Original Research Article

Do socioeconomic factors and primary care model affect early breast cancer diagnosis in a cohort of breast cancer patients in an urban Canadian centre?

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Abstract

Objectives: Studies have shown an association between socioeconomic status (SES) and breast cancer (BC) treatment and diagnosis. We examined the relationship between SES, primary care physician (PCP) model and early detection of BC, as defined by asymptomatic screening and early stage at diagnosis, in a universal healthcare system.

Methods: Data were collected for consecutive patients diagnosed with BC from January 2010 to December 2011.Variables included patient and disease factors, type of PCP, stage at diagnosis and method of tumour identification. Area-level SES variables were obtained from 2006 Canadian census data. Multivariable logistic regression was used to identify predictors of early BC diagnosis. Odds ratios with 95% confidence intervals were reported.

Results: Results: A total of 721 patients were treated for breast cancer during the 2-year period. Predictors of early diagnosis through screening included: patients aged 51-70 (OR 4.3, 95% CI:2.6-7.2), BMI > 30 (1.5, 1.0-2.3), not employed (0.5, 0.3-0.8), and previous screening within 2 years (3.0, 2.0-4.4). Predictors of diagnosis at an early stage were having a 1st degree relative with breast cancer (2.2, 1.3-3.8) and having screening at an Ontario Breast Screening Program (2.9, 1.6-5.2).

Conclusion: Certain patient variables such as age and family history, predicted the likelihood of early detection of BC by asymptomatic screening and diagnosis at an early stage. In our urban cohort of BC patients, SES factors were not found to be predictors of early detection of BC.

Keywords: income quintiles; education; stage at diagnosis; screening; family practitioner; breast cancer

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Introduction

Breast cancer is the most commonly diagnosed type of cancer in women with 26,3000 new cases diagnosed in Canada in 2017[1]. It is also the second most common cause of cancer mortality in Canadian women, accounting for 13% of all cancer deaths[1]. Breast cancer is frequently diagnosed by screening mammography, as per the current Cancer Care Ontario (a provincial government agency created to drive quality and continuous improvement in cancer prevention and screening) guideline recommendations for women starting at age 50.[2,3] Breast cancer is treated with a multidisciplinary approach involving surgery, radiation, chemotherapy, and hormonal treatments. With advances in treatment, it is a highly curable cancer if diagnosed at an early stage[2,3].

There is growing evidence that non-biological factors may have an impact on the detection, treatment, and outcome of breast cancer in women. Many studies have shown a positive relationship with higher socioeconomic status (SES) associated with improved breast cancer survival in the United Kingdom (UK)[4], United States (US)[5-8], the Netherlands[9], Australia[10,] and Canada.[11-14] In addition, women with lower SES in Canada and the US were found to participate less often in screening programs,[15-17] to receive adjuvant chemoradiation less often[18-20], and were more likely to be diagnosed with breast cancer at a later stage than women with higher SES.[21] In Ontario, participation in cancer screening has been found to be lower in women with less education, lower SES, recent immigrant status, and those living in rural areas.[22-25] Furthermore, some studies have suggested that the model of healthcare delivery (universal healthcare vs. private or mixed healthcare) may also affect outcomes [26,27.] A systematic review by Gorey[26] found that in the lowest income areas, Canadian women had a significant five-year survival advantage over women in the US in various metropolitan and urban areas. They also found that US women less than 65 years of age who were not yet Medicare eligible were even more disadvantaged than Canadian women the same age. The authors suggest that the lack of healthcare insurance and consequent lack of access to health care services in the US compared to Canada explained their results.[26,27]

Breast cancer and primary care

In Ontario, Canada, the primary care provider (PCP) is the gate keeper to healthcare who initiates the process of referral to surgeons or oncologists for patients with breast cancer. Women are most frequently diagnosed with breast cancer after presentation to their PCP with a symptomatic lesion, or through a screening procedure.[28] Patients without a PCP may present with breast symptoms to a walk-in clinic or emergency room. Screening can be arranged by a PCP, either by referral to the Ontario Breast Screening Program (OBSP) or by imaging requested by one's PCP. While the OBSP can also be accessed by self-referral (OBSP invites screen-eligible patients by mail to book screening appointments), PCPs are encouraged to inform eligible patients about the program and play a key role in the diagnosis of breast cancer.[29] Some PCP characteristics such as identifying as male, physicians not working in a patient enrollment PCP model, and international medical graduate PCPs in Ontario have been associated with lower rates of cancer screening.[24,28] Esteva et al.[30] found that recommendations from physicians increase participation in public breast screening programs, while Sudtradhar et al.[29] found that visiting a PCP was associated with a significant increase in the uptake of periodic mammograms in an Ontario cohort. Additionally, decreased PCP availability has been shown to be a contributing factor to lower breast cancer survival in some jurisdictions.[31] The Ontario Medical Association (OMA) has estimated that 927,000 residents in Ontario did not have a PCP in 2012, with a shortage of 1000 physicians, potentially affecting breast cancer detection and management.[32]

