






BRIEF COMMUNICATION

# Immigration Status and Sex Differences in Primary Cardiovascular Disease Prevention: A Retrospective Study of 5 Million Adults

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**BACKGROUND:** We evaluated whether immigration status modified the association between sex and the quality of primary cardiovascular disease prevention in Ontario, Canada.

**METHODS AND RESULTS:** We used a population-based administrative database-derived cohort of community-dwelling adults (aged  $\geq 40$  years) without prior cardiovascular disease residing in Ontario on January 1, 2011. In the preceding 3 years, we evaluated screening for hyperlipidemia and diabetes in those not previously diagnosed; diabetes control ( $HbA_{1c} < 7\%$ ); and medication use to control hypertension, hyperlipidemia, or diabetes in those with previous diagnosis. We calculated the absolute prevalence difference (APD) between women and men for each metric stratified by immigration status and then determined the difference-in-differences for immigrants compared with long-term residents. Our sample included 5.3 million adults (19% immigrants), with receipt of each metric ranging from 55% to 90%. Among immigrants, women were more likely than men to be screened for hyperlipidemia (APD, 10.8%; 95% CI, 10.5–11.2) and diabetes (APD, 11.5%; 95% CI, 11.1–11.8) and to be treated with medications for hypertension (APD, 3.5%; 95% CI, 2.4–4.5), diabetes (APD, 2.1%; 95% CI, 0.7–3.6) and hyperlipidemia (APD, 1.8%; 95% CI, 0.5–3.1). Among long-term residents, findings were similar except poorer medication use for diabetes (APD, –2.8%; 95% CI, –3.4 to –2.2) and hyperlipidemia (APD, –3.5%; 95% CI, –4.0 to –3.0) in women compared with men.

**CONCLUSIONS:** The overall quality of primary preventive care can be improved for all adults, and future research should evaluate the impact of observed equal or better care in women than men, irrespective of immigration status, on cardiovascular disease incidence.

**Key Words:** cardiovascular ■ immigration ■ prevention ■ quality ■ sex

Recent immigrants have a lower risk of cardiovascular disease compared with longer-term immigrants and nonimmigrants<sup>1</sup>; however, the magnitude of this health advantage may differ between immigrant women and men because of different post-migration experiences.<sup>2</sup> It is also important to account for the ethnic origins of immigrants as variations in cardiovascular care and outcomes based on ethnicity have been previously described.<sup>1</sup>

Cardiovascular care varies by sex, with women being less likely to be on guideline-recommended medications for hypertension and hyperlipidemia, and less likely to achieve control of vascular risk factors compared with men.<sup>3</sup> Intersectionality theory suggests that immigrant women may be more vulnerable to these sex disparities compared with other women<sup>4</sup>; however, little is known on potential sex differences in the quality of primary cardiovascular preventive care

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among immigrants. We conducted a retrospective cohort study in Ontario, Canada, to compare the quality of primary cardiovascular preventive care in women and men, and to determine if sex differences varied with immigration status. We hypothesized that women would receive poorer quality of primary preventive care compared with men and that this sex difference would be more pronounced in immigrants compared with long-term residents.

## METHODS

The data set from this study is held securely in coded form at ICES. Although data-sharing agreements prohibit ICES from making the data set publicly available, access may be granted to those who meet prespecified criteria for confidential access, available at <https://www.ices.on.ca/das>.

The Sunnybrook Health Sciences Center Research Ethics Board provided ethics approval for this study. The study uses existing administrative healthcare databases, and individual patient consent is not obtained for their use.

### Setting

We used the CANHEART (Cardiovascular Health in Ambulatory Care Research Team) cohort, a population-based cohort derived from linkage of multiple health administrative databases, to identify all community-dwelling adults aged 40 to 105 years on January 1, 2011, without prior cardiovascular disease (up to 23-year look-back window), residing in Ontario and who were eligible for the provincial health insurance plan for at least 5 years before the inception date.<sup>5</sup> We excluded individuals residing in long-term care homes because their care needs may differ from those of community-dwelling adults and because immigrants are less likely than nonimmigrants to reside in a long-term care home.<sup>6</sup> We also excluded those residing in rural Ontario (geographically defined communities with a population of <10 000) because most immigrants reside in urban Ontario.

