors living with disability in Canada in 2013, or 1.20% of the Canadian population aged 12 and older (30.6 million).

Table 4: Estimated Number of Stroke Survivors Living with Disability in Canada
Based on Age and Sex-Specific 2011/12 CCHS Prevalence Rates
2013

	Estimated Canadian Population											
	0-11	12-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80+	Total
Males		6,536,405	1,187,072	1,290,603	1,382,386	1,248,641	1,042,864	851,866	593,923	430,807	542,256	15,106,823
Females		6,398,137	1,184,038	1,277,798	1,372,059	1,253,221	1,067,306	895,133	662,496	515,412	888,968	15,514,568
Total		12,934,542	2,371,110	2,568,401	2,754,445	2,501,862	2,110,170	1,746,999	1,256,419	946,219	1,431,224	30,621,391
<i>Source: CANSIM Table 051-0001 Estimates of population, by age group and sex for July 1, Canada, provinces and territories, annual</i>												
Prevalence of Stroke Survivors Living with Disability in Canada in 2011/12												
Males		0.19%	0.41%	0.57%	0.35%	1.01%	2.37%	3.04%	4.26%	5.55%	6.93%	1.19%
Females		0.26%	0.21%	0.63%	0.68%	0.82%	1.95%	2.92%	3.25%	4.13%	5.76%	1.21%
Total		0.22%	0.31%	0.60%	0.52%	0.91%	2.15%	2.98%	3.72%	4.77%	6.20%	1.20%
Estimated Number of Stroke Survivors Living with Disability in Canada												
Males		12,132	4,884	7,313	4,904	12,624	24,670	25,930	25,273	23,889	37,564	179,182
Females		16,535	2,484	8,070	9,285	10,233	20,765	26,104	21,502	21,264	51,181	187,423
Total		28,667	7,368	15,382	14,190	22,857	45,435	52,034	46,775	45,153	88,745	366,605

It is important to note the key differences between SDAC data (Table 2) and CCHS data (Table 4) when estimating the prevalence for older age groups. SDAC estimates prevalence rates of stroke survivors living with disability that are 32%, 40%, and 41% higher for ages 70-74, 75-79 and 80+, respectively. As described previously, this difference likely reflects the inclusion of individuals living in nursing homes in the Australian SDAC data. In addition, the SDAC includes children aged 0-11 who are not included in the CCHS data.

In the next sections we will make adjustments to the core CCHS data to incorporate individuals living in nursing homes and children aged 0-11.

Adjusting for Individuals Living within Institutions

Residents of Homes for the Aged

Data on the number of residents in “homes for the aged” are available for Canada and the provinces from 1984/85 until 2009/10.²⁹ A summary of the data from 2000/01 to 2009/10 is included in Table 5. In 2009/10, a total of 203,997 Canadians were residents in homes for the aged, increasing from 168,807 in 2000/01.

	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10
Males										
18-44	535	523	579	561	606	605	609	563	563	559
45-64	2,985	3,045	3,346	3,449	3,699	4,024	4,058	4,228	4,405	4,303
65-69	2,381	2,512	2,508	2,567	2,581	2,752	2,723	2,811	2,980	2,887
70-74	4,180	4,489	4,252	4,255	4,295	4,455	4,363	4,386	4,509	4,414
75-79	6,319	6,219	6,846	6,824	6,681	7,264	7,302	7,160	7,338	7,158
80-84	8,149	8,309	8,970	9,353	10,260	10,256	10,318	10,578	10,731	10,702
85+	14,078	14,044	15,090	15,357	16,615	17,580	17,307	17,763	18,855	19,412
Sutotal - Males	38,627	39,141	41,591	42,366	44,737	46,936	46,680	47,489	49,381	49,435
Females										
18-44	444	461	501	515	556	587	533	500	520	512
45-64	3,081	3,225	3,358	3,441	3,637	4,217	4,170	4,278	4,510	4,432
65-69	2,766	2,900	2,825	2,864	2,837	3,006	3,061	3,212	3,491	3,280
70-74	5,886	6,282	6,017	5,837	5,789	6,147	6,017	5,771	6,043	5,957
75-79	12,053	12,306	12,931	12,571	11,949	12,670	12,629	12,742	12,533	12,292
80-84	21,136	21,266	22,335	22,719	24,266	23,723	23,476	24,031	23,747	23,238
85+	52,337	52,923	55,004	55,542	57,103	60,193	61,583	63,572	66,585	66,370
Sutotal - Females	97,703	99,363	102,971	103,489	106,137	110,543	111,469	114,106	117,429	116,081
Total										
18-44	979	984	1,080	1,076	1,162	1,192	1,142	1,063	1,083	1,071
45-64	6,066	6,270	6,704	6,890	7,336	8,241	8,228	8,506	8,915	8,735
65-69	5,147	5,412	5,333	5,431	5,418	5,758	5,784	6,023	6,471	6,167
70-74	10,066	10,771	10,269	10,092	10,084	10,602	10,380	10,157	10,552	10,371
75-79	18,372	18,525	19,777	19,395	18,630	19,934	19,931	19,902	19,871	19,450
80-84	29,285	29,575	31,305	32,072	34,526	33,979	33,794	34,609	34,478	33,940
85+	66,415	66,967	70,094	70,899	73,718	77,773	78,890	81,335	85,440	85,782
Total (excluding Quebec)	136,330	138,504	144,562	145,855	150,874	157,479	158,149	161,595	166,810	165,516
Quebec	32,477	32,749	32,676	33,554	38,431	38,744	38,098	38,784	38,627	38,481
Total (including Quebec)	168,807	171,253	177,238	179,409	189,305	196,223	196,247	200,379	205,437	203,997

Note that the data from Quebec are only provided as a total number and not distributed by age group or sex. We therefore distributed the Quebec total by year into age and sex categories based on the Canadian average (see Table 6).

²⁹ Statistics Canada. Table 107-5504 - Residents on Books in Residential Care Facilities, by Age Group, Sex, Principal Characteristic of the Predominant Group of Residents and Size of Facility, Canada, Provinces and Territories. Available online at <http://www5.statcan.gc.ca/cansim/a05?lang=eng&id=1075504&pattern=1075504&searchTypeByValue=1&p2=35>. Accessed January, 2015.

**Table 6: Residents in Residential Care Facilities (Homes for the Aged)
By Age Group and Sex, Canada**

	Estimated:									
	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10
Males										
18-44	662	647	710	690	760	754	756	698	693	689
45-64	3,696	3,765	4,102	4,242	4,641	5,014	5,036	5,243	5,425	5,303
65-69	2,948	3,106	3,075	3,158	3,238	3,429	3,379	3,486	3,670	3,558
70-74	5,176	5,550	5,213	5,234	5,389	5,551	5,414	5,439	5,553	5,440
75-79	7,824	7,689	8,393	8,394	8,383	9,051	9,061	8,878	9,037	8,822
80-84	10,090	10,274	10,998	11,505	12,873	12,779	12,804	13,117	13,216	13,190
85+	17,432	17,365	18,501	18,890	20,847	21,905	21,476	22,026	23,221	23,925
Sutotal - Males	47,829	48,396	50,992	52,112	56,133	58,483	57,925	58,887	60,816	60,928
Females										
18-44	550	570	614	633	698	731	661	620	640	631
45-64	3,815	3,988	4,117	4,233	4,563	5,254	5,175	5,305	5,554	5,462
65-69	3,425	3,586	3,464	3,523	3,560	3,746	3,798	3,983	4,299	4,043
70-74	7,288	7,767	7,377	7,180	7,264	7,659	7,466	7,156	7,442	7,342
75-79	14,924	15,216	15,854	15,463	14,993	15,787	15,671	15,800	15,435	15,150
80-84	26,171	26,294	27,383	27,946	30,447	29,559	29,131	29,799	29,246	28,641
85+	64,805	65,437	67,437	68,319	71,648	75,002	76,418	78,830	82,004	81,800
Sutotal - Females	120,978	122,857	126,246	127,297	133,172	137,740	138,322	141,492	144,621	143,069
Total										
18-44	1,212	1,217	1,324	1,324	1,458	1,485	1,417	1,318	1,334	1,320
45-64	7,511	7,753	8,219	8,475	9,205	10,269	10,210	10,548	10,979	10,766
65-69	6,373	6,692	6,538	6,680	6,798	7,175	7,177	7,469	7,969	7,601
70-74	12,464	13,318	12,590	12,414	12,653	13,210	12,881	12,595	12,995	12,782
75-79	22,749	22,905	24,247	23,857	23,375	24,838	24,732	24,679	24,472	23,972
80-84	36,261	36,568	38,381	39,450	43,321	42,339	41,935	42,915	42,462	41,831
85+	82,237	82,801	85,938	87,209	92,496	96,907	97,895	100,856	105,225	105,726
Total (including Quebec)	168,807	171,253	177,238	179,409	189,305	196,223	196,247	200,379	205,437	203,997

As the latest data available are from 2009/10, we used population projections³⁰ and age- and sex-specific trends from the preceding ten years to forecast the number of residents living in homes for the aged for years 2010/11 onwards. As such, we estimated that there were 227,823 residents of homes for the aged in Canada in 2013.

Prevalence of Stroke in Residents of Homes for the Aged

We are not aware of any comprehensive data in Canada with respect to the prevalence of stroke in residents of homes for the aged. A study of 3,239 nursing home residents in Ireland found that 570 (17.6%) were stroke survivors living with disability.³¹ A larger study in the United Kingdom of 16,043 care home residents found that 25% of those living in nursing homes had been diagnosed with a stroke.³² We therefore assumed that 25% of Canadians living in homes for the aged would be stroke survivors living with disability.

Adjusting for Residents of Homes for the Aged

To properly adjust for the higher stroke rates in residents of homes for the aged, we first removed these residents from the general population in Table 4 (thereby removing them from the population with a lower estimated stroke prevalence). We then added them back in after accounting for their higher estimated stroke prevalence. Table 7 provides the data with the residents of homes for the aged excluded, while Table 8 reintroduces residents of homes for

³⁰ Statistics Canada. *Table 052-0005 - Projected population, by projection scenario, age and sex, as of July 1, Canada, provinces and territories, annual*. 2014. Available at <http://www5.statcan.gc.ca/cansim/>. Accessed November 2014.

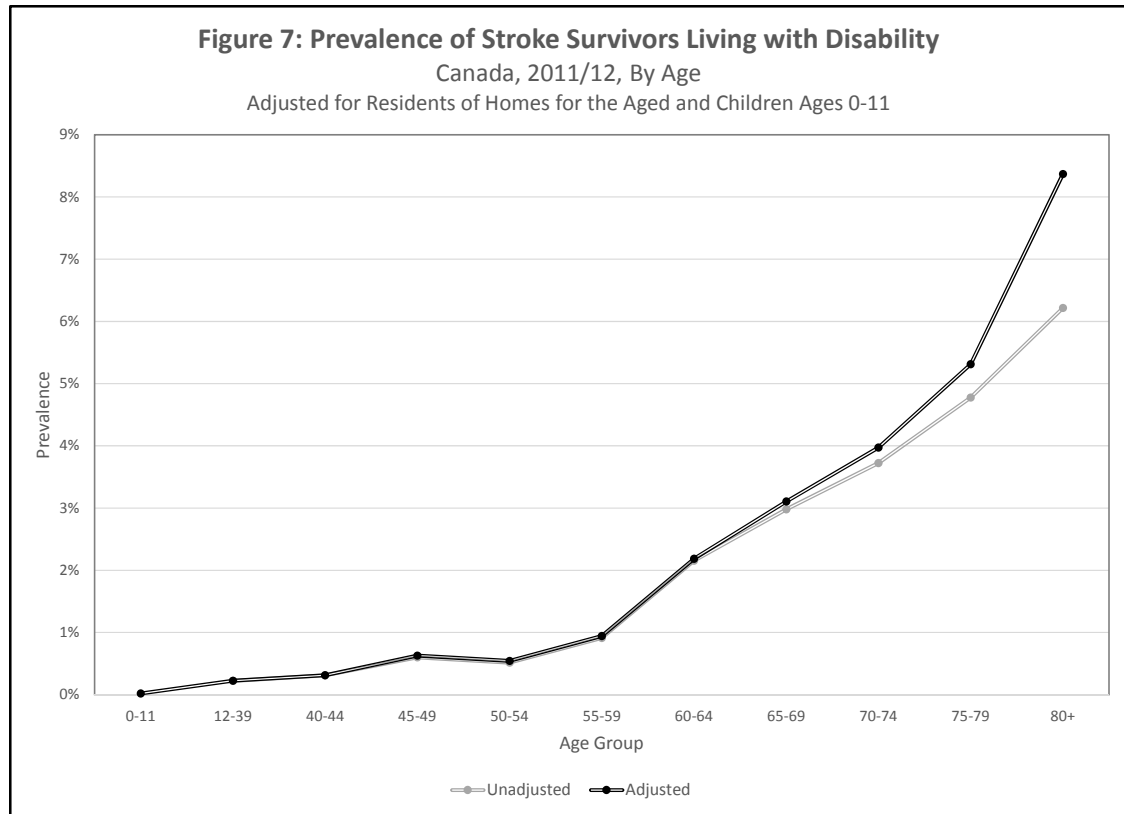
³¹ Cowman S, Royston M, Hickey A et al. Stroke and nursing home care: a national survey of nursing homes. *BMC Geriatrics*. 2010; 10(1): 4.

³² Bowman C, Whistler J and Ellerby M. A national census of care home residents. *Age and Ageing*. 2004; 33(6): 561-6.

the aged and adjusts these data to account for their higher stroke prevalence. Figure 7 provides a summary of the unadjusted and adjusted prevalence rates by age group. Note that the adjusted results now also demonstrate a significant increase in prevalence after age 80, as was previously observed in the Australian data which included residents of institutions.

Table 7: Estimated Number of Stroke Survivors Living with Disability in Canada											
Based on Age and Sex-Specific 2011/12 CCHS Prevalence Rates											
2013 (excluding residents of Homes for the Aged)											
	Estimated Canadian Population										
	12-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80+	Total (12+)
Males	6,535,760	1,186,953	1,289,049	1,380,832	1,247,087	1,041,310	847,111	587,572	421,397	498,314	15,035,386
Females	6,397,520	1,183,924	1,276,219	1,370,480	1,251,642	1,065,727	889,838	654,119	499,714	768,998	15,358,182
Total	12,933,280	2,370,876	2,565,269	2,751,313	2,498,730	2,107,038	1,736,949	1,241,690	921,112	1,267,312	30,393,568
<i>Source: CANSIM Table 051-0001 Estimates of population, by age group and sex for July 1, Canada, provinces and territories, annual</i>											
Prevalence of Stroke Survivors Living with Disability in Canada in 2011/12											
Males	0.19%	0.41%	0.57%	0.35%	1.01%	2.37%	3.04%	4.26%	5.55%	6.93%	1.16%
Females	0.26%	0.21%	0.63%	0.68%	0.82%	1.95%	2.92%	3.25%	4.13%	5.76%	1.17%
Total	0.22%	0.31%	0.60%	0.52%	0.91%	2.15%	2.98%	3.72%	4.78%	6.22%	1.17%
Estimated Number of Stroke Survivors Living with Disability in Canada											
Males	12,131	4,883	7,304	4,899	12,608	24,633	25,785	25,003	23,367	34,520	175,133
Females	16,533	2,484	8,060	9,275	10,220	20,734	25,950	21,230	20,617	44,274	179,376
Total	28,664	7,367	15,363	14,173	22,828	45,368	51,735	46,232	43,984	78,794	354,509

Table 8: Estimated Number of Stroke Survivors Living with Disability in Canada											
Based on Age and Sex-Specific 2011/12 CCHS Prevalence Rates											
2013 (including residents of Homes for the Aged)											
	Estimated Canadian Population										
	12-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80+	Total (12+)
Prevalence of Stroke Survivors Living with Disability in Canada in 2011/12											
Males	0.19%	0.41%	0.60%	0.38%	1.04%	2.40%	3.17%	4.48%	5.97%	8.39%	1.28%
Females	0.26%	0.21%	0.66%	0.70%	0.85%	1.98%	3.05%	3.52%	4.76%	8.35%	1.41%
Total	0.22%	0.31%	0.63%	0.54%	0.94%	2.19%	3.11%	3.97%	5.31%	8.37%	1.34%
Estimated Number of Stroke Survivors Living with Disability in Canada											
Males	12,292	4,913	7,692	5,287	12,996	25,022	26,974	26,591	25,719	45,506	192,992
Females	16,687	2,512	8,454	9,670	10,615	21,129	27,274	23,324	24,541	74,266	218,472
Total	28,980	7,425	16,147	14,956	23,611	46,151	54,247	49,915	50,260	119,772	411,464



Adjusting for Children

Number of Children Aged 0-11 in Canada

In 2013, there were an estimated 4.5 million children aged 0-11 living in Canada, of which 2.3 million were males and 2.2 million were females.

