Relation between socioeconomic variables and surgical, systemic and radiation treatment in a cohort of patients with breast cancer in an urban Canadian centre

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Results from this project were presented as a poster presentation at the Canadian Surgery Forum conference, Toronto, Ont., Sept. 10, 2016.

Accepted Apr. 17, 2018; Published online Feb. 1, 2019

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DOI: 10.1503/cjs.009217

Background: Studies have shown an association between socioeconomic status and breast cancer treatment. We examined the relation between socioeconomic status and the treatment of breast cancer (surgical, systemic and radiation) in a universal health care system.

Method: Data from a single urban Canadian centre were collected for consecutive patients who received a diagnosis of breast cancer from January 2010 to December 2011. Variables included patient and disease factors, surgery type, systemic and radiation treatment, and breast reconstruction. Socioeconomic variables were obtained from 2006 Canadian census data. We used multivariable logistic regression to identify predictors of breast cancer treatment.

Results: A total of 721 patients were treated for breast cancer during the study period. Socioeconomic variables were not related to type of breast surgery for breast cancer. Age less than 50 years, having a first-degree relative with breast cancer and income status were predictors of breast reconstruction. Employment status was a consistent predictor of systemic and radiation treatment.

Conclusion: Employment consistently predicted systemic and radiation treatment, and age and income were predictors of breast reconstruction in a universal health care system. Further research is required to determine precisely how socioeconomic factors affect care and to minimize possible disparities in delivery of health care services.

Contexte : Des études ont montré un lien entre la situation socio-économique et le traitement du cancer du sein. Nous avons analysé ce lien entre la situation socio-économique et le traitement (chirurgie, chimiothérapie, radiothérapie) du cancer du sein dans un système de santé universel.

Méthodes : Les données d'un seul centre urbain canadien ont été compilées pour les patientes consécutives ayant reçu un diagnostic de cancer du sein entre janvier 2010 et décembre 2011. Les variables incluaient des facteurs propres aux patientes et à la maladie, le type de chirurgie, la chimiothérapie, la radiothérapie et la reconstruction mammaire. Les variables socio-économiques proviennent des données du recensement canadien de 2006. Nous avons utilisé la régression logistique multivariée pour identifier les prédicteurs du traitement du cancer du sein.

Résultats : En tout, 721 patientes ont été traitées pour un cancer du sein durant la période de l'étude. Les variables socio-économiques n'ont pas influé sur le type de chirurgie mammaire pour cancer du sein. L'âge inférieur à 50 ans, un cancer du sein chez une parente au premier degré et le revenu ont été des prédicteurs de la reconstruction mammaire. La situation professionnelle a été un prédicteur fiable du traitement systémique et de la radiothérapie.

Conclusion : L'emploi a été un prédicteur fiable du traitement systémique et de la radiothérapie, et l'âge et le revenu ont été des prédicteurs de la reconstruction mammaire, dans un système de santé universel. Il faudra approfondir la recherche pour déterminer plus précisément l'influence des facteurs socio-économiques sur les soins et pour réduire les possibles disparités dans leur prestation.

Breast cancer is the most commonly diagnosed cancer and the second-leading cause of cancer mortality in North American women.[1] Breast cancer is treated with a multidisciplinary approach involving surgery, radiation, chemotherapy and antihormonal treatments. It is a highly curable type of cancer if diagnosed early.

There is evidence that nonbiological factors may affect the presentation, diagnosis, treatment and outcome of breast cancer in women. Many studies have shown a positive relation between higher socioeconomic status and improved breast cancer survival in the United States,[2–5] the United Kingdom,[6] the Netherlands,[7] Australia[8] and Canada.[9–12] In addition, compared to patients of higher socioeconomic status, those of lower socioeconomic status were found to be less often in screening programs,[13–15] to receive adjuvant chemoradiation less often[16–18] and to receive the diagnosis of breast cancer at a later stage.[19] Conversely, Gorey and colleagues[20,21] compared 2 areas in Canada and 2 areas in the US and found a positive association between socioeconomic status and breast cancer survival in Hawaii and Iowa but not in Manitoba and Ontario. They implicated universal health coverage in Canada in their discussion to explain this result. Regionally, socioeconomic status was found to have an impact on overall health and longevity in a study in Hamilton, Ontario.[22] The incidence of breast cancer in the inner city and urban core was lower than in the more affluent suburban areas, where socioeconomic status was higher, but rates of breast cancer mortality were higher in the inner city.[23]

