Determinants of mammography use in rural and urban regions of Canada

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Introduction: National guidelines advocate biennial mammography screening for asymptomatic women aged 50–69 years. Unfortunately many women do not abide by such recommendations, and evidence indicates that compliance rates are lower in rural areas.
Methods: We estimated logistic regression models using data from the Canadian Community Health Survey for 2002/03 and 2004/05. We identified the extent of regional variation within and between Canadian provinces using a new and more detailed set of rural indicators based on economic zones of influence, after accounting for a range of demographic and socio-economic factors.
Results: The odds of asymptomatic women aged 50–69 years having undergone mammography during the previous 2 years were significantly lower for those residing in relatively remote and rural areas than for those residing in census metropolitan areas (odds ratio [OR] 0.58, confidence interval [CI] 0.42–0.80). This was also true of women residing in certain other rural areas that had some limited labour market attachment to larger urban areas (OR 0.81, CI 0.70–0.93), but there were no significant differences between smaller and larger urban areas. We also found variation in mammography use among women living in rural and urban areas across provinces.
Conclusion: Mammography use is significantly lower in rural and remote areas, even after a range of other demographic and socio-economic factors are accounted for. One important factor underpinning this result appears to be differences in attitude about the importance of regular mammography screening between women residing in rural and urban areas. Information campaigns raising awareness about the importance of mammography screening should be targeted, in particular, at women residing in rural and remote areas.

Introduction : Des lignes directrices nationales préconisent une mammographie de dépistage tous les 2 ans pour les femmes asymptomatiques âgées de 50 à 69 ans. Malheureusement, beaucoup de femmes ne suivent pas ces recommandations et les données probantes indiquent que les taux d'observation sont moins élevés dans les régions rurales.
Méthodes : Nous avons estimé des modèles de régression logistique à partir de données tirées de l'Enquête sur la santé dans les collectivités canadiennes pour 2002–2003 et 2004–2005. Nous avons déterminé l'ampleur de la variation régionale à l'intérieur des provinces canadiennes et entre celles-ci en utilisant un ensemble nouveau et plus détaillé d'indicateurs ruraux basés sur les zones d'influence économique, compte tenu d'un éventail de facteurs démographiques et socioéconomiques.
Résultats : Les chances que des femmes asymptomatiques âgées de 50 à 69 ans se soient soumises à une mammographie au cours des 2 années précédentes étaient beaucoup moins élevées chez celles qui habitaient des régions relativement éloignées et rurales que chez celles qui vivaient dans des régions métropolitaines de recensement (coefficient de probabilité [CP] 0,58, intervalle de confiance [IC], 0,42–0,80). C'était aussi le cas chez les femmes habitant d'autres régions rurales comportant une certaine proportion de main-d'œuvre active dans le marché du travail de régions urbaines plus étendues (CP 0,81; IC 0,70–0,93), mais il n'y avait pas de différences significatives

entre les grandes régions urbaines et les régions urbaines plus petites. Nous avons aussi constaté une variation entre les provinces au niveau du recours à la mammographie chez les femmes des régions rurales et urbaines.

Conclusion : Le recours à la mammographie est beaucoup moins élevé dans les régions rurales et éloignées, même si l'on tient compte de tout un éventail d'autres facteurs démographiques et socioéconomiques. Un facteur important qui sous-tend ce résultat semble résider dans les différences au niveau de l'attitude face à l'importance d'une mammographie de dépistage périodique entre les femmes des régions rurales et urbaines. Les campagnes d'information visant à faire mieux comprendre l'importance de la mammographie de dépistage devraient viser en particulier les femmes habitant les régions rurales et éloignées.