Primary care models in Ontario

There are currently several models of primary care in Ontario with differing characteristics, including whether they are solo or group practices, associated with allied health, and the type of monetary compensation received including salaried physicians, "fee-for-service" payments (FFS), enhanced fee-for-service (EFFS), or various blended capitation payments (ie., fixed, pre-arranged payments for each patient enrolled within a PCP's practice not linked to specific service visits).[33-36] The different PCP models include: Community Health Centres (CHC), Fee for Service (FFS), Family Health Groups (FHG), Comprehensive Care Model (CCM), Family Health Organizations (FHO), and Family Health Networks (FHN) that may or may not include a Family Health Team (FHT) (e.g., FHO or FHN with Allied Family Health Team).[33-36] The different PCP models and their characteristics are outlined in Table 1. There is a smaller group of "other" models that are isolated to small rural areas, and a group with no PCP. Glazier et al,[36-38] found that FFS and EFFS models served patients that were predominantly urban, with a higher proportion of recent immigrants, lower income and patients with higher levels of comorbidity and expected resource use compared to FHO and FHO-FHT models. They also found that FHO-FHT had higher colorectal and cervical cancer screening rates compared to FFS and EFFS models[36-38]. We are not aware of studies examining the relationship between the type of PCP and breast cancer diagnosis and stage at presentation.

SES and breast cancer incidence/mortality in Hamilton, Ontario

The relationship between SES and numerous health parameters and longevity have been studied in Hamilton, Ontario.[39] The city of Hamilton is a midsize industrial city with a population of 505,000 residents and is an amalgamation of five generally affluent suburban communities and a central urban area with a lower-income downtown area.[39] Breast cancer incidence in the inner-city core of Hamilton was 3.5% lower than in five more affluent suburbs in Hamilton, but the breast cancer mortality rate was 7% higher.[40] In light of this study, we hypothesize that SES factors may contribute to the early detection of breast cancer, even in a universal healthcare system. There are currently more than 345 PCPs practicing in the Hamilton region (2017 data),

Table 1. Primary Care Physician Models in Ontario[33-36]

Remuneration	**Primary Care Physician (PCP) Model**	**PCP model characteristics**
Salaried models	Community Health Centre (CHC)	• Interdisciplinary teams serve hard to serve communities
Fee for Service (FFS)	Fee for Service (FFS)	• Very few provide comprehensive care • Do not roster patients, no after hour requirements
Enhanced FFS-based blended models (EFFS)	Family Health Group (FHG)	• Primarily fee-for-service • Practice in a group with incentive for preventative care • Must provide after hour availability • Some groups enroll patients
	Comprehensive care model (CCM)	• Solo PCPs with same characteristics as FHG
Capitation based blended models without Allied Health Team	Family Health Organizations (FHO)	• Practice in a group with incentive for preventative care • Must provide after hour availability • Patient rostering/enrolment
	Family Health Networks (FHN)	
Capitation based blended model with Allied Family Health Team (FHT)	Family Health Organizations (FHO-FHT)	• Practice in a group with incentive for preventative care • Must provide after hour availability • Patient rostering/enrolment • Funding available for allied health professionals and overhead associated with it (eg. nurse practitioners, dieticians, social workers)
	Family Health Networks (FHN-FHT)	

within various PCP models.[41,34] It is possible that some aspects of the detection and management of breast cancer may vary with PCP models (e.g., monetary incentives for cancer screening in some PCP models may encourage PCPs to more actively recommend screening tests) or that different PCP models might attract different patient populations, which in turn could affect early detection of breast cancer.[36,42]

Past studies have suggested SES influences the rate of BC screening. The first objective of this study is to assess whether SES predicts asymptomatic screening and early stage at diagnosis in a universal healthcare setting. Secondly, no previous studies have assessed the correlation between type of PCP and BC diagnosis. Our study is the first to investigate the relationship between PCP and breast cancer diagnosis in the Hamilton region.

