Prevalence of Individuals Experiencing the Effects of Stroke in Canada
Trends and Projections

Hans Krueger, PhD; Jacqueline Koot, BSc; Ruth E. Hall, PhD; Christina O’Callaghan, BAppSC; Mark Bayley, MD, FRCP; Dale Corbett, PhD

Background and Purpose—Previous estimates of the number and prevalence of individuals experiencing the effects of stroke in Canada are out of date and exclude critical population groups. It is essential to have complete data that report on stroke disability for monitoring and planning purposes. The objective was to provide an updated estimate of the number of individuals experiencing the effects of stroke in Canada (and its regions), trending since 2000 and forecasted prevalence to 2038.

Methods—The prevalence, trends, and projected number of individuals experiencing the effects of stroke were estimated using region-specific survey data and adjusted to account for children aged <12 years and individuals living in homes for the aged.

Results—In 2013, we estimate that there were 405,000 individuals experiencing the effects of stroke in Canada, yielding a prevalence of 1.15%. This value is expected to increase to between 654,000 and 726,000 by 2038. Trends in stroke data between 2000 and 2012 suggest a nonsignificant decrease in stroke prevalence, but a substantial and rising increase in the number of individuals experiencing the effects of stroke. Stroke prevalence varied considerably between regions.

Conclusions—Previous estimates of stroke prevalence have underestimated the true number of individuals experiencing the effects of stroke in Canada. Furthermore, the projected increases that will result from population growth and demographic changes highlight the importance of maintaining up-to-date estimates. (Stroke. 2015;46:2226-2231. DOI: 10.1161/STROKEAHA.115.009616.)

Key Words: disabled persons ■ epidemiology ■ health surveys ■ prevalence ■ stroke

The effects of a stroke can range from mild to severe, and among those who survive their stroke, many never fully recover. Approximately 36% of these survivors are left with significant disabilities 5 years after their stroke and >40% require assistance with activities of daily living. Complete and inclusive data that report on stroke survivorship and stroke disability among populations are 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.

In Canada, available information on stroke survivorship is limited, and when it is reported, it is typically an imprecise approximation. Hodgson estimated that there were 261,000 stroke survivors living in Canada in 1995, a value that has become outdated because of changing stroke incidence, improved treatments, and an aging population. More recently, various governmental and nongovernmental agencies have quoted that approximately 315,000 Canadians are living with the effects of stroke. This estimate, however, is based solely on results from the Canadian Community Health Survey (CCHS), which is self-reported and fails to account for critical subgroups in the population, including children aged <12 years and those living in institutions.

Several other jurisdictions have approximated the prevalence of stroke survivorship and stroke disability among their populations; however, these estimates are difficult to relate to other regions because of different population characteristics, risk factors, and treatment practices.

The purpose of this study is to provide an updated estimate of the prevalence of individuals experiencing the effects of stroke in Canada (and its regions) based on the analysis of data from multiple sources. In addition to deriving an estimate of the number of individuals experiencing the effects of stroke in 2013, we calculate trends in Canada since 2000 and

Received March 31, 2015; final revision received June 1, 2015; accepted June 9, 2015.
From the School of Population and Public Health, University of British Columbia, Vancouver, British Columbia, Canada (H.K.); H. Krueger & Associates Inc, Delta, British Columbia, Canada (H.K., J.K.); Institute for Clinical Evaluative Sciences, Toronto, Ontario, Canada (R.E.H., M.B.); Ontario Stroke Network, Toronto, Ontario, Canada (R.E.H., M.B., C.O’C.); Canadian Partnership for Stroke Recovery, Ottawa, Ontario, Canada (M.B., D.C.); Department of Cellular and Molecular Medicine, University of Ottawa, Ottawa, Canada (D.C.); Division of Physical Medicine and Rehabilitation, Department of Medicine, University of Toronto, Toronto, Canada (M.B.); Brain and Spinal Cord Rehabilitation Program, UHN-Toronto Rehabilitation Institute, Toronto, Canada (M.B.); and Institute for Health Policy, Management and Evaluation, University of Toronto, Toronto, Ontario, Canada (R.E.H.).
The online-only Data Supplement is available with this article at http://stroke.ahajournals.org/lookup/suppl/doi:10.1161/STROKEAHA.115.009616/-/DC1.
Correspondence to Hans Krueger, PhD, H. Krueger & Associates Inc, 4554 48B St, Delta, British Columbia V4K 2R8, Canada. E-mail hans@krueger.ca © 2015 American Heart Association, Inc.

