Disparities in Receipt of Screening Tests for Cancer, Diabetes and High Cholesterol in Ontario, Canada: A Population-based Study Using Area-based Methods

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ABSTRACT

OBJECTIVES: Few have compared socio-economic disparities in screening tests for cancer with recommended tests for other chronic diseases. We examined whether receipt of testing for colorectal, cervical and breast cancer, as well as diabetes and high cholesterol, differs by neighbourhood-level socio-economic and recent immigrant status.

METHODS: We conducted a population-based retrospective cohort study of patients identified as screen-eligible in 2009 living in Ontario, Canada. Postal codes were used to assign residents to a dissemination area (DA). Using Canadian census data, DAs were stratified by income quintile and proportion of recent immigrants. Prevalence of screening for cancer (colorectal, cervical, breast), diabetes, and high cholesterol, using administrative data, and prevalence ratios (least/most advantaged) were calculated.

RESULTS: The cohort comprised 7,652,592 people. Receipt of screening for colorectal cancer (women 61.6%; men 55.1%) and breast cancer (59.9%) were the lowest and diabetes (women 72.9%; men 61.4%) and high cholesterol (women 82.4%; men 70.3%) were the highest. We found disparities in the receipt of all tests, with the lowest uptake and largest disparities for cancer screening among those living in both low-income and high-immigration DAs: colorectal – women 48.6%; RR 0.77; 95% CI (0.74-0.79) and men 40.6%; RR 0.71 (0.68-0.74); cervical – 52.0%; RR 0.80 (0.78-0.81) and breast – 45.7%; RR 0.74 (0.72-0.77).

CONCLUSION: People living in low-income and high-immigration DAs had the lowest screening participation for all tests, although disparities were highest for cancer. An organized integrated chronic disease screening strategy leveraging the higher diabetes and high cholesterol screening participation may increase screening for cancer and other chronic diseases in never- and underscreened populations.

KEY WORDS: Health care disparities; early detection of cancer; dyslipidemia; diabetes

La traduction du résumé se trouve à la fin de l'article.

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Screening for cancer (or cancer precursors) and other chronic diseases in asymptomatic people is intended to separate healthy persons from those who may be at sufficient increased risk of a disease to warrant further medical attention to prevent the disease, complications from the disease, or death. Screening for colorectal, breast and cervical cancer can detect cancer at an early stage when treatment is more likely to result in a cure.^{1,2} In addition, screening can prevent cancer by identifying precancerous lesions, which are then removed. Canadian cancer screening guidelines for average-risk individuals recommend that all adults 50 to 74 years of age be screened for cancer of the colon and rectum (with the fecal occult blood test (FOBT) every 2 years and/or endoscopic visual examination of the large bowel via a flexible sigmoidoscopy every 5 years or colonoscopy every 10 years),³ and that women who are 50 to 74 years of age be screened for breast cancer (with mammography) every 2 to 3 years⁴ and those 21 to 69 years of age be screened for cervical cancer (using the Pap test) every 3 years.⁵ Despite universal health care, and cancer screening guidelines, socio-demographic disparities both in cancer incidence and uptake of screening persist in Ontario.⁶ In Canada and in other jurisdic-

tions, many new cases of cancer are found in screen-eligible people who have never been screened or are underscreened.^{7,8} Screening for all three cancers are lower among socio-economically disadvantaged groups,^{6,9-15} making these populations especially vulnerable to late diagnosis.

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Box 1. Inclusion and exclusion criteria for the various study cohorts

Screening Cohort	Ages, Sex	Eligible for Screening Cohorts (denominator)		Uptake of Tests (numerator)	
		Included (database)	Excluded (database)	Test (database)	Look-back Window*
Colorectal cancer	50-74 years, men and women	Ontario resident registered in Registered Persons Database (RPDB)	History of colorectal cancer (OCR) or surgical removal of colon (CIHI)	FOBT or large bowel endoscopy (OHIP)	2 years (FOBT) or 10 years (large bowel endoscopy)
Breast cancer	50-74 years, women	Age within specified range on 1 January 2009	History of breast cancer (OCR) or bilateral mastectomy (CIHI)	Mammography (OBSP or OHIP)	2 years
Cervical cancer	21-69 years, women	Continuously eligible for OHIP coverage for the 2009 calendar year (RPDB)	History of cervical cancer (OCR) or hysterectomy (CIHI)	Pap test (CytoBase or OHIP)	3 years
Diabetes	40-74 years, men and women	Valid Ontario Health Insurance Plan (OHIP) number	Diagnosis of diabetes (ODD)	Serum blood glucose test (OHIP)	3 years
High cholesterol	50-74 years, women and 40-74 years, men	Valid postal code corresponding to a DA in Ontario (RPDB)	Diagnosis of MI (OMID)	Serum blood cholesterol test (OHIP)	5 years

