

## Brief Communication

# Sex Differences of Hospital and Emergency Department Presentations of Stroke in Canada

Miranda Wan<sup>1</sup> , Patrice Lindsay<sup>2</sup> , Amy Y. X. Yu<sup>3,4</sup> , Michael D. Hill<sup>1,5,6,7,8,9</sup>  and Jessalyn K. Holodinsky<sup>6,10,11,12</sup> 

<sup>1</sup>Department of Clinical Neurosciences, Cumming School of Medicine, University of Calgary, Calgary, AB, Canada, <sup>2</sup>Heart and Stroke Foundation of Canada, Toronto, ON, Canada, <sup>3</sup>Department of Medicine (Neurology), University of Toronto, Toronto, ON, Canada, <sup>4</sup>Sunnybrook Health Sciences Centre, Toronto, ON, Canada, <sup>5</sup>Hotchkiss Brain Institute, Cumming School of Medicine, University of Calgary, Calgary, AB, Canada, <sup>6</sup>Department of Community Health Sciences, Cumming School of Medicine, University of Calgary, Calgary, AB, Canada, <sup>7</sup>Department of Medicine, Cumming School of Medicine, University of Calgary, Calgary, AB, Canada, <sup>8</sup>Department of Radiology, Cumming School of Medicine, University of Calgary, Calgary, AB, Canada, <sup>9</sup>Foothills Medical Centre, Calgary, AB, Canada, <sup>10</sup>Department of Emergency Medicine, Cumming School of Medicine, University of Calgary, Calgary, AB, Canada, <sup>11</sup>Center for Health Informatics, Cumming School of Medicine, University of Calgary, Calgary, AB, Canada and <sup>12</sup>O'Brien Institute for Public Health, Cumming School of Medicine, University of Calgary, Calgary, AB, Canada

**ABSTRACT:** We provide an updated estimate of adult stroke event rates by age group, sex, and stroke type using Canadian administrative data. In the 2017–2018 fiscal year, there were an estimated 81,781 hospital or emergency department visits for stroke events in Canada, excluding Quebec. Our findings show that overall, the event rate of stroke is similar between women and men. There were slight differences in stroke event rate at various ages by sex and stroke type and emerging patterns warrant attention in future studies. Our findings emphasize the importance of continuous surveillance to monitor the epidemiology of stroke in Canada.

**RÉSUMÉ :** Différences entre les sexes dans le cas de patients victimes d'AVC s'étant présentés à l'hôpital et dans un service des urgences au Canada. À l'aide de données administratives canadiennes, nous avons voulu fournir une estimation actualisée des taux d'AVC chez les adultes par groupe d'âge, par sexe et par type d'AVC. En excluant le Québec, on estime à 81 781 le nombre de visites dans un hôpital ou dans un service des urgences du Canada pour des AVC, et ce, au cours de l'exercice 2017-2018. Dans l'ensemble, nos résultats montrent que le taux d'AVC est similaire entre les femmes et les hommes. De plus, il existe de légères différences dans le taux d'AVC à différents âges selon le sexe et le type d'AVC. Des tendances émergentes méritent par ailleurs d'être étudiées dans de futures études. Enfin, nos résultats soulignent l'importance d'une surveillance continue de l'épidémiologie des AVC au Canada.

**Keywords:** Stroke; vascular neurology; sex differences; epidemiology

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Stroke remains one of the leading causes of morbidity and mortality worldwide.<sup>1</sup> In Canada, there was a notable increase in stroke events from 2003 to 2013, with a higher proportion of women affected by stroke in comparison to men.<sup>2</sup> Additionally, sex differences have been observed for different types of stroke (ischemic stroke, subarachnoid hemorrhage, transient ischemic attack, and intracerebral hemorrhage).<sup>3</sup> Despite the increasing research on sex differences in stroke epidemiology, there is a paucity of recent data on stroke event rates by sex across different age groups.<sup>4</sup>

Ongoing epidemiological surveillance of stroke event rates with an understanding of sex-specific and age-specific events is important to inform health resource planning, public health policy, and improve clinical care. We provide an updated estimate of

stroke event rate in Canada, reporting the sex-specific stroke event rates in adults by age group in the 2017–2018 fiscal year (excluding Quebec) and differentiate by stroke type.