INTRODUCTION

Breast cancer is a common disease and leading source of cancer-related mortality among Canadian women. It is estimated that 1 in 9 women will develop breast cancer during her lifetime, and 1 in 25 will die prematurely from malignancy.[1] Breast cancer correlates related to lifestyle choices include obesity, physical inactivity and excessive alcohol consumption. Given these avoidable risk factors, medical professionals advocate healthy lifestyles to minimize the incidence of breast cancer. Nevertheless, genetic and demographic risk factors, specifically age, are not modifiable. Thus health officials rely on early detection to efficiently manage the treatment of breast cancer. Detection modalities include clinical and self breast examinations, as well as mammography. Studies suggest that timely discovery and quality treatment considerably improve survival rates.[2] In particular, some evidence indicates that mammography screening could reduce breast cancer mortality by one-third.[3] Because the incidence of breast cancer is most prevalent in women aged 50 to 69 years,[4] Health Canada recommends biennial mammography for asymptomatic women in this age group. However, there is more controversy regarding the effectiveness of mammography for women younger than 50 and older than 69 years.[5]

Although Canada is a relatively urbanized country, about 20% of the population resides in rural areas.[6] Some studies have found that rural women in Canada are less likely to undergo mammography compared with those in urban areas,[1,7,8] although other work has found no relationship between mammography use and urban or rural status.[9] Because mammography requires a physician referral and availability of diagnostic equipment, barriers to access may arise from increased wait times, distance to mammography technology and lack of transportation.[1,8,9] Moreover, there may be differences in attitudes and practices between rural and urban doctors.[7] Disparities in knowledge and attitudes about risk and treatment of breast cancer may also exist between rural and urban women.[8,10,11]

In this paper, we identify how mammography use varies across a broader set of rural and urban areas than the simple dichotomous classification used in much of the previous research. These areas range from densely populated cities to isolated rural communities that have few direct links to larger population centres. We also identify any differences in mammography use across rural and urban areas within particular provinces, as federal agencies support the development of mammography guidelines, and provincial governments maintain responsibility for administering them.

METHODS

We used individual-level data from the 2002/03 and 2004/05 waves of the Canadian Community Health Survey (CCHS) Statistics Canada master files. The CCHS is a national biennial survey of about 130 000 people that records detailed information on a wide range of health status, behaviour and use of services. It encompasses people aged 12 years and older residing in all provinces and territories, but excludes people living on Crown lands, full-time military personnel, on-reserve Aboriginal people and residents of institutions. As well, the CCHS does not sample among residents living in the Inuit territory of Nunavik in northern Quebec. We defined our sample as adult women aged 50 to 69 years who resided in one of Canada's 10 provinces, which resulted in a total of 37 794 observations. Residents of the Northwest Territories, the Yukon Territory and Nunavut were omitted because of small sample sizes. We sought to determine the extent of compliance with Health Canada guidelines regarding mammography screening across rural and

urban regions, after accounting for a variety of demographic and socio-economic confounders. These confounders included factors, such as age, marital status and education level, that are likely to influence the take-up of mammography screening but are not specific to rural residents.

The key measure of mammography screening in the CCHS was whether the respondent reported undergoing mammography during the previous 2 years (1 if yes, 0 if no). We wanted to focus only on asymptomatic women, so we omitted from the sample any women who reported undergoing mammography within the last 2 years for reasons other than regular checkup, age or family history of breast cancer. Given the ongoing debate about the efficacy of mammography for women aged 40–49 years, we also estimated results for an expanded sample of women aged 40–69 years. This larger sample comprised 56 830 observations.

The Anderson Model and its refinements[12–14] provided an empirical framework to guide model specification. The model posits that a person's use of health services will be determined by 3 broad factors: predisposing factors, enabling factors and need factors. Predisposing factors capture the person's predisposition to use services and are a function of demographics, social structure and health beliefs. Enabling factors are factors that enable or impede use of health services, and include personal characteristics, such as income and education, as well as community characteristics, such as the concentration of health care professionals. Need factors reflect the need for care based on self-perceived and diagnosed health status.

