Regional Variations in Ambulatory Care and Incidence of Cardiovascular Events

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CMAJ April 3, 2017
Background

• Cardiovascular diseases (CVD) are the 2nd leading cause of death in Canada

• CVD was estimated to cost the Canadian health care system $22.2 billion dollars in 2000

• CVD mortality rates have declined steadily in Canada since the 1960s

• Striking regional variations in CVD incidence and mortality in Canada persist
Possible Causes of Regional Variations in Cardiovascular Disease (CVD)

• Patient factors
  • traditional risk factors, health behaviours, socioeconomic status, *ethnicity*, etc.

• *Health system factors*
  • access and quality of CVD preventive care, supply of family/specialists doctors, drugs, diagnostic tests, etc.

• Community factors (to be studied)
  • built environment, air pollution, etc.
Overall Objectives

• To describe regional variations in the incidence of major cardiovascular events across Ontario’s Local Health Integration Networks (LHINs)

• To determine the relative contribution of patient factors versus health system factors to this regional variation
Data Sources

CANHEART Cohort*

Socio-demographics
- Registered Persons Database (RPDB)
- Citizenship & Immigration Canada Permanent Resident DB
- Ontario Visible Minority Database

CV Risk Factors and Comorbidities
- Canadian Community Health Survey (CCHS)
- Ontario Hypertension Database (OHD)
- Ontario Diabetes Database (ODD)
- Gamma-Dynacare Medical Laboratories (GDML)
- EMRALD (EMR)
- Ontario Chronic Obstructive Pulmonary Disease Database (COPD)
- Ontario Asthma Database (ASTHMA)
- Ontario Cancer Registry (OCR)

Health Care Services and Medications
- ON Health Insurance Plan Physician Claims Database (OHIP)
- ICES Physician Database (IPDB)
- Ontario Drug Benefit Database (ODB)

Clinical Outcomes
- CIHI Discharge Abstract Database (CIHI DAD)
- CIHI National Amb. Care Reporting System (NACRS)
- Registrar General of Ontario Vital Statistics (ORGD)

* Tu et al, Circ Cardiovasc Qual Outcomes 2015;8:204-212.
CIHI=Canadian Institute for Health Information
EMRALD=Electronic Medical Record Administrative Data Linked Database

9.8 million individuals, 20-105 years
(9.4 million primary prevention)
Study Population and Primary Outcome

**Study Population**

Ontario adults:
- 40-79 years on January 1, 2008
- No history of cardiovascular disease
  \[ n \approx 5.5 \text{ million} \]

**Primary Outcome**

Incidence rate of a major cardiovascular event
- Acute myocardial infarction
- Stroke
- Death from heart disease or stroke

5 year follow-up
(2008-12)
Incidence of AMI, Stroke or CV Death by LHIN, 2008-12

Age- and sex-standardized incidence of major cardiovascular events, 40-79 year olds

Event Rate Groups    Rate per 1000 person-years
Low                3.2 - 3.5
Medium             3.9 - 4.7
High               4.8 - 5.7

Overall Ontario rate = 4.1 per 1000 person-years
Incidence of AMI, Stroke or CV Death by LHIN, 2008-12*

*Age-standardized to the 2006 Ontario census population.

www.canheart.ca
## Baseline Demographics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Low risk</th>
<th>Medium risk</th>
<th>High risk</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population size, n</td>
<td>1,683,104</td>
<td>3,019,957</td>
<td>841,086</td>
<td>5,544,147</td>
</tr>
<tr>
<td>Number of LHINs</td>
<td>3</td>
<td>7</td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td>Age on Jan 1, 2008, mean years</td>
<td>54.1</td>
<td>54.8</td>
<td>55.2</td>
<td>54.6</td>
</tr>
<tr>
<td>Female sex, %</td>
<td>51.9</td>
<td>52.2</td>
<td>51.7</td>
<td>52.0</td>
</tr>
<tr>
<td>Less than secondary school graduation, %</td>
<td>13.0</td>
<td>16.3</td>
<td>19.0</td>
<td>15.7</td>
</tr>
<tr>
<td>Ethnicity, %*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>70.0</td>
<td>84.3</td>
<td>92.9</td>
<td>81.3</td>
</tr>
<tr>
<td>South Asian</td>
<td>6.1</td>
<td>4.8</td>
<td>0.7</td>
<td>4.6</td>
</tr>
<tr>
<td>Chinese</td>
<td>9.0</td>
<td>2.7</td>
<td>0.8</td>
<td>4.3</td>
</tr>
<tr>
<td>Black</td>
<td>3.4</td>
<td>2.7</td>
<td>0.5</td>
<td>2.6</td>
</tr>
<tr>
<td>Other</td>
<td>11.4</td>
<td>5.5</td>
<td>5.1</td>
<td>7.2</td>
</tr>
<tr>
<td>Low-income neighborhood, %</td>
<td>34.1</td>
<td>39.7</td>
<td>39.1</td>
<td>37.9</td>
</tr>
<tr>
<td>Rural or small-town residence</td>
<td>0.4</td>
<td>15.1</td>
<td>28.5</td>
<td>12.7</td>
</tr>
</tbody>
</table>
Ethnic Group by LHIN
# Cardiac Risk Factors

