

Health Reports

Factors associated with hypertension control among older Canadians

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Factors associated with hypertension control among older Canadians

by Tracey Bushnik, Deirdre A. Hennessy, Finlay A. McAlister and Douglas G. Manuel

Abstract

Background: In Canada, hypertension control is significantly less likely in older women taking antihypertensive medication than in older men. This study examines factors that may explain some of the differences in hypertension control between women and men.

Methods: The analysis is based on data collected for 2,111 adults aged 60 to 79 who were taking antihypertensive medication in the first four cycles of the Canadian Health Measures Survey. Hypertension, treatment and control were estimated based on measured systolic and diastolic blood pressure and on the Drug Identification Numbers of antihypertensive medications. Risk factors included health behaviours, comorbidities and a family history of hypertension. Sex-specific logistic regression models examined associations between risk factors and hypertension control.

Results: The systolic blood pressure of women taking antihypertensive medication was higher than that of men, regardless of hypertension control. For women, older age and diabetes were significantly associated with poorer hypertension control, while older age, ethnicity, diabetes, no cardiovascular disease, and nonsteroidal anti-inflammatory drug use were significant for men.

Interpretation: Based on current blood pressure targets, women and men aged 60 to 79 taking antihypertensive medication in Canada continue to differ in control and factors associated with control. Further research to better understand the underlying cause of these associations may help reduce disparities in hypertension control rates between women and men in Canada.

Keywords: hypertension, blood pressure control, antihypertensive agents, population surveillance, prevalence

Despite improvements in hypertension screening, treatment initiation and control over the past 20 years, hypertension control in older women taking antihypertensive medication is significantly less likely than in older men in Canada.¹⁻³ Control is defined as having high blood pressure, but achieving targeted blood pressure levels through treatment.⁴ Sex differences in control have been reported in other countries,⁵⁻⁷ but the reasons for these remain unclear. Potential factors include differences in biological mechanisms and the effects of aging,⁸⁻¹⁰ type of antihypertensive treatment and compliance,^{6,11} socioeconomic status,¹² body composition, such as waist circumference and fat mass,^{5,13} and comorbidities, such as diabetes.^{5,6}

Older women represent a growing segment of the population with a high prevalence of hypertension and a high risk of hypertension-related cardiovascular disease.¹⁴ Because of the potential impact of increased hypertension treatment on patient outcomes and the costs of health care, a better understanding is needed of patient characteristics and risk factors that may contribute to hypertension control.¹⁵ Using data from the first four cycles of the Canadian Health Measures Survey (CHMS), this study describes the prevalence of hypertension control among women and men aged 60 to 79 taking antihypertensive medication. It also examines factors that may explain some of the sex differences in hypertension control.

Methods

Data source

The data are from four cycles of the CHMS: the first (2007 to 2009), second (2009 to 2011), third (2012 to 2013) and fourth (2014 to 2015). The CHMS is an ongoing survey designed to

provide comprehensive direct health measures at the national level. It collects information from community-dwelling individuals. Full-time members of the Canadian Armed Forces and people living on reserves or in other Aboriginal settlements, in institutions, and in some remote regions are excluded (about 3% of the Canadian population). The CHMS involves an in-person household interview and a subsequent visit to a mobile examination centre (MEC). The household interview gathers general demographic and socioeconomic data and detailed information on health, nutrition and lifestyle. At the MEC, direct physical measurements are taken, including the collection of blood and urine samples. Information about medication use is obtained during the household interview and at the MEC. CHMS participants receive an accelerometer to wear for one week to monitor their activity levels. Detailed information about the CHMS is available elsewhere from Statistics Canada.¹⁶⁻¹⁹

Cycle 1 collected information from people aged 6 to 79 and had an overall response rate of 51.7%—a total of 5,604 respondents. Cycles 2, 3 and 4 collected information from people aged 3 to 79; the overall response rates were 55.5%, 51.7% and 53.7%, respectively. This resulted in 6,395 respondents for Cycle 2, 5,785 for Cycle 3, and 5,794 for Cycle 4. Participants in one cycle were not eligible to participate in other cycles. The present study combined 60- to 79-year-old participants from each cycle for a total of 4,259 respondents.

Measures

Blood pressure: Systolic and diastolic blood pressure (SBP and DBP) were measured with the BpTRU™ BPM-300 device (BpTRU Medical Devices Ltd., Coquitlam, British Columbia)

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at the MEC. The BpTRU™ is an automated electronic monitor that has been validated and recommended for use by the Canadian Hypertension Education Program.^{20,21} Although the BpTRU™ SBP and DBP readings have been found to be slightly lower than conventional manual blood pressure readings, the BpTRU™ readings may estimate blood pressure status more accurately.²² Six BpTRU™ readings were taken for each CHMS participant, with the last five averaged to determine the SBP and

DBP levels.²³ During the home interview, 43 respondents aged 60 to 79 who could not visit the MEC had their blood pressure measured with the BpTRU™ BPM-100 device. Pulse pressure was estimated from the difference between SBP and DBP.