Location of residence is considered to be an enabling factor because it will reflect proximity to health centres with the necessary diagnostic equipment and the associated costs of travel to obtain screening services.[15] In classifying locations, we relied on Statistics Canada's metropolitan influenced zone (MIZ) classification. The MIZ definition is used to differentiate among less urbanized areas that are outside of both census metropolitan areas (CMAs), which are urban areas with a population of at least 100 000, and census agglomerations (CAs), which are urban areas with a population of more than 10 000 but less than 100 000. Census subdivisions outside of CMAs or CAs are grouped into categories based on commuting flows of the employed labour force in the subdivision to CMAs or CAs.[6] A subdivision outside of these urban areas is classified as "strong MIZ" if 30% or more of its workforce commute to a CMA or CA. "Moderate MIZ" and "weak MIZ" areas comprise subdivisions with commuting flows of 5% to 30% and 0% to 5%, respectively. Subdivisions classified as "no MIZ" have commuting flows to CMA or CAs of fewer than 40 people and are considered to be the most rural and remote areas based on commuting flows to urban centres. In addition, Statistics Canada also differentiates between "tract" CAs and "nontract" CAs, based on whether the CA contains a core population centre, called a tract, of 2500 to 8000 people.[6] This geographical classification is a further refinement of the 5-category classification of urban and rural areas provided by Statistics Canada and has been used in recent research on patterns in use of health services in Canada.[16,17]

Province of residence is also an enabling factor. Although all Canadian provinces and territories offer mammography services to female residents through organized screening initiatives, programs differ by how long they have been in operation and the resources devoted to achieving stated objectives.[18,19] Although federal agencies support the development of mammography guidelines at a national level, provincial governments maintain responsibility for administering health care and have various approaches to encouraging timely use of mammography.[18] To capture these differences, we include a set of province-specific indicator variables as explanatory variables in the regression analysis.

There is ample evidence that physician referral is a primary determinant of mammography use.[1,8–11,20,21] To reflect this, we included an indicator variable for whether the woman had a regular family doctor. In addition, we included both the number of physicians and the number of medical specialists per 100 000 residents in each health region for each CCHS survey year, as broad measures of the general availability of health services at the level of the provincial health region. We obtained these data from the Canadian Institute for Health Information.

It was also necessary to account for other differences between women in rural and urban areas that might explain differential use of mammography screening, and the literature has identified a number of such determinants. These include predisposing factors such as age,[1,2,10,11,20–22] marital status,[1] immigrant status, ethnicity and language fluency.[1,2,8,20,23] Particularly in rural areas, health services in alternate languages may not be available and information campaigns relaying the importance of breast health may be less effective in reaching such women. Other important enabling factors are family income and

level of education, which can affect mammography use through numerous channels. Both family income and level of education have been found to be positively related to mammography use in the literature.[1,2,10,11,20,21] We performed logistic regression analysis, and used population weights and robust standard errors in the calculation of all estimates and confidence intervals (CIs).

RESULTS

Table 1 shows the percentages of asymptomatic women who had undergone mammography within the previous 2 years, categorized by the degree of remoteness from a CMA using the MIZ classification. Overall, only two-thirds of women aged 50–69 years had undergone mammography within the previous 2 years as recommended by Health Canada guidelines, and about one-half of women aged 40–69 years had undergone mammography within the previous 2 years. Interestingly, with the exception of women residing in "no MIZ" areas there were no marked differences in the incidence of mammography screening among women residing in CMAs, CAs and more rural and remote areas. For women living in more remote "no MIZ" areas, the incidence of mammography screening was around 7 percentage points lower for both age groups.