Prevalence and Outcomes of Stroke in Children

Data from the Canadian Paediatric Ischemic Stroke Registry suggest an annual incidence of 3.27 cases of ischemic stroke per 100,000 children aged 0-17.³³ Fullerton et al found the incidence of hemorrhagic stroke in children to be approximately equal to that of ischemic stroke.³⁴ The outcomes, however, are quite different. For ischemic stroke, 9% of children die, 62% are left with disability (lifelong cognitive or motor disability) and 29% are neurologically normal. For hemorrhagic stroke, these proportions are 25%, 32% and 43%, respectively.³⁵ In addition, the incidence of paediatric stroke is approximately 25% higher in males than females.³⁶

³³ Sofronas M, Ichord RN, Fullerton HJ et al. Pediatric stroke initiatives and preliminary studies: what is known and what is needed? *Pediatric Neurology*. 2006; 34(6): 439-45.

³⁴ Fullerton HJ, Wu YW, Zhao S et al. Risk of stroke in children: ethnic and gender disparities. *Neurology*. 2003; 61(2): 189-94.

³⁵ Lynch JK and Han CJ. Pediatric stroke: what do we know and what do we need to know? *Seminars in Neurology*. 2005; 25(4): 410-23.

³⁶ Fullerton HJ, Wu YW, Zhao S et al. Risk of stroke in children: ethnic and gender disparities. *Neurology*. 2003; 61(2): 189-94.

Adjusting for Children Ages 0-11

We used the above information to estimate the prevalence of stroke survivors living with disability among children aged 0-11 in Canada. Using the annual incidence of stroke among children, we calculated that approximately 0.0065% of children suffer a stroke in their first year of live, increasing to 0.0785% in the first 12 years. Based on the number of children in Canada in 2013 and the estimated proportion of children at each age who have suffered a stroke, we calculated that approximately 1,909 children would have suffered a stroke before their 12th birthday. Based on the outcomes following ischemic and hemorrhagic stroke, we further estimated that 897 of these 1,909 children would have survived with a disability. Of the 897, an estimated 498 would have been males, yielding a prevalence of stroke survivors living with disability among Canadian males aged 0-11 of 0.0214%. The estimated 399 females would yield a prevalence of 0.0181%.

After including children and residents of homes for the aged, we have estimated that there were 412,000 stroke survivors living with disability in Canada in 2013 (see Table 9).

Table 9: Estimated Number of Stroke Survivors Living with Disability in Canada												
Based on Age and Sex-Specific 2011/12 CCHS Prevalence Rates												
2013 (including residents of Homes for the Aged and Children ages 0-11)												
	Estimated Canadian Population											
	0-11	12-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80+	Total
Males	2,323,404	6,536,405	1,187,072	1,290,603	1,382,386	1,248,641	1,042,864	851,866	593,923	430,807	542,256	17,430,227
Females	2,209,484	6,398,137	1,184,038	1,277,798	1,372,059	1,253,221	1,067,306	895,133	662,496	515,412	888,968	17,724,052
Total	4,532,888	12,934,542	2,371,110	2,568,401	2,754,445	2,501,862	2,110,170	1,746,999	1,256,419	946,219	1,431,224	35,154,279
<i>Source: CANSIM Table 051-0001 Estimates of population, by age group and sex for July 1, Canada, provinces and territories, annual</i>												
Prevalence of Stroke Survivors Living with Disability in Canada in 2011/12												
Males	0.021%	0.19%	0.41%	0.60%	0.38%	1.04%	2.40%	3.17%	4.48%	5.97%	8.39%	1.11%
Females	0.018%	0.26%	0.21%	0.66%	0.70%	0.85%	1.98%	3.05%	3.52%	4.76%	8.35%	1.23%
Total	0.020%	0.22%	0.31%	0.63%	0.54%	0.94%	2.19%	3.11%	3.97%	5.31%	8.37%	1.17%
Estimated Number of Stroke Survivors Living with Disability in Canada												
Males	498	12,292	4,913	7,692	5,287	12,996	25,022	26,974	26,591	25,719	45,506	193,490
Females	399	16,687	2,512	8,454	9,670	10,615	21,129	27,274	23,324	24,541	74,266	218,871
Total	897	28,980	7,425	16,147	14,956	23,611	46,151	54,247	49,915	50,260	119,772	412,362

Based on the above results, we have determined that the most accurate method for estimating the prevalence of stroke survivors with disability in Canada is by using data from the 2011/2012 CCHS, combined with data concerning the number of individuals living in homes for the aged and estimated rates of stroke survivors with disability among children aged 0-11. Using this method, the estimated overall prevalence in Canada (1.23%) is very similar to the estimated prevalence using SDAC rates (1.29%), which we know was calculated using an inclusive sample that represents all populations. We therefore use the adjusted CCHS method of estimation for the remainder of calculations in this report (i.e., estimates of the prevalence of stroke survivors living with disability in 2013, trends in prevalence of stroke survivors living with disability, and forecasting prevalence of stroke survivors living with disability).

Best Estimate of the Prevalence of Stroke Survivors Living with Disability in 2013

Canada

An estimated 412,000 Canadians were stroke survivors living with disability in 2013, yielding an overall prevalence of 1.17% (see Table 9).

In the following sections, we will provide a best estimate of the 2013 prevalence, trends in prevalence, and forecasted prevalence of stroke survivors living with disability for the Atlantic provinces (Nova Scotia, New Brunswick, Prince Edward Island, and Newfoundland and Labrador), Quebec, Ontario, the Prairie provinces (Manitoba, Saskatchewan and Alberta) and British Columbia based on the approach used for Canada.

Atlantic Provinces

We have applied the age- and sex-specific rates for the Atlantic provinces from the 2011/12 CCHS to the 2013 population aged 12 and over, with the results summarized in Table 10. Based on this approach, the prevalence of stroke survivors living with disability in the Atlantic provinces would be estimated at 1.32% of the population aged 12 and older, or 28,000 individuals (see Table 10).

Table 10: Estimated Number of Stroke Survivors Living with Disability in the Atlantic Provinces											
Based on Age and Sex-Specific 2011/12 CCHS Prevalence Rates											
2013											
	Estimated Atlantic Population										
	12-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80+	Total (12+)
Males	400,696	78,976	88,530	96,112	92,684	83,247	70,419	47,648	32,764	37,201	1,028,277
Females	391,848	81,353	91,489	99,445	95,602	86,209	72,907	51,591	38,443	64,108	1,072,995
Total	792,544	160,329	180,019	195,557	188,286	169,456	143,326	99,239	71,207	101,309	2,101,272
<i>Source: CANSIM Table 051-0001 Estimates of population, by age group and sex for July 1, Canada, provinces and territories, annual</i>											
Prevalence of Stroke Survivors Living with Disability in the Atlantic Provinces in 2011/12											
Males	0.05%	0.35%	0.40%	0.80%	1.15%	2.50%	4.55%	4.32%	7.63%	6.99%	1.47%
Females	0.04%	0.57%	1.28%	0.17%	0.82%	0.79%	1.33%	5.23%	5.83%	5.05%	1.17%
Total	0.04%	0.46%	0.85%	0.48%	0.98%	1.63%	2.91%	4.79%	6.66%	5.76%	1.32%
Estimated Number of Stroke Survivors Living with Disability in the Atlantic Provinces											
Males	195	276	353	768	1,066	2,081	3,203	2,057	2,501	2,601	15,102
Females	143	467	1,171	169	781	677	971	2,698	2,241	3,238	12,557
Total	338	743	1,525	937	1,847	2,757	4,175	4,755	4,742	5,839	27,659

After including children and residents of homes for the aged, we estimate that 1.35% of the population in the Atlantic provinces, or 32,000 individuals, are stroke survivors living with disability (see Table 11).

Table 11: Estimated Number of Stroke Survivors Living with Disability in the Atlantic Provinces
Based on Age and Sex-Specific 2011/12 CCHS Prevalence Rates
2013 (including residents of Homes for the Aged and Children ages 0-11)

	Estimated Population											Total
	0-11	12-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80+	
Males	138,972	400,696	78,976	88,530	96,112	92,684	83,247	70,419	47,648	32,764	37,201	1,167,249
Females	132,020	391,848	81,353	91,489	99,445	95,602	86,209	72,907	51,591	38,443	64,108	1,205,015
Total	270,992	792,544	160,329	180,019	195,557	188,286	169,456	143,326	99,239	71,207	101,309	2,372,264
<i>Source: CANSIM Table 051-0001 Estimates of population, by age group and sex for July 1, Canada, provinces and territories, annual</i>												
Prevalence of Stroke Survivors Living with Disability in 2011/12												
Males	0.021%	0.05%	0.35%	0.44%	0.84%	1.19%	2.54%	4.69%	4.61%	8.13%	8.69%	1.40%
Females	0.018%	0.04%	0.58%	1.32%	0.21%	0.86%	0.83%	1.51%	5.59%	6.73%	8.43%	1.29%
Total	0.020%	0.05%	0.47%	0.89%	0.52%	1.02%	1.67%	3.07%	5.12%	7.37%	8.52%	1.35%
Estimated Number of Stroke Survivors Living with Disability in the Atlantic Provinces												
Males	30	211	279	393	807	1,104	2,117	3,301	2,194	2,663	3,231	16,330
Females	24	160	470	1,209	209	820	715	1,104	2,885	2,587	5,405	15,588
Total	54	370	749	1,602	1,016	1,925	2,833	4,405	5,079	5,250	8,636	31,918

Quebec

We have applied the age- and sex-specific rates for Quebec from the 2011/12 CCHS to the 2013 population aged 12 and over, with the results summarized in Table 12. Based on this approach, the prevalence of stroke survivors living with disability in Quebec would be estimated at 1.14% of the population aged 12 and older, or 81,000 individuals (see Table 12).

Table 12: Estimated Number of Stroke Survivors Living with Disability in Quebec											
Based on Age and Sex-Specific 2011/12 CCHS Prevalence Rates											
2013											
	Estimated Quebec Population										Total (12+)
	12-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80+	
Males	1,471,753	266,274	298,004	326,628	306,955	260,263	217,004	152,005	104,182	127,681	3,530,749
Females	1,423,772	254,540	288,878	321,807	302,265	261,429	227,326	170,995	130,298	226,071	3,607,381
Total	2,895,525	520,814	586,882	648,435	609,220	521,692	444,330	323,000	234,480	353,752	7,138,130
<i>Source: CANSIM Table 051-0001 Estimates of population, by age group and sex for July 1, Canada, provinces and territories, annual</i>											
Prevalence of Stroke Survivors Living with Disability in Quebec in 2011/12											
Males	0.34%	0.40%	0.32%	0.47%	0.89%	2.47%	2.99%	1.93%	7.03%	4.13%	1.12%
Females	0.31%	0.06%	1.00%	0.88%	0.94%	0.89%	2.41%	1.81%	3.22%	5.96%	1.16%
Total	0.32%	0.23%	0.66%	0.67%	0.91%	1.68%	2.69%	1.87%	4.91%	5.30%	1.14%
Estimated Number of Stroke Survivors Living with Disability in Quebec											
Males	4,956	1,060	947	1,526	2,736	6,417	6,479	2,937	7,320	5,273	39,652
Females	4,421	140	2,900	2,821	2,831	2,324	5,479	3,093	4,193	13,463	41,666
Total	9,377	1,200	3,847	4,347	5,567	8,741	11,958	6,030	11,513	18,736	81,318

After including children and residents of homes for the aged, we estimate that 1.11% of the Quebec population, or 91,000 individuals, are stroke survivors living with disability (see Table 13).

Table 13: Estimated Number of Stroke Survivors Living with Disability in Quebec												
Based on Age and Sex-Specific 2011/12 CCHS Prevalence Rates												
2013 (including residents of Homes for the Aged and Children ages 0-11)												
	Estimated Population										Total	
	0-11	12-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79		80+
Males	518,910	1,471,753	266,274	298,004	326,628	306,955	260,263	217,004	152,005	104,182	127,681	4,049,659
Females	496,931	1,423,772	254,540	288,878	321,807	302,265	261,429	227,326	170,995	130,298	226,071	4,104,312
Total	1,015,841	2,895,525	520,814	586,882	648,435	609,220	521,692	444,330	323,000	234,480	353,752	8,153,971
<i>Source: CANSIM Table 051-0001 Estimates of population, by age group and sex for July 1, Canada, provinces and territories, annual</i>												
Prevalence of Stroke Survivors Living with Disability in 2011/12												
Males	0.021%	0.34%	0.40%	0.34%	0.49%	0.91%	2.49%	3.08%	2.12%	7.33%	5.54%	1.05%
Females	0.018%	0.31%	0.06%	1.03%	0.90%	0.96%	0.92%	2.51%	2.04%	3.70%	7.97%	1.17%
Total	0.020%	0.33%	0.23%	0.68%	0.69%	0.94%	1.70%	2.79%	2.08%	5.31%	7.09%	1.11%
Estimated Number of Stroke Survivors Living with Disability in Quebec												
Males	111.22	4,987	1,066	1,021	1,599	2,807	6,484	6,674	3,227	7,633	7,077	42,686
Females	89.79	4,451	146	2,972	2,893	2,903	2,396	5,708	3,484	4,821	18,011	47,874
Total	201	9,438	1,212	3,992	4,492	5,710	8,881	12,382	6,710	12,454	25,088	90,561

Ontario

We have applied the age- and sex-specific rates for Ontario from the 2011/12 CCHS to the 2013 population aged 12 and over, with the results summarized in Table 14. Based on this approach, the prevalence of stroke survivors living with disability in Ontario would be estimated at 1.30% of the population aged 12 and older, or 154,000 individuals (see Table 14).