Medication use: The Drug Identification Numbers of medications reported to be currently used were captured during the household and clinic interviews. They were subsequently assigned codes from the Anatomical Therapeutic Chemical (ATC) classification system. The following categories of antihypertensive medications were specified: beta blockers (ATC codes in category C07, excluding C07AA07, C07AA12 and C07AG02); agents acting on the renin-angiotensin system (ATC codes in category C09); thiazide diuretics (ATC codes in category C03, excluding C03BA08 and C03CA01); calcium channel antagonists (ATC codes in category C08); and miscellaneous antihypertensives (ATC codes in category C02, excluding C02KX01). Respondents were categorized as using antihypertensive medication if an ATC code corresponded to the above list. Treatment type was categorized as monotherapy if only one antihypertensive medication category was reported. Nonsteroidal anti-inflammatory drug (NSAID) and antirheumatic use during the past month was determined from the ATC code M01A.

Diabetes: Respondents were categorized as having diabetes if the measured percentage of glycated hemoglobin A1c in their blood was equal to or greater than 6.5%, if they used glucose-lowering medication (ATC codes in category A10), or if they reported a diagnosis of diabetes from a health care provider.

Hypertension: Respondents without diabetes were considered hypertensive if their mean SBP \geq 140 mmHg or their mean DBP \geq 90 mmHg or they used antihypertensive medication in the past month. Respondents with diabetes were considered hypertensive if their mean SBP \geq 130 mmHg or their mean DBP \geq 80 mmHg or they used antihypertensive medication in the past month.

Controlled hypertension: Hypertensive respondents without diabetes taking antihypertensive medication were considered controlled if they had mean SBP $<$ 140 mmHg and mean DBP $<$ 90 mmHg. Those with diabetes were considered controlled if they had mean SBP $<$ 130 mmHg and mean DBP $<$ 80 mmHg.

Uncontrolled hypertension: Hypertensive respondents without diabetes taking antihypertensive medication were considered uncontrolled if they had mean SBP \geq 140 mmHg or mean DBP \geq 90 mmHg. Those with diabetes taking antihypertensive medication were considered uncontrolled if they had mean SBP \geq 130 mmHg or mean DBP \geq 80 mmHg.

Covariates

Sociodemographic characteristics included the following. Age group (60 to 69 and 70 to 79) was based on age at the time of the visit to the MEC. Marital status was defined as married or living common law, versus not. Highest level of education was defined as less than secondary school graduation, versus secondary school graduation or higher. Household income was categorized as being in the lowest household income quintile, versus being above the lowest quintile. It was derived from total household income divided by the number of people in the household. White or non-white ethnicity was based on the respondent's answer to which racial or cultural group they belong.

Health behaviours included the following. Smoking status was classified as smoking daily or occasionally, versus not smoking. Exercise was categorized as less than 150 minutes per week of moderate-to-vigorous physical activity (MVPA), versus 150 or more minutes per week. This was derived from four valid days of accelerometry data (respondents with less than four valid days of data [n=549] were assigned to the category "not known"). Fruit and vegetable consumption was categorized as five or more times per day, versus less than five times per day (an indicator of diet quality).²⁴

What is already known on this subject?

- Despite improvements in hypertension screening, treatment initiation and control over the past 20 years, hypertension control is significantly less likely in older women taking antihypertensive medication than in older men in Canada.
- Potential factors include sex differences in biological mechanisms and the effects of aging, antihypertensive treatment and compliance, socioeconomic status, and comorbidities.

What does this study add?

- Four cycles of the Canadian Health Measures Survey allowed for sex-specific analysis of risk factors associated with hypertension control.
- The prevalence of risk factors differed between women and men treated for hypertension.
- Differences in blood pressure control persisted between women and men aged 60 to 79.
- More individual risk factors were associated with hypertension control for men than for women.
- The average systolic blood pressure of women was higher than that of men, regardless of control.

This was derived from the sum of the frequency of daily consumption of 100% fruit juices; fruit; tomatoes or tomato sauce (excluding tomato paste, ketchup or pizza sauce); lettuce or green leafy salad; potatoes (including baked, boiled, mashed or in potato salad, but excluding sweet potatoes); spinach, mustard greens or collards (excluding kale); and “other” types of vegetables, excluding those already mentioned.

Comorbidity covariates included the following. Respondents were overweight or obese if they had a body mass index (BMI) of 25.0 kg/m² or more. Diabetes was determined as defined above. Chronic kidney disease was defined as an estimated glomerular filtration rate (GFR) of less than 60 mL/min/1.73 m²—the estimated GFR=175 * (serum creatinine in mg/dL)^{-1.154} * (age)^{-0.203} * (0.742 if female) * (1.212 if cultural or racial background is black).²⁵ Cholesterol was categorized as non-fasting non-high-density lipoprotein (HDL) cholesterol at or above 4.3 mmol/L, versus below 4.3 mmol/L (calculated by subtracting participants’ HDL blood measure of cholesterol from their blood measure of total cholesterol).²⁶ Cardiovascular disease was defined as self-reported heart disease, heart attack or stroke.

Family history covariates included family history of high blood pressure (respondents with missing information [n=247] were assigned to the category “not known”) and family history of early cardiovascular disease (before age 60).