Regression results are presented in Tables 2 and 3. Columns 1 and 2 of Table 2 give estimated odds ratios (ORs) and 95% CIs for the determinants of the likelihood that an asymptomatic woman aged 50–69 years had undergone mammography during the previous 2 years. The key results for the effects of geographic remoteness are contained in Table 2 as well as the results for the confounding variables (predisposing and enabling factors). After accounting for differences in demographic and socio-economic factors, as well as health service access, we found that women residing in the most isolated areas — the "no MIZ" regions — were the least likely to have undergone mammography (OR 0.58, CI 0.42–0.80). The odds of having undergone mammography were also significantly lower in "moderate MIZ" regions (OR 0.81, CI 0.70–0.93) but not "weak MIZ" regions. There were also no significant differences in mammography screening for women living in CAs or in "strong MIZ" areas compared with women living in CMAs. There were, however, pronounced differences among provinces, with women in Newfoundland (OR 0.72, CI 0.57–0.90) and Nova Scotia (OR 0.75, CI 0.61–0.92) less likely than women in Ontario to have undergone mammography during the previous 2 years, and women in New Brunswick more likely (OR 1.39, CI 1.11–1.72).

For the other variables, a number of important results should be noted. First, recent immigrants were significantly less likely to have undergone regular mammography (OR 0.61, CI 0.41–0.89) and the gap was even more pronounced if the woman was not fluent in either English or French (OR 0.21, CI 0.15–0.29). Second, women with higher family incomes and higher levels of education were more likely to have undergone mammography during the previous 2 years than other women. Third, the results clearly indicate the importance of having a family doctor to regular mammography screening. The odds of a woman with a family doctor having undergone mammography during the previous 2 years were almost 3.5 times greater than for women without a family doctor (OR 3.48, CI 3.01–4.03). With these variables included in the regression equation, the concentration of physicians in the associated health region was not a significant determinant of mammography use.

Columns 3 and 4 of Table 2 are based on the larger sample of women aged 40–69 years. As with the other age group, women residing in the most remote areas were significantly less likely to have undergone mammography during the previous 2 years compared with women living in CMAs (OR 0.71, CI 0.54–0.94). As well, women residing in "moderate" and "weak" MIZ regions were less likely to have undergone mammography (OR 0.82, CI 0.73–0.92 and OR 0.86, CI 0.76–0.97, respectively).

Table 1. Percentages of Canadian women who had undergone mammography within the previous 2 years, by remoteness from a census metropolitan area or census agglomeration*

	Women aged 50–69 yr, % (*n* = 37 794)		Women aged 40–69 yr, % (*n* = 56 830)	
Residence	Underwent mammography	Total sample	Underwent mammography	Total sample
CMA	67.7	63.5	50.8	65.0
Tract CA	68.4	6.0	50.5	5.9
Nontract CA	69.2	9.5	52.5	9.1
Strong MIZ	69.0	5.3	49.3	5.2
Moderate MIZ	66.4	8.3	49.9	7.8
Weak MIZ	68.7	6.4	52.8	6.1
No MIZ	61.0	0.9	45.4	0.9
All areas	67.8	100.0	50.8	100.0

CA = census agglomeration; CMA = census metropolitan area; MIZ = metropolitan influenced zone.
*The sample excludes women who had undergone mammography for reasons other than regular screening or a regular checkup. Regions outside of CMAs and CAs are grouped according to MIZ classification.

Table 2. Logistic regression results for mammography within the previous 2 years for adult Canadian women*