Breast reconstruction is available for patients undergoing mastectomy and is offered in an immediate or delayed fashion. Several studies showed that reconstruction was more likely to be chosen by women who were younger and white and who resided in an urban setting where there was better access to plastic surgeons.[24–26] Higher socioeconomic status has also been reported to be associated with a higher rate of breast reconstruction following mastectomy.[27] However, a report from Nova Scotia suggested that this might not be the case in Canada.[28]

The current study aimed to assess the relation between socioeconomic status, surgical and nonsurgical treatment of breast cancer, and the rate of breast reconstruction in an urban Canadian centre where care is publicly funded. The city of Hamilton is an amalgamated city with an older postindustrial core and more affluent suburbs. The potential value of such research is to identify any discrepancy in care that is associated with factors related to socioeconomic status. Universal health care is designed to be equal and accessible to everyone; however, there remains underlying inequality in access to health care services that is not fully understood. The findings from this study should aid in increasing awareness of determinants of health and consumption of health care services, and potentially foster changes in public policy, resource allocation and education.

Methods

Study cohort

Consecutive patients with a diagnosis of breast cancer (surgical and nonsurgical cases, including invasive cancer and ductal carcinoma in situ) living in Hamilton from January 2010 to December 2011 were included in this retrospective chart review. Cases were identified through health record queries of hospital databases and the Regional Cancer Centre database in Hamilton. Male patients, patients with a diagnosis of benign breast disease and patients who resided outside of Hamilton or had their primary treatment for breast cancer outside Hamilton were excluded. Local research ethics board approval was obtained for the study.

Data collection

Trained data abstractors reviewed hospital and cancer centre charts and extracted the following information: patient demographic characteristics (age at diagnosis, marital status, obesity [body mass index > 30]), employment status, smoking status, comorbidities, presence of first-degree relative with breast cancer, previous breast cancer, method of tumour identification (asymptomatic screening v. symptomatic investigation), location of primary imaging (Ontario Breast Screening Program, hospital or nonhospital clinic), disease stage at diagnosis, type of breast and nodal surgery (breast-conserving surgery or mastectomy, sentinel lymph node biopsy, axillary lymph node dissection or status on breast reconstruction), pathological features (tumour size, nodal status, receptor status), receipt of neoadjuvant or adjuvant therapy (chemotherapy including trastuzumab, radiation to breast, chest wall and nodes, and hormonal therapy) and, for nonsurgical cases, type of palliative treatment. Employment status was coded as employed versus not employed (i.e., unemployed, receiving disability support, homemaker or retired).

Census data

We linked patients' postal codes to 2006 Canadian census data to extract the following data: education level (proportion of census tract population who completed college or university), immigration status (proportion of census tract population who immigrated in the previous 5 yr) and average income of the census tract of patient residence. We divided income into quintiles.

Statistical analysis

For data analysis, we performed descriptive statistics. Categorical variables were reported as counts and percentages and were compared with the use of the χ^2 test or the Fisher

exact test. Continuous variables were reported as mean and standard deviation and were compared with the use of a *t* test for independent samples. We performed multivariable logistic regression analysis to identify patient, pathological and socioeconomic status variables that had an impact on surgical and nonsurgical treatment of breast cancer, and rate of breast reconstruction. Odds ratios (ORs) with 95% confidence intervals (CIs) and Hosmer–Lemeshow goodness-of-fit values are reported. We checked multicolinearity using correlation analysis. To maximize power, we performed univariable analysis and entered variables with a value less than 0.1 into the multivariable regression. Statistical significance was set at $p < 0.05$. Data analyses were performed with SPSS Statistical Software version 23.0 (IBM Corp.).

Results

A total of 721 cases met the inclusion criteria and were reviewed. Table 1 outlines the demographic and clinical characteristics of the study cohort. Breast-conserving surgery was performed in 393 patients (54.5%), nodal surgery in 545 (75.6%) and reconstruction after mastectomy in 67/276 (24.3%). Most patients presented with early-stage disease, but 176 (24.4%) presented with stage 3 or 4 disease. Almost half (337 [46.7%]) presented with screen-detected cancers. Income quintile, completion of college or university, and immigration status showed relatively similar distributions across the various categories.