### Exposures and Outcomes

Our exposures were sex and immigration status. People born outside of Canada and arriving in 1985 or later as per the Immigration, Refugees and Citizenship Canada Permanent Resident database were categorized as immigrants. Those born in Canada or immigrating before 1985 were categorized as long-term residents. This definition was necessary because data on immigration status were not available before 1985.

The primary outcomes were screening for hyperlipidemia and diabetes in patients without these

diagnoses and glycemic control ( $\text{HbA}_{1c} < 7\%$ ) in those with diabetes in the 3 years before cohort inception. We also evaluated whether medications to control hypertension, hyperlipidemia, and diabetes were filled at least once in the year prior among patients aged >64 years (between January 1, 2010, and December 31, 2010) in those with relevant diagnoses. We used the Ontario Laboratories Information System database to determine screening of hyperlipidemia and screening and control of diabetes, and the Ontario Drug Benefit database to determine medication use.

We obtained information on demographic characteristics (age and neighborhood-level income), comorbidities (hypertension, diabetes, hyperlipidemia, atrial fibrillation, chronic obstructive pulmonary disease, congestive heart failure), Charlson comorbidity index (categorized as tertiles), and, on a subsample linked to survey data,<sup>7</sup> self-reported vascular risk factors (physical activity, smoking status, and obesity status based on self-reported height and weight, unhealthy diet, alcohol consumption, and stress). Details on data sources and operationalization of these variables are provided in Table S1.

### Statistical Analysis

We compared differences in demographics, comorbidities, and self-reported vascular risk factors between women and men, stratified by immigration status, using the chi-square test for categorical variables and the Kruskal-Wallis test for continuous variables, and by reporting standardized difference, with values >0.10 suggesting a potentially meaningful difference.<sup>8</sup> Standardized differences express the difference in means or prevalence between 2 populations as a proportion of the pooled standard deviation.

For each outcome, we used generalized linear models with the binomial distribution and identity link function to calculate absolute prevalence differences (APD) in women compared with men. We undertook these analyses separately for immigrants and long-term residents, reporting unadjusted estimates for the outcome of medication use and age-adjusted estimates for the screening and control outcomes. We calculated the difference-in-difference estimates by taking the difference in APD between women and men among immigrants (first difference) and that among long-term residents (second difference) to evaluate the modifying role of immigration status on sex-outcome associations.

### World Region of Immigrants and Years Lived in Ontario

To evaluate if the region of origin of immigrants (which closely relates to ethnicity of immigrants) had an influence on the observed sex differences in the quality

of preventive care, we calculated estimates of association for each quality metric comparing women to men based on the following 7 world regions: Africa, Caribbean, East Asia, Latin America, Middle East, South Asia, and Western countries. We calculated the difference-in-differences estimate for each world region with long-term residents as the reference group.

Finally, we evaluated whether sex differences in primary preventive care varied among immigrants based on the number of years lived in Ontario (<10 years or ≥10 years).

## RESULTS

We included 5.3 million adults (19% immigrants). The proportion of women among immigrants was slightly lower than in long-term residents (51.5% versus 53.4%;  $P < 0.001$ ) (Table). Compared with men, women in both immigrant and long-term resident groups had a lower prevalence of diabetes and hyperlipidemia and a higher prevalence of hypertension (Table). Information on self-reported vascular risk factors, obtained through linkage with self-reported community health surveys, was available for only 0.7% of the total sample. Among both immigrants and long-term residents, women were less likely than men to have an unhealthy diet, be a current smoker, or have heavy alcohol use, but were more likely to be physically inactive (Table). Immigrant women were more likely to report being obese than immigrant men, whereas the reverse was observed among long-term residents (Table).