Variable	Women aged 50–69 yr (n = 37 794)		Women aged 40–69 yr (n = 56 830)	
	OR†	95% CI‡	OR†	95% CI‡
Remoteness (CMA = 1)				
Tract CA	1.03	0.85–1.24	0.90	0.79–1.03
Nontract CA	0.89	0.77–1.04	0.91	0.81–1.02
Strong MIZ	1.02	0.85–1.21	0.92	0.80–1.05
Moderate MIZ	**0.81**	**0.70–0.93**	**0.82**	**0.73–0.92**
Weak MIZ	0.92	0.77–1.10	**0.86**	**0.76–0.97**
No MIZ	**0.58**	**0.42–0.80**	**0.71**	**0.54–0.94**
Province (Ontario = 1)				
Newfoundland	**0.72**	**0.57–0.90**	1.06	0.87–1.28
Prince Edward Island	0.96	0.70–1.32	1.00	0.78–1.28
Nova Scotia	**0.75**	**0.61–0.92**	**1.27**	**1.06–1.52**
New Brunswick	**1.39**	**1.11–1.72**	**1.41**	**1.20–1.67**
Quebec	1.08	0.88–1.33	0.89	0.77–1.04
Manitoba	0.88	0.70–1.13	**0.74**	**0.62–0.88**
Saskatchewan	0.85	0.69–1.05	**0.67**	**0.57–0.78**
Alberta	1.10	0.91–1.33	**1.37**	**1.19–1.58**
British Columbia	0.92	0.78–1.09	**1.26**	**1.10–1.44**
Predisposing factors§				
Married	**1.71**	**1.44–2.02**	**1.40**	**1.25–1.58**
Widowed	**1.64**	**1.33–2.01**	**1.31**	**1.10–1.55**
Separated/divorced	**1.34**	**1.12–1.61**	**1.14**	**1.00–1.31**
French	1.25	0.99–1.57	1.15	0.97–1.35
English and French	**1.22**	**1.03–1.44**	**1.26**	**1.12–1.42**
English and other language	0.89	0.76–1.04	1.12	0.98–1.27
French and other language	**1.11**	**0.47–2.60**	**1.10**	**0.64–1.91**
Neither English nor French	**0.21**	**0.15–0.29**	**0.25**	**0.19–0.33**
Foreign-born	0.99	0.85–1.15	0.98	0.86–1.11
Foreign-born and arrived within the past 10 yr	**0.61**	**0.41–0.89**	**0.70**	**0.54–0.92**
Enabling factors§				
Income < $10 000	0.97	0.76–1.24	1.12	0.89–1.40
Income $20 000–$40 000	**1.32**	**1.12–1.55**	**1.19**	**1.04–1.36**
Income $40 000–$60 000	**1.45**	**1.21–1.74**	**1.32**	**1.14–1.53**
Income $60 000–$80 000	**1.40**	**1.14–1.72**	**1.27**	**1.09–1.48**
Income > $80 000	**1.60**	**1.29–1.98**	**1.41**	**1.21–1.64**
< secondary education	**0.82**	**0.72–0.95**	**0.74**	**0.66–0.83**
Some postsecondary education	**1.22**	**1.00–1.50**	0.95	0.82–1.11
Certificate or diploma	**1.24**	**1.09–1.41**	1.03	0.94–1.14
Bachelor degree	**1.44**	**1.19–1.74**	1.13	0.99–1.29
Bachelor degree plus	**1.47**	**1.13–1.91**	1.08	0.92–1.28
Has a regular doctor	**3.48**	**3.01–4.03**	**2.49**	**2.20–2.82**
No. of doctors per population of 100 000	1.00	1.00–1.01	1.00	1.00–1.00
No. of specialists per population of 100 000	1.00	1.00–1.00	1.00	1.00–1.00
Pseudo-R^2¶	0.08	—	0.21	—

CA = census agglomeration; CI = confidence interval; CMA = census metropolitan area; MIZ = metropolitan influenced zone; OR = odds ratio.
*The sample excludes women who had undergone mammography for reasons other than regular screening or a regular checkup. Regression equations also include variables for age, age-squared, indicator variables for 5-year age cohorts and survey year.
†Odds ratios in bold are significantly different from 1 at the 5% level of significance.
‡95% CIs are based on robust standard errors.
§Default categories for the predisposing and enabling factors are as follows: single, speaks English only, Canadian born, family income between $80 000 and $100 000, high school education only and no regular family doctor.
¶Pseudo-R^2 is an approximate measure of the overall fit of the model and is calculated using log-likelihood statistics of the full model and the null model with no covariates included.

Although most of the other results are comparable to what was discussed above, the inclusion of asymptomatic women aged 40–49 years in the sample had a marked effect on the OR for provinces: the odds of having undergone mammography during the previous 2 years were predicted to be significantly higher for women in Nova Scotia (OR 1.27, CI 1.06–1.52) and British Columbia (OR 1.26, CI 1.10–1.44) than for women in Ontario, in contrast to what was found when the sample was restricted to women aged 50–69 years.

