

Reduced Screening Mammography Among Women With Diabetes

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Background: Despite regular health care, preventive health issues may be neglected in patients with chronic diseases such as diabetes. Case-control studies in the United States have shown lower mammogram rates in women with diabetes; however, it is not known whether the presence of diabetes mellitus affects mammography use in a Canadian setting, where there is universal access to health care.

Methods: Using health databases in Ontario from April 1, 1999, to March 31, 2002, this retrospective cohort study observed women aged 50 to 67 years, who were free of breast cancer, until their first mammogram in a 2-year period. Mammogram rates were compared between women who had had diabetes for a minimum of 2 years (n=69 168) and women without diabetes (n=663 519).

Results: Compared with women without diabetes, diabetic patients were older, had more physician visits, were

more often from a lower-income neighborhood, and, in those 65 years or older, were less likely to be taking estrogen. The odds ratio of having a mammogram during the 2-year period was 0.68 (95% confidence interval, 0.67-0.70; $P<.001$) for women with diabetes, and adjustment for age and other covariates did not modify this effect.

Conclusions: Women with diabetes were significantly less likely to have had a mammogram during a 2-year period than were women without diabetes, despite more health care visits. These results suggest that, because of the complexity involved in diabetes care, routine preventive care such as cancer screening is often neglected. These findings highlight the need for better organization of primary care for patients with chronic diseases.

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BREAST CANCER IS THE MOST common malignancy in females and the second leading cause of cancer death among women.¹ Screening mammography allows for early detection of malignancies, and it has been shown to reduce breast cancer mortality by up to 40% in women between the ages of 50 and 69 years.^{2,3} On the basis of these findings, clinical practice guidelines recommend routine mammography for all women in this age group every 1 to 2 years.^{2,4}

Despite these recommendations, current evidence suggests that a significant number of women eligible for screening are not getting regular mammograms.⁵⁻¹¹ Previous studies from both the United States and Canada have identified a number of factors that predict lower rates of mammography use. Women with less education, lower income, poorer preventive health behaviors, and obesity and those from certain minority groups receive fewer mammograms than women without these

characteristics.^{5-7,9,12-14} In addition, women living in rural areas or who lack a regular care provider are also less likely to obtain screening.^{5,7,9,11,14,15} Underusers of mammography most often cite being unaware of the benefits of mammograms, or that they were not advised to obtain a mammogram by their physician despite regular checkups.^{9,10,14,16,17} These findings highlight the importance of the physician's role in screening promotion. Highly educated women may be more likely to advocate for and remind their physicians about preventive screening, while women with greater socioeconomic and cultural barriers to health education may be more reliant on their provider for health advice.

With increasing time constraints on physicians, patients with chronic diseases like diabetes mellitus may be particularly vulnerable to receiving inadequate preventive care. Office-based diabetes management has become significantly more complex and time consuming during the past decade because of a

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shift toward more intensive therapeutic and lifestyle interventions.¹⁸ This, combined with limited office visit times, may therefore pose a barrier to unrelated preventive management despite regular health care visits. Furthermore, added socioeconomic and cultural barriers may render diabetic patients less likely to advocate for preventive care. Indeed, studies have shown that patients with chronic diseases are less likely to receive preventive health care such as lipid-lowering therapy, arthritis treatment, colon cancer screening, and Papanicolaou smears.¹⁹⁻²¹ Two case-control studies from the United States have shown a reduction in mammograms among women with diabetes,^{19,22} but these studies were limited by small sample sizes, the use of self-reported data on mammography use, and inadequate adjustment for potential confounders. Moreover, financial barriers may have been a limiting factor for women with diabetes in centers where cost sharing was applied. In contrast, a UK study failed to identify an association between diabetes and participation in mammography screening programs; however, this study may have been underpowered.²³

Breast cancer screening may be especially important in women with type 2 diabetes mellitus. Evidence from prospective studies suggests that diabetes increases the risk of breast cancer²⁴⁻²⁶ and breast cancer mortality.^{25,27,28} This potential risk underscores the need for adequate breast cancer screening in women with diabetes.