Stroke is available at http://stroke.ahajournals.org DOI: 10.1161/STROKEAHA.115.009616
a forecast through to 2038. The majority of stroke survivors are adults living in the community; therefore, we calculated the prevalence, trends, and projected number of individuals experiencing the effects of stroke using Canada-specific data and adjusted it to account for children aged <12 years and individuals living in homes for the aged. Collectively, these 3 populations capture almost all stroke survivors in Canada.

Materials and Methods

Estimates of prevalence, trends, and projected number of individuals experiencing the effects of stroke were produced for Canada as a whole, as well as using region-specific data for the following regions: the Atlantic provinces (Prince Edward Island, Newfoundland and Labrador, New Brunswick, and Nova Scotia), Quebec, Ontario, the Prairie provinces (Manitoba, Saskatchewan, and Alberta), and British Columbia. The Northwest Territories, Yukon, and Nunavut were excluded from our regional analysis, but included in our analysis of Canada as a whole.

We define individuals experiencing the effects of stroke as individuals who have been diagnosed by a health professional as having had a stroke with resulting cognitive or physical effects that have lasted, or are expected to last, at least 6 months. Many individuals who have had a transient ischemic attack or stroke have no such cognitive or physical consequences and are thus excluded from our analysis.

Stroke Prevalence in the Community-Dwelling Population

The CCHS survey has been conducted annually since 2007 (with data combined into 2-year cycles), and biennially before that. The CCHS produces a Public Use Microdata File that includes annual and combined data for 2-year periods. We estimated the number of individuals experiencing the effects of stroke using data from the 2000/2001, 2003, 2005, 2007/2008, 2009/2010, and 2011/2012 CCHS cycles. Each cycle included ~130,000 survey respondents. Age-, sex-, and region-specific prevalence values were calculated from the weighted number of responses to the question: Do you suffer from the effects of a stroke? (microdata file variable CCC_151). This question was prefaced with the statement: 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. Ages were grouped as follows: 12 to 39, 40 to 44, 45 to 49...75 to 79, ≥80 years. The CCHS does not survey individuals living in institutions, on Aboriginal reserves, or in the Canadian Forces; therefore, we assume that all these populations, excluding individuals living in homes for the aged, have the same rate of stroke as the surveyed portion of the Canadian population. The number of community-dwelling individuals experiencing the effects of stroke aged ≥12 was calculated using age-, sex-, and region-specific prevalence values based on CCHS data multiplied by population estimates (minus the number of residents of homes for the aged, calculated as below).

Stroke Prevalence in Homes for the Aged

The number of individuals living in homes for the aged in 2013 was estimated based on trends from 2000/2001 to 2009/2010 for each region as well as population growth. Data were not available by age or sex for Quebec; therefore, we distributed the Quebec population living in homes for the aged and sex groups based on the Canadian average. Canadian data from 2012/2013 suggest that 21.9% of residents in homes for the aged have been diagnosed with a stroke. This is within the range of estimates from other countries (18%-25%) (see online-only Data Supplement).

Stroke Prevalence in Children

We calculated the incidence of ischemic and hemorrhagic stroke in children aged <1 year (7.90 and 1.53/100,000, respectively) and 1 to 11 (0.74 and 0.55/100,000, respectively) based on 5 years of Canadian hospitalization data. We assumed a mortality rate of 9% after ischemic stroke and 25% after hemorrhagic stroke, and that 62% of ischemic and 32% of hemorrhagic strokes result in disability, based on combined data from multiple studies. Finally, the male to female predominance in pediatric stroke is 1.5:1. From these values we estimated that the prevalence of stroke among males and females aged 0 to 11 years was 10.3 and 7.3/100,000, respectively (see online-only Data Supplement).

Overall population prevalence rates for each region were calculated as the sum of individuals experiencing the effects of stroke in the above 3 groups, with the population for the region of interest as the denominator. All calculated prevalence rates were age adjusted to the 2013 Canadian population.