Materials and methods

Study cohort and data collection

A retrospective chart review of consecutive patients diagnosed with breast cancer (surgical and non-surgical cases) living in Hamilton, Ontario was conducted over a two year period (January 2010 to December 2011). Cases were identified through health records queries using Canadian Classification of Health Interventions (CCI) codes for breast cancer surgical procedures (ICES Atlas Appendix[43]) and ICD-9 and ICD-10 Diagnosis codes (for invasive and DCIS) for day surgery and inpatient charts from hospital databases. Newly diagnosed breast cancer cases were also identified in the Regional Cancer Centre database to ensure all cases were identified (duplicates were excluded). Breast cancer included invasive disease and ductal cancer in situ. Male patients, duplicate charts, those diagnosed with benign breast disease, and patients who reside outside of Hamilton or had their primary treatment for breast cancer outside Hamilton were excluded. Local Research Ethics Board approval was obtained (REB #14-193-C). Trained data abstractors performed chart review from hospital and cancer centre charts to extract data on patient and disease characteristics. Patient demographics included age at diagnosis, marital status, obesity, and body mass index BMI > 30. Employment status was defined as employed, not employed (includes those on disability and homemakers), or retired. Data on smoking status, comorbidities, 1st degree relative with breast cancer, method of tumor identification (asymptomatic screening vs. symptomatic), location of primary imaging (Ontario Breast Screening Program (OBSP), hospital or non-hospital clinic), and disease stage at diagnosis were also collected.

Primary care physician model

The name of each patient's PCP was identified from the hospital chart. A College of Physicians and Surgeons of Ontario (CPSO) search (http://www.cpso.on.ca/Public-Register/All-Doctors-Search) was used to identify the number of years of practice, gender, and hospital privileges of each PCP. PCP model under which each PCP practiced was obtained from the Hamilton Physicians Primary Care Physician Database and included the following groups: FFS, EFFS FHO, and FHO-FHT.

Census data

Patients' postal codes were linked to the 2006 Canadian Census data to extract the following variables: immigration status (% immigrant last five years), education level (% completing college or university), and average income of the census tract of patient residence. Income was divided into quintiles.

Statistical analyses

Categorical variables were reported as counts and percentages and compared using Chi square or Fisher's exact test. Continuous variables were reported as mean with standard deviation (SD) and compared using t test for independent samples. Multivariable logistic regression analysis was performed to identify which variables (patient, SES, PCP model) had an impact on method of tumour identification and stage at diagnosis. Odds ratios (OR) with the corresponding 95% confidence intervals and Hosmer-Lemeshow goodness-of-fit values were calculated. Multicollinearity was checked using correlation analysis. To maximize power, univariable analysis was performed and variables with value less than 0.1 were entered into the multivariable regression. A p-value of 0.05 was considered for statistical significance. Data analyses were performed using SPSS Statistical Software Version 25.0 (IBM, New York, NY).

Results

Health records queries identified 1057 consecutive breast cancer surgical cases between January 2010 and December 2011 that were reviewed. Of these, 649 cases met inclusion criteria. An additional 72 breast cancer cases were identified (non-surgical and neo-adjuvant therapy cases) by cross-referencing with the Regional Cancer Centre database. Full data were abstracted from these 721 breast cancer cases (Figure 1). Table 2 outlines demographic, area-level SES, and breast cancer characteristics of the study cohort. Of note, there was a relatively even distribution of income quintiles, and a relatively even split of diagnosis by screening or symptomatic disease (47% vs 53%).

Ninety-eight percent of patients in our cohort had a PCP. Of the 11 (1.5%) patients without a PCP, 90% had their tumour identified by symptomatic presentation compared to 53% of patients with a PCP, and 55% were stage 3-4 compared to 24% of those with a PCP ($p<0.01$, data not shown). Sixty-four percent of PCPs were male, 41% had an academic appointment, and 79% had hospital privileges. Seventeen percent had