Table 14: Estimated Number of Stroke Survivors Living with Disability in Ontario											
Based on Age and Sex-Specific 2011/12 CCHS Prevalence Rates											
2013											
	Estimated Ontario Population										
	12-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80+	Total (12+)
Males	2,496,461	461,089	510,660	534,988	461,262	383,324	315,815	222,783	167,472	211,741	5,765,595
Females	2,499,897	474,336	512,892	536,448	477,073	406,507	341,632	254,627	201,470	343,431	6,048,313
Total	4,996,358	935,425	1,023,552	1,071,436	938,335	789,831	657,447	477,410	368,942	555,172	11,813,908
<i>Source: CANSIM Table 051-0001 Estimates of population, by age group and sex for July 1, Canada, provinces and territories, annual</i>											
Prevalence of Stroke Survivors Living with Disability in Ontario in 2011/12											
Males	0.17%	0.57%	0.96%	0.27%	1.13%	2.63%	3.32%	5.02%	5.17%	7.13%	1.28%
Females	0.29%	0.32%	0.54%	0.72%	0.64%	3.05%	3.79%	3.48%	4.93%	4.97%	1.32%
Total	0.23%	0.45%	0.75%	0.50%	0.88%	2.85%	3.57%	4.20%	5.04%	5.79%	1.30%
Estimated Number of Stroke Survivors Living with Disability in Ontario											
Males	4,326	2,633	4,889	1,468	5,191	10,083	10,486	11,191	8,658	15,107	74,033
Females	7,277	1,538	2,782	3,882	3,059	12,403	12,959	8,866	9,939	17,064	79,770
Total	11,603	4,171	7,672	5,351	8,251	22,486	23,445	20,057	18,597	32,171	153,803

After including children and residents of homes for the aged, we estimate that 1.28% of the Ontario population, or 173,000 individuals, are stroke survivors living with disability (see Table 15).

Table 15: Estimated Number of Stroke Survivors Living with Disability in Ontario												
Based on Age and Sex-Specific 2011/12 CCHS Prevalence Rates												
2013 (including residents of Homes for the Aged and Children ages 0-11)												
	Estimated Ontario Population											
	0-11	12-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80+	Total
Males	890,247	2,496,461	461,089	510,660	534,988	461,262	383,324	315,815	222,783	167,472	211,741	6,655,842
Females	846,774	2,499,897	474,336	512,892	536,448	477,073	406,507	341,632	254,627	201,470	343,431	6,895,087
Total	1,737,021	4,996,358	935,425	1,023,552	1,071,436	938,335	789,831	657,447	477,410	368,942	555,172	13,550,929
<i>Source: CANSIM Table 051-0001 Estimates of population, by age group and sex for July 1, Canada, provinces and territories, annual</i>												
Prevalence of Stroke Survivors Living with Disability in 2011/12												
Males	0.021%	0.18%	0.57%	0.99%	0.30%	1.16%	2.67%	3.46%	5.25%	5.65%	8.67%	1.20%
Females	0.018%	0.29%	0.33%	0.57%	0.75%	0.67%	3.09%	3.93%	3.78%	5.62%	7.94%	1.35%
Total	0.020%	0.23%	0.45%	0.78%	0.53%	0.91%	2.88%	3.70%	4.47%	5.63%	8.22%	1.28%
Estimated Number of Stroke Survivors Living with Disability in Ontario												
Males	190.82	4,375	2,642	5,036	1,620	5,338	10,220	10,918	11,704	9,468	18,354	79,866
Females	153.00	7,329	1,548	2,942	4,040	3,218	12,545	13,432	9,624	11,313	27,284	93,428
Total	344	11,705	4,189	7,978	5,660	8,555	22,765	24,350	21,329	20,781	45,638	173,294

Prairie Provinces

We have applied the age- and sex-specific rates for the Prairie provinces from the 2011/12 CCHS to the 2013 population aged 12 and over, with the results summarized in Table 16. Based on this approach, the prevalence of stroke survivors living with disability in the Prairie provinces would be estimated at 0.96% of the population aged 12 and older, or 52,000 individuals (see Table 16).

Table 16: Estimated Number of Stroke Survivors Living with Disability in the Prairie Provinces											
Based on Age and Sex-Specific 2011/12 CCHS Prevalence Rates											
2013											
	Estimated Prairie Population										
	12-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80+	Total (12+)
Males	1,305,473	219,601	225,129	243,017	217,532	166,467	125,717	85,102	62,931	83,387	2,734,356
Females	1,241,202	208,444	211,513	228,567	206,180	163,693	128,680	94,191	75,364	135,660	2,693,494
Total	2,546,675	428,045	436,642	471,584	423,712	330,160	254,397	179,293	138,295	219,047	5,427,850
<i>Source: CANSIM Table 051-0001 Estimates of population, by age group and sex for July 1, Canada, provinces and territories, annual</i>											
Prevalence of Stroke Survivors Living with Disability in the Prairie Provinces in 2011/12											
Males	0.18%	0.07%	0.11%	0.29%	0.95%	1.62%	2.06%	5.17%	3.65%	7.66%	0.87%
Females	0.20%	0.06%	0.42%	0.79%	0.55%	0.82%	2.75%	4.82%	2.83%	7.34%	1.04%
Total	0.19%	0.07%	0.26%	0.53%	0.75%	1.23%	2.41%	4.99%	3.20%	7.47%	0.96%
Estimated Number of Stroke Survivors Living with Disability in the Prairie Provinces											
Males	2,324	162	243	705	2,059	2,696	2,589	4,397	2,298	6,391	23,863
Females	2,541	130	879	1,811	1,132	1,348	3,537	4,542	2,129	9,963	28,013
Total	4,865	292	1,122	2,516	3,192	4,045	6,126	8,939	4,427	16,353	51,877

After including children and residents of homes for the aged, we estimate that 0.92% of the population in the Prairie provinces, or 59,000 individuals, are stroke survivors living with disability (see Table 17).

Table 17: Estimated Number of Stroke Survivors Living with Disability in the Prairie Provinces												
Based on Age and Sex-Specific 2011/12 CCHS Prevalence Rates												
2013 (including residents of Homes for the Aged and Children ages 0-11)												
	Estimated Population											
	0-11	12-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80+	Total
Males	487,324	1,305,473	219,601	225,129	243,017	217,532	166,467	125,717	85,102	62,931	83,387	3,221,680
Females	463,677	1,241,202	208,444	211,513	228,567	206,180	163,693	128,680	94,191	75,364	135,660	3,157,171
Total	951,001	2,546,675	428,045	436,642	471,584	423,712	330,160	254,397	179,293	138,295	219,047	6,378,851
<i>Source: CANSIM Table 051-0001 Estimates of population, by age group and sex for July 1, Canada, provinces and territories, annual</i>												
Prevalence of Stroke Survivors Living with Disability in 2011/12												
Males	0.021%	0.18%	0.08%	0.14%	0.32%	0.98%	1.66%	2.19%	5.41%	4.16%	9.18%	0.81%
Females	0.018%	0.21%	0.07%	0.45%	0.82%	0.58%	0.86%	2.89%	5.09%	3.49%	9.85%	1.04%
Total	0.020%	0.19%	0.07%	0.29%	0.56%	0.78%	1.26%	2.54%	5.24%	3.79%	9.60%	0.92%
Estimated Number of Stroke Survivors Living with Disability in the Prairie Provinces												
Males	104.45	2,367	169	312	773	2,126	2,761	2,749	4,602	2,618	7,654	26,234
Females	83.78	2,582	138	945	1,877	1,198	1,414	3,720	4,794	2,628	13,365	32,746
Total	188	4,949	308	1,257	2,649	3,324	4,174	6,470	9,396	5,247	21,019	58,980

British Columbia

We have applied the age- and sex-specific rates for British Columbia from the 2011/12 CCHS to the 2013 population aged 12 and over, with the results summarized in Table 18. Based on this approach, the prevalence of stroke survivors living with disability in British Columbia would be estimated at 1.24% of the population aged 12 and older, or 50,000 individuals (see Table 18).

Table 18: Estimated Number of Stroke Survivors Living with Disability in BC											
Based on Age and Sex-Specific 2011/12 CCHS Prevalence Rates											
2013											
	Estimated BC Population										
	12-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80+	Total (12+)
Males	836,761	157,072	164,223	177,172	166,418	146,906	121,058	85,409	62,872	81,721	1,999,612
Females	816,936	161,428	169,166	181,705	168,904	147,001	123,081	90,218	69,238	119,033	2,046,710
Total	1,653,697	318,500	333,389	358,877	335,322	293,907	244,139	175,627	132,110	200,754	4,046,322
<i>Source: CANSIM Table 051-0001 Estimates of population, by age group and sex for July 1, Canada, provinces and territories, annual</i>											
Prevalence of Stroke Survivors Living with Disability in BC in 2011/12											
Males	0.03%	0.44%	0.54%	0.26%	0.91%	2.29%	2.54%	5.63%	5.26%	9.88%	1.32%
Females	0.24%	0.01%	0.22%	0.29%	1.36%	2.47%	2.54%	2.30%	3.62%	6.10%	1.16%
Total	0.14%	0.22%	0.38%	0.28%	1.14%	2.38%	2.54%	3.92%	4.40%	7.64%	1.24%
Estimated Number of Stroke Survivors Living with Disability in BC											
Males	277	693	891	465	1,521	3,366	3,080	4,808	3,307	8,076	26,484
Females	1,994	22	366	535	2,303	3,632	3,127	2,078	2,507	7,260	23,825
Total	2,271	715	1,258	1,000	3,824	6,998	6,207	6,887	5,814	15,336	50,309

After including children and residents of homes for the aged, we estimate that 1.22% of the British Columbian population, or 56,000 individuals, are stroke survivors living with disability (see Table 19).

Table 19: Estimated Number of Stroke Survivors Living with Disability in British Columbia												
Based on Age and Sex-Specific 2011/12 CCHS Prevalence Rates												
2013 (including residents of Homes for the Aged and Children ages 0-11)												
	Estimated Population											
	0-11	12-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80+	Total
Males	276,868	836,761	157,072	164,223	177,172	166,418	146,906	121,058	85,409	62,872	81,721	2,276,480
Females	259,435	816,936	161,428	169,166	181,705	168,904	147,001	123,081	90,218	69,238	119,033	2,306,145
Total	536,303	1,653,697	318,500	333,389	358,877	335,322	293,907	244,139	175,627	132,110	200,754	4,582,625
<i>Source: CANSIM Table 051-0001 Estimates of population, by age group and sex for July 1, Canada, provinces and territories, annual</i>												
Prevalence of Stroke Survivors Living with Disability in 2011/12												
Males	0.021%	0.04%	0.44%	0.57%	0.29%	0.94%	2.32%	2.67%	5.81%	5.63%	11.03%	1.24%
Females	0.018%	0.25%	0.02%	0.25%	0.32%	1.39%	2.50%	2.66%	2.54%	4.22%	8.40%	1.20%
Total	0.020%	0.14%	0.23%	0.41%	0.31%	1.17%	2.41%	2.67%	4.13%	4.89%	9.47%	1.22%
Estimated Number of Stroke Survivors Living with Disability in BC												
Males	59.34	299	697	941	515	1,570	3,412	3,237	4,964	3,540	9,018	28,251
Females	46.88	2,008	25	415	584	2,350	3,677	3,278	2,289	2,921	10,002	27,596
Total	106	2,307	721	1,357	1,100	3,920	7,089	6,514	7,253	6,461	19,019	55,847

Summary

The prevalence of stroke survivors living with disability, unadjusted for differences in age structure between the regions, varies across the country from a low of 0.92% in the Prairie provinces to a high of 1.35% in the Atlantic provinces. The age-adjusted prevalence rates range from a low of 1.05% in Quebec to a high of 1.29% in Ontario (see Table 20).

Table 20: Estimated Prevalence of Stroke Survivors Living with Disability in Canada						
By Region in 2013						
Including residents of Homes for the Aged and Children ages 0-11						
	Atlantic Provinces	Quebec	Ontario	Prairie Provinces	British Columbia	Canada
Prevalence of Stroke Survivors Living with Disability						
Males	1.40%	1.05%	1.20%	0.81%	1.24%	1.11%
Females	1.29%	1.17%	1.35%	1.04%	1.20%	1.23%
Total	1.35%	1.11%	1.28%	0.92%	1.22%	1.17%
Prevalence of Stroke Survivors Living with Disability (Age-Adjusted to the 2013 Canadian Population)						
Males	1.24%	1.01%	1.20%	0.96%	1.13%	1.11%
Females	1.18%	1.10%	1.36%	1.20%	1.16%	1.23%
Total	1.21%	1.05%	1.29%	1.08%	1.14%	1.17%
Estimated Number of Stroke Survivors Living with Disability						
Males	16,000	43,000	80,000	26,000	28,000	193,000
Females	16,000	48,000	93,000	33,000	28,000	219,000
Total	32,000	91,000	173,000	59,000	56,000	412,000

Eighty six percent of stroke survivors living with disability in Canada (355,000 individuals) are adults who live in the community, while an additional 13.8% live in institutions (57,000 individuals). Almost 900 Canadian children aged 0-11 have survived a stroke and are living with disability (see Table 21).

Table 21: Estimated Prevalence of Stroke Survivors Living with Disability in Canada						
By Region in 2013						
	Atlantic Provinces	Quebec	Ontario	Prairie Provinces	British Columbia	Canada
Males						
Children Aged 0-11	30	111	191	104	59	498
Community-Dwelling Adults	14,729	39,110	72,299	23,174	25,735	175,133
Adults Living in Institutions	1,571	3,466	7,376	2,956	2,457	17,859
Females						
Children Aged 0-11	24	90	153	84	47	399
Community-Dwelling Adults	11,841	40,084	76,657	26,444	22,823	179,376
Adults Living in Institutions	3,723	7,700	16,618	6,218	4,726	39,096
Total						
Children Aged 0-11	54	201	344	188	106	897
Community-Dwelling Adults	26,570	79,194	148,956	49,618	48,558	354,509
Adults Living in Institutions	5,295	11,166	23,995	9,174	7,183	56,956
Total Stroke Survivors with Disability	32,000	91,000	173,000	59,000	56,000	412,000

Trends in the Prevalence of Stroke Survivors Living with Disability – 2000 to 2012

Canada

In addition to the 2011/12 cycle, CCHS surveys were also administered in 2000/01, 2003, 2005, 2007/08 and 2009/10. In all cycles, respondents were asked the question, “Do you suffer from the effects of a stroke?” Using these data from the CCHS PUMF, we calculated the age- and sex- specific prevalence of stroke survivors living with disability among non-institutionalized persons aged 12 and older, for each year that the survey was conducted.

Using the same methods as described above, we adjusted these prevalence rates to account for children aged 0-11 and residents of homes for the aged. We assumed the rate of disability as a result of stroke in children remained consistent across years (0.0214% and 0.0181% for males and females, respectively).

Using population estimates from Statistics Canada,³⁷ we applied these rates to all non-institutionalized individuals in the given survey year to estimate the total number of non-institutionalized stroke survivors living with disability. For CCHS cycles that spanned two years, we used a population average of the two years.

For our calculations from 2000/01, 2003, 2005, 2007/08 and 2009/10, the number of residents in homes for the aged was available from Statistics Canada.³⁸ For 2011/12, we projected the number of residents in homes for the aged, based on ten years of age- and sex-specific trends. We assumed that the prevalence of stroke survivors living with disability among residents of homes for the aged remained at 25% for all years, as described above.

All prevalence rates were age-adjusted to the 2013 population, as to avoid the effect of changing age structure between years.