Long-term resident women received the most care and immigrant men received the least care. Among immigrants, compared with men, women were more likely to be screened for hyperlipidemia (67.0% versus 55.5%; age-adjusted APD, 10.8%; 95% CI, 10.5–11.2) and diabetes (74.7% versus 64.0%; age-adjusted APD, 11.5%; 95% CI, 11.1–11.8); equally likely to have glycemic control (69.0% versus 67.7%; age-adjusted APD, 95% CI, 0.8%; 95% CI, 0.0–1.1); and more likely to be treated with medications for hypertension (65.2% versus 61.8%; APD, 3.5%; 95% CI, 2.4–4.5), diabetes (56.1% versus 53.9%; APD, 2.1%; 95% CI, 0.7–3.6), and hyperlipidemia (56.6% versus 54.8%; APD, 1.8%; 95% CI, 0.5–3.1) (Figure 1). Among long-term residents, findings were similar, except women were less likely than men to be treated with medications for diabetes (53.6% versus 62.1%; APD, –2.8%; 95% CI, –3.4 to –2.2) and hyperlipidemia (58.6% versus 62.1%; APD, –3.5%; 95% CI, –4.0 to –3.0), and, among those with diabetes, women were more likely than men to achieve glycemic control (73.2% versus 69.7%; APD, 3.2%; 95% CI, 2.7–3.6). Immigration status did

not modify the sex-outcome association, except for medication use (Figure 1).

## Results by World Region of Immigrants and Years Lived in Ontario

Findings of equal or better care in women compared with men were generally similar across immigrant groups from different world regions, with variable magnitude, except for the use of medications for hyperlipidemia and diabetes, which was less common in women than men among immigrants from Africa (Figure 2). The sex differences in primary preventive care did not vary among immigrants on the basis of their years lived in Ontario, except for a relative improvement in the use of medications for hyperlipidemia and diabetes in women compared with men among immigrants who have been in Ontario longer (Figure S1).

## DISCUSSION

In this population-based cohort of over 5 million people, the overall quality of primary cardiovascular preventive care in women was similar to or better than that in men, and this was true in both immigrants and long-term residents.

These findings are consistent with some previous studies that have shown that women are more likely than men to have adequate control of diabetes<sup>9</sup> and to be screened for vascular risk factors.<sup>10</sup> Improvements in awareness of cardiovascular disease in women over time<sup>11</sup> may explain the favorable results for women in our study. Further studies are needed to identify patient-, physician-, or organization-level drivers of the observed sex-specific variation in the quality of primary preventive care.

Immigration status-sex differences in the prevalence of hypertension have been observed in the United States,<sup>12</sup> and we found similar differences in medication use for hyperlipidemia and diabetes. Our finding of a lack of variation in sex differences by immigration status for other outcomes supports the need to evaluate this in other jurisdictions. An explanation may be that all Ontario residents, including immigrants, are covered for hospital and essential physician services, investigations ordered by physicians, and medications in those aged >64 years.

Sex, race, and ethnicity differences in primary preventive care have been previously described, but immigration status is generally not accounted for.<sup>13</sup> Compared with men, African immigrant women in our study, but not Caribbean immigrant women, were less likely to be on cholesterol-lowering drugs. We found variation in the magnitude of difference in screening for vascular risk factors between women and men by region of origin of immigrants, but these were not