Figure 1: Study Cohort

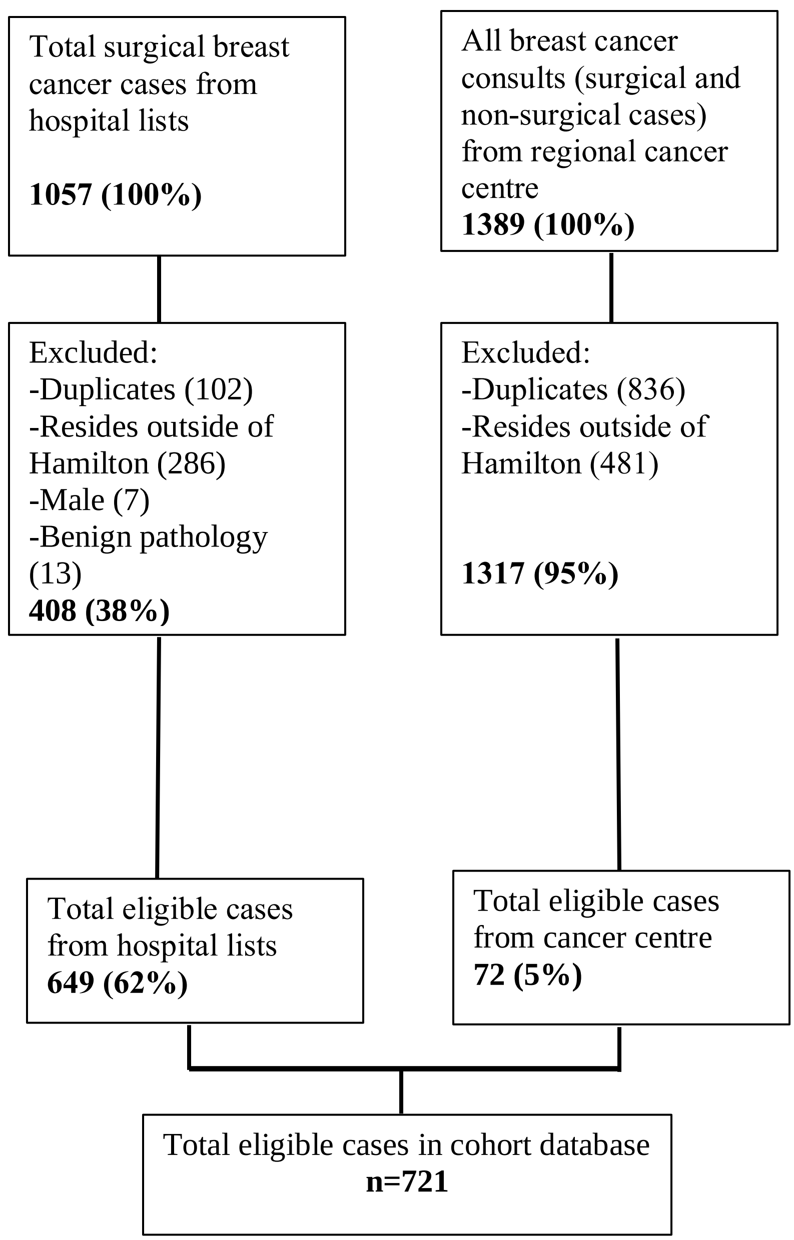

Table 2. Patient, socioeconomic factors, disease status and type of surgery for breast cancer cohort.

Variable	n=721	%
Age at diagnosis		
≤ 50 years	149	21
51 – 70 years	364	50
> 70 years	208	29
Obese (BMI > 30)		
Yes	255	35
No	435	61
NOS	31	4
Employment		
Employed	277	38
Not employed	151	21
Retired	279	39
NOS	14	2
Marital Status		
Married	447	62
Not married	272	38
NOS	2	0.3
First Degree Relative with BC		
Yes	159	22
No	519	72
NOS	43	6
Smoking History		
Smoker or previous smoker	289	40
Never smoked	426	59
NOS	6	1
Comorbidities		
None	183	25
1 or more	538	75
Income Quintiles		
1 (lowest)	147	20
2	141	20
3	148	21
4	140	19
5 (highest)	139	19
% neighborhood pursuing post-secondary education		
>40%	304	42
31-40%	237	33
< 31%	177	25
% neighborhood who are new immigrants		
> 30%	199	28
21-30%	224	31

< 20%	295	41
Method Tumour Identification		
Asymptomatic Screening	337	47
Symptomatic work-up	383	53
Location Primary Imaging		
OBSP	258	36
Hospital	314	44
Non-hospital Clinic	140	19
NOS	9	1
Imaging in past 2 years		
Yes	317	44
No	313	43
NOS	91	13
Previous Breast Cancer		
Yes	87	12
No	634	88
Recurrent Breast Cancer		
Yes	50	7
No	671	93
Disease Stage (TNM)		
Stage 0 & 1	323	45
Stage 2	222	31
Stage 3 & 4	176	24

BC – breast cancer; NOS – not otherwise specified/missing; BMI – body mass index; OBSP – Ontario Breast Screening Program; Comorbidities included were chronic obstructive pulmonary disease, rheumatic disease, coronary artery disease, myocardial infarction, coronary heart failure, diabetes, kidney disease, major psychiatric illness, morbid obesity (BMI >40), other cancer diagnosis, osteoporosis, hypertension, hypercholesterolemia, and neurodegenerative diseases (e.g. Parkinson's disease).