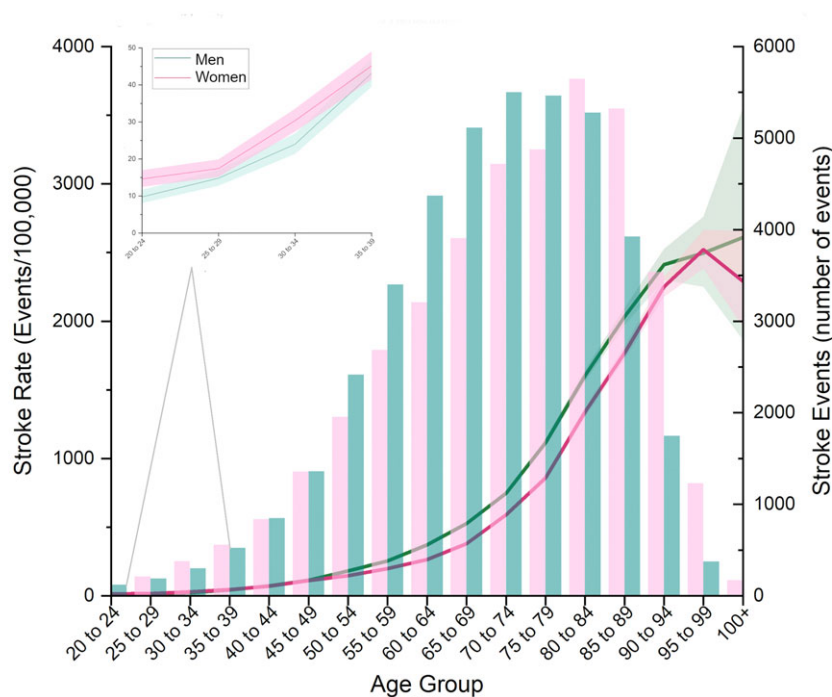
Previously, Holodinsky et al.<sup>4</sup> estimated the overall event rate of stroke presenting to the hospital or emergency department in Canada. Here, we use the same data sources and similar methodologies to obtain age and sex-specific estimates. Stroke events occurring in adults, including ischemic stroke, intracerebral hemorrhage, subarachnoid hemorrhage, and transient ischemic attack, were identified across all hospital and emergency department visits between April 1, 2017, and March 31, 2018, across Canada (excluding Quebec) using data from the Canadian Institute for Health Information (CIHI) Discharge Abstract Database and CIHI National Ambulatory Care Reporting System (NACRS).<sup>4</sup> For

**Corresponding author:** J. K. Holodinsky; Email: [jessalyn.holodinsky@ucalgary.ca](mailto:jessalyn.holodinsky@ucalgary.ca)

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Rate of All Stroke Presenting to Care (Hospitalizations and Emergency Department Visits) and Event Number



**Figure 1:** Stroke rates (events per 100,000 people) and number of stroke events presenting to care (hospitalizations and/or emergency department visits) for all stroke types (ischemic stroke, intracerebral hemorrhage, subarachnoid hemorrhage, transient ischemic attack) stratified by age and sex in the fiscal year 2017–2018 in Canada (excluding Quebec). Population rate of stroke per 100,000 people with 95% confidence intervals stratified by sex are shown on the line graph (left y-axis). Number of stroke events stratified by sex are shown on the histogram (right y-axis). The inset line plot highlights stroke occurrence rate per 100,000 in the young, from age groups 20–39, with 95% confidence intervals stratified by sex. Overall, young women have higher stroke rates per 100,000 people compared to men in the same age group, while middle-aged and older men have higher stroke rates per 100,000 people than women in the same age group, although the differences are minimal.