**Table. Baseline Characteristics of 5.3 Million Ontario Adults (≥40 years) Without Cardiovascular Disease**

| Characteristics of interest                          | Immigrants (N=984 978) |                      | Long-term residents (N=4 352 340) |                        |
|--|------------------------|----------------------|-----------------------------------|------------------------|
|  | Women n=502 905 (51.5) | Men n=482 073 (48.5) | Women n=2 323 935 (54.5)          | Men n=2 028 405 (45.5) |
| Median age, Q1–Q3                                    | 50 (45–60)             | 50 (45–57)           | 56 (48–67)                        | 55 (47–64)             |
| Neighborhood-level income, n (%)                     |                        |                      |                                   |                        |
| Lowest quintile                                      | 128 970 (25.6)         | 122 313 (25.4)       | 372 257 (16.0)                    | 323 560 (16.0)         |
| Highest quintile                                     | 66 691 (13.3)          | 62 107 (12.9)        | 547 364 (23.6)                    | 483 694 (23.8)         |
| Comorbidities, n (%)                                 |                        |                      |                                   |                        |
| Hypertension   | 147 532 (29.3)         | 128 990 (26.8)       | 874 481 (37.6)                    | 709 875 (35.0)         |
| Diabetes   | 63 785 (12.7)          | 65 935 (13.7)        | 282 151 (12.1)                    | 278 767 (13.7)         |
| Hyperlipidemia                                       | 113 836 (22.6)         | 142 853 (29.6)       | 584 285 (25.1)                    | 574 884 (28.3)         |
| Atrial fibrillation                                  | 3912 (0.8)             | 3858 (0.8)           | 46 108 (2.0)                      | 47 719 (2.4)           |
| CHF  | 3173 (0.6)             | 2380 (0.5)           | 27 870 (1.2)                      | 23 390 (1.2)           |
| COPD   | 3980 (0.8)             | 5945 (1.2)           | 77 020 (3.3)                      | 67 914 (3.3)           |
| Charlson comorbidity, n (%)                          |                        |                      |                                   |                        |
| Medium   | 12 122 (2.4)           | 9745 (2.0)           | 92 206 (4.0)                      | 76 497 (3.8)           |
| High   | 12 278 (2.4)           | 9845 (2.0)           | 103 400 (4.4)                     | 94 572 (4.7)           |
| <b>Subsample with self-reported measures*, n (%)</b> |                        |                      |                                   |                        |
|  | <b>n=2149 (0.4)</b>    | <b>n=1997 (0.4)</b>  | <b>n=35 983 (1.5)</b>             | <b>n=26 591 (1.3)</b>  |
| Physically inactive                                  | 1382 (60.4)            | 1214 (57.8)          | 19 804 (51.3)                     | 12 700 (45.9)          |
| Current smoker                                       | 196 (8.3)              | 422 (19.7)           | 7278 (18.7)                       | 6605 (23.3)            |
| Obese  | 319 (14.2)             | 239 (11.4)           | 8068 (21.7)                       | 6334 (22.9)            |
| Unhealthy diet                                       | 1212 (54.6)            | 1385 (68.6)          | 21 637 (57.8)                     | 19 604 (73.0)          |
| Heavy alcohol use                                    | 60 (2.5)               | 212 (10.0)           | 2511 (6.4)                        | 6079 (21.6)            |
| Significant stress                                   | 606 (25.6)             | 554 (26.0)           | 8366 (21.5)                       | 5390 (19.1)            |
| Region of origin of immigrants                       |                        |                      |                                   |                        |
| Africa   | 21 345 (4.4)           | 22 164 (4.8)         |                                   |                        |
| Caribbean  | 33 122 (6.9)           | 27 906 (6.1)         |                                   |                        |
| East Asia  | 120 303 (25.0)         | 92 238 (20.2)        |                                   |                        |
| Latin America  | 36 512 (7.6)           | 34 827 (7.6)         |                                   |                        |
| Middle East  | 42 400 (8.8)           | 49 784 (10.9)        |                                   |                        |
| South Asia   | 98 570 (20.5)          | 110 039 (24.1)       |                                   |                        |
| Western countries                                    | 129 351 (26.9)         | 120 562 (26.4)       |                                   |                        |

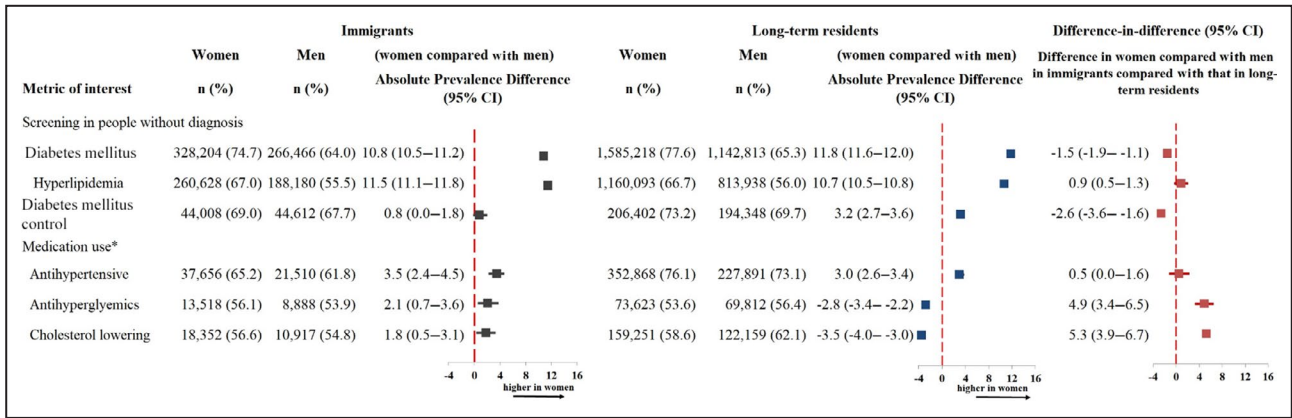
Values in parentheses represent proportion unless otherwise specified. CHF indicates congestive heart failure; and COPD, chronic obstructive pulmonary disease.