* The look-back window reflects the recommended screening interval for each test. There are different look-back windows because each test has a different recommended screening interval according to each specific screening guideline. For example, a woman who is screen-eligible for a Pap test in 2009 is recommended to have a Pap every 3 years. To identify whether she had one, we used the OHIP and CytoBase databases to find any record of her having a Pap test during the 3-year period (or look-back window) from 2007-2009 inclusive.

OCR=Ontario Cancer Registry; CIHI=Canadian Institute for Health Information; FOBT=fecal occult blood test; OBSP=Ontario Breast Screening Program; ODD=Ontario Diabetes Database; OMID=Ontario Myocardial Infarction Database.

Screening cholesterol and glucose levels is important as high cholesterol is a leading risk factor for heart disease, and high blood glucose levels may be a sign of prediabetes or diabetes; early detection and intervention can lead to improved control of cholesterol and glucose levels resulting in reduced cardiovascular disease and death.^{16,17} Screening of the plasma lipid profile is recommended in adult men who are at least 40 years of age, and in women who are at least 50 years of age or postmenopausal, every 5 years.¹⁶ Screening for diabetes is recommended in adults 40 years of age and older every 3 years.¹⁷ There is limited evidence of an association between socio-demographic factors and screening for diabetes and high cholesterol in Ontario.^{9,18,19} While low-income men were less likely to be screened for diabetes in Ontario,¹⁹ screening tests for diabetes and high cholesterol appear to be higher than for cancer.

Few studies have compared the socio-demographic disparities in chronic disease screening by examining these two groups of tests in concert,^{9,10} as most previous publications have examined these screening tests separately.^{11-15,18,19} And while other studies have documented disparities in breast or cervical cancer screening by socio-economic status (SES) and recent immigration in Canada and the US,^{10,11,13-15} to our knowledge, no previous Canadian study has compared the differences in uptake of all three screening tests for cancer among women. Systematic differences, if present, may inform strategies to increase screening uptake. Furthermore, it is unknown whether inequities in receipt of colorectal cancer screening persist in Ontario after an organized screening program for colorectal cancer was introduced in 2008.²⁰ The objective of this research was to examine whether the uptake of various screening tests – both for cancer (colorectal, cervical and breast) and other chronic diseases (diabetes and high cholesterol) – differs by neighbourhood-level socio-economic and recent immigrant status.

METHODS

We obtained approval for this study from the Research Ethics Board at Sunnybrook Health Sciences Centre in Toronto, Ontario, Canada.

Study population

We conducted a population-based retrospective cohort study using linked administrative databases to examine screening for cancer, diabetes and high cholesterol in 2009 among all age-eligible residents of Ontario, Canada living in 19,177 dissemination areas (DA).

Screen-eligible cohorts by disease (denominators)

We used Ontario's health care registry, the Registered Persons Database (RPDB), to identify denominator cohorts, comprised of Ontario residents defined as eligible for screening for each disease of interest. The RPDB maintains age, sex, residential postal code information and vital statistics for all Ontario residents with a valid Ontario Health Insurance Plan (OHIP) number. All Ontario residents are eligible for coverage by OHIP after 3 months of residency. To assemble our retrospective cohorts, we used the RPDB to identify all women and men continuously eligible for coverage for the 2009 calendar year, living in Ontario, and who were women or men aged within the specified range on 1 January 2009. For each of our screening cohorts, the recommended age range and screening intervals correspond with either Canadian or Ontario screening guidelines. For example, the Ontario cervical cancer screening guidelines advise that women 21 to 69 years of age be screened using the Pap test every 3 years.⁵ An age group of those 18-66 years on January 1, 2007 corresponds to an age group of those 21-69 years at the end of the 3-year period on December 31, 2009. We recognize that some of the individuals in our study cohort may have been outside the age range for a particular screening test (e.g., age 20 when a woman had her Pap test). However, a woman age 21 who had a Pap test 1 year ago, would be considered "up-to-date" with screening and not require a Pap test. Given that we were comparing the screening prevalence for a number of chronic disease screening tests with varying intervals, we chose 2009 to be the 'anchor' year. Chronic disease screening guidelines are recommendations put forward by an independent panel of individuals with both clinical and methodological expertise who assess the evidence. The age groups specified are those individuals for whom there is undeniable benefit and reduced potential for harm that comes with a positive diagnosis and/or unnecessary investigation and treat-