Projected Stroke Prevalence in 2038

We forecasted the prevalence of individuals experiencing the effects of stroke between 2013 and 2038 using 4 different approaches (referred to as projections A–D). All age-, region- and sex-specific population projections were based on the Statistics Canada medium growth–historical trends (1981–2008) scenario (M1). For projection A, we assumed that the age-, region-, and sex-specific prevalence of individuals experiencing the effects of stroke would remain the same for all years as in 2011/2012; in projection B, we assumed that the prevalence would remain the same as the weighted average for 2007/2008, 2009/2010, and 2011/2012; and in projection C, we assumed that the prevalence would remain the same as the weighted average for all 6 CCHS cycles. To calculate projection D, we performed a linear regression analysis on all age-, region-, and sex-specific prevalence rates from 2000/2001 to 2011/2012. If trends were both significant (P<0.05) and had a predicted R² > 50%, they were used to forecast future prevalence rates. For populations in which the regression analysis did not meet these 2 criteria, the weighted average of all CCHS cycles was used to project stroke prevalence (as in projection C; see online-only Data Supplement).

To estimate the prevalence among residents of homes of the aged, all projections used forecasted rates of residential home occupancy based off of 10 years of age- and sex-specific trends from Statistics Canada. As above, we assumed that 21.9% of residents of homes for the aged were experiencing the effects of stroke. We assumed the prevalence of children experiencing the effects of stroke remained consistent across years. We applied these prevalence rates to population estimates for years 2013 and 2014 and population projections for years 2015 to 2038.

Sensitivity Analysis

We tested the assumption that there would be a 1% annual relative increase in age- and sex-specific prevalence rates starting in 2013, as well as a similar 1% decrease.

Results

Stoke Prevalence in 2013

An estimated 405,000 Canadians were experiencing the effects of stroke in 2013, yielding an overall population prevalence of 1.15% (Table 1). Among males, the overall prevalence was 1.10% (191,000 individuals) and among females was 1.21% (214,000 individuals). Of the 405,000, an estimated 354,500 (87.6%) are community-dwelling adults, 49,900 (12.3%) live in homes for the aged, and 400 (0.1%) are children. As expected, the prevalence of stroke increases substantially with age (Figure 1). The age-adjusted prevalence of individuals experiencing the effects of stroke varies across the country from a low of 1.04% in Quebec to a high of 1.26% in Ontario (Table 2).
For Canada as a whole, the age-adjusted prevalence of individuals experiencing the effects of stroke ranged from a maximum of 1.23% in 2005 to a minimum of 1.14% in 2009/2010 (Figure 2). Although all regions demonstrated an overall decreasing trend in age-adjusted prevalence, none of these trends were statistically significant. Despite relatively stable prevalence rates between 2000 and 2013, the total number of individuals experiencing the effects of stroke in Canada increased by 95,000 (31%) as a result of population growth and aging (Table 3).

Projected Stroke Prevalence in 2038
The number of individuals experiencing the effects of stroke in Canada is projected to increase from 405,000 in 2013 to between 654,000 and 726,000 in 2038 (Figure 3). This represents an expected increase from 2013 that ranges between 62% and 79%. In some regions, we expect that the prevalence of individuals experiencing the effects of stroke will as much as double by 2038. The overall prevalence in the population is expected to increase from 1.15% in 2013 (Table 1) to between 1.50% and 1.67% in 2038 (data not shown). The largest increase is projected for the Prairie provinces, where we

![Figure 1. Prevalence of individuals experiencing the effects of stroke, Canada, 2013.](image-url)
estimate that there will be between 116,000 and 132,000 individuals experiencing the effects of stroke in 2038. This represents an expected increase from 2013 that ranges between 100% and 128%.

A sensitivity analysis testing the assumption that the prevalence of stroke increases by a relative 1% annually suggests that 923,000 individuals would be experiencing the effects of stroke in 2038, whereas a similar 1% decrease would result in 560,000.

### Discussion

We estimate that there were ≈405,000 individuals experiencing the effects of stroke in Canada in 2013, a value that is considerably higher than commonly quoted estimates of 315,000. Primarily, this difference is because of the failure of previous estimates to account for children aged <12 years and individuals living in homes for the aged (ie, using only prevalence rates among community-dwelling adolescents and adults). By updating and expanding on the data used previously to account for missing data and higher rates in these 2 populations, it is possible to calculate a high-level estimate of the total number individuals experiencing the effects of stroke in Canada, and within each region of Canada.