Socioeconomic status versus surgical treatment of breast cancer

Table 2 outlines patient, disease and socioeconomic status factors for type of breast surgery received. Univariate analysis showed that mastectomy rates were significantly higher among women less than 51 years of age, those with stage 3 or 4 disease and those with a previous history of breast cancer. Mastectomy rates did not vary with other factors, such as higher education or income quintile. Of the 276 patients who underwent mastectomy, 67 (24.3%) had breast reconstruction (immediately in 40 cases [60%] and delayed in 27 [40%]). Breast reconstruction was done significantly more frequently in women who were younger, employed, healthier (fewer comorbidities) and more educated, had earlier-stage disease and lived in higher-income census tracts. Multivariable analysis showed that only early disease stage (stage 0–1: OR 22.75, 95% CI 12.8–40.5; stage 2: OR 9.44, 95% CI 5.3–16.6) and a previous history of breast cancer (OR 5.25, 95% CI 2.9–9.4) were independent predictors of breast-conserving surgery versus mastectomy (Table 3). Socioeconomic status factors were not significant predictors. After baseline differences were adjusted for, multivariable logistic regression analysis showed that patients younger than 50 years were 30 times more likely to have reconstruction, and those with a first-degree relative with breast cancer were twice as likely to have reconstruction. Furthermore, with each increase in income quintile, the odds of having breast reconstruction doubled for women aged 51–70 years (Table 3).

Table 4 outlines patient, disease and socioeconomic status factors compared with the type of nodal surgery. Of the 721 patients, 545 (75.6%) had nodal surgery, of whom 317 (58.2%) had sentinel lymph node biopsy and 228 (41.8%) had axillary lymph node dissection. Univariate analysis showed that age, having a first-degree relative with breast cancer and disease stage predicted sentinel lymph node biopsy; socioeconomic status factors (e.g., income quintile, higher education) were not significant. On multivariable analysis, predictors of not having nodal surgery were age more than 70 (OR 1.54, 95% CI 0.9–2.5), not employed (OR 1.85, 95% CI 1.1–3.1), nonsmoker (OR 1.97, 95% CI 1.3–3.1) and previous breast cancer (OR 3.66, 95% CI 2.2–6.2) (Table 3). Independent predictors of sentinel lymph node biopsy versus axillary lymph node dissection included no previous breast cancer (OR 3.00, 95% CI 1.3–7.0) and early stage disease (stage 0–1: OR 166.26, 95% CI 64.8–426.6; stage 2: OR 26.58, 95% CI 11.1–63.9).

Socioeconomic status versus systemic and radiation treatment for breast cancer

Table 5 outlines the demographic and socioeconomic status factors compared to systemic and radiation therapies. A total of 256 patients (35.5%) received chemotherapy, either in a neoadjuvant or an adjuvant setting, and 342 patients (87.0%) who had breast-conserving surgery received adjuvant radiation to the breast. Hormonal therapy was taken by 390 patients (72.8%) with positive receptor status. On multivariable analyses, predictors for chemotherapy included age less than 51 (OR 5.25, 95% CI 2.9–9.4), later-stage disease (stage 2: OR 7.50, 95% CI 4.40–13.1; stage 3–4: OR 36.64, 95% CI 19.5–68.6), being employed (OR 4.84, 95% CI 2.9–7.9) and being married (OR 1.90, 95% CI 1.2–3.0) (Table 3). Predictors of radiation included being employed (OR 3.06, 95% CI 1.1–8.3) and having no comorbidities (OR 9.34, 95% CI 1.2–71.2). Finally, predictors for hormonal therapy included being employed (OR 3.55, 95% CI 2.1–60.5) and later-stage disease (stage 2: OR 7.45, 95% CI 2.1–5.8; stage 3–4: OR 14.00, 95% CI 5.8–33.8). No relation was identified between socioeconomic status factors and these adjuvant therapies.