been in practice 10 years or less, 21% had practiced for 11-20 years, 28% had practiced for 21-30 years, and 33% had been in practice more than 30 years. The majority of PCPs worked in a FHO-FHT (64%) compared to 15% in a FHO and 17% in FFS/EFFS

Table 3 shows the univariate analysis for the method of cancer identification, stage at diagnosis, and patient characteristics for each type of PCP model. The method of diagnosis and stage at diagnosis, as well as most patient characteristics, did not vary with the PCP type. However, differences were found between PCP models for immigrant status, education, income quintile, employment status, and location of imaging ($p<0.05$). The FFS model had more patients living in neighbourhoods with a higher percentage of immigrants, lower percentage with post-secondary education, more women who were not employed and in the lowest income quintile than capitation-based models. FFS also had more patients who had their breast cancer diagnosed by imaging performed at a non-hospital clinic and fewer through an OBSP site.

Table 4 presents the univariate analysis of area-level SES and method of tumour identification and stage at diagnosis. Breast cancer was more often identified by asymptomatic

Table 3. Primary Care Physician Model by outcomes and SES variables.

Variable	Primary Care Physician Model				
	FFS (n=49) n (%)	EFFS (n=72) n (%)	FHO (n=106) n (%)	FHO-FHT (n=463) n (%)	p-value
Method of Tumour Identification					
Asymptomatic Screening	28 (58)	40 (55)	57 (54)	234 (51)	0.645
Symptomatic Work-up	20 (42)	32 (44)	49 (46)	229 (49)	
Disease Stage (TMN)					
Stage 0 - 2	15 (31)	20 (28)	20 (19)	107 (23)	0.332
Stage 3 - 4	34 (69)	52 (72)	86 (81)	356 (77)	
% neighborhood pursuing post-secondary education					
> 40%	15 (31)	31 (44)	54 (51)	185 (40)	**0.027**
31-40%	13 (27)	22 (31)	27 (26)	166 (36)	
< 31%	21 (43)	18 (25)	24 (22)	111 (24)	
% neighborhood who are immigrants					
> 30%	15 (31)	29 (40)	21 (20)	127 (28)	**0.003**
21-30%	22 (45)	21 (30)	28 (27)	145 (31)	
< 21%	12 (24)	21 (30)	56 (53)	190 (41)	
Income Quintiles					
1 (lowest)	19 (39)	14 (20)	14 (13)	94 (21)	**<0.001**
2	10 (20)	14 (20)	24 (23)	88 (19)	
3	5 (10)	10 (14)	15 (14)	111 (24)	
4	9 (18)	17 (24)	17 (16)	91 (20)	
5 (highest)	6 (12)	16 (22)	35 (33)	75 (16)	
Age at diagnosis					
≤ 50 years	9 (18)	17 (23)	19 (18)	97 (21)	0.844
51 – 70 years	25 (51)	35 (49)	50 (47)	237 (51)	
> 70 years	15 (31)	20 (28)	37 (35)	129 (28)	
Obese (BMI > 30)					

Yes	14 (30)	35 (51)	39 (38)	158 (36)	0.072
No	33 (70)	34 (49)	63 (62)	285 (64)	
Employment					
Employed	14 (30)	30 (42)	35 (33)	187 (41)	**0.002**
Not employed	21 (44)	16 (23)	24 (23)	79 (18)	
Retired	13 (27)	25 (35)	46 (44)	186 (41)	
Marital Status					
Married	27 (55)	47 (65)	70 (67)	287 (62)	0.535
Not married	22 (45)	25 (35)	35 (33)	175 (38)	
First Degree Relative with BC					
Yes	9 (24)	17 (26)	26 (26)	102 (23)	0.913
No	29 (76)	48 (74)	76 (74)	342 (77)	
Smoking History					
Smoker or previous smoker	18 (37)	25 (36)	49 (46)	184 (40)	0.511
Never smoked	31 (63)	44 (64)	57 (54)	277 (60)	
Comorbidities					
None	12 (25)	18 (25)	26 (24)	116 (25)	0.999
1 or more	37 (75)	54 (75)	80 (76)	347 (75)	
Location Primary Imaging					
OBSP	12 (24)	25 (35)	37 (35)	176 (39)	**0.043**
Hospital	19 (39)	29 (41)	52 (49)	198 (43)	
Non-hospital Clinic	18 (37)	17 (24)	17 (16)	82 (18)	
Imaging in past 2 years					
Yes	14 (33)	28 (44)	45 (48)	217 (54)	0.050
No	28 (67)	35 (56)	49 (52)	187 (46)	
Previous Breast Cancer					
Yes	2 (4)	5 (7)	16 (15)	62 (13)	0.100
No	47 (96)	67 (85)	90 (85)	401 (84)	

BC – breast cancer; FFS – Fee-for-Service; EFFS – Enhanced Fee-for-Service; FHO – Family Health Organization; FHO-FHT – Family Health Organization with Allied Family Health Team; BMI – body mass index; OBSP – Ontario Breast Screening Program;

Table 4. Univariate analysis of socioeconomic factors vs. methods of tumour identification and stage at diagnosis.