Table 1. Descriptive Statistics of the Base Population and the 8 Screen-eligible Cohorts

Characteristic	Ontario	Women					Men		
		FOBT or Endoscopy	Pap Test	Mammo-gram	Glucose Test	Cholesterol Test	FOBT or Endoscopy	Glucose Test	Cholesterol Test
No. age eligible	8,765,330	1,986,584	5,193,840	1,988,175	3,294,249	1,988,175	1,958,803	3,326,192	3,326,192
No. screen eligible	7,652,592	1,807,122	4,156,698	1,773,500	2,660,027	1,814,464	1,734,010	2,531,117	2,852,219
No. (%) who received screening	5,756,316 (75.2)	1,106,530 (61.2)	2,606,221 (62.7)	1,052,092 (59.3)	1,891,833 (71.1)	1,461,880 (80.6)	950,774 (54.8)	1,515,960 (59.9)	1,958,434 (68.7)
Age, mean (range), yrs	48.4 (21-74)	59.8 (50-74)	43.0 (21-69)	59.8 (50-74)	53.4 (40-74)	59.8 (50-74)	59.6 (50-74)	52.9 (40-74)	53.5 (40-74)
Number of Dissemination Areas (DAs) with screen-eligible individuals	19,003	18,977	18,995	18,975	18,989	18,976	18,987	18,992	18,994
Number of DAs with screen-eligible individuals and with income data	18,818	18,808	18,818	18,806	18,814	18,808	18,813	18,816	18,817
Number of DAs with screen-eligible individuals and with income/immigration data	18,400	18,391	18,400	18,391	18,396	18,391	18,397	18,399	18,400
Mean household income, mean (range), Can\$	80,876 (12,322 to 822,107)	81,243 (12,322 to 822,107)	80,955 (12,322 to 822,107)	81,148 (12,322 to 822,107)	82,413 (12,322 to 822,107)	81,312 (12,322 to 822,107)	81,758 (12,322 to 822,107)	81,810 (12,322 to 822,107)	81,385 (12,322 to 822,107)
Income quintile with mean income per quintile, Can\$, n (%)									
Q1 (44,722)	1,469,244 (19.3)	328,354 (18.2)	814,189 (19.7)	323,340 (18.3)	470,616 (17.8)	328,593 (18.2)	312,344 (18.1)	466,389 (18.5)	534,129 (18.8)
Q2 (62,080)	1,505,288 (19.7)	355,299 (19.7)	819,208 (19.8)	349,235 (19.8)	510,842 (19.3)	356,298 (19.7)	335,326 (19.4)	486,338 (19.3)	554,418 (19.5)
Q3 (74,910)	1,505,262 (19.7)	351,968 (19.5)	819,308 (19.8)	345,491 (19.6)	521,353 (19.7)	353,325 (19.5)	336,380 (19.5)	492,486 (19.5)	557,459 (19.6)
Q4 (88,465)	1,568,267 (20.6)	370,460 (20.6)	848,927 (20.5)	363,340 (20.6)	557,587 (21.0)	372,448 (20.6)	358,021 (20.7)	524,833 (20.8)	588,001 (20.7)
Q5 (129,777)	1,576,318 (20.7)	395,086 (21.9)	839,906 (20.3)	386,238 (21.9)	591,597 (22.3)	397,822 (22.0)	385,308 (22.3)	551,713 (21.9)	607,279 (21.4)
Immigration within previous 10 years, n (%)									
High ($\geq 51.9\%$)	720,017 (9.5)	140,844 (7.9)	422,166 (10.2)	138,656 (7.9)	225,307 (8.5)	141,038 (7.8)	136,680 (7.9)	224,417 (8.9)	253,922 (9.0)
Moderate (27.1-51.8%)	2,216,587 (29.2)	481,098 (26.8)	1,267,494 (30.7)	472,139 (26.8)	736,005 (27.8)	482,527 (26.8)	454,632 (26.4)	697,115 (27.8)	793,105 (28.0)
Low ($\leq 27\%$)	4,657,948 (61.3)	1,173,224 (65.4)	2,435,709 (59.0)	1,150,972 (65.3)	1,682,004 (63.6)	1,178,914 (65.4)	1,129,245 (65.6)	1,589,974 (63.3)	1,782,678 (63.0)