the purposes of this analysis, an adult is defined as greater than or equal to age 20 to be consistent with Statistics Canada population estimates, which are only provided in 5-year age intervals. As complete NACRS data were only complete in Alberta and Ontario projections for ED-only admissions for other provinces were made. This process has been previously described.<sup>4</sup>

Using Statistics Canada data for the Canadian population for the year 2017, age, sex, and stroke-type-specific event rates per 100,000 were generated with exact confidence intervals. Event rates for men and women were compared overall and subdivided by 5-year age group, stroke type, and visit type (emergency department vs hospitalization). Comparisons between men and women were made using exact p-values with binomial probabilities. A p-value less than 0.05 was considered statistically significant. P-values were not adjusted for multiple comparisons.<sup>5</sup> All data handling and analyses were performed using Stata17 (Stata Corp., College Station, TX). Graphs were created with OriginPro 2023. The analyses, conclusions, opinions, and statements expressed herein are those of the authors and not those of CIHI.

There were 81,781 total stroke events, of which 40,623 resulted in hospitalizations and 41,158 were emergency department-only visits. In total, there were 42,193 ischemic strokes, 2,709 subarachnoid hemorrhages, 5,859 intracerebral hemorrhages, and 31,020 transient ischemic attacks.

The rate of hospitalizations and emergency department visits for all stroke events in adults was higher in men (292.0 events per 100,000 95% CI 289.2, 294.8) than in women (281.3 events per 100,000 95% CI 278.5, 284.0). When stratified by age, event rates were higher in younger women (significantly so in the 20–24 and 30–34 age groups) but after age 50, event rates were higher in men (significantly so until age 94) (Fig. 1, Supplementary Material 1: Table 1).

Among hospitalizations for all stroke events, event rate was higher for men (148.5 events per 100,000 95% CI 146.5, 150.6) than

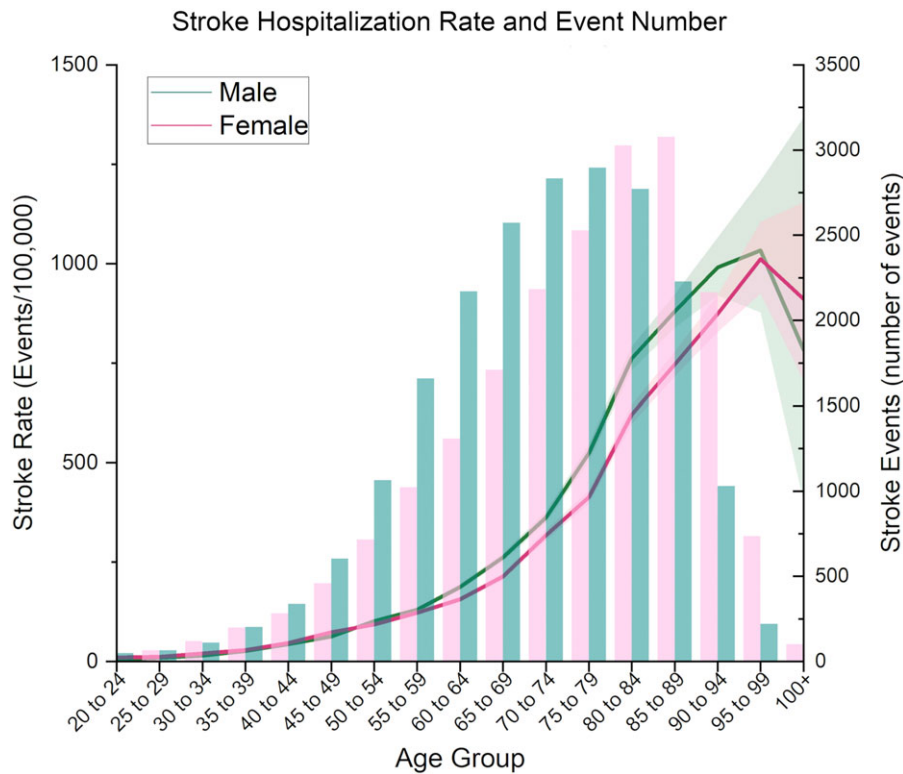
women (136.3 events per 100,000 95% CI 134.4, 138.2). When stratified by age, no differences were seen in individuals <40 or ≥90 years of age. In age groups from 40 to 89 years, event rates were higher in men (Fig. 2, Supplementary Material 1: Table 2).