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Low risk</th>
<th>Medium risk</th>
<th>High risk</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cigarette smoker, %</td>
<td>14.9</td>
<td>18.1</td>
<td>22.2</td>
<td>17.7</td>
</tr>
<tr>
<td>Hypertension, %</td>
<td>31.4</td>
<td>32.1</td>
<td>33.5</td>
<td>32.1</td>
</tr>
<tr>
<td>Diabetes, %</td>
<td>12.5</td>
<td>12.0</td>
<td>12.0</td>
<td>12.1</td>
</tr>
<tr>
<td>Obesity (BMI ≥ 30 kg/m²), %</td>
<td>14.5</td>
<td>19.2</td>
<td>22.4</td>
<td>18.2</td>
</tr>
<tr>
<td>Physically inactive, %</td>
<td>48.3</td>
<td>46.9</td>
<td>46.5</td>
<td>47.3</td>
</tr>
<tr>
<td>Inadequate fruit and vegetable consumption (&lt; 5/day), %</td>
<td>57.9</td>
<td>59.1</td>
<td>62.4</td>
<td>59.2</td>
</tr>
<tr>
<td>Total cholesterol, mean mmol/L</td>
<td>4.82</td>
<td>4.83</td>
<td>4.89</td>
<td>4.83</td>
</tr>
<tr>
<td>High density lipoprotein, mean mmol/L</td>
<td>1.36</td>
<td>1.34</td>
<td>1.33</td>
<td>1.35</td>
</tr>
<tr>
<td>Low density lipoprotein, mean mmol/L</td>
<td>2.84</td>
<td>2.85</td>
<td>2.84</td>
<td>2.84</td>
</tr>
<tr>
<td>Framingham 10-year CVD risk, mean %</td>
<td>11.0</td>
<td>12.4</td>
<td>13.6</td>
<td>12.1</td>
</tr>
</tbody>
</table>
Smoking and Obesity*

*Age-standardized to the 2006 Ontario census population. R is for correlation with cardiovascular event rate.
Diet and Physical Activity*

*Age-standardized to the 2006 Ontario census population. R is for correlation with cardiovascular event rate.
## Physician Visits and Risk Factor Screening by Risk Group

<table>
<thead>
<tr>
<th></th>
<th>Low risk</th>
<th>Medium risk</th>
<th>High risk</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visited a family doctor, %</td>
<td>86.4</td>
<td>87.5</td>
<td>86.4</td>
<td>87.0</td>
</tr>
<tr>
<td>Mean annual visits to a family doctor, per person</td>
<td>4.2</td>
<td>3.6</td>
<td>3.5</td>
<td>3.8</td>
</tr>
<tr>
<td>Periodic health exam, %</td>
<td>63.8</td>
<td>56.2</td>
<td>48.5</td>
<td>57.4</td>
</tr>
<tr>
<td>Visited a specialty doctor, %</td>
<td>60.0</td>
<td>57.8</td>
<td>55.8</td>
<td>58.1</td>
</tr>
<tr>
<td>Mean annual visits to a specialty doctor, per person</td>
<td>1.8</td>
<td>1.6</td>
<td>1.4</td>
<td>1.6</td>
</tr>
<tr>
<td>Cholesterol screening, %</td>
<td>71.9</td>
<td>67.3</td>
<td>58.0</td>
<td>67.3</td>
</tr>
<tr>
<td>Diabetes screening, %</td>
<td>73.6</td>
<td>69.9</td>
<td>60.4</td>
<td>69.6</td>
</tr>
</tbody>
</table>
Visited a Family Doctor (≥1 visit), 2006-07*

*Age-standardized to the 2006 Ontario census population.
Annual Visits to a Family Doctor, 2006-07*

*Age-standardized to the 2006 Ontario census population.