ment. Ontario providers are asked to recommend cancer and other chronic disease screening to the age groups specified in the guidelines, while at the same time encourage patients to make an informed decision about whether to participate.

People with a missing or invalid postal code or living in a DA for which no socio-economic data were available were excluded. The inclusion and exclusion criteria for the disease-specific screen-eligible cohorts are summarized in Box 1. Other health administrative databases, including the Ontario Cancer Registry (OCR), the Canadian Institute for Health Information (CIHI) database, Ontario Diabetes Database (ODD), and Ontario Myocardial Infarction Database (OMID), were used to define those who were ineligible for screening for a particular disease and thereby exclude them from the relevant denominator cohort. The OCR records all cancer diagnoses in Ontario residents. The CIHI database contains diagnostic and procedural information on all patients discharged from hospitals and same-day surgery units. The ODD contains all residents with physician-diagnosed diabetes, and the OMID records all those with a diagnosis of MI.

Uptake of tests (numerator)

Receipt of tests for cancer, diabetes, and high cholesterol was determined using fee and laboratory codes in the OHIP database, CytoBase and Ontario Breast Screening Program (OBSP) database. The OHIP database records all physician service claims in Ontario. The CytoBase database contains records of Papanicolaou (Pap) tests performed on patients in Ontario. The OBSP database contains information related to Cancer Care Ontario's breast screening program.

Any record of having received at least one screening test during the screening interval (or look-back window) was considered uptake of that test.

Analysis

Postal codes from the RPDB were used to assign each person to a 2006 dissemination area (DA) or neighbourhood using Statistics Canada's Postal Code Conversion File.²¹ The first three characters of a postal code identify the forward sortation area (FSA) and the last three characters are the Local Delivery Unit (LDU). There are typically 10-15 households in a LDU-level unique 6-digit postal code. DAs are the smallest adjacent geographic areas for which Statistics Canada census data are reported, and each is the area canvassed by 1 census representative. A DA is composed of one or more neighbouring LDUs or blocks; about 400 to 700 persons live in each DA. 2006 Canadian census data were used to determine the population socio-demographic characteristics for each DA, including: mean household income, and % recent immigrant (those who immigrated to Canada within the previous 10 years). DAs were categorized using the above socio-demographic variables, with persons assigned to categories based on their DA of residence. DAs were first stratified by income quintile (a well-known proxy for SES),^{22,23} each containing approximately 20% of the Ontario population, that were based on the mean household income: \$44,722 for the first quintile, \$62,080 for the second, \$74,910 for the third, \$88,465 for the fourth and \$129,777 for the fifth. We then further dichotomized DAs as low-income if the neighbourhood income quintile was Q1 (least affluent); otherwise they were classified as

Table 2. Screening Prevalence and Prevalence Ratios [median with 95% confidence intervals (CI)], Overall and for Neighbourhood Income and Immigration Strata, Among 8 Screening Cohorts