Among emergency department-only visits for all stroke events, event rate was not different between women and men overall (Fig. 3, Supplementary Material 1: Table 3). When stratified by age, differences were seen with higher event rates in women <50 years old (significantly so for those aged 20–24, 30–34, and 45–49) and higher event rates in men ages 50–94 (significantly so for all age groups except 55–59) (Supplementary Material 1: Table 3).

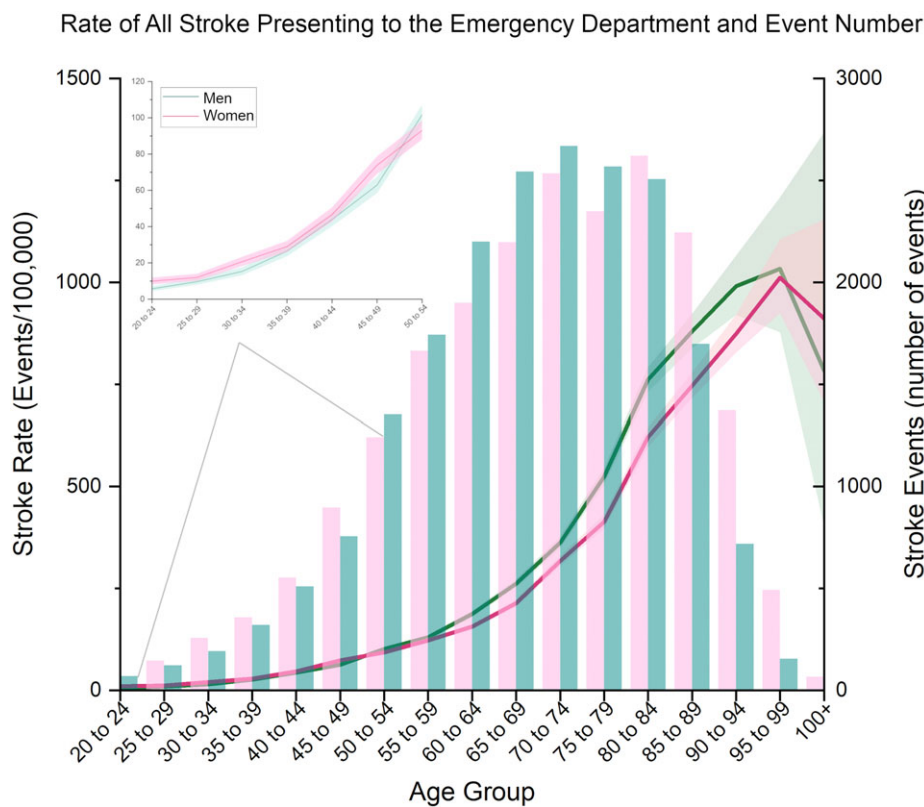
When stratified by stroke type, men had higher event rates of ischemic stroke (Fig. 4, Supplementary Material 1: Table 4) and intracerebral hemorrhage (Supplementary Material 2, Supplementary Material 1: Table 5) compared to women. For ischemic stroke, when stratified by age group, we found higher event rates in younger women (<44 years of age, significantly so in the 20–24 and 25–29 age groups) as well as among those aged ≥95 years of age (Supplementary Material 1: Table 4). Intracerebral hemorrhage rates were higher in men across all age groups (significantly so for ages 25–29, 35–39, and the age groups spanning 45–84, Supplementary Material 1: Table 5).