The goal of the current study was to determine whether the presence of diabetes affects utilization of mammography in a population of Canadian women, where this service is fully covered by insurance.

METHODS

DATA SOURCES AND STUDY POPULATION

This retrospective cohort study examined mammography use during a 2-year period among women aged 50 to 67 years with and without diabetes who were living in the province of Ontario from 1999 to 2002. Data were obtained from anonymous, administrative health care databases that include records for all individuals eligible for coverage under the Ontario provincial health plan. Patient records are individually linked across data sets by means of a unique patient identifier. The study period was April 1, 1999, to March 31, 2002. Ethics approval was obtained from the institutional review board at Sunnybrook and Women's College Health Sciences Centre, Toronto, Ontario.

The study population included women who were between the ages of 50 and 67 years from April 1, 1999, to March 31, 2000. Physician service claims were used to identify women who had 1 or more visits to a family physician or general internist during this time frame. Because women who do not use health care services may not have the opportunity to be referred for mammography, those who did not have any visits to a family or general practitioner or internist during that year were excluded from the study. Women were also excluded if they had a history of breast cancer or if they died during the study period. To minimize the inclusion of mammograms performed during the treatment and follow-up of breast cancer, women who had a mammogram after a recent breast cancer diagnosis were also excluded. Breast cancer records were obtained from a linkable provincial cancer registry.

DIABETES GROUP

Women with prevalent diabetes at baseline, defined as having had a diagnosis of diabetes for at least 2 years, were included in the study. The presence of diabetes was determined by linking records to the Ontario Diabetes Database, an administrative data-derived registry of diabetes cases. Creation of the database was described in full elsewhere.²⁹ Briefly, hospital discharge abstracts were used to identify patients admitted to the hospital with a diagnosis of diabetes based on the presence of an *International Classification of Diseases, Ninth Revision, Clinical Modification*³⁰ (ICD-9-CM) code of 250.x on any one of 16 diagnostic fields. Physicians' service claims records were used to identify visits for diabetes (code 250.x). Any individuals having at least 1 hospitalization or 2 physicians' service claims bearing a diagnosis of diabetes within a 2-year period were included in the Ontario Diabetes Database. The database has been well validated and shown to have a high sensitivity (86%) and specificity (97%) for identifying individuals in whom diabetes was recorded in primary care charts. It is not possible to distinguish between type 1 and type 2 diabetes with this database, but it is estimated that more than 90% of patients have type 2 diabetes mellitus.³¹

COMPARISON GROUP

The comparison group consisted of all remaining Ontario women between ages 50 and 67 years at baseline who met inclusion criteria and did not have a diagnosis of diabetes at any time during the study period. These women were identified from a provincial registry that contains demographic and residential information on Ontario residents eligible for coverage under the Ontario Health Insurance Plan.

PRIMARY OUTCOME AND COVARIATES

Use of mammography and physician services was detected from claims to the provincial insurer, and demographic and residential data were recorded from the provincial registry of Ontario residents. Women were followed up for a 2-year period starting from their first physician visit during the baseline year (April 1, 1999, to March 31, 2000). The primary outcome was the first bilateral mammogram during follow-up as recorded in the physicians' service claims database. The following baseline covariates were included in the analysis: age, region of residence, rural vs nonrural residence, income quintile, the number of primary care visits in the baseline year, having at least 1 visit to an internal medicine specialist (general internist or endocrinologist) in the baseline year, having a regular provider of care (defined as having >50% of the physician visits in the baseline year with the same primary care physician), comorbidity status, and estrogen treatment.