Data were missing for some covariates: marital status (n=2), education (n=24), smoking (n=14), fruit and vegetable consumption (n=15), overweight or obesity (n=8), chronic kidney disease (n=38), and non-HDL cholesterol (n=33).

Among women and men, 97% reported having a regular family doctor.

Statistical analysis

Descriptive statistics were used to examine the characteristics of the study population and the prevalence of hypertension, treatment and control. Logistic regression models were run separately for women and men to estimate

the association between all covariates and hypertension control. Each model was rerun to test whether the age group modified the association between the covariates and hypertension control. All models included a CHMS cycle indicator. To account for the survey’s complex sampling design, all analyses were weighted using the combined survey weight from cycles 1, 2, 3 and 4 of the CHMS.²⁷ Variance estimation (95% confidence interval [CI]) and significance testing were done using the replicate weights generated by Statistics Canada.¹⁶⁻¹⁹ The data were analyzed with SAS 9.3 and SUDAAN 11.0, using 46 denominator degrees of freedom in the SUDAAN procedure statements.

Two sensitivity analyses were undertaken. First, the average BpTRU™ blood pressure readings were adjusted using the following correction factors: adjusted BpTRU™ SBP=11.4+(0.93 * BpTRU™ SBP) and adjusted BpTRU™ DBP=15.6+(0.83 * BpTRU™ DBP).²² This allowed for comparability between the present study and others based on manual blood pressure readings. Second, the blood pressure thresholds to indicate hypertension in the general population (mean SBP≥140 mmHg or mean DBP≥90 mmHg) and hypertension control (mean SBP<140 mmHg and mean DBP<90 mmHg) were applied to everyone in the study population, regardless of diabetes status. This also allowed for comparability with other studies.

Results

Hypertension status could be determined for almost all respondents meeting the age criteria (4,246), resulting in a study sample of 2,484 respondents with hypertension. Among them, 2,111 respondents reported using antihypertensive medication. Of those treated with medication, 1,580 were controlled and 531 were uncontrolled.

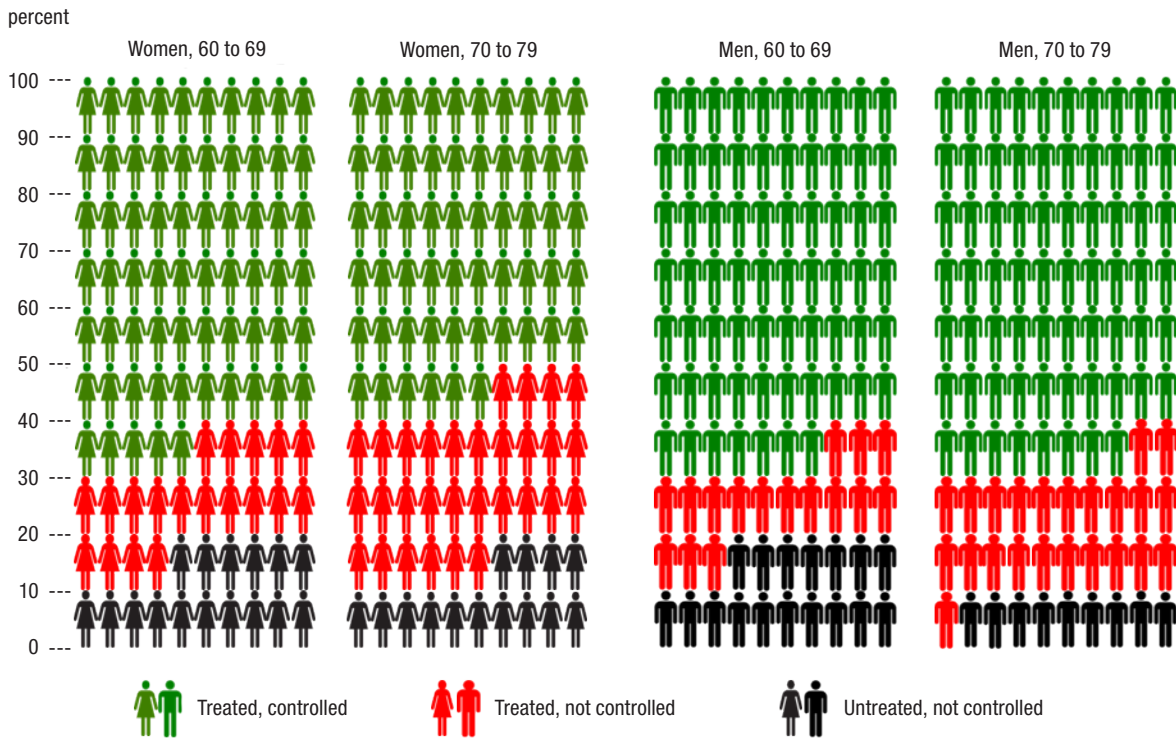
Overall, the prevalence of hypertension for women aged 60 to 69 was 47% (95% CI: 43% to 51%) and, for those aged 70 to 79, 69% (95% CI: 63% to 74%). For men aged 60 to 69, it was