Women had higher event rates of subarachnoid hemorrhage (Supplementary Material 3, Supplementary Material 1: Table 6) and transient ischemic attack (Supplementary Material 4, Supplementary Material 1: Table 7) overall compared to men. When stratified by age, women had higher event rates of subarachnoid hemorrhage across most age groups (Supplementary Material 1: Table 6). For transient ischemic attack, rates were higher in women in the younger (<50) and oldest (100+) age groups (only significantly so for those aged 30–34) and were higher in men in the 50–99 age groups (significantly so among the age groups spanning 60–89, Supplementary Material 1: Table 7).

Consistent with previous Canadian data from 2012 to 2013, our findings show that there are minimal sex differences among



**Figure 2:** Hospitalization stroke rates (events per 100,000 people) and number of stroke events for all stroke types (ischemic stroke, intracerebral hemorrhage, subarachnoid hemorrhage, transient ischemic attack) stratified by age and sex in the fiscal year 2017–2018 in Canada (excluding Quebec). The population hospitalization visit rate of stroke per 100,000 people with 95% confidence intervals stratified by sex is shown on the line graph (left y-axis). Number of stroke events from hospitalization visits stratified by sex are shown on the histogram (right y-axis). Overall, men have a higher stroke hospitalization visit rate per 100,000 people compared to women in the same age group, although the differences are minimal.

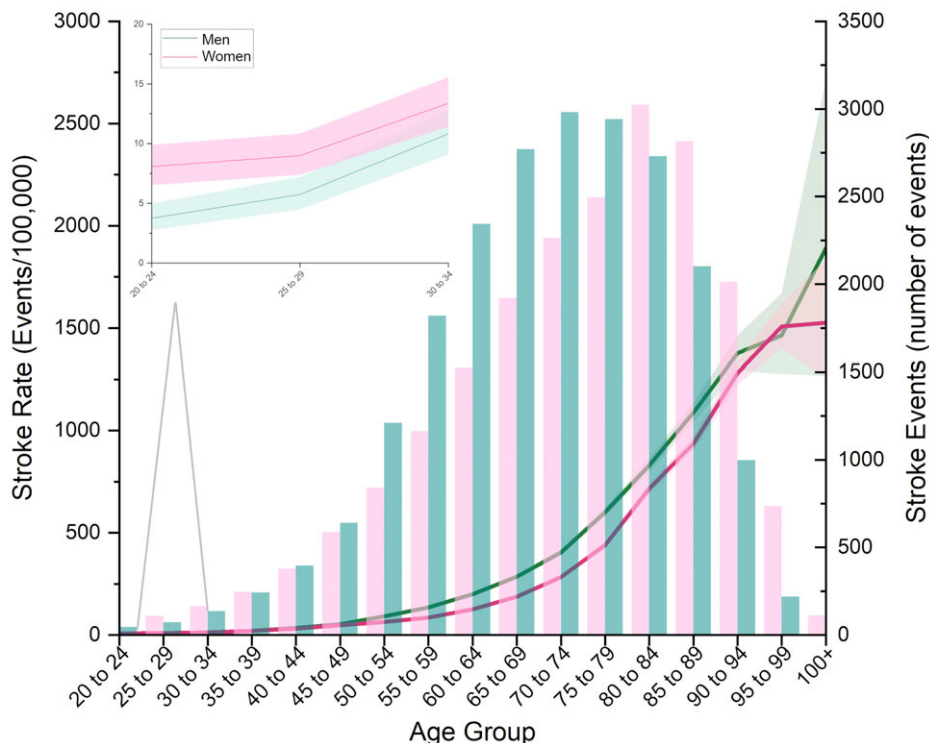


**Figure 3:** Stroke rates (events per 100,000 people) and number of stroke events presenting to the emergency department for all stroke types (ischemic stroke, intracerebral hemorrhage, subarachnoid hemorrhage, transient ischemic attack) stratified by age and sex in the fiscal year 2017–2018 in Canada (excluding Quebec). The population emergency department visit rate of stroke per 100,000 people with 95% confidence intervals stratified by sex are shown on the line graph (left y-axis). Number of stroke events from emergency department visits stratified by sex is shown on the histogram (right y-axis). The inset line plot highlights stroke occurrence rate per 100,000 from age groups 20–54, with 95% confidence intervals stratified by sex. Overall, stroke occurrence rate presenting to the emergency department per 100,000 people did not have any sex differences, with the exception of age groups 30–34 and 45–49 where stroke occurrence rate presenting to the emergency department per 100,000 people was greater than males, although differences are minimal.