In addition, the previous estimate of 315,000, based on data from 2009/2010, was static and did not consider population changes over time. Our results demonstrate that, although the prevalence remained relatively consistent over 11 years of data, the number of individuals experiencing the effects of stroke rose considerably as a result of population growth, aging, and decreasing stroke mortality rates. In coming years, we expect that this will be an ongoing issue as the population continues to age, resulting in rising stroke prevalence. These demonstrated increases underscore the importance that estimates be continually updated to reflect this progression in future years. Indeed, when we adjusted the previous estimate of 315,000 to take recent data, population growth and changes in population distribution into consideration, the number of community-dwelling individuals experiencing the effects of stroke increased by ≈52,000 people. This value still underestimated true prevalence, however, and by expanding these

### Table 2. Estimated Prevalence of Individuals Experiencing the Effects of Stroke in Canada by Region 2013

<table>
<thead>
<tr>
<th>Region</th>
<th>Atlantic Provinces</th>
<th>Quebec</th>
<th>Ontario</th>
<th>Prairie Provinces</th>
<th>British Columbia</th>
<th>Canada</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prevalence of individuals experiencing the effects of stroke, %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>1.38</td>
<td>1.04</td>
<td>1.18</td>
<td>0.80</td>
<td>1.23</td>
<td>1.10</td>
</tr>
<tr>
<td>Females</td>
<td>1.25</td>
<td>1.14</td>
<td>1.32</td>
<td>1.01</td>
<td>1.17</td>
<td>1.21</td>
</tr>
<tr>
<td>Total</td>
<td>1.32</td>
<td>1.09</td>
<td>1.26</td>
<td>0.91</td>
<td>1.20</td>
<td>1.15</td>
</tr>
<tr>
<td>Prevalence of individuals experiencing the effects of stroke (age-adjusted to the 2013 Canadian population), %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>1.22</td>
<td>1.00</td>
<td>1.19</td>
<td>0.95</td>
<td>1.12</td>
<td>1.10</td>
</tr>
<tr>
<td>Females</td>
<td>1.14</td>
<td>1.07</td>
<td>1.33</td>
<td>1.17</td>
<td>1.13</td>
<td>1.21</td>
</tr>
<tr>
<td>Total</td>
<td>1.18</td>
<td>1.04</td>
<td>1.26</td>
<td>1.06</td>
<td>1.12</td>
<td>1.15</td>
</tr>
<tr>
<td>Estimated number of individuals experiencing the effects of stroke</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>16,000</td>
<td>42,000</td>
<td>79,000</td>
<td>26,000</td>
<td>28,000</td>
<td>191,000</td>
</tr>
<tr>
<td>Females</td>
<td>15,000</td>
<td>47,000</td>
<td>91,000</td>
<td>32,000</td>
<td>27,000</td>
<td>214,000</td>
</tr>
<tr>
<td>Total</td>
<td>31,000</td>
<td>89,000</td>
<td>170,000</td>
<td>58,000</td>
<td>55,000</td>
<td>405,000</td>
</tr>
</tbody>
</table>
prevalence rates to account for higher rates of stroke among individuals living in homes for the aged, and missing data for children aged 0 to 11 years, the number of individuals experiencing the effects of stroke increased by another 38,000.

Similar data from the Australian Survey of Disability, Aging and Carers\(^{18}\) captured a sample that well represents the entire Australian population, including children and those living in care-accommodation facilities, and estimated the prevalence of stroke survivors who have long-term effects of their stroke that interfere with everyday activities. When we applied the age- and sex-specific prevalence from this survey to the Canadian population in 2013, we estimated that 455,000 (1.29%) individuals in Canada were living with the long-term effects of a stroke. Although this value is similar to the one we obtained using Canada-specific data, the differences may be accounted for by a variation in the distribution of stroke-specific risk factors. For example, obesity rates in 2013 among those aged ≥20 years in Canada were 21.9% in men and 20.5% in women, compared with 27.5% and 29.8% in the equivalent Australian populations.\(^{19}\) Obesity is associated with an ∼50% increase in the risk of stroke,\(^{20}\) therefore we would expect that stroke incidence may be higher in Australia as a result.

In other countries, the self-reported prevalence of stroke in those aged ≥65 years has been reported between 4.6% and 7.4%,\(^{21}\) whereas we estimated that 5.0% of this age group were experiencing the effects of stroke. In European countries, the estimated prevalence of stroke among those aged 65 to 74 years ranged from 2.4% to 14.2% for men, and from 1.5% to 9.0% for women.\(^{22}\) We estimated that 3.7% of men and 3.4% of women in this age group were experiencing the effects of stroke.