Screening Prevalence	Women					Men		
	FOBT or Endoscopy	Pap Test	Mammogram	Glucose Test	Cholesterol Test	FOBT or Endoscopy	Glucose Test	Cholesterol Test
Overall median, % (95% CI)	61.6 (61.4-61.9)	63.4 (63.2-63.7)	59.9 (59.6-60.0)	72.9 (72.7-73.1)	82.4 (82.2-82.6)	55.1 (54.8-55.6)	61.4 (61.1-61.6)	70.3 (70.0-70.5)
Neighbourhood income quintile, %								
Q1	54.8	56.1	51.8	68.9	79.5	46.0	54.3	63.4
Q2	59.0	60.6	57.5	72.1	82.0	51.7	59.6	68.5
Q3	61.8	64.0	60.3	73.8	83.2	55.1	62.2	71.3
Q4	63.9	66.5	62.7	74.8	83.8	58.2	64.4	73.1
Q5	66.2	68.1	64.4	74.3	83.1	61.8	64.7	73.1
Prevalence ratio, Q1/Q5 (95% CI)	0.83 (0.82-0.84)	0.82 (0.82-0.83)	0.80 (0.79-0.82)	0.93 (0.92-0.94)	0.96 (0.95-0.97)	0.74 (0.73-0.76)	0.84 (0.83-0.85)	0.87 (0.86-0.88)
Immigration within previous 10 years, %								
High	54.8	56.2	51.7	69.0	79.2	46.9	55.6	64.9
Moderate	59.6	60.9	57.3	72.9	82.4	53.2	61.2	70.3
Low	63.0	64.8	61.4	73.4	82.9	56.7	62.2	71.0
Prevalence ratio, High/Low (95% CI)	0.87 (0.85-0.89)	0.87 (0.85-0.88)	0.84 (0.82-0.87)	0.94 (0.93-0.95)	0.96 (0.95-0.97)	0.83 (0.80-0.85)	0.89 (0.87-0.91)	0.91 (0.90-0.93)

higher-income (Q2-Q5). DAs were also stratified by proportion of recent immigrants. Statistics Canada defines DAs as having a high, moderate or low immigrant population if the immigrant population is $\geq 51.9\%$, 27.1-51.8% or $\leq 27\%$, respectively.²¹ Based on this definition, we then further dichotomized DAs into “high” (meeting the Statistics Canada definition of high immigrant population) or “lower” (meeting the Statistics Canada definition of low or moderate immigrant population). As recent immigrants tend to reside in low-income areas, we created a 4-level variable to better understand the separate effects of income and immigration at the DA level. The 4-level variable is based on each group’s expected advantage in accessing care: 1) low-income, high-immigration (least advantaged); 2) low-income, lower-immigration; 3) higher-income, high-immigration; 4) higher-income, lower-immigration (most advantaged). Average household income was similar in the two low-income groups (\$43,708 and \$45,271, respectively) but more different in the two higher-income groups (\$76,221 and \$90,265, respectively). Recent immigration was similar in the two high-immigration groups (65% and 62%, respectively) and in the two lower-immigration groups (22% and 18%, respectively).

The percentage of each disease-specific screen-eligible cohort that received the relevant testing (i.e., screening prevalence) was calculated for each category. Prevalence ratios (Q1/Q5 or least/most advantaged) were calculated for each variable. Statistical analysis was conducted using SAS Version 9.3 (SAS Institute, Cary, NC). All 95% confidence intervals were calculated using bootstrapping methods.²⁴ Results were considered statistically significant if the confidence interval did not include 1.00.

RESULTS

Of the 8,765,330 men and women (ages 21-74 years) considered age-eligible for screening in 2009, 1.8% had a missing or invalid postal code. Of the 7,652,592 people who met the inclusion criteria and comprised the study cohort, 5,756,316 (75.2%) had at least one screening test; 4,734,419 (61.9%) of those in the cohort were women. The screen-eligible cohort lived in 19,003 DAs in Ontario, of which 603 DAs (3.2%) have no income quintile or recent immigration information. Table 1 summarizes the descriptive statistics of the base population and 8 screen-eligible cohorts.

Table 2 reports the overall screening prevalence and compares the screening prevalence and prevalence ratios for neighbourhood

income and immigration strata, among the 8 screening cohorts. Overall uptake of screening tests for colorectal and breast cancer was the lowest. The proportion of women and men having at least one FOBT or large bowel endoscopy was 61.6% and 55.1%, respectively. Receipt of screening for breast cancer was 59.9%. Screening for diabetes (women 72.9%; men 61.4%) and high cholesterol (women 82.4%; men 70.3%) had the highest participation of all screening tests. For women, the overall uptake for cervical cancer screening tests was the highest of the three cancer tests at 63.4%. Men had a consistently lower screening uptake than women for all diseases. There is a gradient in screening prevalence for almost all tests in both men and women for both the 5 income quintiles and the 3 immigration strata. The largest jump in screening prevalence (sometimes as much as 6 points) occurs between Q1 and Q2, and between high and moderate immigration.