Mean annual visits to a family doctor, per person

Incidence of a major cardiovascular event, per 1000 person-years

R = -0.65, p=0.01

Ontario average
(3.8 visits/year)

Ontario average
(4.1 per 1000 person-years)
Periodic Health Exam, 2005-07*

*Age-standardized to the 2006 Ontario census population.
Cholesterol Screening, 2005-07*

*Age-standardized to the 2006 Ontario census population.
Diabetes Screening, 2005-07*

Incidence of a major cardiovascular event, per 1000 person-years

Received screening, %

R = -0.89, p <0.01

Ontario average (69.6%)

Ontario average (4.1 per 1000 person-years)

*Age-standardized to the 2006 Ontario census population.
## Risk Factor Management / Control

<table>
<thead>
<tr>
<th></th>
<th>Low risk</th>
<th>Medium risk</th>
<th>High risk</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prescribed statins, %</td>
<td>31.4</td>
<td>31.9</td>
<td>31.3</td>
<td>31.7</td>
</tr>
<tr>
<td>LDL ≤2 mmol/L among statin users, %</td>
<td>51.8</td>
<td>53.5</td>
<td>49.6</td>
<td>52.6</td>
</tr>
<tr>
<td><strong>Among individuals with hypertension</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prescribed ≥2 anti-hypertensive medications, %</td>
<td>54.8</td>
<td>56.1</td>
<td>56.3</td>
<td>55.8</td>
</tr>
<tr>
<td>Controlled blood pressure, %</td>
<td>67.4</td>
<td>65.0</td>
<td>53.3</td>
<td>64.4</td>
</tr>
<tr>
<td><strong>Among individuals with diabetes</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prescribed any anti-glycemic medication, %</td>
<td>70.9</td>
<td>70.1</td>
<td>74.1</td>
<td>70.8</td>
</tr>
<tr>
<td>Prescribed any ACE inhibitor/ARB, %</td>
<td>67.2</td>
<td>67.7</td>
<td>69.4</td>
<td>67.7</td>
</tr>
<tr>
<td>Prescribed statins, %</td>
<td>60.8</td>
<td>60.4</td>
<td>57.2</td>
<td>60.2</td>
</tr>
<tr>
<td>Mean HbA1c ≤7%, %</td>
<td>58.2</td>
<td>59.6</td>
<td>60.8</td>
<td>59.3</td>
</tr>
</tbody>
</table>

*Age-standardized to the 2006 Ontario census population.*
Statin Use in ≥65 year olds*

*Age-standardized to the 2006 Ontario census population.
Blood Pressure Control*

*Age-standardized to the 2006 Ontario census population.
Diabetes Control – HbA1c ≤7%*

*Age-standardized to the 2006 Ontario census population.
Statin Use in Elderly Diabetics*

*Age-standardized to the 2006 Ontario census population.

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Proportion of Variation in CV Events Explained*

<table>
<thead>
<tr>
<th>Factors adjusted for</th>
<th>Explained LHIN level variation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unadjusted</td>
<td>--</td>
</tr>
<tr>
<td>Age, sex</td>
<td>26.3</td>
</tr>
<tr>
<td>+ traditional risk factors</td>
<td>33.2</td>
</tr>
<tr>
<td>(smoking, hypertension, diabetes, lipids)</td>
<td></td>
</tr>
<tr>
<td>+ neighbourhood income</td>
<td>35.8</td>
</tr>
<tr>
<td>+ ethnicity</td>
<td>59.0</td>
</tr>
<tr>
<td>+ health system factors</td>
<td>74.5</td>
</tr>
<tr>
<td>(family doctor visits, periodic health exam, cholesterol screening)</td>
<td></td>
</tr>
</tbody>
</table>

* Cardiovascular events include AMI, stroke and death due to ischemic heart disease or stroke. From a Cox proportional hazards model with frailty.
Summary

• 2-fold variation in incidence rates of cardiovascular events across Ontario’s 14 LHINs
• Patients in high risk regions:
  • Are more likely to smoke, be obese and not eat fruits/vegetables
  • Have fewer annual family doctor/specialists visits (including periodic health exams)
  • Are less likely to receive cholesterol and diabetes screening
  • Are less likely to have controlled blood pressure
• Many opportunities to improve CVD prevention and care exist
• Both population health and health system strategies need to be considered to reduce regional variations in CVD
Funding Acknowledgements

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- Canadian Vascular Network

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