Discussion

There are numerous treatment options in the management of breast cancer. Recommendations are based on many

Table 1 (part 1 of 2). Demographic characteristics, disease factors and type of treatment among women with breast cancer

Variable	No. (%) of patients *n* = 721
Age at diagnosis, yr	
≤ 50	149 (20.7)
51–70	364 (50.5)
> 70	208 (28.8)
Obese (body mass index > 30)	
Yes	255 (35.4)
No	435 (60.3)
NOS	31 (4.3)
First-degree relative with breast cancer	
Yes	159 (22.0)
No	519 (72.0)
NOS	43 (6.0)
Smoking status	
Smoker/previous smoker	289 (40.1)
Never smoked	426 (59.1)
NOS	6 (0.8)
No. of comorbidities	
0	183 (25.4)
1–2	296 (41.0)
≥ 3	242 (33.6)
Previous breast cancer	87 (12.1)
Location of primary imaging	
Ontario Breast Screening Program	258 (35.8)
Hospital	314 (43.6)
Nonhospital clinic	140 (19.4)
NOS	9 (1.2)
Method of tumour identification	
Asymptomatic screening	337 (46.7)
Symptomatic investigation	383 (53.1)
NOS	1 (0.1)
Imaging in previous 2 yr	
Yes	317 (44.0)
No	313 (43.4)
NOS	91 (12.6)
Marital status	
Married	447 (62.0)
Not married	272 (37.7)
NOS	2 (0.3)
Employment status	
Employed	277 (38.4)
Not employed	430 (59.6)
NOS	14 (1.9)
Income quintile	
1 (lowest)	147 (20.4)
2	141 (19.6)
3	148 (20.5)
4	140 (19.4)
5 (highest)	139 (19.3)
NOS	6 (0.8)
% of census tract population who completed college or university	
> 40	304 (42.2)
31–40	237 (32.9)
< 31	177 (24.5)
NOS	3 (0.4)

Table 1 (part 2 of 2). Demographic characteristics, disease factors and type of treatment among women with breast cancer

Variable	No. (%) of patients *n* = 721
% of census tract population who immigrated in previous 5 yr	
> 30	199 (27.6)
21–30	224 (31.1)
< 21	295 (40.9)
NOS	3 (0.4)
Type of breast surgery	
Breast-conserving	393 (54.5)
Mastectomy	276 (38.3)
No surgery	52 (7.2)
Type of nodal surgery	
Sentinel lymph node biopsy	317 (44.0)
Axillary lymph node dissection*	228 (31.6)
No nodal surgery	176 (24.4)
Breast reconstruction after mastectomy (*n* = 276)	67 (24.3)
Tumour stage	
Tis	74 (10.3)
T1	291 (40.4)
T2	223 (30.9)
T3–T4	133 (18.4)
Nodal stage	
N0	365 (50.6)
N1–N3	228 (31.6)
NX	127 (17.6)
NOS	1 (0.1)
Disease stage (TNM)	
0–1	323 (44.8)
2	222 (30.8)
3–4	176 (24.4)
Estrogen receptor/progesterone receptor status† (*n* = 637)	
Positive	536 (84.1)
Negative	101 (15.8)
Tumour grade	
I	145 (20.1)
II	362 (50.2)
III	175 (24.3)
NOS	39 (5.4)
Histologic type† (*n* = 647)	
Ductal	529 (81.8)
Lobular‡	78 (12.0)
Other (e.g., mucinous, tubular)	32 (4.9)
NOS	8 (1.2)
Chemotherapy§	
Yes	256 (35.5)
No	461 (63.9)
NOS	4 (0.6)
Hormonal therapy§	
Yes	395 (54.8)
No	322 (44.7)
NOS	4 (0.6)
Radiation therapy	460 (63.8)
Recurrent breast cancer	50 (6.9)
No treatment	5 (0.7)
Neoadjuvant treatment	79 (11.0)

NOS = not otherwise specified.
*Includes cases with sentinel lymph node biopsy and axillary lymph node dissection, and axillary lymph node dissection alone
†For invasive cases only.
‡Lobular or mixed ductal/lobular.
§Includes neoadjuvant and adjuvant.