Table 3 shows that people from low income–high immigration neighbourhoods had the lowest screening prevalence for colorectal, breast, and cervical cancer. Screening for all cancer screening services were particularly low in the 643 DAs belonging to the low income–high immigration group; in these DAs, only 48.6% of women and 40.6% of men participated in colorectal cancer screening, 52.0% of women had at least one Pap test, and 45.7% of women had at least one mammogram. There is a gradient in screening prevalence for all tests in both men and women from the least to the most advantaged groups. The largest jump in screening prevalence is from the low income–high immigration group and the low income–lower immigration group and is especially glaring for some tests (7 points for women and men for FOBT or endoscopy and 7 points for mammography). Prevalence ratios for screening tests for cancer are all significantly below 1.0, showing a decreasing uptake by the least advantaged compared to the most advantaged group.

Table 3 also shows that people living in low income–high immigration neighbourhoods had lower uptake of diabetes and cholesterol screening tests than their more advantaged counterpart. Fifty-two percent and 61% of men in low income–high immigration DAs compared to 74% and 83% of women in higher income–lower immigration DAs had a blood glucose and blood cholesterol test, respectively. However, with smaller variation across income quintiles and recent immigration categories resulting in prevalence ratios closer to 1.0, disparities in screening tests for diabetes and

Table 3. Screening Prevalence and Prevalence Ratio [median with 95% confidence intervals (CI)], Overall and for Income–Immigration 4-level Variable, Among 8 Screening Cohorts

Screening Prevalence	No. of DAs	Women			Men				
		FOBT or Endoscopy	Pap Test	Mammo- gram	Glucose Test	Cholesterol Test	FOBT or Endoscopy	Glucose Test	Cholesterol Test
Overall median, % (95% CI)		61.6 (61.4-61.9)	63.4 (63.2-63.7)	59.9 (59.6-60.0)	72.9 (72.7-73.1)	82.4 (82.2-82.6)	55.1 (54.8-55.6)	61.4 (61.1-61.6)	70.3 (70.0-70.5)
4-level variable, %									
Low-income, high-immigration (A)	643	48.6	52.0	45.7	65.8	77.0	40.6	51.7	61.0
Low-income, lower-immigration	2719	56.0	57.3	52.9	69.8	80.2	47.4	55.4	64.2
Higher-income, high-immigration	729	60.2	61.0	57.6	71.7	81.3	52.9	59.8	68.9
Higher-income, lower-immigration (B)	14,309	63.1	65.1	61.5	73.9	83.2	57.1	63.0	71.8
Prevalence ratio, (A/B) (95% CI)		0.77 (0.74-0.79)	0.80 (0.78-0.81)	0.74 (0.72-0.77)	0.89 (0.87-0.91)	0.93 (0.91-0.95)	0.71 (0.68-0.74)	0.82 (0.79-0.85)	0.85 (0.82-0.87)

* A DA is defined as low-income if the neighbourhood income quintile is Q1 (least affluent); otherwise it is defined as higher-income (Q2–Q5); a DA is defined as high-immigration if $\geq 51.9\%$ of its population immigrated to Canada in the previous 10 years; otherwise it is defined as lower-immigration.

cholesterol were not as great as for cancer; this finding was more pronounced for women. Men from both low-income and high-immigration neighbourhoods had the lowest uptake of diabetes and cholesterol screening tests (see Table 2), with especially low participation among those living in low income–high immigration areas.

DISCUSSION

We found that screening for cancer, diabetes, and high cholesterol were all lower among men and women living in neighbourhoods with a low average income and/or high proportion of recent immigrants. However, screening for diabetes and high cholesterol were higher and disparities in receipt of screening were not as great as for cancer. Neighbourhoods characterized by both low income and a high proportion of recent immigrants have particularly high concentrations of residents eligible for screening. Our results suggest that strategies to increase screening for cancer and other chronic diseases in never- and underscreened populations should be the highest priority. The development of new strategies may be informed by the finding that disparities in screening differ by type of service (cancer screening versus other chronic disease screening).