\*On the basis of information obtained by linkage with the Canadian Community Health Surveys. Charlson comorbidity index divided into low, medium, and high categories based on tertiles.

significantly different. Further, our findings of slight improvement in the use of cholesterol-lowering and antihyperglycemic medications in immigrant women compared with men with longer duration of stay suggests that acculturation could play a role and needs further evaluation using appropriate measures of acculturation. Future research should evaluate drivers of these variations based on region of origin, which may include sex-based health-seeking patterns of immigrant groups based on their country of origin<sup>14</sup> and characteristics of health systems.<sup>15</sup>

Most guidelines recommend screening for hyperlipidemia and diabetes in people aged >40 years

at least once in 3 years, and our finding of 60% to 75% screening for these risk factors in the overall sample suggests the need to improve guideline-recommended preventive care. The format of the guidelines, the language used, and the lack of absolute risk differences reporting are some factors associated with poor uptake of guideline recommendations in clinical practice.<sup>16</sup> Organizational change and physician and patient education are potential avenues to improve screening and treatment of vascular risk factors.<sup>17</sup> Finally, targeted screening in relatives of people with cardiovascular disease and use of e-health tools or decision-support software in



**Figure 1. Sex differences in cardiovascular preventive care comparing women with men among immigrants and long-term residents, and the difference-in-difference estimates comparing sex differences among immigrants and long-term residents.**

\*In people aged >64 years with a relevant diagnosis.

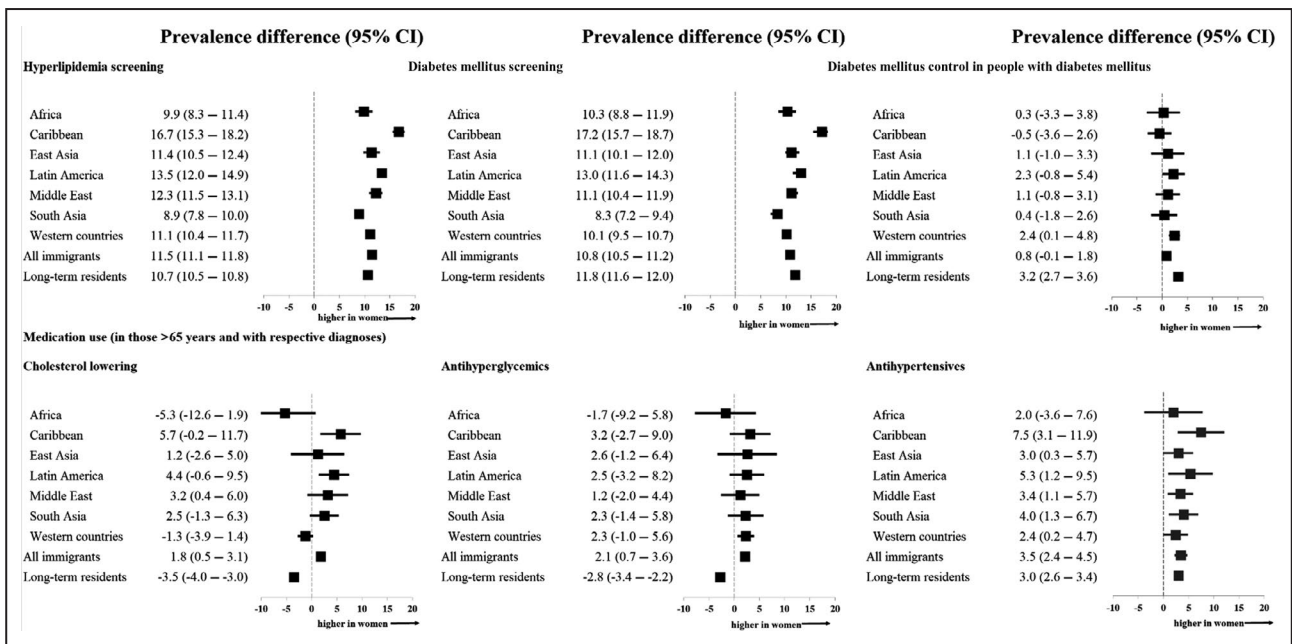
primary care practices have also been shown to improve screening rates.<sup>18</sup>

### Strengths and Limitations

Our study is strengthened by using routinely collected data to determine screening and control of vascular risk factors, and drug claims to capture drug use among almost the entire population of a province.