Income data were attributed from census data based on neighborhood of residence.²⁹ Despite availability of neighborhood-level census data, information on ethnicity could not be accurately obtained because of the tendency for ethnic populations to be mixed within a single neighborhood. Comorbidity at baseline was estimated by means of the Johns Hopkins Adjusted Clinical Group Case-Mix assignment software (Sun Sparc/Solaris, version 4.52).^{32,33} This software assigns diagnostic categories based on ICD-9-CM³⁰ codes from administrative outpatient encounter records, to provide a composite estimate of health status and future health service use. For this study, the collapsed ambulatory diagnostic group category of "unstable chronic disease" was used to control for the presence of comorbid conditions during the year before study entry that may have precluded the benefit of screening mammograms. This cat-

Table 1. Baseline Characteristics for Diabetes and Comparison Groups

Characteristic	Diabetes (n = 69 168)	No Diabetes (n = 663 519)	P Value
Age, y*	59.0 (58.9-59.0)	57.5 (57.5-56.0)	<.001
Lowest income quintile, %	25.6	17.2	<.001
Highest income quintile, %	14.4	22.8	<.001
Rural residence, %	13.9	13.7	.15
No. of primary care physician visits/y*	9.4 (9.3-9.4)	6.7 (6.66-6.69)	<.001
Regular health care provider, %	30.2	36.0	<.001
Specialist care, %	29.2	10.6	<.001
Unstable chronic disease, %	32.6	21.4	<.001
Receiving estrogen treatment (age ≥65 y), %	23.3	33.7	<.001

*Mean (95% confidence interval).

egory includes conditions such as diabetes, heart disease, vascular disease, renal failure, malignancy, and other major chronic illnesses.³³ Because we were interested in nondiabetes comorbidity, the diagnostic code for diabetes (ICD-9-CM code 250.x) was excluded from the list of codes contributing to this category. Comprehensive data on prescription medication use were available only for Ontario residents 65 years or older from the Ontario Drug Benefit Program Database. Using this database, we recorded estrogen treatment from April 1, 1999, to March 31, 2002, for women 65 years or older.

STATISTICAL ANALYSIS

Baseline characteristics were described by means of summary statistics. Logistic regression was used to compare the number of women who had a mammogram in the diabetes and comparison groups. Multivariate logistic regression was done to adjust for covariates that were significant on univariate analyses with $P < .05$. Adjusted subgroup analyses were performed in the following subgroups: ages 50 to 54, 55 to 59, and 60 to 67 years; rural and nonrural region of residence; income quintiles; quartiles of primary care physician visits; at least 1 vs no internal medicine specialist visit; presence or absence of unstable chronic disease; and estrogen vs no estrogen treatment in those 65 years or older for whom drug data were available. All analyses were done with SAS statistical software, version 8 (SAS Institute Inc, Cary, NC).

RESULTS

Our final cohort included 69 168 women with diabetes and 663 519 women without diabetes. Baseline characteristics are presented in **Table 1**. Compared with women without diabetes, women with diabetes were significantly older and resided in lower-income neighborhoods. These women also had more primary care physician visits, were more likely to be categorized as having unstable chronic disease, and were more likely to have seen a specialist than those without diabetes.

During the 2-year period, 46.5% of the 732 687 women had at least 1 screening mammogram. Approxi-

mately one-third fewer women with diabetes had a mammogram than did women without diabetes (**Table 2**). In addition, the odds of having a mammogram remained significantly reduced for women with diabetes and did not change after adjustment for age, income, region of residence, comorbidity, frequency of primary care physician visits, specialist care, and having a regular provider of care.

The proportion of women who had a mammogram declined with age in both the diabetes and nondiabetes groups (Table 2). Mammograms were also less common in rural dwellers and were only minimally reduced in women with vs those without unstable chronic disease. Specialist care did not affect the likelihood of a mammogram in either group of women.

The odds of a mammogram among women with diabetes within prespecified subgroups are presented in Table 2. Adjusted odds ratios for diabetes remained significantly reduced and of a similar magnitude across age groups, specialty care, comorbidity status, and income quintiles for women with diabetes. The effect of diabetes on mammography rates was more pronounced in rural dwellers and in those who had less frequent health care visits. However, patients with diabetes continued to have significantly fewer mammograms than those without diabetes even if they visited a primary care physician more than 8 times per year.