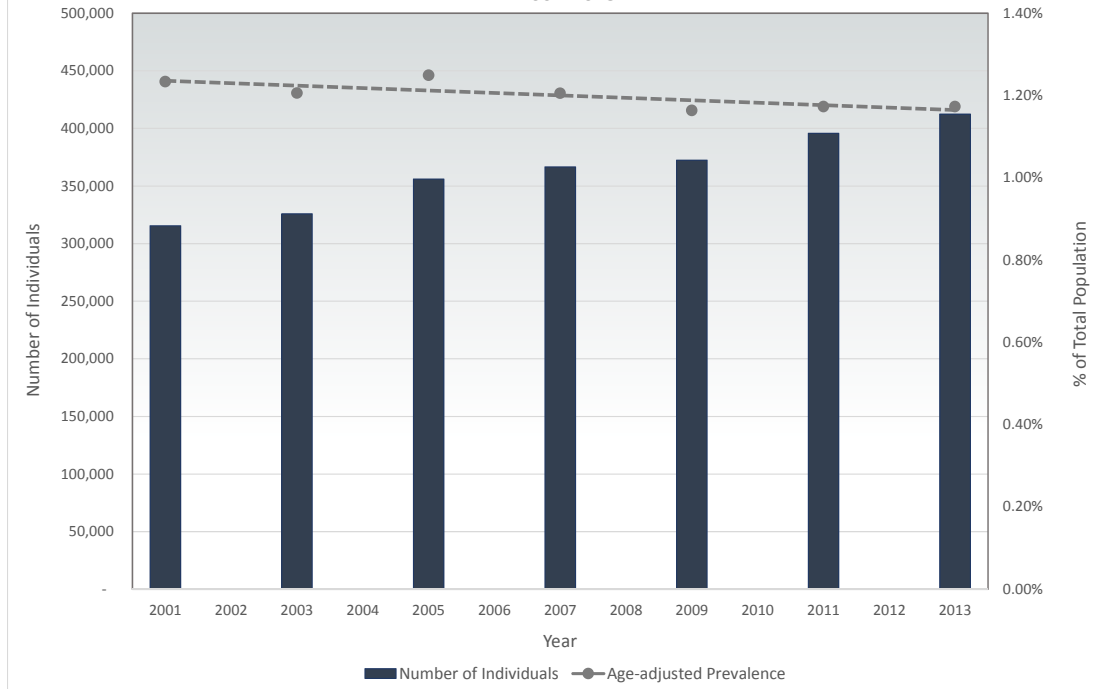
These age-adjusted prevalence rates for the entire Canadian population ranged from a minimum of 1.16% in 2009/10, to a maximum of 1.25% in 2005 (see Figure 8). While there was a marginal decrease in the overall prevalence of stroke survivors living with disability between 2000/01 and 2011/12, this trend was not significant ($p=0.074$). Due to population growth and aging, the total number of stroke survivors living with disability increased by over 80,000.

³⁷ Statistics Canada. *Table 051-0001 - Estimates of population, by age group and sex for July 1, Canada, provinces and territories, annual*. 2014. Available at <http://www5.statcan.gc.ca/cansim/>. Accessed November 2014.

³⁸ Statistics Canada. *Table 107-5504 - Residents on Books in Residential Care Facilities, by Age Group, Sex, Principal Characteristic of the Predominant Group of Residents and Size of Facility, Canada, Provinces and Territories*. Available online at <http://www5.statcan.gc.ca/cansim/a05?lang=eng&id=1075504&pattern=1075504&searchTypeByValue=1&p2=35>. Accessed January, 2015.

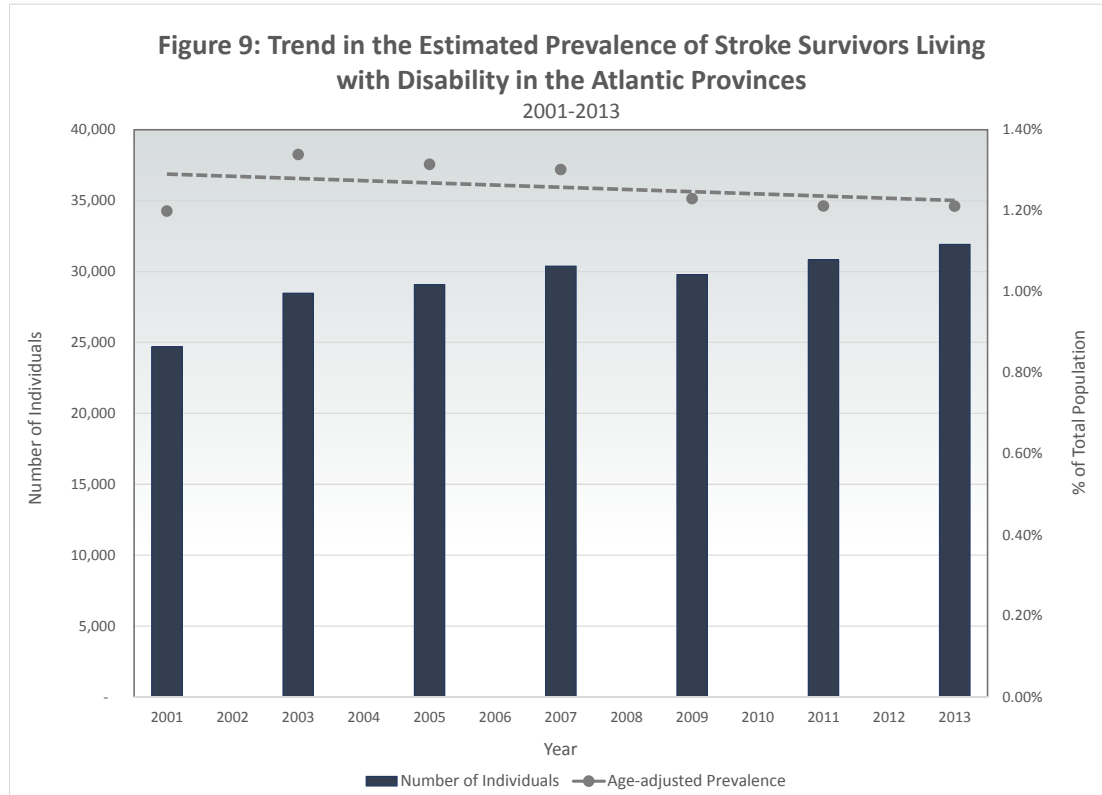
Figure 8: Trend in the Estimated Prevalence of Stroke Survivors Living with Disability in Canada

2001-2013



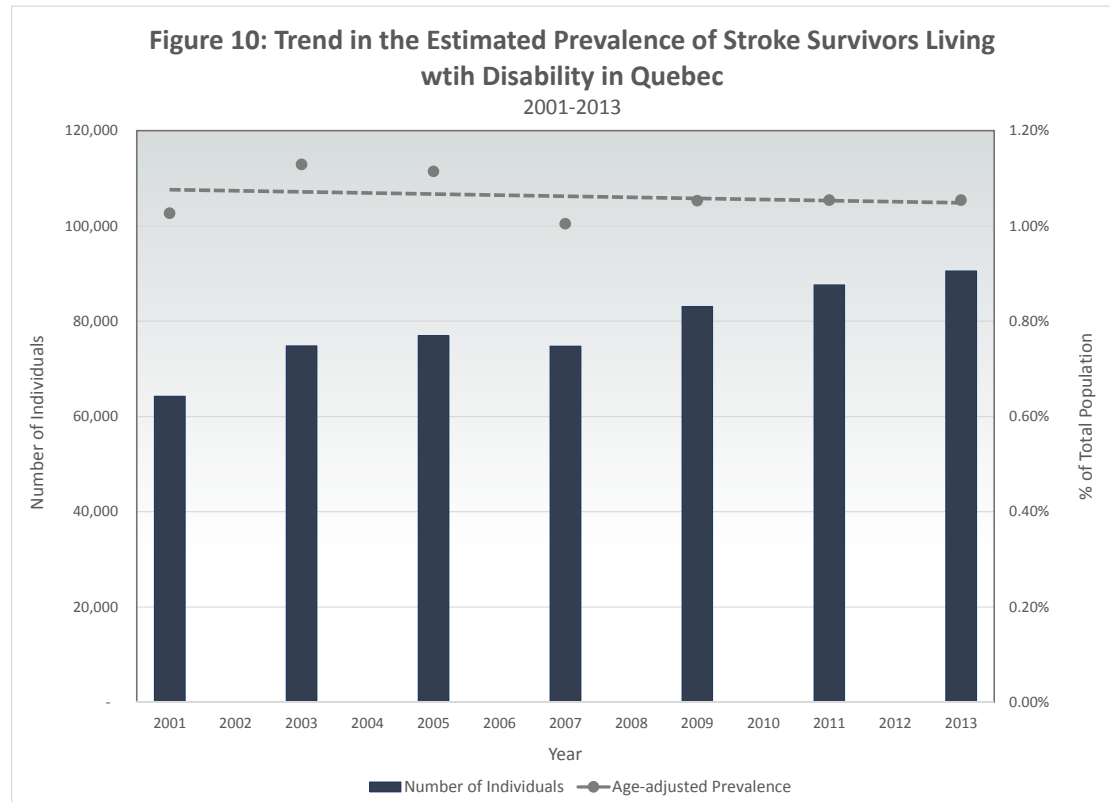
Atlantic Provinces

The age-adjusted prevalence of stroke survivors living with disability in the Atlantic Provinces ranged from a minimum of 1.20% in 2000/01, to a maximum of 1.34% in 2003 (see Figure 9). While there was a marginal decrease in the overall prevalence between 2000/01 and 2011/12, this trend was not significant ($p=0.672$). Due to population growth and aging, the total number of stroke survivors living with disability increased by over 6,000.



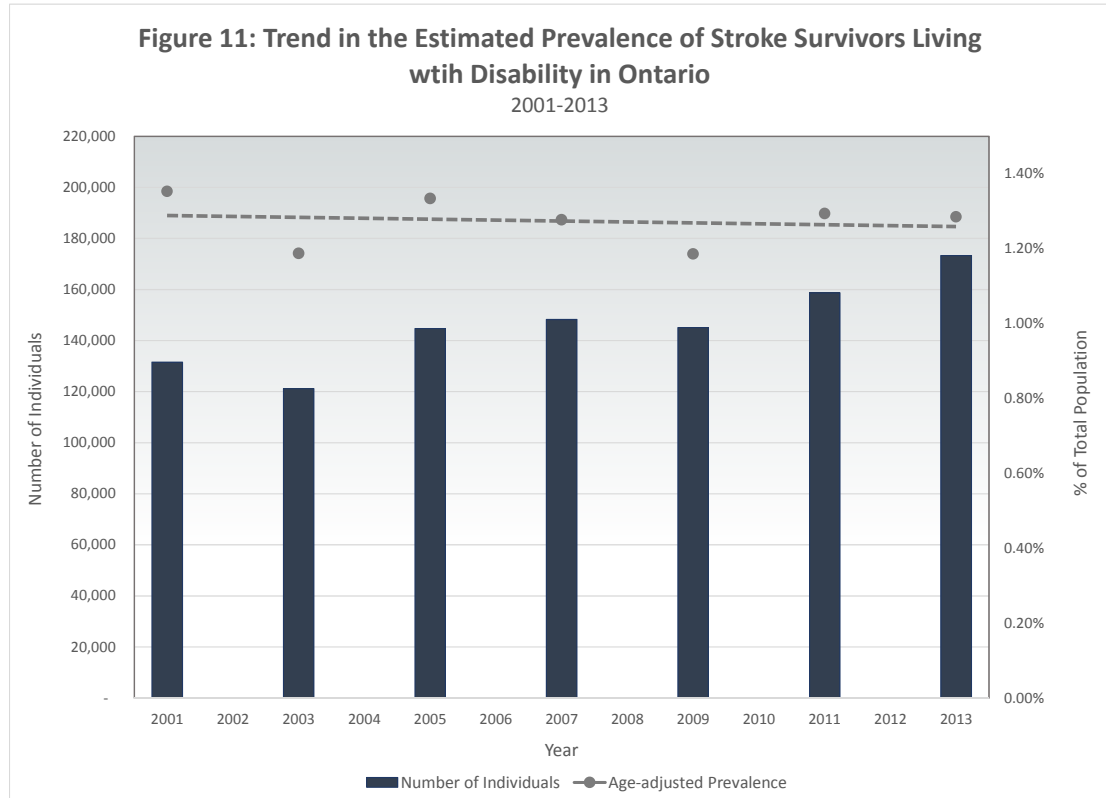
Quebec

The age-adjusted prevalence of stroke survivors living with disability in Quebec ranged from a minimum of 1.00% in 2007/08, to a maximum of 1.13% in 2003 (see Figure 10). While there was a marginal decrease in the overall prevalence between 2000/01 and 2011/12, this trend was not significant ($p=0.675$). Due to population growth and aging, the total number of stroke survivors living with disability increased by over 23,000.



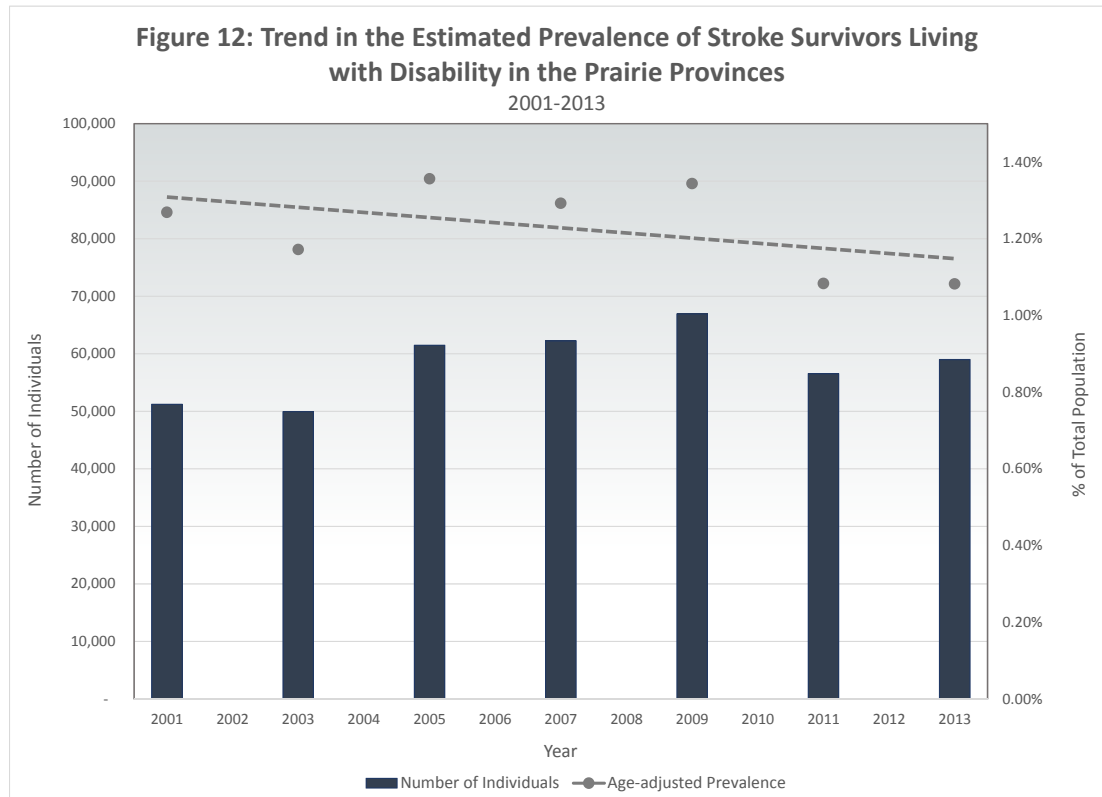
Ontario

The age-adjusted prevalence of stroke survivors living with disability in Ontario ranged from a minimum of 1.19% in both 2003 and 2009/10, to a maximum of 1.35% in 2000/01 (see Figure 11). While there was a marginal decrease in the overall prevalence between 2000/01 and 2011/12, this trend was not significant ($p=0.577$). Due to population growth and aging, the total number of stroke survivors living with disability increased by over 27,000.