Study limitations include a lack of medication data in patients aged <65 years. Further work in younger adults is needed, as prior data have suggested lower use of antihyperglycemic drug in women compared

with men for cost-cutting purposes in this population.<sup>19</sup> A potential explanation for an overall lower rate of screening and treatment of vascular risk factors could be attributable to incomplete data in administrative databases; however, the incompleteness is unlikely to vary by sex or immigration status. For example, HbA<sub>1c</sub> measurements in the prior 3 years were available in about 90% of people with diabetes, without significant differences in this testing either by sex or immigration status. We could only evaluate self-reported measures of vascular risk factors in <1% of the study sample; however, these data were derived from cross-sectional



**Figure 2. Primary cardiovascular preventive care in immigrant women compared with men based on region of origin of immigrants.**

surveys of representative Ontarians, allowing us to draw meaningful conclusions. Furthermore, among immigrants, we were unable to rule out cardiovascular disease occurring before migration, leading to potential misclassification as receiving primary preventive care. We also did not have information on factors that might affect use of preventive care, such as education or occupation. Although we did not have individual-level income data, we used neighborhood-level income as a proxy for socioeconomic status. Our data sources only allowed us to identify immigrants who arrived in 1985 or later, and so our findings are most generalizable to recent immigrants (ie, those arriving within the past 3 decades). We also do not have information on postmigration patterns; however, prior work suggests that only a minority of immigrants who landed in Ontario between 1991 and 2006 had moved to other provinces.<sup>20</sup> Our study cohort was assembled in 2011, and it is possible that there have been changes in patterns of preventive care since that time. However, to our knowledge, these are the most recent data on sex differences in primary cardiovascular preventive care at a population level.

### Implications of Our Findings

Contrary to our hypothesis, the observed sex differences in screening and treatment favored women over men, whereas immigration status did not significantly modify the association between sex and primary cardiovascular preventive care. These findings may suggest the importance of adequate healthcare coverage in eliminating immigration status-specific healthcare disparities in primary cardiovascular preventive care. Additionally, population-level efforts to improve the overall quality of primary preventive care for all are needed, and future projects should evaluate the impact of the observed sex differences in primary preventive care on cardiovascular disease incidence and outcomes.

### ARTICLE INFORMATION

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#### Supplementary Material

Table S1  
Figure S1

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# **SUPPLEMENTAL MATERIAL**



**Table S1. Definitions and data sources.**

| <b>Variable</b>                    | <b>Definition</b>   | <b>Data source and operationalization</b>         |
|------------------------------------|---|---|
| <i>Exposures</i>                   |   |   |
| Sex                                | biological sex  | RPBD. Female vs. male (binary)                    |
| Immigration status                 | <i>Immigrants</i> defined as those born outside of Canada and arrived in Canada after 1985<br><br><i>Long-term residents</i> are Canadian-born or arrived before 1985   | IRCC. Immigrants vs. long-term residents (binary) |
| Region of origin                   | Based on country of citizenship at the time of application, immigrants were classified to belong to one of the pre-specified world regions, whereas long-term residents were considered Canadian                | IRCC. Categorical with 7 distinct categories.     |
| <i>Outcomes</i>                    |   |   |
| Screening in those without disease |   |   |
| Hyperlipidemia                     | 1. physician code billing codes L055, L117 and L243 on the same day   | OHIP.   |
| Diabetes                           | 1. OLIS test result for HbA1c or fasting blood glucose test<br><b>OR</b><br>2. OLIS test for Oral Glucose Tolerance Test <b>OR</b><br>3. OHIP lab claim with feecode = L104, L111 or L093                       | OLIS or OHIP.                                     |
| Medication use                     |   |   |
| Hypertension                       | prescription filled between October 1, 2011 and January 1, 2011.<br><br>Beta blockers – subclnam begins with 'BETA-BLOCKERS'<br>ACE inhibitors or ARBs – subclnam begins with 'ACE INHIBITORS' or 'ANGIOTENSIN' | ODB.  |