The Australian Survey of Disability, Aging and Carers also 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, 37% of stroke survivors in Australia did not have ongoing effects.\(^{18}\) This difference draws attention to the challenge of clarifying the intended population to be included in calculating stroke prevalence. The focus of the current analysis has been on the prevalence of stroke survivors living with disability or other stroke consequences and therefore does not include stroke survivors who have experienced a full recovery. This challenge is compounded because research suggests that some individuals are left with mild cognitive disability of which they may or may not be aware. Other researchers have also shown that many individuals diagnosed with dementia have a cerebrovascular cause or contribution to their impairments.\(^{23}\) It would be difficult to obtain an accurate estimate of the overall prevalence.
of stroke survivors in Canada unless a comprehensive national survey was to ask questions similar to those that were covered by the Survey of Disability, Aging and Carers.

Projecting future trends is notoriously difficult as the future prevalence depends on changes in the incidence of stroke, improvements in treatment, increases in population, and changes in the age structure of the population. The incidence of stroke, however, is at least partially associated with the prevalence of specific risk factors. In Canada, for example, the prevalence of tobacco smoking has declined by 22% between 2000 and 2012 and physical inactivity has declined by 13%. In contrast, the prevalence of alcohol use that could be considered harmful or hazardous has increased by 28% and obesity by 17%. Approximately 60% of strokes are attributable to these 4 risk factors. Limitations

We were restricted to primarily self-report data in completing this analysis. Clinical registries or medical charts are arguably the gold standard for ascertaining cases of stroke but, because of their expense, are rarely used at a population level. Using algorithms to access administrative data such as hospital, physician, and prescription drug records is an alternative approach but the results can vary substantially depending on the algorithm used. Comparisons between administrative data and CCHS survey results suggest a fair to moderate agreement between the 2 approaches. Our prevalence results for Canada are within the range of published results from other countries.

We were unable to incorporate information on stroke severity as these data are not routinely collected in Canada. A previous Canadian study suggested that 54.2% of those who received stroke care in Canada had scored 0, 1, or 2 on the Rankin Scale, 20.5% scored 3, and 25.3% scored 4 or 5.

Finally, we were unable to find age and sex-specific prevalence rates of stroke in residents of homes for the aged and used instead a single estimate of 21.9% in our estimates and projections. Using age- and sex-specific rates, as we did for the noninstitutionalized population, would lead to greater precision in our projections.

Sources of Funding

This study was funded by the Heart & Stroke Foundation Canadian Partnership for Stroke Recovery.

Disclosures

None.

References

7. CANSIM table 051-0001 [database online]. Ottawa, ON: Statistics Canada; 2014.
Prevalence of Individuals Experiencing the Effects of Stroke in Canada: Trends and Projections
Hans Krueger, Jacqueline Koot, Ruth E. Hall, Christina O'Callaghan, Mark Bayley and Dale Corbett

Stroke. 2015;46:2226-2231; originally published online July 23, 2015;
doi: 10.1161/STROKEAHA.115.009616
Stroke is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 2015 American Heart Association, Inc. All rights reserved.
Print ISSN: 0039-2499. Online ISSN: 1524-4628

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://stroke.ahajournals.org/content/46/8/2226

Data Supplement (unedited) at:
http://stroke.ahajournals.org/content/suppl/2015/07/24/STROKEAHA.115.009616.DC1

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published in Stroke can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the Permissions and Rights Question and Answer document.

Reprints: Information about reprints can be found online at:
http://www.lww.com/reprints

Subscriptions: Information about subscribing to Stroke is online at:
http://stroke.ahajournals.org//subscriptions/
SUPPLEMENTAL MATERIAL

Prevalence of individuals suffering from the effects of stroke in Canada: trends and projections

Hans Krueger, PhD (1,2); Jacqueline Koot, BSc (2); Ruth Hall, PhD (3,4); Christina O’Callaghan, B.App SC (4); Mark Bayley, MD, FRCPC (3, 4, 5, 7, 8); Dale Corbett, PhD (5,6)