Our study confirms previously documented cancer screening disparities,^{11–13,15} despite the existence of organized screening programs in Ontario. With invitations to participate mailed to the target population eligible for screening, organized screening programs are designed to minimize screening disparities. An organized screening program for breast cancer was introduced in 1990²⁵ and more recently for colorectal cancer in 2008.²⁶ Encouragingly, we found that receipt of colorectal cancer screening tests increased to 61.6% for women and 55.1% for men between 2000 and 2009 (or 58.0% and 51.9% based on a 5-year interval between 2005 and 2009) compared with an earlier report of only 21% of people in the age-eligible group receiving a colorectal cancer investigation in Ontario between 1997 and 2001.¹² However, disparities in receipt of colorectal cancer screening tests by socio-economic status persist¹² and disparities also exist by recent immigrant status. Recent immigrants tend to reside in low-income areas. Based on our 4-level variable analysis to separate out the effects of income and immigration, we further demonstrated that areas of high recent immigration have low uptake of colorectal cancer screening tests, independent of income effects. This result was consistent across all cancer screening tests. Although screening tests for cervical cancer were higher than for colorectal and breast cancer overall and by socio-economic

and recent immigration status, prevalence ratios gave similar results for all three screening tests for cancer among women. To our knowledge, no previous Canadian study has compared the differences in uptake of all three screening tests for cancer among women.

We found that disparities in receipt of screening for diabetes and high cholesterol were lower than for cancer and greater among men. Our study findings are consistent with previous research reporting higher participation for cholesterol testing than for Pap tests and mammography overall and by income,^{9,10} and disparities in diabetes screening among low-income men.¹⁹ In contrast to previous research reporting that immigrant status was associated with an increased likelihood of being screened for diabetes,^{18,19} we found a disparity in receipt of screening for diabetes, especially for men. Our study differed from previous research in that we examined diabetes screening among individuals who reside in neighbourhoods characterized by a high proportion of recent immigrants who are known to experience the greatest barriers to accessing health services.

Screening disparities that we have described may be due to patient,^{26,27} physician,²⁸ or system factors.²⁹ Low-income persons may save visits to the doctor for only urgent matters as they may not be able to afford to miss a day's pay or the cost of transportation. For recent immigrants, cultural beliefs may play a role²⁶ or they may find it difficult to navigate the health care system if they do not speak English or have low health literacy.²⁷ Having a primary care physician is central to receiving a recommendation for screening;²⁹ Ontario's least advantaged have less access to primary care.³⁰ The relatively greater uptake of cholesterol and glucose testing compared to cancer screening tests may reflect the nature of the disease or the nature of the test itself. Physicians may elect to recommend the screening tests for those diseases perceived by patients to be less frightening and that require the least explanation and intervention (i.e., a simple blood test compared to more invasive cancer screening tests such as the Pap test).

Our findings suggest that screening guidelines and current organized population-based cancer screening programs are not sufficient to eliminate disparities in screening for low-income persons or recent immigrants. A potential strategy to increase cancer screening participation in never- and underscreened populations is to leverage the higher screening rates for diabetes and high cholesterol. An organized one-stop integrated chronic disease screening strategy that streamlines screening for chronic diseases and cancers into one may help to reduce the disparities.³¹ We found particular-

ly low uptake in the 643 DAs belonging to the low income–high immigration group (i.e., 3.4% of all DAs in Ontario). Due to their small size, the population socio-demographic characteristics for each DA are relatively homogeneous, making them highly suitable for community-based targeted interventions such as the use of community-based navigators³² or interventions that facilitate social network factors, so that individuals are influenced by their peers to adopt screening behaviours.³³