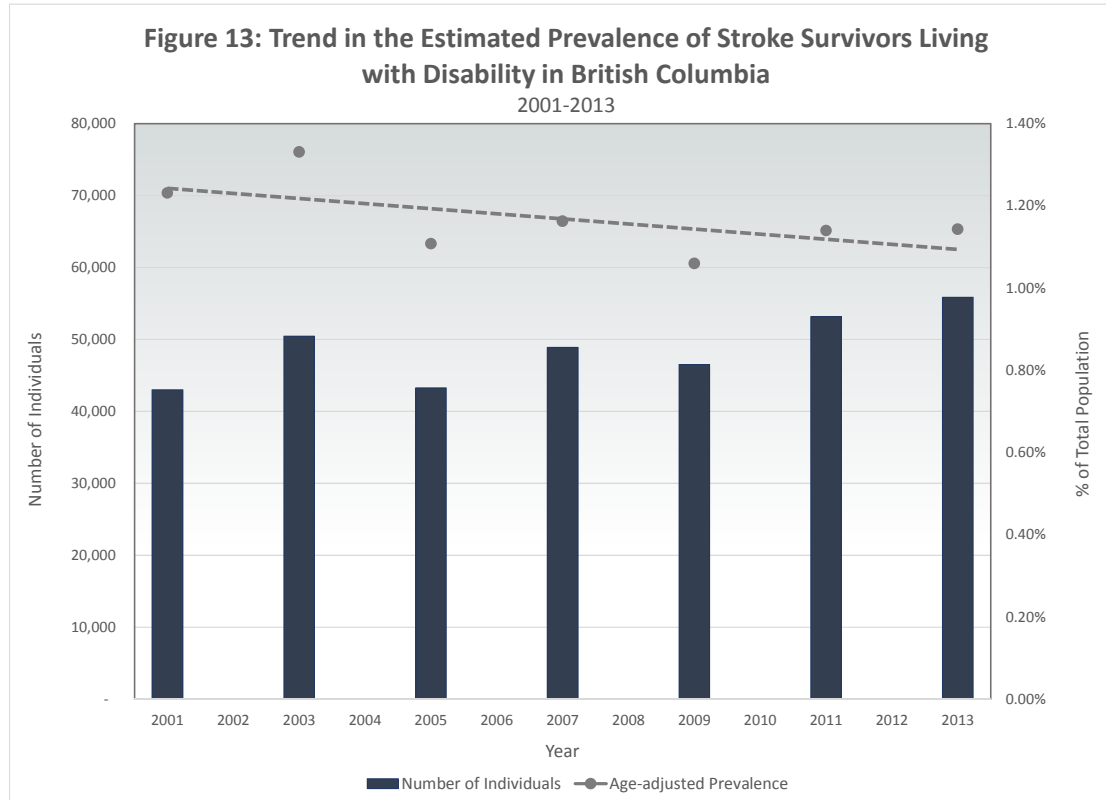
Prairie Provinces

The age-adjusted prevalence of stroke survivors living with disability in the Prairie Provinces ranged from a minimum of 1.08% in 2011/12, to a maximum of 1.36% in 2005 (see Figure 12). While there was a marginal decrease in the overall prevalence between 2000/01 and 2011/12, this trend was not significant ($p=0.662$). Due to population growth and aging, the total number of stroke survivors living with disability increased by over 5,000.



British Columbia

The age-adjusted prevalence of stroke survivors living with disability in British Columbia ranged from a minimum of 1.06% in 2009/10, to a maximum of 1.33% in 2003 (see Figure 13). While there was a marginal decrease in the overall prevalence between 2000/01 and 2011/12, this trend was not significant ($p=0.150$). Due to population growth and aging, the total number of stroke survivors living with disability increased by over 10,000.



Forecasted Prevalence of Stroke Survivors Living with Disability – 2013 to 2038

Canada

We forecasted the prevalence of stroke survivors living with disability in Canada between 2013 and 2038 using a number of different methods. In all methods, we used the same calculations to estimate the prevalence of stroke survivors living with disability among children and residents of homes for the aged.

In order to estimate the prevalence among residents of homes of the aged, all projections used forecasted rates of residential home occupancy based off of ten years of age- and sex-specific trends from Statistics Canada. As above, we assumed that 25% of residents of homes for the aged were stroke survivors living with disability.

We assumed the rate of stroke survivors living with disability among children remained consistent across years (0.0214% and 0.0181% for males and females, respectively). We applied these prevalence rates to population estimates³⁹ for years 2013 and 2014, and population projections⁴⁰ for years 2015 to 2038.

The only variation between the methods was the technique used to forecast the prevalence of stroke survivors living with disability in Canadians aged 12 or older living in the community (i.e., non-institutionalized individuals). Four different approaches were taken, as follows:

Projection A: As there was no significant trend in the overall prevalence of stroke survivors living with disability between 2000/01 and 2011/12, we assumed that rates would remain the same as they were in 2011/12. These age- and sex- specific prevalence rates were applied to non-institutionalized population estimates⁴¹ for years 2013 and 2014, and projections⁴² for years 2015 to 2038.

Projection B: Assuming that the three most recent CCHS cycles would most accurately reflect true prevalence rates, we combined the prevalence of stroke survivors living with disability for 2007/08, 2009/10, and 2011/12 to determine the weighted average for all three cycles. These age- and sex- specific averages were then applied to non-institutionalized population estimates and projections up to 2038.

Projection C: A weighted average of the prevalence of stroke survivors living with disability was calculated for all CCHS cycles. These age- and sex- specific prevalences were applied to non-institutionalized population estimates and populations projections up to 2038.

³⁹ Statistics Canada. *Table 051-0001 - Estimates of population, by age group and sex for July 1, Canada, provinces and territories, annual*. 2014. Available at <http://www5.statcan.gc.ca/cansim/>. Accessed November 2014.

⁴⁰ Statistics Canada. *Table 052-0005 - Projected population, by projection scenario, age and sex, as of July 1, Canada, provinces and territories, annual*. 2014. Available at <http://www5.statcan.gc.ca/cansim/>. Accessed November 2014.

⁴¹ Statistics Canada. *Table 051-0001 - Estimates of population, by age group and sex for July 1, Canada, provinces and territories, annual*. 2014. Available at <http://www5.statcan.gc.ca/cansim/>. Accessed November 2014.

⁴² Statistics Canada. *Table 052-0005 - Projected population, by projection scenario, age and sex, as of July 1, Canada, provinces and territories, annual*. 2014. Available at <http://www5.statcan.gc.ca/cansim/>. Accessed November 2014.

Projection D: A regression analysis over time was performed on all age- and sex-specific prevalence rates from 2000/01 to 2011/12. If trends were both significant ($p < 0.05$) and had a predicted $R^2 > 50\%$, they were used to forecast future age- and sex-specific prevalence rates. For age groups in which the regression analysis did not meet these two criteria, than the weighted average prevalence for all CCHS cycles was used to project stroke prevalence to 2038 (as in Projection C).

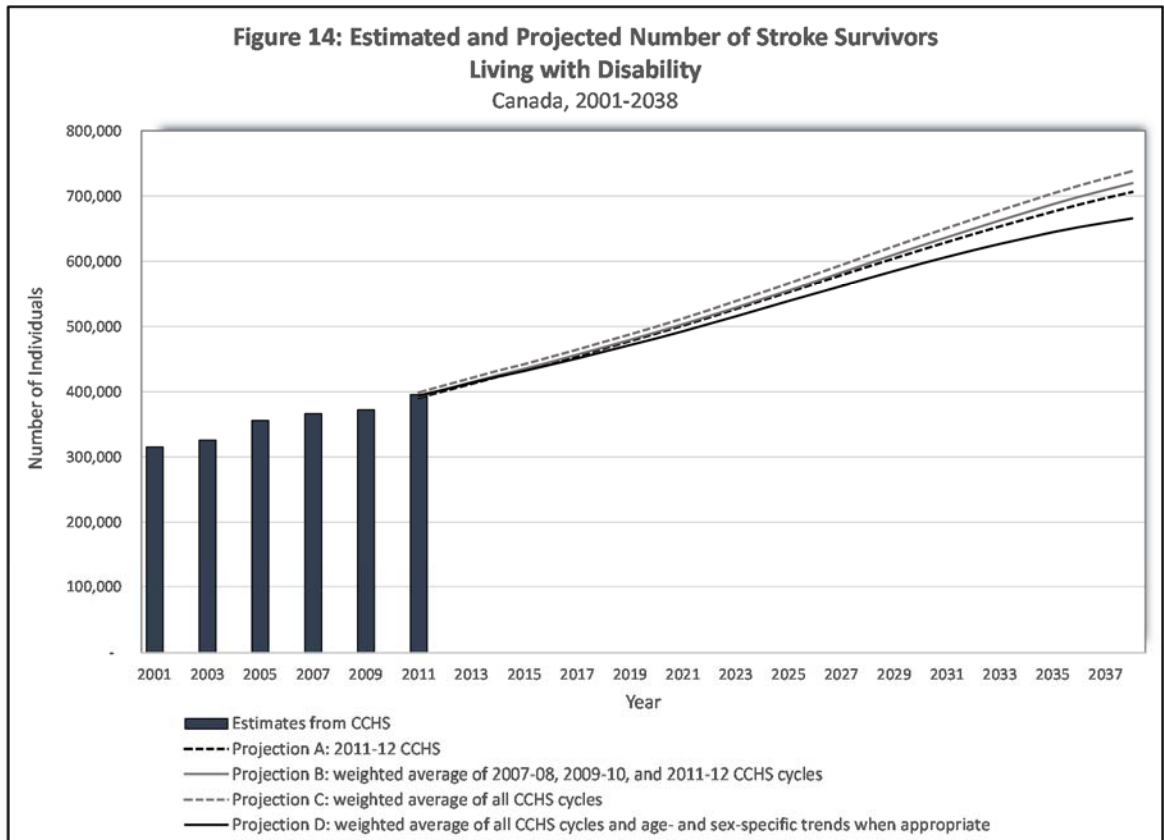
The relevant statistics from our regression analyses for age- and sex- specific trends in CCHS prevalence data for Canada are presented in Table 22. Only two age groups met our criteria for a sufficient trend (females, aged 55-59 and 80+), as highlighted.

Table 22: Interpretation of Stroke Prevalence Regression Analysis										
CCHS 2001/02 - 2011/12, by Age and Sex, for Non-institutionalized Individuals in Canada										
Males	Statistical Results				CCHS Stroke Prevalence					
	S (linear)	R ²	R ² (Pred)	P	2000/01	2003	2005	2007/08	2009/10	2011/12
12-39	3.32	48.0%	0.0%	0.127	0.10%	0.11%	0.18%	0.12%	0.15%	0.19%
40-44	3.90	28.2%	0.0%	0.279	0.25%	0.24%	0.31%	0.49%	0.25%	0.41%
45-49	3.73	34.5%	0.0%	0.221	0.41%	0.36%	0.61%	0.55%	0.48%	0.57%
50-54	4.38	9.7%	0.0%	0.548	0.61%	0.96%	0.87%	0.90%	0.88%	0.35%
55-59	4.57	1.5%	0.0%	0.817	1.03%	1.09%	1.61%	1.33%	1.02%	1.01%
60-64	4.59	0.6%	0.0%	0.888	2.01%	2.37%	2.48%	1.92%	2.08%	2.37%
65-69	3.72	34.7%	0.0%	0.219	3.61%	2.90%	3.60%	3.05%	2.63%	3.04%
70-74	4.60	0.2%	0.0%	0.937	4.43%	4.66%	4.26%	5.54%	4.29%	4.26%
75-79	2.85	61.8%	35.5%	0.064	7.98%	6.73%	5.13%	5.23%	5.18%	5.55%
80+	2.39	73.0%	0.0%	0.030	9.16%	8.91%	8.53%	8.77%	8.21%	6.93%
Females										
12-39	4.29	13.0%	0.0%	0.482	0.15%	0.13%	0.15%	0.11%	0.11%	0.26%
40-44	4.55	2.4%	0.0%	0.771	0.28%	0.41%	0.30%	0.30%	0.43%	0.21%
45-49	3.90	28.2%	0.0%	0.278	0.38%	0.41%	0.84%	0.49%	0.74%	0.63%
50-54	4.30	12.9%	0.0%	0.485	0.51%	0.90%	0.81%	0.83%	0.95%	0.68%
55-59	1.53	89.0%	77.6%	0.005	1.18%	1.16%	1.11%	0.94%	0.98%	0.82%
60-64	3.59	39.4%	0.0%	0.182	1.67%	1.57%	1.48%	2.02%	1.74%	1.95%
65-69	2.99	57.8%	22.3%	0.079	2.25%	1.97%	2.33%	2.12%	2.94%	2.92%
70-74	4.24	15.4%	0.0%	0.441	3.50%	3.35%	2.82%	2.51%	3.03%	3.25%
75-79	3.34	47.4%	2.9%	0.130	5.11%	4.26%	4.19%	4.58%	3.50%	4.13%
80+	2.32	74.6%	56.6%	0.027	7.11%	6.53%	6.83%	6.73%	6.18%	5.76%

The R^2 value, or the coefficient of determination, measures the closeness of the data points to the fitted regression line. This value indicates the percentage of the variation in the data that is accounted for by a linear trend, as opposed to unexplained variation. A higher R^2 value means that the model better fits the data. Alternatively, the predicted R^2 value is an indication of how well the model will predict future observations, and accounts for noise created by too many predictors.

Like R^2 , the standard error of the estimate, or S , is also measures the goodness-of-fit of the model. If trends were both significant ($p < 0.05$) and had a predicted $R^2 > 50\%$, we also checked the results using a quadratic trend. In all cases the S value remained relatively unchanged, suggesting that a quadratic trend did not produce a better fitting model than a linear trend. This value indicates the average distance each data point falls from the regression line. An S value of 0 means that all data points fall directly on the line. A lower S value using a quadratic trend would suggest a better fit than a linear trend.

Using these four projection methods, we were able to predict the total number of stroke survivors living with disability from 2013-2038 (Figure 14).



We project that in 2038, there will be between 666,000 (Projection D) and 738,000 (Projection C) stroke survivors living with disability in Canada. This represents an expected increase of between 61.4% and 79.0% from 2013.