55% (95% CI: 51% to 58%); it was 74% (95% CI: 69% to 78%) for those aged 70 to 79. Figure 1 presents the prevalence of hypertension treatment and control among the hypertensive population by sex and age group. The prevalence of treatment without control was highest among women aged 70 to 79 (30%, 95% CI: 26% to 34%) (p<0.02). The prevalence of treatment and control was higher among men aged 60 to 69 (67%, 95% CI: 62% to 72%), men aged 70 to 79 (68%, 95% CI: 63% to 73%) and women aged 60 to 69 (65%, 95% CI: 60% to 69%) than among women aged 70 to 79 (56%, 95% CI: 51% to 61%) (p<0.01). Men aged 70 to 79 were less likely than men and women aged 60 to 69 to be untreated (9%, 95% CI: 6% to 14%) (p<0.01).

The median pulse pressure of treated hypertensive women (55 mmHg, 95% CI: 53 to 56) was significantly higher than that of treated men (48 mmHg, 95% CI: 46 to 50). Median DBP was similar (70 mmHg, 95% CI: 69 to 71, versus 71 mmHg, 95% CI: 70 to 72). The median SBP of women was higher than that of men (125 mmHg, 95% CI: 123 to 127, versus 120 mmHg, 95% CI: 118 to 121). SBP values for women were higher across most of the distribution, regardless of age group or control status, compared with men (Figure 2). About 70% of women aged 60 to 69 with uncontrolled hypertension had a measured SBP equal to or greater than the threshold value of 140 mmHg. This was the case for about 85% of their counterparts aged 70 to 79.

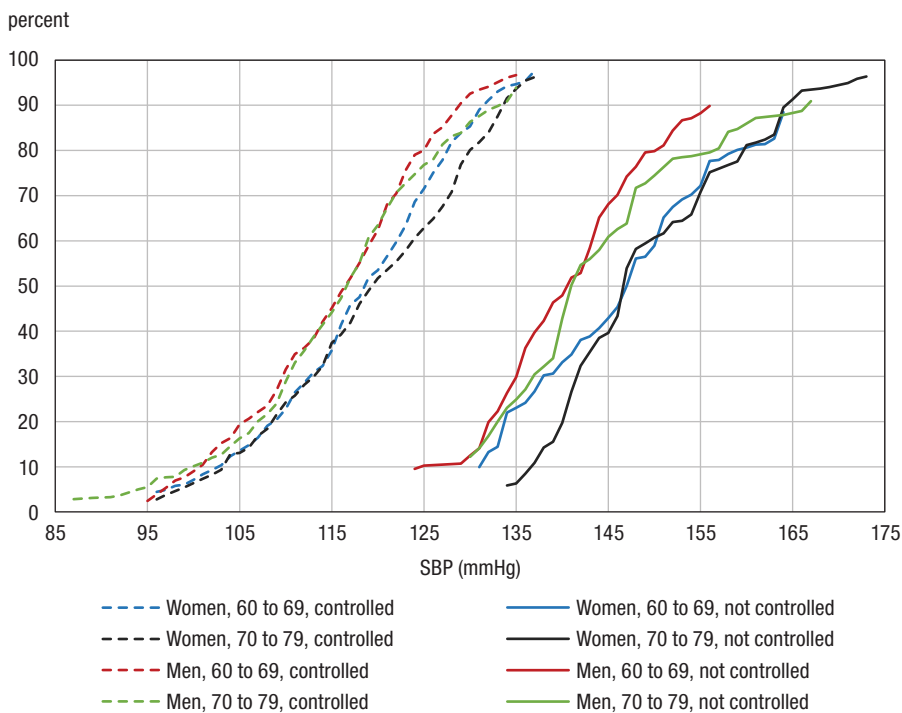
Women treated for hypertension were less likely than men treated for hypertension to be married or living common law, to smoke, to eat fruits or vegetables less than five times per day, to be overweight or obese, or to have diabetes or cardiovascular disease (Table 1). On the other hand, treated women were more likely than treated men to be in the lowest income quintile, to participate in less than 150 minutes per week of MVPA, to have non-HDL cholesterol of 4.3 mmol/L or greater, or to have a family history of high blood pressure or early cardiovascular disease. Treated women were

Figure 1
Prevalence of hypertension treatment and control by sex and age group, hypertensive household population aged 60 to 79, 2007 to 2015



Source: 2007 to 2009, 2009 to 2011, 2012 to 2013, and 2014 to 2015 Canadian Health Measures Survey, combined.

Figure 2
Cumulative distribution of SBP (mmHg) among the hypertensive population aged 60 to 79 taking antihypertensive medication, by sex, age group and control status, 2007 to 2015



Source: 2007 to 2009, 2009 to 2011, 2012 to 2013, and 2014 to 2015 Canadian Health Measures Survey, combined.

more likely to report using diuretics and NSAIDs, and less likely to report using agents acting on the renin-angiotensin system or beta blockers.