It has been established in the literature that screening in accordance with recommended guidelines varies widely among Canadian provinces, from 41% in Newfoundland to 69% in British Columbia.[8] To assess how rural–urban differences in mammography use may also vary among provinces, we estimated the same regression models separately by provincial group: Atlantic provinces, Quebec, Ontario, the Prairies and British Columbia. Selected results are presented in Table 3. The regression equation for each provincial group includes the full

Table 3. Logistic regression results by province for mammography within the previous 2 years for Canadian women*

	Women aged 50–69 yr (*n* = 37 794)		Women aged 40–69 yr (*n* = 56 830)	
Province†	OR‡	95% CI§	OR‡	95% CI§
Atlantic provinces				
Tract CA	0.93	0.49–1.76	0.74	0.48–1.15
Nontract CA	0.65	0.42–1.01	**0.68**	**0.48–0.96**
Strong MIZ	0.91	0.51–1.62	0.67	0.43–1.05
Moderate MIZ	**0.64**	**0.42–0.98**	0.75	0.54–1.05
Weak MIZ	0.84	0.54–1.31	0.83	0.58–1.17
No MIZ	**0.41**	**0.21–0.80**	0.87	0.38–2.00
Quebec				
Tract CA	0.62	0.36–1.10	0.67	0.42–1.06
Nontract CA	0.93	0.62–1.41	0.99	0.76–1.30
Strong MIZ	1.12	0.76–1.65	0.88	0.66–1.17
Moderate MIZ	0.84	0.61–1.15	0.86	0.67–1.09
Weak MIZ	0.84	0.40–1.76	1.05	0.67–1.66
No MIZ	**0.32**	**0.13–0.74**	0.65	0.27–1.61
Ontario				
Tract CA	1.29	0.97–1.70	1.11	0.92–1.33
Nontract CA	1.06	0.86–1.31	1.08	0.91–1.27
Strong MIZ	1.02	0.79–1.31	1.01	0.84–1.22
Moderate MIZ	**0.67**	**0.53–0.84**	**0.73**	**0.61–0.88**
Weak MIZ	0.97	0.68–1.39	0.84	0.64–1.09
No MIZ	1.02	0.39–2.64	1.03	0.46–2.32
The Prairies				
Tract CA	0.89	0.54–1.48	0.66	0.44–1.00
Nontract CA	0.75	0.49–1.16	**0.64**	**0.45–0.92**
Strong MIZ	0.79	0.47–1.34	**0.63**	**0.42–0.96**
Moderate MIZ	1.10	0.75–1.64	0.72	0.51–1.01
Weak MIZ	0.84	0.57–1.23	**0.64**	**0.46–0.91**
No MIZ	0.79	0.48–1.29	**0.65**	**0.44–0.96**
British Columbia				
Tract CA	1.06	0.73–1.54	0.84	0.64–1.09
Nontract CA	0.75	0.50–1.13	0.83	0.63–1.11
Strong MIZ	1.04	0.55–1.98	1.34	0.79–2.30
Moderate MIZ	**0.61**	**0.38–0.98**	0.82	0.57–1.18
Weak MIZ	0.81	0.51–1.28	**0.69**	**0.50–0.95**
No MIZ	**0.30**	**0.10–0.91**	**0.31**	**0.14–0.69**

CA = census agglomeration; CI = confidence interval; MIZ = metropolitan influenced zone; OR = odds ratio.
*The sample excludes women who had undergone mammography for reasons other than regular screening or a regular checkup. Regression equations include variables for age, age-squared, indicator variables for 5-year age cohorts, and survey year as well as the variables reported in Table 1. These results are not reported in Table 2, but are available on request from the authors.
†Census metropolitan area = 1.
‡Odds ratios in bold are significantly different from 1 at the 5% level of significance.
§95% CIs are based on robust standard errors.