The results were also analyzed in women aged 65 to 67 years, so that adjustment could be made for estrogen treatment. There were 96 587 women in this age group: 13 037 had diabetes and 83 550 did not have diabetes. After adjustment for estrogen therapy and other covariates, the odds ratio of a mammogram for women with diabetes remained significantly reduced in this age group (Table 2).

COMMENT

This population-based study demonstrated that women with diabetes had an estimated one-third lower odds of receiving a screening mammogram, despite a higher number of primary care physician and specialist visits. This underutilization was not explained by differences in comorbidity, income, age, regional access to care, or use of estrogen therapy between the 2 populations. This deficit translates into an extra 19 829 women with diabetes who were not screened during a 2-year period, yet might have been had they been free of diabetes. With an average incidence of breast cancer of 0.3% per year,¹ an estimated 120 new breast cancer cases may have been missed during this period.

Although these results support previous studies from the United States suggesting suboptimal preventive care in patients with chronic disease,¹⁹⁻²² this is, to our knowledge, the first population-based cohort study demonstrating a discrepancy in cancer screening practices among diabetic patients who were fully insured for the service. In addition, previous case-control studies showing lower mammography rates among patients with diabetes did not address the role of comorbidity, health care frequency, and estrogen treatment on screening rates.¹⁹⁻²²

Table 2. Proportion of Women Who Had at Least 1 Mammogram and Odds Ratios for Diabetes vs No Diabetes

Variable	No Diabetes		Diabetes		Odds Ratio (95% CI)*
	No.	% Who Had Mammogram	No.	% Who Had Mammogram	
All women					
Unadjusted	663 519	47.3	69 168	38.1	0.68 (0.67-0.70)
Adjusted†	NA	NA	NA	NA	0.68 (0.67-0.69)
Age group, y‡§					
50-54	231 733	49.7	17 143	41.4	0.70 (0.67-0.71)
55-59	191 553	48.1	18 307	39.2	0.68 (0.66-0.70)
60-67	240 233	44.7	33 718	36.0	0.68 (0.66-0.69)
Region of residence‡§					
Rural	90 589	40.7	9 581	30.1	0.62 (0.59-0.65)
Nonrural	572 930	48.5	59 587	39.5	0.69 (0.68-0.70)
Income quintile‡§					
1	111 747	41.2	17 242	33.9	0.67 (0.65-0.69)
2	127 845	45.0	15 803	37.2	0.69 (0.66-0.71)
3	130 983	47.4	13 344	39.2	0.68 (0.66-0.71)
4	130 048	49.7	11 263	41.5	0.68 (0.65-0.70)
5	147 731	52.8	9 699	43.5	0.68 (0.65-0.71)
No. of primary care physician visits/y‡§					
0-3	191 811	42.0	10 055	31.4	0.64 (0.61-0.67)
4-5	147 685	48.9	10 641	36.3	0.62 (0.60-0.65)
6-8	154 533	50.4	16 655	39.4	0.68 (0.65-0.70)
>8	169 490	49.6	31 817	40.3	0.72 (0.70-0.74)
Unstable chronic disease‡§					
Yes	142 218	46.9	22 570	36.9	0.67 (0.65-0.69)
No	521 301	47.6	46 598	38.8	0.68 (0.66-0.69)
Specialist care §					
Specialist visit	70 202	48.5	20 201	38.7	0.66 (0.64-0.68)
No specialist visit	593 317	47.3	48 967	38.0	0.69 (0.67-0.70)
Estrogen status (age ≥65 y)‡¶					
Taking estrogen§	83 550	43.0	13 037	34.6	0.72 (0.69-0.75)
Not taking estrogen§	28 133	53.7	3 040	48.1	0.81 (0.75-0.87)
	55 417	37.6	9 997	30.5	0.68 (0.65-0.72)

Abbreviations: CI, confidence interval; NA, not applicable.