Among women, older age and diabetes were each associated with poorer hypertension control after covariate adjustment (Table 2). Women aged 60 to 69 were 21% more likely to have controlled hypertension than women aged 70 to 79, whereas women with diabetes were 30% less likely than women without diabetes to have their hypertension under control. Age, ethnicity, diabetes, cardiovascular disease and NSAID use were each associated with hypertension control for men after covariate adjustment (Table 2). White men were 19% more likely to have controlled hypertension, while men with cardiovascular disease were 10% more likely. Men with diabetes were 24% less likely to have controlled hypertension; men who used NSAIDs were 15% less likely.

The association between several characteristics and hypertension control varied between age groups. After covariate adjustment, white women aged 60

Table 1
Prevalence of risk factors among people treated for hypertension, by sex, household population aged 60 to 79, 2007 to 2015

| Socio-demographic characteristics | Women | | | | Men | | | |
|--|-------------|-------------------|------------------------------------|------|-------------|------|------------------------------------|------|
| | Sample size | % | 95% confidence interval from to | | Sample size | % | 95% confidence interval from to | |
| Age group | | | | | | | | |
| 60 to 69 years | 551 | 55.6 | 50.3 | 60.8 | 620 | 59.0 | 55.0 | 62.9 |
| 70 to 79 years | 499 | 44.4 | 39.2 | 49.7 | 441 | 41.0 | 37.1 | 45.0 |
| Married/Common-law | 548 | 62.8 [†] | 58.5 | 66.8 | 784 | 80.7 | 77.0 | 83.9 |
| Less than secondary school graduation | 308 | 28.5 | 24.0 | 33.4 | 275 | 29.6 | 25.5 | 34.1 |
| In lowest income quintile | 321 | 28.0 [†] | 24.2 | 32.2 | 228 | 20.4 | 16.6 | 24.7 |
| White | 933 | 85.8 | 79.8 | 90.2 | 930 | 88.4 | 83.0 | 92.3 |
| Has regular doctor | 1021 | 97.9 | 96.6 | 98.7 | 1027 | 96.8 | 95.2 | 97.9 |
| Health behaviours | | | | | | | | |
| Current smoker (daily or occasional) | 108 | 9.9 [†] | 7.6 | 12.8 | 155 | 14.7 | 12.1 | 17.7 |
| Less than 150 minutes/week in moderate-to-vigorous physical activity | 657 | 63.9 [†] | 59.5 | 68.2 | 614 | 57.6 | 53.3 | 61.8 |
| Eats fruits or vegetables less than 5 times per day | 681 | 67.9 [†] | 63.5 | 72.0 | 802 | 75.7 | 72.3 | 78.8 |
| Co-morbidity | | | | | | | | |
| Overweight or obese | 813 | 78.1 [†] | 74.1 | 81.6 | 900 | 85.9 | 82.6 | 88.6 |
| Diabetes | 281 | 25.0 [†] | 22.0 | 28.3 | 353 | 32.9 | 29.1 | 37.0 |
| Chronic kidney disease | 276 | 24.8 | 21.0 | 29.1 | 213 | 19.4 | 16.0 | 23.4 |
| Non-HDL cholesterol 4.3 mmol/L or more | 230 | 22.7 [†] | 19.2 | 26.6 | 168 | 16.3 | 13.8 | 19.3 |
| Cardiovascular disease | 228 | 19.8 [†] | 16.7 | 23.3 | 374 | 35.7 | 31.6 | 40.0 |
| Family history | | | | | | | | |
| High blood pressure | 642 | 61.3 [†] | 57.4 | 65.1 | 539 | 54.7 | 49.8 | 59.5 |
| Early cardiovascular disease | 338 | 33.0 [†] | 29.7 | 36.6 | 278 | 23.5 | 20.6 | 26.8 |
| Medication use | | | | | | | | |
| One antihypertensive medication (monotherapy) | 561 | 54.0 | 50.1 | 57.9 | 553 | 51.8 | 47.4 | 56.1 |
| Two antihypertensive medications | 362 | 35.0 | 31.6 | 38.5 | 356 | 33.2 | 29.5 | 37.1 |
| Three or more antihypertensive medications | 127 | 11.0 | 8.6 | 13.9 | 152 | 15.1 | 12.1 | 18.6 |
| Medication type | | | | | | | | |
| Diuretic | 341 | 31.5 [†] | 27.4 | 35.9 | 221 | 19.8 | 16.2 | 23.8 |
| Calcium channel antagonist | 314 | 29.8 | 25.7 | 34.3 | 310 | 29.3 | 24.7 | 34.4 |
| Agent acting on renin-angiotension system | 719 | 68.4 [†] | 64.7 | 71.9 | 840 | 80.1 | 77.3 | 82.7 |
| Beta-blocker | 294 | 27.7 [†] | 24.4 | 31.4 | 356 | 34.6 | 30.5 | 38.9 |
| Non-steroidal anti-inflammatory and antirheumatic | 246 | 24.1 [†] | 20.9 | 27.7 | 169 | 14.3 | 12.2 | 16.8 |

[†] estimate for women is significantly different from estimate for men (p <=0.05)

Notes: Sample sizes are unweighted counts. Percentages and confidence intervals are based on weighted estimates. Family history of high blood pressure and less than 150 minutes/week in moderate-to-vigorous physical activity each include a third response category for "unknown" which accounts for 12% and 25% of total response, respectively.