various age groups in the 2017–2018 fiscal year.<sup>2</sup> However, there are emerging patterns of higher stroke event rates in younger women and older men compared to the opposite sex of the same

age groups. Prior literature on sex differences in stroke is conflicting due to small sample sizes, heterogeneity of methodologies, and lack of detailed data reporting.<sup>6</sup> However, a recent

## Ischemic Stroke Rate Presenting to Care (Hospitalizations and Emergency Department Visits) and Event Number



**Figure 4:** Stroke rates (events per 100,000 people) and number of stroke events presenting to care (hospitalizations and/or emergency department visits) for ischemic stroke stratified by age and sex in the fiscal year 2017–2018 in Canada (excluding Quebec). Population rate of ischemic stroke per 100,000 people with 95% confidence intervals stratified by sex is shown on the line graph (left y-axis). Number of ischemic stroke events stratified by sex is shown on the histogram (right y-axis). The inset line plot highlights ischemic stroke occurrence rate per 100,000 in the young, from age groups 20–34, with 95% confidence intervals stratified by sex. Overall, young women have higher ischemic stroke rates per 100,000 people compared to men in the same age group, while middle-aged and older men have higher stroke rates per 100,000 people than women in the same age group, although the differences are minimal.

systematic review showed that younger women may be at higher risk of ischemic stroke compared to men in multiple developed countries.<sup>6</sup> This highlights the importance of assessing for and managing female-specific vascular risk factors, such as use of hormonal contraceptives, migraines, pregnancy, and a higher incidence of autoimmune disorders but these specific data were not captured in our study.<sup>7</sup>

We also found minimal sex differences in stroke type, with the exception of subarachnoid hemorrhage. Women have a higher event rates of subarachnoid hemorrhage than men and a slightly higher event rates of transient ischemic attack, while men have higher event rates of ischemic stroke and intracerebral hemorrhage compared to the opposite sex, which was in keeping with previous studies.<sup>3,8</sup> These differences may be related to the underlying pathophysiology and risk factors for each stroke type, but these specific data were not captured in this study.<sup>9,10</sup>

Limitations of the study related to the database have been previously discussed.<sup>4</sup> Our overall estimated number of events differs from that previously reported by Holodinsky et al. because Quebec (22% of Canada's population) was not included in this study due to lack of information on age and sex of stroke presentations and this study was restricted to adults ages 20 and over. In our study, differences between men and women are ascribed to their sex. However, we acknowledge that we were not able to identify the mechanism of stroke and the prevalence of traditional vascular risk factors were not accounted for when comparing sexes. Our data source has limitations in describing these factors and this should be subject to future study. Additionally, our study did not include individuals with stroke who did not present for care or died out of hospital due to their stroke.

In summary, while there are slight differences in stroke event rates at various ages by sex and stroke type, we can broadly conclude that event rate of stroke is similar between women and

men. However, patterns emerged suggesting that young women and older men have higher event rates of stroke, which warrants further attention in future studies. Our findings emphasize the importance of continuous surveillance to monitor the epidemiology of stroke in Canada to improve stroke prevention for both women and men.

**Supplementary material.** The supplementary material for this article can be found at <https://doi.org/10.1017/cjn.2023.290>.

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**Author contributions.** Study concept and supervision: JKH, MDH.

Data analysis, interpretations, manuscript preparation: MW, JKH, MDH.

Data interpretation and manuscript editing for important intellectual content: AYYX, PL, JKH, MDH.

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