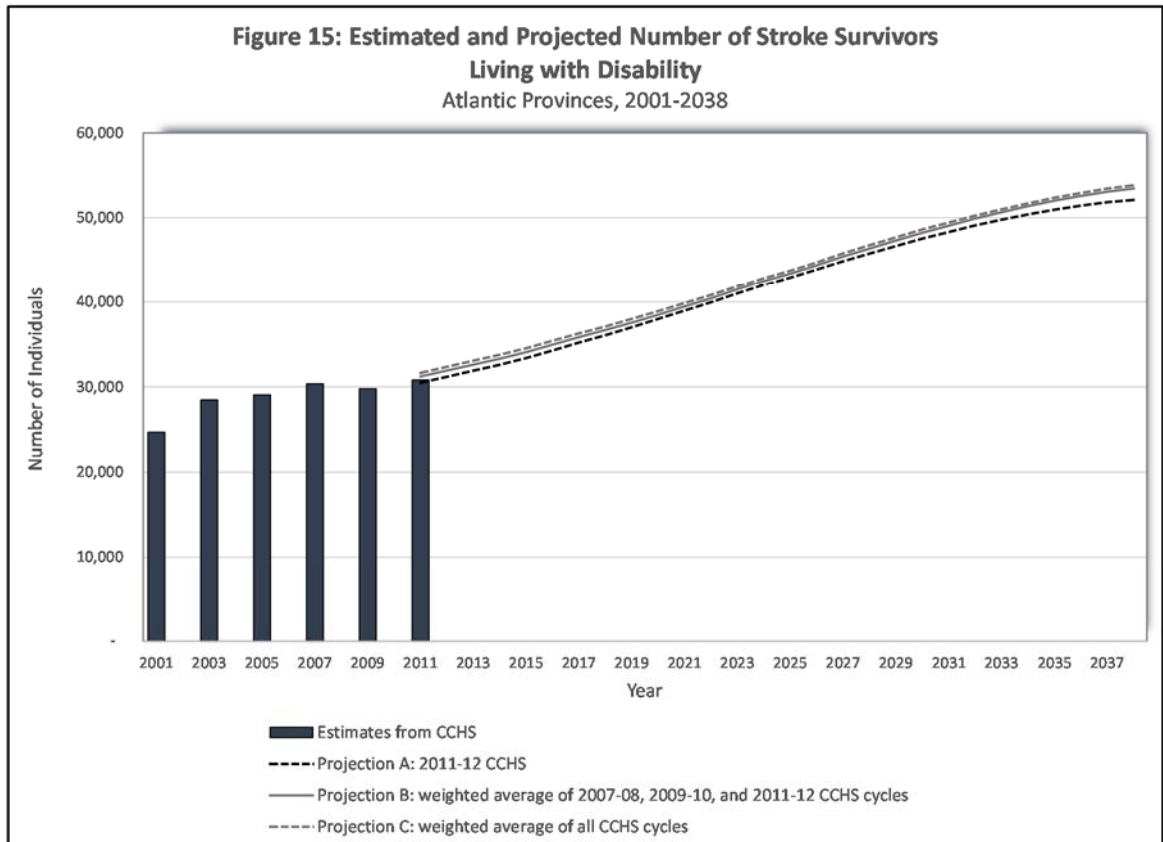
Atlantic Provinces

The four methods for projecting the number of stroke survivors living with disability, as described above, were also used with age- and sex-specific prevalence rates for the Atlantic Provinces. Using Projection D, no age- or sex-specific trends met our criteria for use, therefore Projection D was not included for this region (see Table 23).

Table 23: Interpretation of Stroke Prevalence Regression Analysis
 CCHS 2001/02 - 2011/12, by Age and Sex, for Non-institutionalized Individuals
 in the Atlantic Provinces

	Statistical Results				CCHS Stroke Prevalence					
	S (linear)	R ²	R ² (Pred)	P	2000/01	2003	2005	2007/08	2009/10	2011/12
Males										
12-39	4.08	21.5%	0.0%	0.354	0.03%	0.02%	0.03%	0.06%	0.02%	0.05%
40-44	4.52	3.6%	0.0%	0.718	0.90%	0.20%	0.00%	0.87%	0.38%	0.35%
45-49	3.64	37.6%	0.0%	0.196	0.63%	0.86%	0.81%	0.81%	0.20%	0.40%
50-54	4.58	0.9%	0.0%	0.859	0.85%	0.86%	0.57%	1.09%	0.84%	0.80%
55-59	3.24	50.5%	3.6%	0.113	0.41%	0.74%	1.49%	1.13%	1.58%	1.15%
60-64	4.22	15.9%	0.0%	0.433	1.65%	2.60%	2.35%	4.29%	2.53%	2.50%
65-69	4.61	0.0%	0.0%	0.998	3.16%	3.92%	5.09%	1.96%	2.80%	4.55%
70-74	3.90	28.2%	0.0%	0.278	6.14%	7.03%	3.54%	5.32%	5.23%	4.32%
75-79	4.39	9.2%	0.0%	0.559	6.61%	4.45%	6.77%	6.83%	5.13%	7.63%
80+	4.49	4.9%	0.0%	0.673	8.75%	10.89%	5.18%	7.25%	10.04%	6.99%
Females										
12-39	2.90	60.4%	27.6%	0.069	0.17%	0.18%	0.12%	0.13%	0.14%	0.04%
40-44	2.99	58.0%	3.3%	0.079	0.13%	0.18%	0.36%	0.11%	0.65%	0.57%
45-49	4.59	0.6%	0.0%	0.889	0.86%	0.92%	0.96%	0.20%	0.35%	1.28%
50-54	3.34	47.4%	23.6%	0.130	0.42%	0.54%	0.50%	0.44%	0.40%	0.17%
55-59	4.47	5.7%	0.0%	0.647	1.04%	0.98%	1.97%	0.98%	1.08%	0.82%
60-64	2.86	61.4%	19.2%	0.065	1.82%	2.12%	1.14%	1.26%	1.42%	0.79%
65-69	4.04	23.0%	0.0%	0.335	2.77%	2.49%	3.49%	3.82%	1.82%	1.33%
70-74	3.87	29.5%	0.0%	0.266	2.54%	2.20%	3.24%	2.02%	2.39%	5.23%
75-79	3.32	47.9%	0.0%	0.127	2.55%	5.89%	4.40%	5.62%	5.44%	5.83%
80+	4.54	2.7%	0.0%	0.757	5.69%	7.12%	8.82%	7.19%	7.22%	5.05%

The results of these projections are presented in Figure 15.



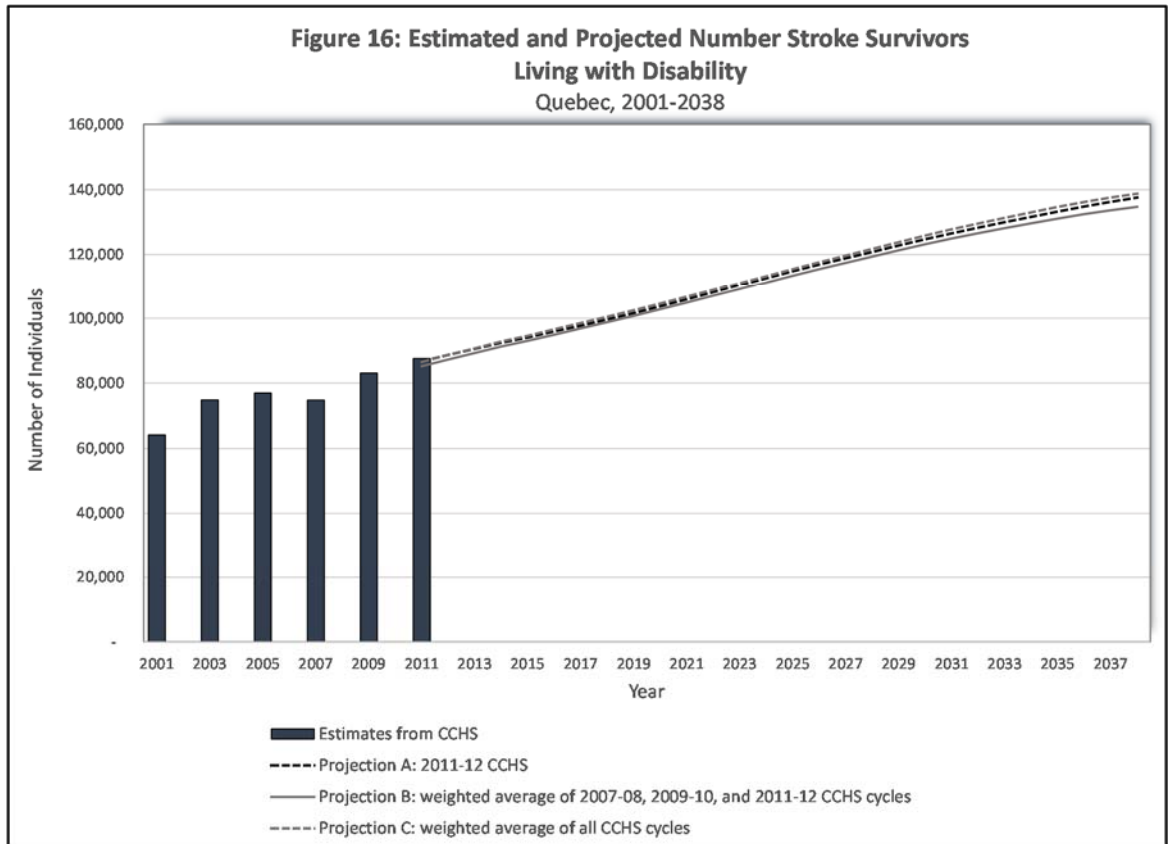
We project that in 2038, there will be between 52,000 (Projection A) and 54,000 (Projection C) stroke survivors living with disability in the Atlantic Provinces. This represents an expected increase between 63.2% and 68.6% from 2013.

Quebec

The four methods for projecting the number of stroke survivors living with disability, as described above, were also used with age- and sex-specific prevalence rates for Quebec. Using Projection D, no age- or sex-specific trends met our criteria for use, therefore Projection D was not included for this region (see Table 24).

Table 24: Interpretation of Stroke Prevalence Regression Analysis										
CCHS 2001/02 - 2011/12, by Age and Sex, for Non-institutionalized Individuals in Quebec										
	Statistical Results				CCHS Stroke Prevalence					
	S (linear)	R ²	R ² (Pred)	P	2000/01	2003	2005	2007/08	2009/10	2011/12
Males										
12-39	4.54	2.6%	0.0%	0.760	0.22%	0.17%	0.39%	0.19%	0.15%	0.34%
40-44	4.12	19.8%	0.0%	0.377	0.10%	0.50%	0.34%	0.21%	0.47%	0.40%
45-49	4.60	0.0%	0.0%	0.979	0.67%	0.12%	0.69%	0.39%	0.85%	0.32%
50-54	3.83	31.0%	0.0%	0.251	1.22%	0.97%	0.83%	0.99%	1.19%	0.47%
55-59	4.39	9.1%	0.0%	0.562	0.81%	1.78%	1.31%	1.33%	0.86%	0.89%
60-64	4.48	5.4%	0.0%	0.657	2.33%	2.40%	2.29%	2.62%	1.48%	2.47%
65-69	3.81	31.5%	0.0%	0.247	2.65%	2.14%	2.76%	2.32%	3.07%	2.99%
70-74	4.51	4.0%	0.0%	0.704	3.80%	2.20%	3.56%	5.27%	3.11%	1.93%
75-79	4.57	1.3%	0.0%	0.828	4.61%	9.33%	3.86%	4.29%	6.58%	7.03%
80+	3.85	30.2%	0.0%	0.259	5.83%	8.33%	8.69%	4.98%	6.09%	4.13%
Females										
12-39	3.47	43.2%	0.0%	0.156	0.10%	0.14%	0.22%	0.19%	0.12%	0.31%
40-44	4.32	11.8%	0.0%	0.505	0.10%	1.07%	0.20%	0.12%	0.30%	0.06%
45-49	3.99	24.9%	0.0%	0.313	0.67%	0.10%	0.70%	0.21%	0.94%	1.00%
50-54	4.60	0.0%	0.0%	0.979	0.96%	0.73%	0.48%	0.96%	0.70%	0.88%
55-59	4.32	11.9%	0.0%	0.503	1.01%	1.11%	1.31%	0.79%	1.04%	0.94%
60-64	4.50	4.7%	0.0%	0.679	1.52%	1.45%	1.36%	2.34%	1.44%	0.89%
65-69	4.09	21.3%	0.0%	0.357	2.03%	1.51%	2.78%	1.75%	2.88%	2.41%
70-74	4.60	0.3%	0.0%	0.915	1.63%	3.86%	1.53%	2.39%	2.81%	1.81%
75-79	4.54	3.0%	0.0%	0.745	2.96%	2.28%	2.30%	2.98%	2.15%	3.22%
80+	4.60	0.2%	0.0%	0.941	5.08%	5.70%	4.69%	3.05%	4.69%	5.96%

The results of these projections are presented in Figure 16.



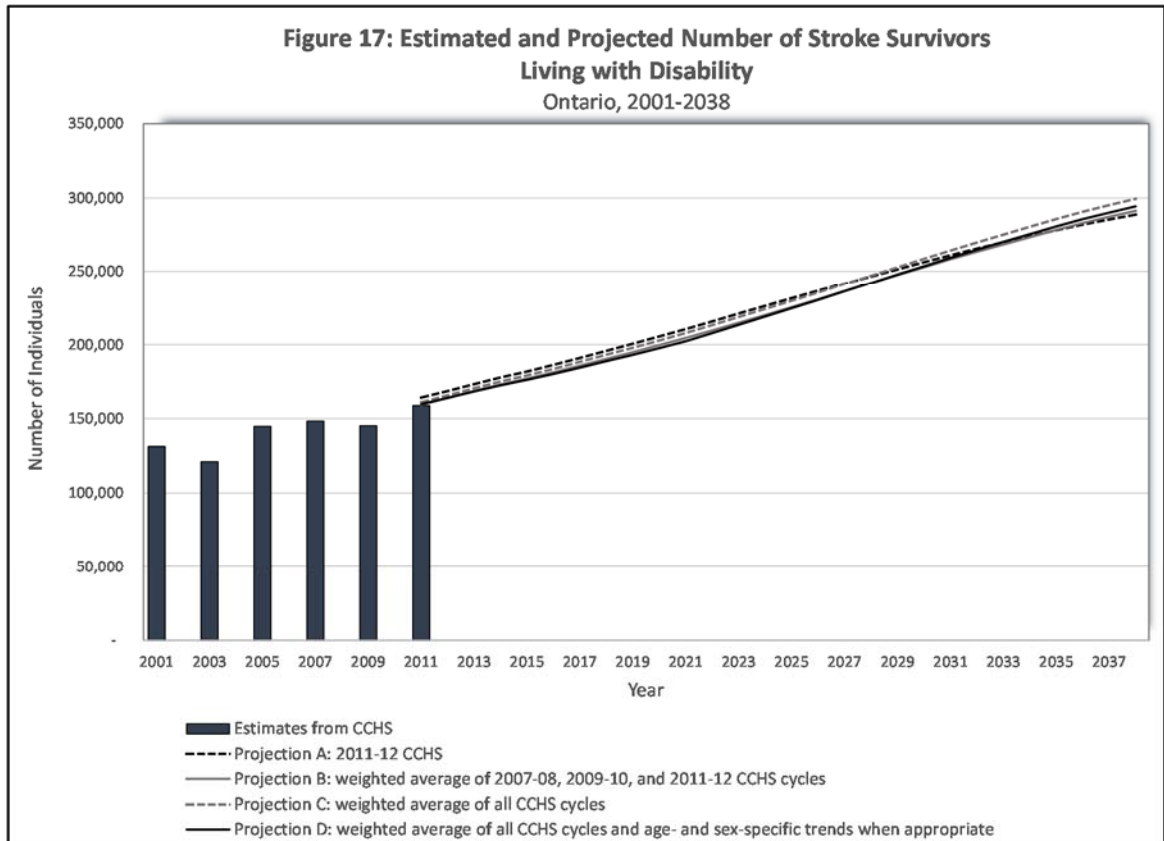
We project that in 2038, there will be between 135,000 (Projection B) and 139,000 (Projection C) stroke survivors living with disability in Quebec. This represents an expected increase between 48.8% and 53.3% from 2013.

Ontario

The four methods for projecting the number of stroke survivors living with disability, as described above, were also used with age- and sex-specific prevalence rates for Ontario. For Projection D, only females aged 55-59 met our criteria for a sufficient trend, as highlighted in Table 25.