Source: 2007 to 2009, 2009 to 2011, 2012 to 2013, and 2014 to 2015 Canadian Health Measures Survey, combined.

to 69 were more likely than non-white women to have their hypertension controlled, but this was not the case for women aged 70 to 79 (Table 3). Women aged 60 to 69 who smoked were more likely to have their hypertension controlled, and men aged 60 to 69 in the lowest income quintile were less likely. These associations were not observed for women and men aged 70 to 79.

Applying the correction factors to adjust the average values of BpTRU™ SBP and DBP had little effect on the prevalence of hypertension (results not shown) or the prevalence of hypertension control (Figure 3).

Removing the diabetes-specific thresholds of SBP >=130 mmHg or mean DBP >=80 mmHg and applying the general population thresholds of mean SBP >=140 mmHg or mean DBP >=90 mmHg to all respondents did not result in a substantial decrease in the proportion of women and men categorized as hypertensive (results not shown). However, the prevalence of hypertension control for women and men increased (Figure 3). In the regression analysis, removing the diabetes-specific threshold eliminated the association between diabetes and hypertension control for both women and men. It also attenuated the

association between hypertension control and ethnicity and cardiovascular disease for men (results not shown).

Discussion

This study found that women and men aged 60 to 79 were equally likely to have hypertension. However, among those taking antihypertensive medication, almost one-third of women aged 70 to 79 did not have their hypertension controlled, a much higher percentage than for men. The SBP of women was also higher than that of men, regardless of control. Older age and diabetes were significantly associated with poorer hypertension control for women, after covariate adjustment. Older age, white ethnicity, diabetes, no cardiovascular disease, and NSAID use were associated with poorer hypertension control for men.

Similar to other studies,^{7,13} this study found that the SBP of women was higher than that of men, regardless of age group or control status. Furthermore, isolated systolic hypertension was more prevalent among women than men (results not shown). Median SBP values for women were substantially higher than those for men at ages 60 to 69 (a difference of 4 mmHg) and at ages 70 to 79 (a difference of 9 mmHg). High SBP is of concern because of its significant association with the risk of cardiovascular and renal disease.²⁸ It has been shown that a decrease in mean SBP of 2 mmHg is associated with a 7% reduction in mortality from ischaemic heart disease and a 10% reduction in stroke mortality.²⁹

Older age was significantly associated with poorer hypertension control among women and men—a finding that is consistent with other studies.^{6,30} Age group modified the association between hypertension control and ethnicity and smoking for women, and between hypertension control and NSAID use for men. These results suggest that not only are women and men in older age groups at greater risk of poorer hypertension control, but that certain groups at older ages may be particularly at risk. Studies have found that older adults with uncon-

Table 2
Model-adjusted risk ratios relating health behaviours and other characteristics to controlled hypertension by sex, household population aged 60 to 79 treated for hypertension, 2007 to 2015

| | Women | | | Men | | |
|--|------------|-------------------------|------|------------|-------------------------|------|
| | Risk ratio | 95% confidence interval | | Risk ratio | 95% confidence interval | |
| | | from | to | | from | to |
| Socio-demographic characteristics[†] | | | | | | |
| 60 to 69 years ^{††} | 1.21* | 1.11 | 1.33 | 1.13* | 1.02 | 1.26 |
| Married/Common-law | 0.97 | 0.87 | 1.08 | 1.06 | 0.96 | 1.17 |
| In lowest income quintile | 1.08 | 0.97 | 1.20 | 0.91 | 0.81 | 1.03 |
| White | 1.15 | 0.93 | 1.43 | 1.19* | 1.01 | 1.40 |
| Health behaviours[†] | | | | | | |
| Current smoker (daily or occasional) | 1.07 | 0.89 | 1.28 | 0.99 | 0.86 | 1.14 |
| Less than 150 minutes/week in moderate-to-vigorous physical activity | 1.08 | 0.87 | 1.33 | 1.00 | 0.85 | 1.18 |
| Eats fruits or vegetables less than 5 times per day | 0.96 | 0.86 | 1.08 | 0.99 | 0.89 | 1.10 |
| Co-morbidity[†] | | | | | | |
| Overweight or obese | 0.97 | 0.81 | 1.16 | 1.00 | 0.90 | 1.11 |
| Diabetes | 0.70* | 0.60 | 0.83 | 0.76* | 0.68 | 0.84 |
| Chronic kidney disease | 0.98 | 0.84 | 1.15 | 1.00 | 0.91 | 1.11 |
| Non-HDL cholesterol 4.3 mmol/L or more | 0.91 | 0.77 | 1.07 | 0.98 | 0.87 | 1.10 |
| Cardiovascular disease | 1.01 | 0.89 | 1.16 | 1.10* | 1.01 | 1.21 |
| Family history[†] | | | | | | |
| High blood pressure | 0.97 | 0.85 | 1.12 | 0.99 | 0.89 | 1.10 |
| Early cardiovascular disease | 1.07 | 0.94 | 1.21 | 1.04 | 0.94 | 1.14 |
| Medication use[†] | | | | | | |
| Monotherapy | 1.03 | 0.90 | 1.18 | 1.01 | 0.92 | 1.10 |
| Non-steroidal anti-inflammatory and antirheumatic | 0.99 | 0.87 | 1.11 | 0.85* | 0.75 | 0.97 |