1. School of Population and Public Health, University of British Columbia, Vancouver, British Columbia, Canada
2. H. Krueger & Associates Inc., Delta, British Columbia, Canada
3. Institute for Clinical Evaluative Sciences, Toronto, Ontario, Canada
4. Ontario Stroke Network, Toronto, Ontario, Canada
5. Canadian Partnership for Stroke Recovery, Ottawa, Ontario, Canada
6. Department of Cellular and Molecular Medicine, University of Ottawa
7. Division of Physical Medicine and Rehabilitation, Dept. Of Medicine, University of Toronto
8. Brain and Spinal Cord Rehabilitation program, UHN-Toronto Rehabilitation Institute
Detailed Methods and Results - Incorporating Residents of Homes for the Aged and Children

We 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 Supplemental Table I. Based on this approach, we estimate that there would be 367,000 individuals suffering from the effects of stroke in Canada in 2013, or 1.20% of the Canadian population aged 12 and older (30.6 million).

In the next sections we describe the adjustments made 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. A summary of the data from 2000/01 to 2009/10 is included in Supplemental Table II. In 2009/10, a total of 203,997 Canadians were residents in homes for the aged, increasing from 168,807 in 2000/01.
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 Supplemental Table III).
## As the latest data available are from 2009/10, we used population projections 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

The Continuing Care Reporting System (CCRS) includes data from 984 residential care facilities in Canada. Out of the 135,333 residents who were assessed in 2012/13, 29,644 (21.9%) had received a stroke diagnosis. We therefore assumed that 21.9% of individuals living in homes for the aged were suffering from the effects of stroke. This is similar to results from other jurisdictions. A study of 3,239 nursing home residents in Ireland found that 570 (17.6%) were stroke survivors living with disability. 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.

### 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 Supplemental Table III (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. Supplemental Table IV provides the data with the residents of homes for the aged excluded, while Supplemental Table V reintroduces residents of homes for the aged and adjusts these data to account for their higher stroke prevalence.

### 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

Canadian hospitalization data suggests that in the five-years between 2004/05 and 2008/09, there were 139 hospitalizations for ischemic stroke and 27 hospitalizations for hemorrhagic stroke among children aged <1. Among those aged 1-19, there were 277 ischemic stroke hospitalizations and 205 hemorrhagic stroke hospitalizations. According to combined data from multiple studies, 9% of children who suffer an
ischemic stroke 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. The male to female predominance in pediatric stroke is approximately 1.5:1.

Adjusting for Children Aged 0-11

We used the above information to estimate the prevalence of children aged 0-11 who are suffering from the effects of stroke. Using the hospitalization data, we calculated the annual incidence of ischemic and hemorrhagic stroke in children younger than one (7.90 and 1.53/100,000, respectively) and 1-11 (0.74 and 0.55/100,000, respectively). 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 743 children would have suffered a stroke before their 12th birthday. Based on the outcomes following ischemic and hemorrhagic stroke, we further estimated that 400 of these 743 children would have survived with long-term effects. Of the 400, an estimated 239 would have been males, yielding a prevalence of 10.3/100,000. The estimated 161 females would yield a prevalence of 7.3/100,000.

After including children and residents of homes for the aged, we have estimated that there were 405,000 individuals suffering from the effects of stroke in Canada in 2013 (see Supplemental Table VI).

Supplemental Table VI: Estimated Number of Individuals Suffering from the Effects of Stroke 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)

<table>
<thead>
<tr>
<th>Prevalence of Individuals Suffering from the Effects of Stroke in Canada in 2011/12</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-11 12-39 40-44 45-49 50-54 55-59 60-64 65-69 70-74 75-79 80+ Total</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Estimated Canadian Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males 2,323,404 6,536,405 1,187,072 1,382,386 1,248,641 1,042,864 851,866 593,923 430,807 542,256 17,400,227</td>
</tr>
<tr>
<td>Females 2,209,484 6,398,137 1,184,038 1,372,059 1,253,221 1,067,306 895,133 662,466 515,412 888,968 17,724,052</td>
</tr>
<tr>
<td>Total 4,532,888 12,934,542 2,371,110 2,568,401 2,754,445 2,517,186 2,101,895 1,256,419 946,219 1,431,224 35,154,279</td>
</tr>
</tbody>
</table>

Source: CANSIM Table 051-0001 Estimates of population, by age group and sex for July 1, Canada, provinces and territories, annual