set of variables listed in Table 2, although, for brevity, we chose to report only the results for the set of rural–urban indicators. Columns 1 and 2 of Table 3 show that, other things being equal, women aged 50–69 years who reside in more remote rural areas of the Atlantic provinces, Quebec and British Columbia had the lowest odds of having undergone mammography during the previous 2 years. As well, residents of "moderate MIZ" regions of the Atlantic provinces, Ontario and British Columbia had lower odds of having undergone mammography than residents of large urban CMAs in those provinces. (It should be noted that the large and less populated regions of northern and western Ontario are classified by Statistics Canada as "moderate MIZ.") Further, in no provincial group were the odds of having undergone mammography significantly higher in any other rural or urban regions than in CMAs. In columns 3 and 4 of Table 3, we considered the expanded sample of women aged 40–69 years. The results are broadly comparable for the Atlantic provinces, Quebec, Ontario and British Columbia, although some ORs for "no MIZ" areas were no longer significant. The residents of all types of region of the Prairie provinces outside of CMAs had lower odds of having undergone mammography than residents of CMAs in Prairie provinces.

We can gain some insights into this possibility because the CCHS asked women who had not undergone mammography during the previous 2 years about their reasons for not doing so. We identified 4 reasons as indicating barriers in undergoing timely mammography: service not available when required, service not available in the area, wait times too long and transportation problems. Relevant summary statistics are presented in Table 4. Only a small percentage of women aged 50–69 who had not undergone timely mammography gave one of these reasons. The percentage doing so did increase with increasing remoteness from major population centres — from 1.6% of women in CMAs and 2.0% of women in "tract" CAs, to 6.1% of women in "weak MIZ" regions and 6.0% of women in "no MIZ" regions — but even in the most rural regions only about 1 in 20 women identified access barriers as the reason for not having undergone mammography.

DISCUSSION

We found evidence that mammography screening among asymptomatic women aged 50–69 years varies by rural or urban status. Specifically, women living in more rural and remote areas of Canada were less likely to have undergone mammography during the previous 2 years than women living in larger urban areas. We observed this discrepancy after accounting for a host of other potentially important determinants of mammography use, including age, marital status, language fluency, education level, family income and whether the woman had a family doctor. Our results also clearly indicate that many of these factors significantly affect the odds of a woman having undergone mammography. Of particular note are the much lower odds of having undergone mammography among recent immigrants and women not fluent in either English or French, and the importance of having a family doctor to mammography screening.

The results also indicate that mammography screening programs that include women aged 40–49 years have a positive impact on the use of mammography by women in that age group, who reside in the provinces with such programs. Nova Scotia, Alberta and British Columbia unconditionally accept and annually recall women aged 40–49 years and the other provinces do not (though Alberta requires an initial written referral from a doctor for a woman in this age range to be accepted into the provincial screening program). Women aged

Table 4. Reasons given by 37 794 women aged 50–69 years for not having undergone mammography during the previous 2 years, by region of residence

	Weighted % of total							
Reason	CMA	Tract CA	Nontract CA	Strong MIZ	Moderate MIZ	Weak MIZ	No MIZ	Overall
Didn't get around to it	25.4	31.8	29.4	26.8	25.8	27.9	19.4	26.4
Respondent didn't think necessary	36.0	37.2	32.8	38.8	43.1	37.9	48.4	36.8
Doctor didn't think necessary	15.2	13.9	14.8	15.7	11.7	12.8	14.8	14.6
Fear of outcome or process	6.0	6.4	8.4	4.5	6.8	6.9	5.8	6.3
Barriers to timely access*	1.6	2.0	2.9	3.8	4.6	6.1	6.0	2.4
Other	15.8	8.7	11.6	10.4	8.0	8.3	5.6	13.5

CA = census agglomeration; CMA = census metropolitan area; MIZ = metropolitan influenced zone.
*Barriers to timely access include the following: service not available when required, service not available in the area, wait times too long and transportation problems.