Variables	Asymptomatic Screening (n=337)	Symptomatic Work-up (n=383)	p-value	Stage 0-2 (n=545)	Stage 3-4 (n=176)	p-value
	n (%)	**n (%)**		**n (%)**	**n (%)**	
Age at Diagnosis						
< 51 years	37 (11)	112 (29)	**<0.001**	102 (19)	47 (27)	**0.044**
51-70 years	220 (65)	143 (37)		287 (53)	77 (44)	
> 70 years	80 (24)	128 (33)		156 (29)	52 (30)	
Obese (BMI > 30)						
Yes	130 (40)	124 (34)	0.074	188 (36)	67 (39)	0.531
No	192 (60)	243 (66)		330 (64)	105 (61)	
Employment						
Employed	125 (38)	152 (40)	**0.001**	203 (38)	74 (43)	**0.006**
Not employed	53 (16)	98 (26)		103 (19)	48 (28)	
Retired	150 (46)	128 (34)		227 (43)	52 (30)	
Marital Status						
Married	218 (65)	228 (60)	0.152	351 (66)	96 (55)	0.056
Not married	118 (35)	154 (40)		99 (18)	42 (24)	
First Degree Relative with BC						
Yes	91 (28)	68 (19)	**0.005**	134 (26)	25 (15)	**0.003**
No	231 (72)	288 (81)		378 (74)	141 (85)	
Smoking History						
Smoker/previous smoker	134 (40)	155 (41)	0.807	215 (40)	74 (43)	0.468
Never smoked	201 (60)	224 (59)		327 (60)	99 (57)	
Comorbidities						
None	77 (23)	106 (28)	0.145	140 (26)	43 (24)	0.739
≥ 1	260 (77)	277 (72)		405 (74)	133 (76)	

Income Quintiles						
1 (lowest)	66 (20)	80 (21)		111 (21)	36 (21)	
2	63 (19)	78 (21)		99 (18)	42 (24)	
3	75 (22)	73 (19)	0.464	112 (21)	36 (21)	0.496
4	71 (21)	69 (18)		111 (21)	29 (17)	
5 (highest)	58 (17)	81 (21)		107 (20)	32 (18)	
% neighborhood pursuing post-secondary education						
> 40%	145 (43)	159 (42)	0.597	222 (41)	82 (47)	0.332
31-40%	104 (31)	132 (35)		186 (34)	51 (29)	
< 31%	86 (26)	91 (24)		135 (25)	42 (24)	
% neighborhood who are immigrants						
> 30%	95 (27)	104 (27)	0.466	152 (28)	47 (27)	0.653
21-30%	110 (33)	113 (30)		173 (32)	51 (29)	
< 21%	130 (39)	165 (43)		218 (40)	77 (44)	
Location Primary Imaging						
OBSP	--	--		222 (41)	36 (21)	**<0.001**
Hospital	--	--		229 (42)	85 (50)	
Non-hospital clinic	--	--		92 (17)	48 (28)	
Imaging in last 2 years						
Yes	204 (67)	113 (35)	**<0.001**	263 (55)	54 (37)	**<0.001**
No	102 (33)	210 (65)		220 (45)	93 (63)	
Previous BC						
Yes	49 (15)	38 (10)	0.058	71 (13)	16 (9)	0.163
No	288 (85)	345 (90)		474 (87)	160 (91)	
PCP Model						
FFS	20 (6)	28 (8)		34 (6)	15 (9)	
EFFS	32 (10)	10 (11)	0.645	52 (10)	20 (12)	0.332
FHO	49 (15)	57 (16)		86 (16)	20 (12)	
FHO-FHT	229 (69)	234 (65)		356 (67)	107 (66)	

BC – breast cancer; BMI – body mass index; ; FFS – Fee-for-Service; EFFS – Enhanced Fee for Service; FHO – Family Health Organization; FHO-FHT –Family Health Organization with Allied Family Health Team; PCP - primary care physician; OBSP – Ontario Breast Screening Program

Table 5. Multivariable analyses exploring the predictors of tumour identification by asymptomatic screening and early disease stage at diagnosis.