<table>
<thead>
<tr>
<th>Estimated Number of Individuals Suffering from the Effects of Stroke in Canada</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males 239 12,272 4,910 7,644 5,239 12,948 24,974 26,826 26,394 25,428 44,145 191,020</td>
</tr>
<tr>
<td>Females 161 16,668 2,509 8,405 9,621 10,566 21,080 27,110 23,065 24,055 70,552 213,791</td>
</tr>
<tr>
<td>Total 400 28,941 7,418 16,050 14,859 23,514 46,054 53,936 49,459 49,483 114,697 404,811</td>
</tr>
</tbody>
</table>

Supplemental Figure I 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 would be expected when including residents of institutions.
Detailed Methods and Results – Forecasting the Prevalence of individuals suffering from the effects of stroke, 2013 to 2038

We forecasted the prevalence of individuals suffering from the effects of stroke 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 individuals suffering from the effects of stroke 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 suffering from the effects of stroke.

We assumed the rate of children suffering from the effects of stroke remained consistent across years (0.0103% and 0.0073% for males and females, respectively). We applied these prevalence rates to population estimates\(^1\) for years 2013 and 2014, and population projections\(^2\) for years 2015 to 2038.

The only variation between the methods was the technique used to forecast the prevalence of individuals aged 12 or older living in the community who are suffering from the effects of stroke (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 individuals suffering from the effects of stroke 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 estimates\(^1\) for years 2013 and 2014, and projections\(^2\) 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 individuals suffering from the effects of stroke 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 individuals suffering from the effects of stroke 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.

**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 Supplemental Table VII. Only two age groups met our criteria for a sufficient trend (females, aged 55-59 and 80+), as highlighted.
### Supplemental Table VII: Interpretation of Stroke Prevalence Regression Analysis

CCHS 2001/02 - 2011/12, by Age and Sex, for Non-institutionalized Individuals in Canada

<table>
<thead>
<tr>
<th>Sex</th>
<th>Age Group</th>
<th>Statistical Results</th>
<th>CCHS Stroke Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Males</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12-39</td>
<td></td>
<td>3.32</td>
<td>48.0%</td>
</tr>
<tr>
<td>40-44</td>
<td></td>
<td>3.90</td>
<td>28.2%</td>
</tr>
<tr>
<td>45-49</td>
<td></td>
<td>3.73</td>
<td>34.5%</td>
</tr>
<tr>
<td>50-54</td>
<td></td>
<td>4.38</td>
<td>9.7%</td>
</tr>
<tr>
<td>55-59</td>
<td></td>
<td>4.57</td>
<td>1.5%</td>
</tr>
<tr>
<td>60-64</td>
<td></td>
<td>4.59</td>
<td>0.6%</td>
</tr>
<tr>
<td>65-69</td>
<td></td>
<td>3.72</td>
<td>34.7%</td>
</tr>
<tr>
<td>70-74</td>
<td></td>
<td>4.60</td>
<td>0.2%</td>
</tr>
<tr>
<td>75-79</td>
<td></td>
<td>2.85</td>
<td>61.8%</td>
</tr>
<tr>
<td>80+</td>
<td></td>
<td>2.39</td>
<td>73.0%</td>
</tr>
<tr>
<td><strong>Females</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12-39</td>
<td></td>
<td>4.29</td>
<td>13.0%</td>
</tr>
<tr>
<td>40-44</td>
<td></td>
<td>4.55</td>
<td>2.4%</td>
</tr>
<tr>
<td>45-49</td>
<td></td>
<td>3.90</td>
<td>28.2%</td>
</tr>
<tr>
<td>50-54</td>
<td></td>
<td>4.30</td>
<td>12.9%</td>
</tr>
<tr>
<td>55-59</td>
<td></td>
<td>1.53</td>
<td>89.0%</td>
</tr>
<tr>
<td>60-64</td>
<td></td>
<td>3.59</td>
<td>39.4%</td>
</tr>
<tr>
<td>65-69</td>
<td></td>
<td>2.99</td>
<td>57.8%</td>
</tr>
<tr>
<td>70-74</td>
<td></td>
<td>4.24</td>
<td>15.4%</td>
</tr>
<tr>
<td>75-79</td>
<td></td>
<td>3.34</td>
<td>47.4%</td>
</tr>
<tr>
<td>80+</td>
<td></td>
<td>2.32</td>
<td>74.6%</td>
</tr>
</tbody>
</table>
References

1. CANSIM table 052-0004 [database online]. Ottawa, ON: Statistics Canada. 2014

2. CANSIM table 052-0005 [database online]. Ottawa, ON: Statistics Canada. 2014