40–49 years in these provinces are more likely to undergo mammography, other things being equal. Although the benefits of regular screening in this age group are debatable, there may still be an indirect benefit if such programs subsequently increase screening rates of women once they enter the critial 50–69 age range. However, there is no evidence that provincial screening programs for women in their 40s lead to increased screening rates among women aged 50–69 years in those provinces.

One possible explanation for the difference in mammography use between women in rural and urban areas is that women in relatively rural and remote areas face greater access barriers to mammography screening because of the limited availability of services in the area and distances and wait times involved in obtaining screening. However, it is also interesting to note that in our data there are only minor differences between provinces with and without mobile clinics in the incidence of mammography screening among women aged 50–69 years who live in "no MIZ" areas: 61% of women in provinces with mobile clinics had undergone mammography during the previous 2 years, compared with 62% of women in provinces where there were no mobile clinics.

Physician referral is an important determinant in a woman's choice to undergo mammography,[1,8–11,20,21] and Zapka and colleagues[11] found that 83% of women would partake in breast screening if recommended to do so by a doctor. Although we controlled for the incidence of having a family physician as well as the concentration of physicians in rural and urban areas, differences in mammography screening may still arise because of differences in the incidence of regular doctor visits or because of the interaction between women and their physicians. Recent research[17] has found that older individuals living in Canadian regions outside of CMAs and CAs are less likely to visit their doctor during a given year than those living within CMAs and CAs. Thus there may be less of an opportunity for a rural woman's physician to discuss with her the importance of mammography screening. As well, Abdel-Malek and coauthors[24] found that physicans in large urban areas of Ontario are less likely to adhere to screening guidelines compared with their rural counterparts. However, the results in Table 4 indicate that there are no meaningful differences in the percentage of women not undergoing recent mammography who reported that the reason for this was that their doctor did not think it necessary.

Differences in mammography use between rural and urban areas may instead reflect variation in individual health beliefs, since it is well established that personal beliefs about breast cancer and mammography play a very important role in the take-up of regular screening.[8,10,11,23,25] Previous research has reported that about 50% of women who forgo mammography do so because they believe it is unnecessary.[8,11] Results in Table 4 show that 48.4% of women living in "no MIZ" regions who had not undergone mammography stated that they had not thought it necessary, compared with 36.0% of women living in CMAs. In a related vein, Bryant and Mah[7] report that although knowledge of breast cancer and access barriers to mammography are comparable between rural and urban women, less than half of rural women agree that breast cancer is curable given early detection.

Findings from this research are accompanied by several caveats. First, the CCHS is based on self-reporting, so responses may be subject to recall bias. Second, women living on Crown lands, full-time military personnel, residents of northern territories, on-reserve Aboriginal women and women living in institutions were excluded, so our results do not necessarily generalize to the wider population of women aged 40–69 years. As well, the CCHS does not sample residents of Nunavik in northern Quebec, which means that residents of remote areas of Quebec in particular are underrepresented in the data. Third, although the detailed categories of rural and urban areas are a marked improvement over a simple dichotomous rural–urban distinction, particular types of regions are still likely to be quite heterogeneous. Finally, our data are drawn from only 2 points in time, so a more comprehensive evaluation of the effectiveness of public information campaigns and organized screening programs is not possible. Differences among provinces may be due to differences in how provincial screening programs are conducted, but a host of other province-specific factors may also underpin observed differences.

CONCLUSION

Our analysis suggests that information campaigns raising awareness about the importance of mammography should be targeted, in particular, at women residing in rural and remote areas. More generally, it seems reasonable that information campaigns to boost compliance might be used in conjunction with greater employment of mobile mammography clinics in rural areas, where women are less likely to have a family doctor. British Columbia, Manitoba, Saskatchewan, Quebec and New Brunswick have implemented such

clinics and report some successes.[26] Our analysis suggests that the use of mobile clinics in rural and remote areas should be accompanied by efforts to increase awareness of the importance of mammography screening among women living in those areas. More research is needed on the extent to which personal opinions about the importance of periodic mammography is driving lower rates of mammography use in Canada's rural and remote areas.

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