Table 25: Interpretation of Stroke Prevalence Regression Analysis										
CCHS 2001/02 - 2011/12, by Age and Sex, for Non-institutionalized Individuals in Ontario										
	Statistical Results				CCHS Stroke Prevalence					
	S (linear)	R ²	R ² (Pred)	P	2000/01	2003	2005	2007/08	2009/10	2011/12
Males										
12-39	2.76	64.0%	30.2%	0.056	0.08%	0.03%	0.12%	0.08%	0.18%	0.17%
40-44	4.11	20.1%	0.0%	0.373	0.24%	0.21%	0.28%	0.51%	0.10%	0.57%
45-49	2.97	58.5%	31.2%	0.077	0.35%	0.19%	0.44%	0.57%	0.41%	0.96%
50-54	4.60	0.2%	0.0%	0.937	0.38%	0.64%	0.96%	0.75%	0.78%	0.27%
55-59	4.60	0.4%	0.0%	0.901	1.18%	0.99%	1.82%	1.31%	1.15%	1.13%
60-64	4.43	7.4%	0.0%	0.601	1.29%	2.10%	3.51%	1.30%	2.11%	2.63%
65-69	4.54	2.7%	0.0%	0.758	3.52%	2.70%	3.22%	3.96%	2.12%	3.32%
70-74	4.26	14.6%	0.0%	0.455	3.73%	5.44%	5.21%	4.61%	4.88%	5.02%
75-79	2.92	59.8%	0.0%	0.071	10.92%	5.57%	6.00%	5.13%	3.79%	5.17%
80+	4.41	8.2%	0.0%	0.582	10.03%	7.89%	9.46%	11.20%	9.36%	7.13%
Females										
12-39	4.56	1.9%	0.0%	0.793	0.19%	0.12%	0.12%	0.06%	0.07%	0.29%
40-44	3.52	41.7%	0.0%	0.166	0.53%	0.35%	0.44%	0.37%	0.42%	0.32%
45-49	4.28	14.9%	0.0%	0.450	0.14%	0.23%	1.40%	0.56%	0.99%	0.54%
50-54	4.17	18.1%	0.0%	0.401	0.23%	1.25%	0.47%	0.96%	1.36%	0.72%
55-59	2.36	73.7%	51.7%	0.029	1.59%	1.33%	0.84%	1.13%	0.95%	0.64%
60-64	4.18	17.6%	0.0%	0.407	1.88%	1.74%	1.54%	2.19%	1.26%	3.05%
65-69	3.79	32.1%	0.0%	0.241	2.82%	2.34%	2.04%	2.09%	3.30%	3.79%
70-74	3.94	26.8%	0.0%	0.292	4.89%	3.36%	2.96%	2.22%	3.28%	3.48%
75-79	3.99	25.0%	0.0%	0.312	7.32%	5.03%	4.33%	6.83%	3.77%	4.93%
80+	3.08	55.2%	15.7%	0.091	7.95%	6.25%	7.70%	7.32%	5.97%	4.97%

The results of these projections are presented in Figure 17.



We project that in 2038, there will be between 289,000 (Projection A) and 299,000 (Projection C) stroke survivors living with disability in Ontario. This represents an expected increase between 66.6% and 72.8% from 2013.

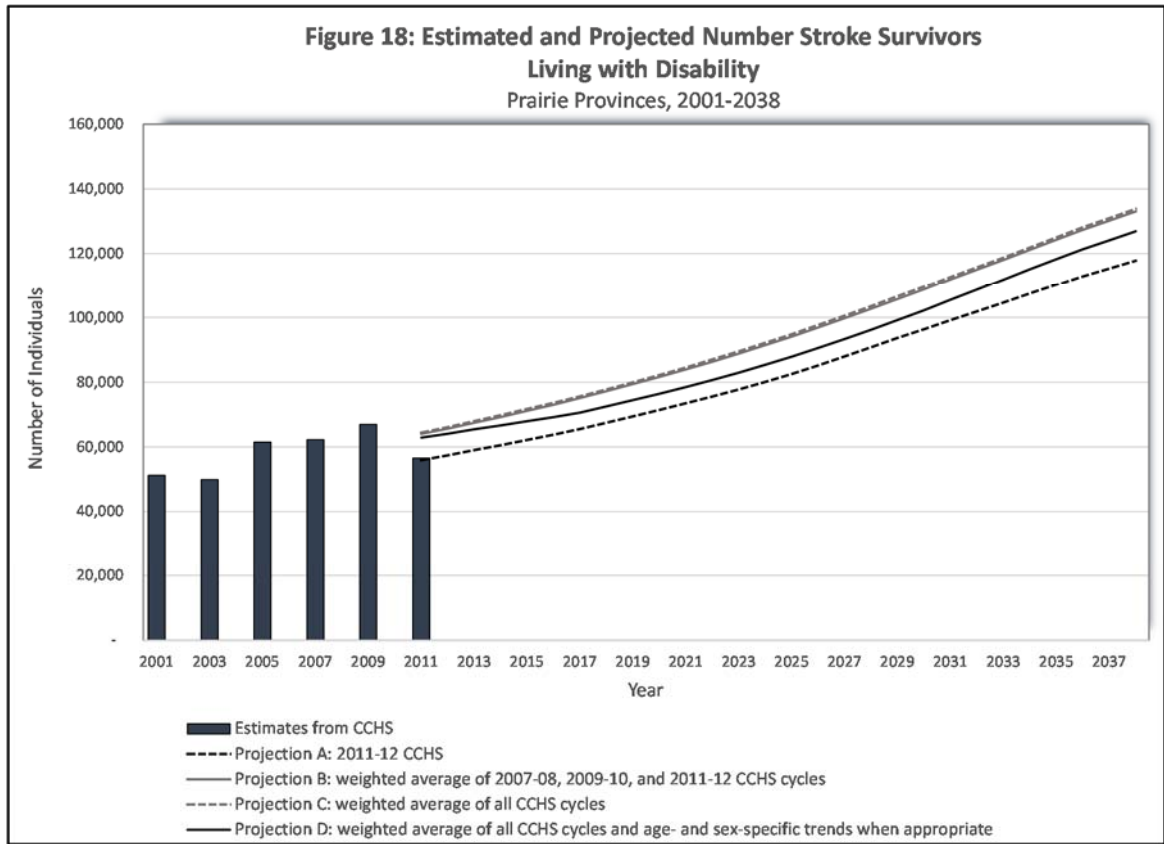
Prairie Provinces

The four methods for projecting the number of stroke survivors living with disability, as described above, were also used with age- and sex-specific prevalence rates for the Prairie Provinces. For Projection D, only males aged 65-69 met our criteria for a sufficient trend, as highlighted in Table 26.

Table 26: Interpretation of Stroke Prevalence Regression Analysis
CCHS 2001/02 - 2011/12, by Age and Sex, for Non-institutionalized Individuals
in the Prairie Provinces

	Statistical Results				CCHS Stroke Prevalence					
	S (linear)	R ²	R ² (Pred)	P	2000/01	2003	2005	2007/08	2009/10	2011/12
Males										
12-39	3.29	48.9%	0.0%	0.122	0.10%	0.13%	0.13%	0.14%	0.11%	0.18%
40-44	4.52	3.8%	0.0%	0.711	0.25%	0.17%	0.78%	0.58%	0.18%	0.07%
45-49	4.45	6.8%	0.0%	0.618	0.08%	0.81%	0.79%	0.20%	0.40%	0.11%
50-54	4.08	21.7%	0.0%	0.352	0.40%	1.05%	0.86%	0.72%	0.32%	0.29%
55-59	4.57	1.7%	0.0%	0.808	1.55%	0.30%	1.99%	2.00%	0.74%	0.95%
60-64	4.58	0.9%	0.0%	0.858	2.58%	2.87%	1.69%	1.42%	3.98%	1.62%
65-69	1.22	93.0%	82.9%	0.002	5.67%	4.04%	4.12%	2.65%	2.45%	2.06%
70-74	4.38	9.3%	0.0%	0.556	5.01%	3.39%	4.08%	6.73%	4.37%	5.17%
75-79	4.43	7.6%	0.0%	0.596	7.31%	3.40%	5.65%	6.05%	6.65%	3.65%
80+	2.23	76.5%	18.2%	0.023	11.47%	9.48%	8.17%	7.93%	8.08%	7.66%
Females										
12-39	4.57	1.4%	0.0%	0.822	0.16%	0.18%	0.23%	0.09%	0.20%	0.20%
40-44	4.35	10.6%	0.0%	0.528	0.21%	0.01%	0.09%	0.26%	0.73%	0.06%
45-49	4.37	10.1%	0.0%	0.539	0.09%	0.54%	0.07%	1.21%	0.36%	0.42%
50-54	4.59	0.7%	0.0%	0.873	0.65%	0.73%	1.60%	0.17%	1.29%	0.79%
55-59	4.60	0.3%	0.0%	0.919	0.94%	0.69%	0.90%	1.04%	1.37%	0.55%
60-64	4.38	9.7%	0.0%	0.549	0.44%	1.86%	2.73%	1.90%	3.71%	0.82%
65-69	4.00	24.4%	0.0%	0.319	2.28%	2.43%	2.28%	1.94%	3.85%	2.75%
70-74	4.59	0.7%	0.0%	0.875	4.08%	3.25%	4.31%	3.06%	2.99%	4.82%
75-79	4.61	0.0%	0.0%	0.994	3.43%	2.89%	7.15%	3.31%	5.27%	2.83%
80+	4.47	5.7%	0.0%	0.649	6.53%	6.49%	5.82%	10.84%	5.98%	7.34%

The results of these projections are presented in Figure 18.



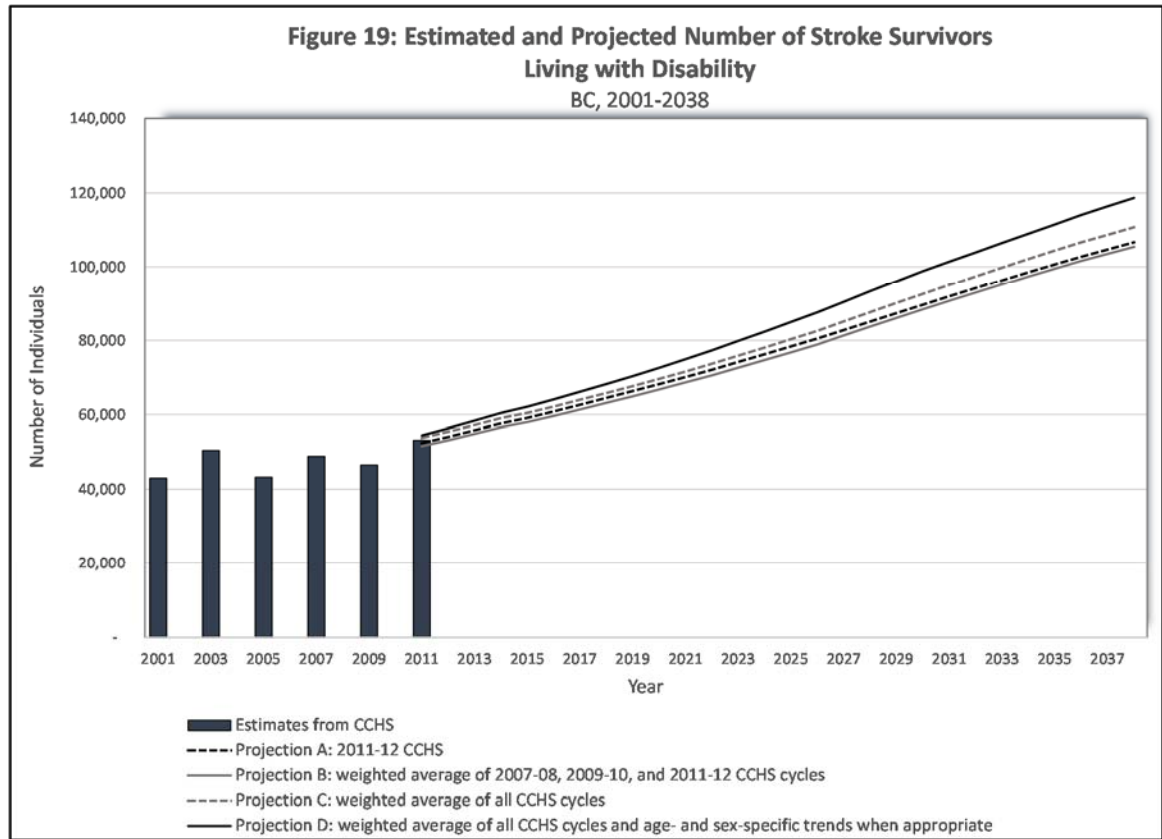
We project that in 2038, there will be between 118,000 (Projection A) and 134,000 (Projection C) stroke survivors living with disability in the Prairie Provinces. This represents an expected increase between 99.7% and 126.9% from 2013.

British Columbia

The four methods for projecting the number of stroke survivors living with disability, as described above, were also used with age- and sex-specific prevalence rates for British Columbia. For Projection D, only females aged 65-69 met our criteria for a sufficient trend, as highlighted in Table 27.

Table 27: Interpretation of Stroke Prevalence Regression Analysis										
CCHS 2001/02 - 2011/12, by Age and Sex, for Non-institutionalized Individuals in British Columbia										
	Statistical Results				CCHS Stroke Prevalence					
	S (linear)	R²	R² (Pred)	P	2000/01	2003	2005	2007/08	2009/10	2011/12
Males										
12-39	4.60	0.4%	0.0%	0.902	0.02%	0.25%	0.11%	0.09%	0.18%	0.03%
40-44	3.57	40.0%	0.0%	0.178	0.21%	0.00%	0.00%	0.64%	0.40%	0.44%
45-49	4.56	2.0%	0.0%	0.789	0.42%	0.38%	0.63%	1.17%	0.24%	0.54%
50-54	4.60	0.2%	0.0%	0.943	0.18%	1.78%	0.86%	1.14%	1.28%	0.26%
55-59	4.16	18.5%	0.0%	0.394	0.92%	1.11%	1.22%	0.76%	0.82%	0.91%
60-64	4.15	18.6%	0.0%	0.393	2.77%	2.39%	0.82%	1.30%	0.77%	2.29%
65-69	4.15	18.9%	0.0%	0.389	3.63%	3.10%	5.05%	2.81%	3.31%	2.54%
70-74	4.50	4.6%	0.0%	0.684	5.84%	7.27%	3.40%	7.15%	4.08%	5.63%
75-79	4.05	22.8%	0.0%	0.339	6.80%	10.93%	3.52%	5.11%	5.13%	5.26%
80+	4.38	9.5%	0.0%	0.552	9.67%	10.40%	8.34%	9.58%	7.56%	9.88%
Females										
12-39	4.15	18.9%	0.0%	0.389	0.10%	0.07%	0.03%	0.14%	0.02%	0.24%
40-44	4.57	1.4%	0.0%	0.826	0.09%	0.04%	0.30%	0.56%	0.20%	0.01%
45-49	3.30	48.7%	0.0%	0.123	0.60%	0.97%	0.39%	0.10%	0.34%	0.22%
50-54	0.46	2.2%	0.0%	0.779	0.31%	0.69%	1.62%	1.22%	0.27%	0.29%
55-59	0.46	0.5%	0.0%	0.895	0.79%	1.32%	1.16%	0.49%	0.45%	1.36%
60-64	4.55	2.4%	0.0%	0.768	2.67%	0.44%	0.43%	1.47%	1.48%	2.47%
65-69	1.90	80.0%	67.4%	0.012	0.85%	0.84%	1.75%	2.10%	1.78%	2.54%
70-74	4.28	13.5%	0.0%	0.474	3.11%	2.88%	2.90%	3.30%	3.21%	2.30%
75-79	3.11	54.4%	12.3%	0.094	5.35%	6.27%	4.05%	2.07%	2.31%	3.62%
80+	3.63	37.9%	0.0%	0.193	9.90%	8.01%	8.11%	6.35%	9.22%	6.10%

The results of these projections are presented in Figure 19.