* significantly different from reference category (p-value) (p < 0.05)

[†] reference category is absence of characteristic

^{††} reference category is age 70 to 79 years

Source: 2007 to 2009, 2009 to 2011, 2012 to 2013, and 2014 to 2015 Canadian Health Measures Survey, combined.

trolled hypertension are at increased risk of mild cognitive impairment or probable dementia, accelerated decline in physical function, and increased incidence of disability.³¹

Cardiovascular disease was significantly associated with improved hypertension control in men and was 1.8 times more prevalent in men than women. This study's finding that having cardiovascular disease was associated with better hypertension control among men has also been observed elsewhere.³⁰ Similar to diabetes, existing cardiovascular disease is a strong predictor of recurrent events; therefore, hypertension control is emphasized,⁴ resulting in improved patient adherence to treatment.^{32,33} Furthermore, medications such as agents acting on the renin-angiotensin system and beta blockers are recommended for people with cardiovascular disease, regardless of hypertension

status.⁴ This study found that these therapies were more commonly prescribed for men.

Diabetes was significantly associated with poorer hypertension control and was more prevalent in men. Poor hypertension control in people with diabetes has been observed in many other studies.^{5-7,13,34} This likely reflects the difficulty in meeting the more stringent blood pressure targets of mean SBP < 130 mmHg and mean DBP < 80 mmHg. When the blood pressure targets for the general population were applied to people with and without diabetes in this study, hypertension control no longer differed between the two groups.

The association of NSAID use with poorer control among men in the current study is consistent with the prohypertensive effect of these medications among those treated for hypertension.³⁵⁻³⁸ This association was not observed among

women. This may be related to their less frequent use of certain antihypertensive medication classes found to be susceptible to an interaction with NSAIDs, namely agents acting on the renin-angiotensin system^{35,38} and beta blockers.^{37,38}

This study has several strengths. The results are based on a nationally representative sample of respondents for whom SBP and DBP were assessed objectively using an automated device with high quality control. The comprehensive nature of the CHMS allowed many risk factors to be considered in the analysis, including BMI and physical activity based on measured data.

At the same time, this analysis has some limitations. Statistical power was somewhat limited because of small sample sizes. Information about medication use was gathered directly from respondents and not verified in medical records. This may have led to some misclassification of conditions such as diabetes. The CHMS excludes the institutionalized population; therefore, this study's findings apply only to the community-dwelling population in Canada. The combined non-response rate for 60- to 79-year-olds in the four cycles of the CHMS was 52.7%. While the combined survey weight adjusted for non-response, some unknown bias might still exist if non-respondents to the CHMS differed systematically from respondents.

Conclusion

Based on current blood pressure targets, differences in blood pressure control persist among women and men aged 60 to 79 taking antihypertensive medication in Canada. Ethnicity, diabetes, cardiovascular disease and NSAID use were significantly associated with hypertension control for men, while diabetes was the only risk factor other than older age associated with control for women. Further research to better understand the underlying cause of these associations may help reduce disparities in hypertension control rates between women and men in Canada. ■

Table 3
Model-adjusted risk ratios relating health behaviours and other characteristics to controlled hypertension by age group and by sex, household population aged 60 to 79 treated for hypertension, 2007 to 2015