Variable	Odds ratio (95% CI)	p-value
Predictors of asymptomatic screening vs. symptomatic work-up (n=532)		
Age at Diagnosis – < 51 years	Ref	
51–70 years of age	4.30 (2.60, 7.20)	**<0.001**
>70 years of age	2.12 (1.22, 3.68)	**0.007**
Obese (BMI > 30)	1.53 (1.03, 2.267)	**0.035**
Not employed	0.52 (0.32, 0.85)	**0.009**
Imaging in past 2 years	3.00 (2.05, 4.42)	**<0.001**
Hosmer-Lemeshow p-value = 0.369		
Predictors of early stage disease at diagnosis (Stage 0-2) vs. late stage (stage 3-4) (n=531)		
First degree relative with BC	2.25 (1.32, 3.85)	**0.003**
Location Primary Imaging		
Non-hospital clinic	Ref	
Hospital	1.14 (0.69, 1.90)	0.603
OBSP	2.96 (1.67, 5.25)	**<0.001**
Hosmer-Lemeshow p-value = 0.375		

OBSP – Ontario Breast Screening Program; BC – breast cancer; BMI – body mass index; CI – confidence interval screening for women aged 51-70 years, for cases with imaging in the last two years and those with a 1st degree relative with breast cancer ($p < 0.05$). Women aged 51 – 70 years and women who were retired were more likely to have their breast cancer diagnosed at an earlier stage. Women who had their imaging performed at OBSP and imaging performed within the last two years as well as women having a first degree relative with breast cancer were also more often diagnosed at an earlier stage.

Table 5 presents multivariable analyses of SES, patient factors, and method of tumour identification as well as stage at diagnosis. Independent predictors of cancer detection with asymptomatic screening included: older age (OR 4.30 for patients who were diagnosed with breast cancer at age 51-70 compared to women < 51 years, OR 2.12 for patients above age 70 compared to women < 51 years); being obese (OR 1.53), and patients who had imaging within the past two years (OR 3.00). Unemployed patients were less likely to have their breast cancer diagnosed through asymptomatic screening (OR 0.52) compared to women who were employed or retired. Predictors for early stage disease at diagnosis included patients with a first-degree relative with breast cancer (OR 2.25) and patients who had their primary imaging at OBSP. Those diagnosed through OBSP were more likely to be diagnosed early (OR 2.96) compared to those who had their imaging at a non-hospital clinic.

Discussion

Breast cancer management and outcomes can be affected by a wide-range of factors and SES may be an important contributor.[4,5] One of the most potent prognostic factors for breast cancer outcome is early diagnosis[2,3]. In our study we specifically examined early detection of breast cancer, defined as diagnosis by asymptomatic screening and diagnosis at an early stage. Our hypothesis was that SES level may be related to breast cancer screening and diagnosis, in light of the association between breast cancer mortality by neighbourhood SES reported by Johnston et al. in the Hamilton region.[40] However, we found that area-level income, education, and immigration status did not affect the rate of early detection of breast cancer. We also found no association between area-level income and stage at diagnosis. Booth et al.[12] and Brewster et al.[44] , also found a lack of strong association between stage at diagnosis and income in cohorts from Ontario, Canada and in the UK. In comparison, several US studies[4,20] found that patients with lower socioeconomic status were more likely to be diagnosed with more advanced disease. Gorey[45] found that the rate of early breast cancer diagnosis in Ontario was significantly better than the rate for US women uninsured or Medicaid/Medicare insured in California. Both Canada and the UK have universal health care systems that may provide better access to breast cancer screening.

Such results may be partially attributable to ongoing efforts in promoting breast cancer screening through media and PCP offices.[46] In Hamilton, a “Screen for life” bus initiative offered more than 600 people breast cancer breast cancer screening each year, targeting areas with low SES, difficult access to screening centres, and certain cultural groups identified as being less familiar with cancer screening.[47,48] Such programs have also been utilized in remote areas of Northern Ontario where healthcare accessibility is an issue.