Our study had limitations. First, was our inability to distinguish between tests used for screening and those used for diagnosis or clinical management of medical conditions. However, because we included people who were screening-eligible and excluded those with a history of any relevant cancer, prior relevant surgical procedures or diagnosis of diabetes or MI, these data represent “best case” estimates of screening uptake. Furthermore, with regards to diabetes testing, the OHIP billing code for serum blood glucose does not differentiate between random and fasting blood glucose measurements, with only fasting blood glucose recommended for the screening of asymptomatic individuals. Similarly, the OHIP billing code for cholesterol testing may have been used for the clinical management of a current medical condition. As such, we are certain that the true proportions screened were less than what we report here. And since low SES and high immigration DAs are not likely to have less disease, with the inclusion of diagnostic investigations, the true prevalence ratios were likely less than what we report here. Second, as in any health services research, there are individuals or tests that may not have been captured. For example, people may have cholesterol and glucose measured at worksite “health fairs” or similar events. These tests would constitute “screening” but would not show up in the administrative database used in this study. Third, we did not have individual-level data, rather we imputed socio-demographic characteristics using DA of primary residence. The main limitation of using DA-level measures as a proxy for individual-level measures is the measurement error which will be greater in rural DAs that are less homogeneous than urban DAs. However, neighbourhood income is a widely used measure of SES that correlates well with individual-level measures.^{22,23} Our other socio-demographic indicators at the DA level conform to those used by Statistics Canada²¹ and provide conservative estimates of the effects of recent immigrant status.³⁴ Fourth, there is a lack of systematic updating of addresses and incomplete removal of deceased persons in Ontario’s health care registry; because these numbers are few in a relatively large study cohort, this is not likely to affect estimates of socio-demographic disparities. None of these effects would be expected to significantly influence the main findings of this study.

In conclusion, a significant number of the screen-eligible people living in Ontario’s least advantaged neighbourhoods do not receive screening for cancer and other chronic diseases. An organized integrated chronic disease screening program is one potential strategy that may help to reduce the observed screening disparities. Area-based methods identified DAs with high concentrations of low-income or recent immigrant men and women eligible for screening for multiple diseases. Interventions targeting these communities may be another important strategy to increase uptake.

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RÉSUMÉ

OBJECTIFS : Peu d'études comparent les disparités socioéconomiques dans le recours aux tests de dépistage du cancer et aux tests recommandés pour dépister d'autres maladies chroniques. Nous avons cherché à déterminer si le recours aux tests de dépistage du cancer colorectal, du col utérin et du sein, ainsi que du diabète et de l'hypercholestérolémie, diffère selon le niveau socioéconomique du quartier et le statut d'immigrant récent.

MÉTHODE : Nous avons mené une étude de cohortes populationnelle rétrospective auprès de patients vivant en Ontario (Canada) identifiés comme étant admissibles au dépistage en 2009. Les codes postaux ont servi à affecter chaque résident à une aire de diffusion (AD). À l'aide des données du Recensement du Canada, les AD ont été stratifiées selon le quintile de revenu et la proportion d'immigrants récents. Nous avons calculé la prévalence du dépistage du cancer (colorectal, du col utérin, du sein), du diabète et de l'hypercholestérolémie à l'aide de données administratives, ainsi que les ratios de prévalence (moins/mieux nantis).

RÉSULTATS : La cohorte comptait 7 652 592 personnes. La participation au dépistage du cancer colorectal (femmes 61,6 %; hommes 55,1 %) et du cancer du sein (59,9 %) était la plus faible, et la participation au dépistage du diabète (femmes 72,9 %; hommes 61,4 %) et de l'hypercholestérolémie (femmes 82,4 %; hommes 70,3 %) était la plus élevée. Nous avons constaté des disparités dans le recours à tous les tests, la participation la plus faible et les plus grandes disparités dans le dépistage du cancer étant observés chez les résidents des AD à faible revenu et à forte immigration : cancer colorectal – femmes 48,6 %; RT 0,77; IC de 95 % (0,74-0,79) et hommes 40,6 %; RT 0,71 (0,68-0,74); cancer du col utérin – 52,0 %; RT 0,80 (0,78-0,81) et cancer du sein – 45,7 %; RT 0,74 (0,72-0,77).

CONCLUSIONS : Les résidents des AD à faible revenu et à forte immigration affichaient la plus faible participation au dépistage pour l'ensemble des tests, mais avec des disparités plus prononcées pour le dépistage du cancer. Une stratégie structurée et intégrée de dépistage des maladies chroniques misant sur la participation plus élevée au dépistage du diabète et de l'hypercholestérolémie pourrait accroître le dépistage du cancer et d'autres maladies chroniques dans les populations jamais ou insuffisamment dépistées.

MOTS CLÉS : disparités d'accès aux soins; dépistage précoce du cancer; dyslipidémies; diabète