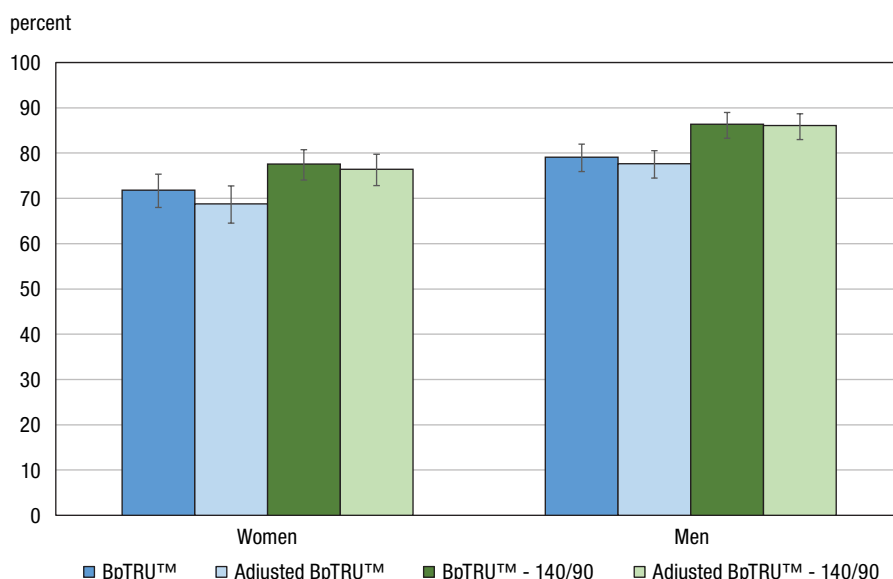
| | Women | | | | | | Men | | | | | |
|--|-------------------------|------|------|--------------------|------|------|-------------------------|------|------|--------------------|------|------|
| | Age 60 to 69 years | | | Age 70 to 79 years | | | Age 60 to 69 years | | | Age 70 to 79 years | | |
| | 95% confidence interval | | | | | | 95% confidence interval | | | | | |
| | % | from | to | % | from | to | % | from | to | % | from | to |
| Socio-demographic characteristics† | | | | | | | | | | | | |
| Married/Common-law | 0.96 | 0.83 | 1.09 | 0.99 | 0.83 | 1.18 | 1.07 | 0.96 | 1.18 | 1.05 | 0.85 | 1.30 |
| In lowest income quintile | 1.04 | 0.93 | 1.18 | 1.14 | 0.94 | 1.38 | 0.84* | 0.72 | 0.98 | 1.02 | 0.86 | 1.22 |
| White | 1.33* | 1.02 | 1.75 | 0.84 | 0.69 | 1.01 | 1.24 | 0.96 | 1.60 | 1.14 | 0.90 | 1.45 |
| Health behaviours† | | | | | | | | | | | | |
| Current smoker (daily or occasional) | 1.16* | 1.04 | 1.29 | 0.76 | 0.42 | 1.38 | 1.02 | 0.91 | 1.13 | 0.93 | 0.64 | 1.36 |
| Less than 150 minutes/week in moderate-to-vigorous physical activity | 0.93 | 0.76 | 1.12 | 1.52 | 0.87 | 2.67 | 1.00 | 0.87 | 1.16 | 1.01 | 0.75 | 1.37 |
| Eats fruits or vegetables less than 5 times per day | 0.88 | 0.77 | 1.01 | 1.10 | 0.89 | 1.34 | 0.93 | 0.82 | 1.04 | 1.12 | 0.91 | 1.36 |
| Co-morbidity† | | | | | | | | | | | | |
| Overweight or obese | 1.06 | 0.82 | 1.37 | 0.87 | 0.71 | 1.08 | 1.02 | 0.89 | 1.16 | 0.97 | 0.79 | 1.19 |
| Diabetes | 0.65* | 0.53 | 0.82 | 0.79* | 0.62 | 1.01 | 0.73* | 0.63 | 0.85 | 0.80* | 0.66 | 0.98 |
| Chronic kidney disease | 0.90 | 0.74 | 1.10 | 1.04 | 0.83 | 1.30 | 0.99 | 0.84 | 1.16 | 1.02 | 0.90 | 1.16 |
| Non-HDL cholesterol 4.3 mmol/L or more | 0.91 | 0.76 | 1.08 | 0.92 | 0.69 | 1.21 | 0.97 | 0.83 | 1.13 | 0.99 | 0.80 | 1.24 |
| Cardiovascular disease | 1.08 | 0.94 | 1.24 | 0.94 | 0.74 | 1.20 | 1.05 | 0.95 | 1.17 | 1.18* | 1.01 | 1.39 |
| Family history† | | | | | | | | | | | | |
| High blood pressure | 0.98 | 0.84 | 1.14 | 0.96 | 0.74 | 1.24 | 1.01 | 0.85 | 1.20 | 0.97 | 0.77 | 1.21 |
| Early cardiovascular disease | 1.09 | 0.96 | 1.24 | 1.02 | 0.84 | 1.23 | 1.01 | 0.90 | 1.13 | 1.08 | 0.91 | 1.29 |
| Medication use† | | | | | | | | | | | | |
| Monotherapy | 1.01 | 0.89 | 1.16 | 1.06 | 0.84 | 1.35 | 1.02 | 0.94 | 1.12 | 0.97 | 0.82 | 1.16 |
| Non-steroidal anti-inflammatory and antirheumatic | 1.03 | 0.89 | 1.18 | 0.92 | 0.67 | 1.25 | 0.92 | 0.81 | 1.06 | 0.69* | 0.48 | 0.99 |

* significantly different from reference category (p < 0.05)

† reference category is absence of characteristic

Source: 2007 to 2009, 2009 to 2011, 2012 to 2013, and 2014 to 2015 Canadian Health Measures Survey, combined.

Figure 3
Model-adjusted prevalence of hypertension control according to various hypertension criteria, by sex, household population aged 60 to 79 treated for hypertension, 2007 to 2015



I = 95% confidence interval

Note: BpTRU™ = status quo; Adjusted BpTRU™ = applied the correction factors to systolic blood pressure (SBP) and diastolic blood pressure (DBP); BpTRU™ - 140/90 = removed the diabetes-specific SBP and DBP thresholds; Adjusted BpTRU™ - 140/90 = applied the correction factors to SBP and DBP and removed the diabetes-specific SBP and DBP thresholds. Each sex-specific model adjusted for cycle of CHMS and all covariates listed in Table 2.

Source: 2007 to 2009, 2009 to 2011, 2012 to 2013, and 2014 to 2015 Canadian Health Measures Survey, combined.

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