Predictors of breast cancer detection from screening included patients in the recommended screening age range (51-70 years) and with a body mass index greater than 30 where a breast lump was more likely non-palpable. Patients with a first degree relative with breast cancer, a personal history of breast cancer, and regular screening within the past two years were more likely to have their breast cancer diagnosed through screening and at an earlier stage. Patients with a previous diagnosis of breast cancer or strong family history were likely more educated and sensitive to their screening, leading to earlier diagnoses. Other studies have found that attendees for breast screening were more likely to have breast cancer in their family or among friends.[49,50]

Lack of accessibility to primary care has been associated with lower rates of cancer screening.[28,51] In our study cohort only 11 out of 721 patients (1.5%) did not have a PCP, and these cases had a higher percentage of breast tumours detected by symptomatic presentation and at an advanced stage. This is consistent with the literature and highlights the benefit of primary care and regular screening.[34] Although efforts have been made to connect patients with PCPs through the Health Care Connect Program in Ontario (telephone/online registry to match prospective patients with available PCPs)[52], some patients still do not have a regular PCP. Interestingly, only 1.5% of patients in our study cohort did not have PCP, which suggests that a shortage of PCPs or access to PCPs may not be as great a problem in Hamilton (for women similar to those in our cohort) as in other areas of Ontario. Almost 80% of patients in our Hamilton cohort were enrolled in a capitation-based model (FHO or FHO-FHT), which is higher than results found in other Ontario metropolitan/urban areas.[24,33,34]

To the authors' knowledge, this study is the first study to examine the relationship between PCP model and method of identification and stage at diagnosis of breast cancer. We postulated that patients enrolled in a PCP model with incentives as a part of remuneration may have more breast cancer detected through screening. However, no such association was found in our cohort, although FHO/FHO-FHT patients more often had their breast cancer diagnosed through OBSP, rather than at a non-hospital clinic, compared to FFS and were more likely to have had imaging in the past two years (although this did not reach statistical significance). We found differences in patient characteristics treated by different PCP models similar to those found by Glazier et al.[36] FFS-based models had more patients living in neighbourhoods with a higher percentage of immigrants and more unemployed patients compared to FHO/FHO-FHT models. Other studies examining PCP characteristics and cancer screening in metropolitan and urban areas in Canada found that rates of breast cancer and cervical cancer screening were highest in enrolled PCP models with incentives for preventative care and lowest in those in straight FFS or receiving no PCP care.[24,28] Interestingly, a longitudinal study by Kiran et al.[53] found that PCP models receiving incentives for cancer screening showed little or no increase in cancer screening rates (3% increase for breast cancer) in Ontario in the three years after widespread implementation of the program, suggesting that pay-for-performance incentives had little impact.

Our analysis found that unemployed patients were less likely to have their breast cancer diagnosed by asymptomatic screening. Lagerlund et al.[48,54] found that women who were not regularly employed were twice as likely to be non-attenders for mammography screening in a universal health care system with an outreach screening program and a UK study by Coyle et al.[55] found a similar result. Li et al.[56] found that being employed predicted compliance with chemotherapy, radiation, and hormonal therapy in a cohort of breast cancer patients. Langerlund suggests that employment status may serve as a proxy for degree of social integration.[54]

A strength of our study is that the clinical and demographic data were obtained directly from patient charts, which allowed us to retrieve extensive and accurate data.[57-58] Despite this strength, chart reviews are limited to the information contained within a patient's chart. We used area-level data from the Canadian Census for income, immigration status, and education as a proxy for individual level data as these variables were not available in the patient chart. Ecological fallacy (e.g., the tendency that those living in lower SES neighbourhood may not be of low SES) may occur when using area-level data to estimate individual-level data, although the use of ecological income is generally accepted as valid and is commonly used in health services research.[59-61] The sample size for FFS and EFFS groups was smaller than expected and this may have limited our ability to detect a difference between PCP models. This study was also restricted to the Hamilton region, which may limit the generalizability of our results to other jurisdictions with different types and distributions of PCP models and without universal health care. Inclusion of a wider, rural/urban region would potentially be more representative, provide a larger, more varied sample, and enable a more robust and detailed analysis.

Conclusions

Area-level SES variables did not affect early detection of breast cancer by diagnosis through screening or diagnosis at an early stage in our study cohort from an urban Canadian centre. Likewise, PCP models did not have a significant impact on breast cancer detection or stage at diagnosis, but these results may be compromised by our limited sample size. Our results suggest that early detection of breast cancer is not dependent on SES variables in our urban setting within a universal health care system with readily available primary care for the vast majority of women. There are numerous models of primary care delivery and many factors that can affect cancer diagnosis and management. This study demonstrates that research into these factors can yield important information and knowledge that can impact access to care. Possible differences in access to care, or processes of care based on the type of PCP deserve further study.

Conflicts of Interests

The authors declare that there is no conflict of interest regarding the publication of this paper.

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