We project that in 2038, there will be between 105,000 (Projection B) and 119,000 (Projection D) stroke survivors living with disability in British Columbia. This represents an expected increase between 88.8% and 112.5% from 2013.

Summary

The number of stroke survivors living with disability in Canada is projected to increase from 412,000 in 2013, to 666,000-738,000 in 2038 (see table 28). In some regions, we expect that the prevalence of stroke survivors living with disability will as much as double by 2038.

Table 28: Projected Number of Stroke Survivors Living with Disability
By Region in 2013 and 2039
Including residents of Homes for the Aged and Children ages 0-11

	Estimated Number of Individuals in 2013	Projected Number of Individuals in 2038
Atlantic Provinces	32,000	52,000 - 54,000
Quebec	91,000	135,000 - 139,000
Ontario	173,000	289,000 - 299,000
Prairie Provinces	59,000	118,000 - 134,000
British Columbia	56,000	105,000 - 119,000
Canada	412,000	666,000 - 738,000

Summary and Conclusions

Previous estimates of stroke prevalence have suggested that there are 315,000 stroke survivors living with disability in Canada. This value was estimated based off of the 2009/10 Canadian Community Health Survey (CCHS), which asked respondents, “Do you suffer from the effects of a stroke?” However, the CCHS, an annual survey of over 65,000 Canadians, does not capture children under the age of 12, or individuals living in institutions. In particular, there are much higher rates of stroke survivors living with disability among people living in institutions than those living in the community, suggesting that the estimate of 315,000 could underestimate the true prevalence of stroke survivors living with disability.

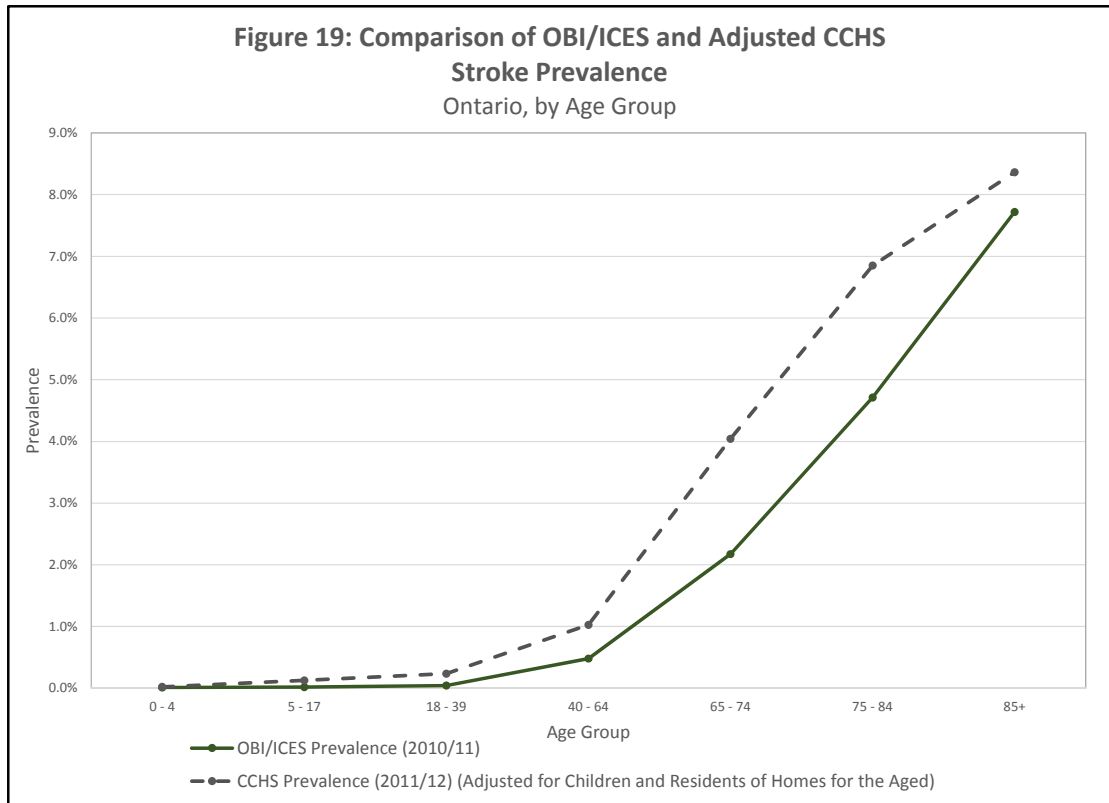
We investigated a number of sources of stroke prevalence data in order to determine one or more suitable options for providing an updated estimate of the prevalence of stroke in Canada and a forecast through to 2038. These sources include prevalence estimates from the US BRFSS, the Australian SDAC, the Ontario OBI/ICES project, and the CCHS. When applicable, we applied age- and sex- specific prevalence rates from these sources to the 2013 Canadian population.

The US BRFSS included a question regarding stroke diagnosis; however, based on the nature of the survey and the low response rate, the results are not suitable for estimating stroke in the Canadian population.

The SDAC, however, captured a sample that well represents the entire Australian population, including children and those living in cared-accommodation facilities. It included questions that enable the calculation of both the number of stroke survivors, and those who have long-term effects of stroke that interfere with everyday activities. From these data, the large difference between rates of stroke survivorship and rates of stroke survivorship with disability becomes clear. In fact, the overall prevalence of stroke survivors in Australia was 2.34%, of which two-thirds were living with disability, and one-third were fully recovered. This difference draws attention to the importance of clarifying the intended population to be included in calculating the prevalence of stroke survivors. The focus of the current analysis has been on the prevalence of stroke survivors living with disability and therefore does not include stroke survivors who have experienced a full recovery.

Estimates of stroke prevalence in Ontario from the OBI and ICES, were calculated from administrative data on hospitalizations, and provide an excellent source of data for determining stroke event incidence and survivorship among those hospitalized.

We suspect, however, that the OBI and ICES data may underestimate the prevalence of stroke survivors among non-elderly populations, as the data do not account for individuals who suffered their stroke prior to the beginning of the data collection period and have not been hospitalized for stroke since. Indeed, when Ontario-specific prevalence rates were applied to the entire Canadian population in 2013, we estimated that approximately 264,000 individuals were stroke or TIA survivors. This value is much lower than the value obtained using adjusted 2011/12 CCHS data. However, as demonstrated in Figure 19, CCHS prevalence rates among non-elderly individuals (adjusted for children and residents of homes for the aged) were up to two times higher than those for OBI/ICES. Conversely, prevalence rates among the elderly were very similar (for ages 85+, 7.72% and 8.36% from OBI/ICES and adjusted CCHS, respectively).



In addition to this, a comparison of CCHS data across the country suggests that Ontario has the highest age-adjusted prevalence of stroke survivors living with disability in Canada (in 2011/12, 1.29% compared to a range from 1.05% in Quebec to 1.21% in the Atlantic provinces, with an average of 1.17% for all of Canada, see Table 20). For this reason, the OBI/ICES prevalence rates may not be applicable to the entire country.

Although the CCHS does not survey children under the age of 12 or those living in institutions, it is able to provide a useful indication of the number of stroke survivors living with disability within the survey population. By expanding these prevalence rates to account for individuals living in homes for the aged (where stroke prevalence is much higher than the general population), and for children aged 0-11, it is possible to calculate a high-level estimate of the total number stroke survivors living with disability in Canada, and within each region of Canada.

In comparing prevalence rates for stroke survivors living with disability among these five regions (the Atlantic provinces, Quebec, Ontario, the Prairie provinces and British Columbia), it is apparent that there is wide variation between jurisdictions. It is likely that a population's risk for stroke can vary largely between regions based on underlying factors such as obesity and smoking rates; therefore, prevalence rates that are derived directly from the Canadian population are considered to be the most accurate estimate. For this reason, combined with the limitations of the OBI/ICES data source, we determined that the CCHS data, enhanced with information on residents of homes for the aged and estimates from the literature for stroke among children aged 0-11, is most suitable for estimating the prevalence of stroke survivors living with disability among Canadians. It also allows for region-specific estimations, which have shown to vary across the provinces.

Using these age- and sex-specific CCHS data and data from homes for the aged and stroke estimates from the literature for children, we estimated that 412,000 Canadians in 2013 were stroke survivors living with disability. Of these, 32,000 were living in the Atlantic provinces, 91,000 in Quebec, 173,000 in Ontario, 59,000 in the Prairie provinces, and 56,000 in British Columbia. When age-adjusted to the 2013 Canadian population, the prevalence of stroke survivors with disability ranged from a high of 1.29% in Ontario, to a low of 1.05% in Quebec.

Between 2000 and 2012, all regions demonstrated a non-significant ($p = .08$) decreasing trend in the age-adjusted prevalence of stroke survivors living with disability. For Canada as a whole, the age-adjusted prevalence of stroke survivors living with disability ranged from a minimum of 1.16% in 2009/10, to a maximum of 1.25% in 2005. Despite the decreasing trend in prevalence over this period, the total number of stroke survivors living with disability increased by over 80,000, largely as a result of population growth and aging.

Using age- and sex-specific data from 2000/01, 2003, 2005, 2007/08 and 2009/10, and 2011/12 CCHS cycles, we forecasted the number of stroke survivors living with disability in each region, up to 2038. The number of stroke survivors living with disability in Canada is projected to increase from 412,000 in 2013, to between 666,000 and 738,000 in 2038. This represents an expected increase from 2011/12 ranging between 68.2% and 86.5%. In some regions, we expect that the prevalence of stroke survivors living with disability will as much as double by 2038. The largest increase is expected in the Prairie provinces, where we estimate that between 118,000 and 134,000 individuals in 2038 will be stroke survivors living with disability. This represents an expected increase from 2011/12 ranging between 108.3% and 136.6%.

The focus of this analysis and report has been to provide an updated estimate of the prevalence of stroke survivors living with disability in Canada, rather than the prevalence of all stroke survivors. Data from Australia in 2012 suggest that 202,000 out of 551,000 (37%) stroke survivors in that country do not have an ongoing disability (see Table 29).

Table 29: Estimated Prevalence of Stroke Survivors by Age and Sex in Australia 2012

Estimated Australian Population											
	0-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80+	Total
Males	6,207,223	810,931	758,763	754,574	675,681	608,506	508,941	371,237	266,923	341,239	11,304,018
Females	6,000,886	824,676	772,109	769,911	690,004	615,776	515,707	384,616	305,304	527,345	11,406,334
Total	12,208,109	1,635,607	1,530,872	1,524,485	1,365,685	1,224,282	1,024,648	755,853	572,227	868,584	23,578,936
Number of Stroke Survivors Living with Disability											
Males	6,813	3,137	4,141	7,285	8,698	13,397	22,044	25,977	23,509	32,367	147,368
Females	7,047	2,446	3,112	6,853	11,392	13,517	10,951	11,826	15,209	43,361	125,714
Total	13,860	5,583	7,253	14,138	20,090	26,914	32,995	37,803	38,718	75,728	348,810
Prevalence of Stroke Survivors Living with Disability											
Males	0.11%	0.39%	0.55%	0.97%	1.29%	2.20%	4.33%	7.00%	8.81%	9.49%	1.30%
Females	0.12%	0.30%	0.40%	0.89%	1.65%	2.20%	2.12%	3.07%	4.98%	8.22%	1.10%
Total	0.11%	0.34%	0.47%	0.93%	1.47%	2.20%	3.22%	5.00%	6.77%	8.72%	1.48%
Number of Stroke Survivors Living without Disability											
Males	3,826	1,687	841	3,377	6,318	7,283	10,918	14,261	11,577	25,713	85,801
Females	3,549	486	1,944	4,156	3,401	3,581	4,669	3,744	6,785	29,071	61,386
Total	7,375	2,173	2,785	7,533	9,719	10,864	15,587	18,005	18,362	54,784	201,971
Prevalence of Stroke Survivors Living without Disability											
Males	0.06%	0.21%	0.11%	0.45%	0.94%	1.20%	2.15%	3.84%	4.34%	7.54%	0.76%
Females	0.06%	0.06%	0.25%	0.54%	0.49%	0.58%	0.91%	0.97%	2.22%	5.51%	0.54%
Total	0.06%	0.13%	0.18%	0.49%	0.71%	0.89%	1.52%	2.38%	3.21%	6.31%	0.86%
Total Number of Stroke Survivors											
Males	10,639	4,824	4,982	10,662	15,016	20,680	32,962	40,238	35,086	58,080	233,169
Females	10,596	2,932	5,056	11,009	14,793	17,098	15,620	15,570	21,994	72,432	187,100
Total	21,235	7,756	10,038	21,671	29,809	37,778	48,582	55,808	57,080	130,512	550,781
Total Prevalence of Stroke Survivors											
Males	0.17%	0.59%	0.66%	1.41%	2.22%	3.40%	6.48%	10.84%	13.14%	17.02%	2.06%
Females	0.18%	0.36%	0.65%	1.43%	2.14%	2.78%	3.03%	4.05%	7.20%	13.74%	1.64%
Total	0.17%	0.47%	0.66%	1.42%	2.18%	3.09%	4.74%	7.38%	9.98%	15.03%	2.34%

To be able to capture this level of information within the CCHS, it would require that the survey include children under the age of 12 and individuals living within institutions. Furthermore, the type of questions in the CCHS with respect to stroke would require enhancement. The current CCHS asks only the following question on stroke: “Do you suffer from the effects of a stroke?” Prior to asking the question, the interviewer is instructed to say: “Remember, we’re interested in conditions diagnosed by a health professional and that are expected to last or have already lasted 6 months or more.”⁴³ The Australian SDAC poses three questions with respect to stroke. All respondents are asked, “Have you ever had a stroke?” If the respondent answers “yes” they are asked the following question: “Do you have any long-term effects as a result of the stroke, that interfere with your doing everyday activities?” Finally, they are asked, “What are the long-term effects that the stroke has caused?”⁴⁴

One of the only ways in which we could obtain an accurate estimate of the overall prevalence of stroke survivors in Canada is if a comprehensive national survey were to ask questions

⁴³ Statistics Canada. *Canadian Community Health Survey Annual Component - 2012 Questionnaire*. 2013. Available at http://www23.statcan.gc.ca/imdb-bmdi/instrument/3226_Q1_V9-eng.pdf. Accessed December 2014.

⁴⁴ Australian Bureau of Statistics. *Survey of Disability Ageing and Carers (SDAC): Household Survey Questionnaire*. 2012-2013. Available at [http://www.ausstats.abs.gov.au/ausstats/subscriber.nsf/0/F1079EC1FADE48B8CA257C21000D88C2/\\$File/44300do001_household_questionnaire.pdf](http://www.ausstats.abs.gov.au/ausstats/subscriber.nsf/0/F1079EC1FADE48B8CA257C21000D88C2/$File/44300do001_household_questionnaire.pdf). Accessed December 2014.

similar to those that were covered by the SDAC. Complete and inclusive data that reports on stroke survivorship and stroke disability among *all* Canadians is essential for agencies charged with planning for the provision of services to those who have experienced a stroke, as well as for monitoring improvements in treatment and prevention.