* $P < .001$ for all odds ratios for diabetes vs no diabetes.

†Adjusted for age, income, rural region, specialist care, physician visits, comorbidity, and regular provider of care.

‡ $P < .001$ for comparisons between subgroups.

§Adjusted for all covariates except stratified variable. Numbers may not add up to the total owing to missing values.

|| $P = .09$ between subgroups.

¶Adjusted for all covariates and estrogen treatment.

This study found that the presence of other comorbidities did not modify the effect of diabetes on mammography, suggesting that diabetes uniquely poses a significant barrier to preventive care.

There are some limitations to these findings. First, approximately 24% of mammograms in Ontario are provided through a breast cancer screening program that does not generate claims data and were therefore not captured in our analyses.³⁴ This alternatively funded program provides mammograms through dedicated clinics across Ontario on the basis of self-referral, and therefore women with and without diabetes have comparable access to this service. In contrast, mammograms that we were able to detect (up to 76%) rely on physician referral and thus may be more vulnerable to the competing demands of diabetes care. However, because we measured claims data, in cases where mammograms were not obtained we cannot determine whether the physician failed to refer the patient or the patient chose not to obtain the recommended test. Nonetheless, these data identify a population at risk for inadequate screening for whom

patient- and provider-directed interventions may be required.³⁵ Second, this study was not able to examine the role of patient characteristics that have may affected screening mammography, such as lifestyle, ethnicity, education, and obesity.^{5-9,11,13-15} Diabetes may also be more common among women with these risk factors, possibly contributing to the reduction in mammogram use in this study. Finally, our comorbidity index may not have fully captured diabetes-related conditions. Although this index has been used to estimate comorbidity in several studies,^{32,36-38} it was originally developed to predict resource utilization. While some comorbid illnesses that may pose additional barriers to preventive care may have been missed, this variable was primarily used to account for poor health status that may preclude the benefit of mammograms. Further studies would be required to better assess the impact of other chronic conditions on mammogram use.

Possible reasons for the discrepancy in mammograms among women with diabetes include time constraints associated with complex disease care, particu-

larly in contexts where care is physician centered and reimbursed on a fee-for-service basis. In addition, a perception of diminished survival by patients and/or their physicians may make long-term disease prevention seem less important. Finally, sociocultural barriers to adequate health education may also contribute to lower screening in this population.

This study found that overall time-appropriate screening rates were low at 46.5%, indicating that our current methods of providing breast cancer screening need to be improved. This finding may be partly explained by the inability to capture all mammograms; however, even with approximately 24% unrecorded activity, at most 71% of eligible Ontario women underwent screening during a 2-year period. These results are consistent with reported Canadian rates of 53% to 70%,⁹ as well as reported US rates ranging from 33% to 58%.^{6,7,11,20}

In contrast, UK rates are higher at around 70% to 80%, in part because of a national breast cancer screening program that invites eligible women for screening and reminds them when tests are due.³⁹ Indeed, several studies have found that simple, inexpensive interventions such as letters to patients, mailed educational materials, and telephone calls significantly improve mammography screening uptake rates.⁴⁰⁻⁴² These strategies would decrease the dependence on the increasingly time-constrained primary care physician and may be particularly useful for women in whom greater educational gaps exist. As our data have shown, the tendency to overlook preventive care may be further magnified in patients with complex health status, such as those with diabetes, who need multiple issues addressed. Moreover, comprehensive primary care may become more neglected as we see a greater shift toward specialty-based chronic disease management programs.

In conclusion, this study found that the presence of diabetes poses a barrier to regular screening mammography and supports previous observations that preventive care may be relatively neglected in patients with chronic disease. As the complexity of diabetes care increases, it will be important to develop more standardized strategies to ensure that comprehensive care continues to be provided.

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Additional Information: Dr Lipscombe had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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