|  |  |                  |
|--|--|------------------|
|  | <p>Calcium channel blockers –<br/>subclnam begins with<br/>'CALCIUM BLOCKERS' or<br/>'CALCIUM CHANNEL<br/>BLOCKERS'</p> <p>Diuretics –<br/>subclnam='DIURETICS' or<br/>'DIURETICS (POTASSIUM-<br/>SPARING)'</p> <p>Other –<br/>drugname='CLONIDINE<br/>HCL', 'DOXAZOSIN<br/>MESYLATE',<br/>'GUANETHIDINE<br/>MONOSULFATE',<br/>'PRAZOSIN HCL',<br/>'RESERPINE', 'RESERPINE<br/>&amp;<br/>HYDROCHLOROTHIAZIDE',<br/>'TERAZOSIN HCL',<br/>'METHYLDOPA',<br/>'METHYLDOPA HCL' or<br/>'PRAZOSIN'</p> |                  |
| Hyperlipidemia                         | <p>subclnam='ANTILIPEMIC:<br/>STATINS', 'CALCIUM<br/>BLOCKERS ANTILIPEMIC<br/>COMBINATIONS',<br/>'ANTILIPEMIC: FIBRATES'<br/>or 'ANTILIPEMIC: OTHER' or<br/>drugname=('NIACINAMIDE',<br/>'NICOTINIC ACID', 'NIACIN',<br/>'CHOLESTYRAMINE<br/>RESIN', 'COLESTIOL HCL')</p>  |                  |
| Diabetes                               | <p><i>subclnam</i> begins with<br/>'INSULINS' or 'ORAL ANTI-<br/>GLYCEMICS' in the 100 days<br/>prior to index date (from<br/>ODB)</p>   |                  |
| Physician visits                       |  | OHIP.            |
| At least one family<br>physician visit | <p>physician code for family<br/>doctor visit – can only allow 1<br/>visit/person/day</p>  |                  |
| At least one specialist visit          | <p>physician code for specialist<br/>doctor visit (any specialist) –<br/>can only allow 1<br/>visit/person/day</p>   |                  |
|  |  |                  |
| <i>Covariates</i>                      |  |                  |
| Age                                    | Biological age   | RPDB. Continuous |

|                            |  |                            |
|----------------------------|--|----------------------------|
| Neighbourhood-level income | Based on self-reported income in postal code-linked data   | Censu and PCCF. Quintiles. |
| Comorbidities              |  |                            |
| Hypertension               | ≥ 1 Hospitalization<br>OR<br>≥ 2 physician claims in a two-year period<br>OR<br>1 physician claim followed by another physician claim or hospitalization within two years.                                     | CIHI-DAD/OHIP.             |
| Diabetes                   | ≥ 3 physician diagnostic code (250) in a one-year period.  | OHIP.                      |
| Atrial fibrillation        | 1 hospitalization <b>OR</b><br>1 ED visit <b>OR</b><br>4 physician claims in 1 year  | CIHI-DAD/OHIP.             |
| COPD                       | ≥1 Hospitalization for COPD<br>OR<br>≥ 3 physician claims in a two-year period   | CIHI-DAD/OHIP.             |
| Hyperlipidemia             | 1 hospitalization (ICD-9 272 or ICD-10 E78 as any diagnosis, excluding suspect)<br><b>OR</b><br>2 physician claims (dxcode 272)<br><b>OR</b><br>1 physician claim followed by 1 hospitalization within 2 years | CIHI-DAD/OHIP.             |
| Charlson comorbidity index | Derived measure of various comorbidity   | Multiple databases         |
|                            |  |                            |

CIHI-DAD – Canadian Institutes of Health Information – Discharge Abstract Database

IRCC – Immigration, Refugees and Citizenship Canada

OHIP – Ontario Health Insurance Plan

ODB – Ontario Drug Benefit

PCCF – Postal Code Conversion File

RPDB – Registered Persons Database

**Figure S1. Sensitivity analysis to evaluate sex differences in the quality of primary preventive care based on years live in Ontario (< 10 year or ≥ 10 years).**