Table 2. Univariate analysis of demographic, clinical and socioeconomic factors versus surgical treatment of breast cancer and reconstruction following mastectomy

Variable	No. (%) of patients* Breast-conserving surgery *n* = 393	Mastectomy *n* = 276	*p* value	No. (%) of patients* Breast reconstruction *n* = 67	No breast reconstruction *n* = 209	*p* value
Age at diagnosis, yr						
< 51	68 (17.3)	76 (27.5)	0.004	37 (55.2)	39 (18.7)	< 0.001
51–70	219 (55.7)	126 (45.6)		29 (43.3)	97 (46.4)	
> 70	106 (27.0)	74 (26.8)		1 (1.5)	73 (34.9)	
Obese						
Yes	146 (38.6)	95 (35.7)	0.4	21 (31.8)	74 (37.0)	0.4
No	232 (61.4)	171 (64.3)		45 (68.2)	126 (63.0)	
Employment						
Employed	152 (39.6)	118 (43.1)	0.4	49 (75.4)	69 (33.0)	< 0.001
Not employed	232 (60.4)	156 (56.9)		16 (24.6)	140 (67.0)	
Marital status						
Married	256 (65.1)	172 (62.8)	0.5	44 (66.7)	128 (61.8)	0.6
Not married	137 (34.9)	102 (37.2)		22 (33.3)	79 (38.2)	
First-degree relative with breast cancer						
Yes	92 (24.5)	54 (21.0)	0.3	18 (40.9)	36 (18.6)	0.1
No	283 (75.5)	203 (79.0)		26 (59.1)	157 (81.3)	
Smoking status						
Smoker/previous smoker	152 (38.8)	117 (42.8)	0.3	31 (47.0)	86 (41.5)	0.4
Never smoked	240 (61.2)	156 (57.1)		35 (53.0)	121 (58.4)	
No. of comorbidities†						
0	105 (26.7)	71 (25.7)	0.8	30 (44.8)	41 (19.6)	< 0.001
≥ 1	288 (73.3)	205 (74.3)		37 (55.2)	168 (80.4)	
Income quintile						
1	78 (20.1)	60 (21.8)	0.2	9 (13.4)	51 (24.5)	0.01
2	66 (17.0)	63 (22.9)		9 (13.4)	54 (26.0)	
3	84 (21.6)	55 (20.0)		15 (22.4)	40 (19.2)	
4	77 (19.8)	55 (20.0)		19 (28.4)	36 (17.3)	
5	83 (21.4)	42 (15.3)		15 (22.4)	27 (13.0)	
% of census tract population who completed college or university						
> 40	159 (40.7)	121 (44.0)	0.07	39 (58.2)	82 (39.4)	0.02
31–40	143 (36.6)	78 (28.4)		16 (23.9)	62 (29.8)	
< 31	89 (22.8)	76 (27.6)		12 (17.9)	64 (30.8)	
% of census tract population who immigrated in previous 5 yr			> 0.99			
> 30	107 (27.4)	75 (27.3)		14 (20.9)	61 (29.3)	0.1
21–30	124 (31.7)	88 (32.0)		19 (28.4)	69 (33.2)	
< 21	160 (40.9)	112 (40.7)		34 (50.7)	78 (37.5)	
Previous breast cancer						
Yes	29 (7.4)	51 (18.5)	< 0.001	9 (13.4)	42 (20.1)	0.2
No	364 (92.6)	225 (81.5)		58 (86.6)	167 (79.9)	
Disease stage (TNM)						
0–1	241 (61.3)	80 (29.0)	< 0.001	30 (44.8)	50 (23.9)	0.004
2	130 (33.1)	83 (30.1)		17 (25.4)	66 (31.6)	
3–4	22 (5.6)	113 (40.9)		20 (29.8)	93 (44.5)	

*Numbers do not sum to total in all cases because of missing data.
†Includes chronic obstructive pulmonary disease, rheumatic disease, coronary artery disease, myocardial infarction, coronary heart failure, diabetes, kidney disease, major psychiatric illness, morbid obesity (body mass index > 40), other cancer diagnosis, osteoporosis, hypertension, hypercholesterolemia and neurodegenerative diseases (e.g., Parkinson's disease).

Table 3. Multivariable analyses exploring predictors of breast cancer treatment

Variable	OR (95% CI)
Predictors of breast-conserving surgery v. mastectomy (*n* = 591)	
No previous breast cancer	5.25 (2.9–9.4)
Stage 0–1 disease	22.75 (12.8–40.5)
Stage 2 disease	9.44 (5.3–16.6)
Stage 3–4 disease	Reference
Hosmer–Lemeshow *p* value = 0.7	
Predictors of breast reconstruction (*n* = 276)	
Age < 50 yr at diagnosis	30.3 (9.2–99.2)
Age 51–70 yr by income quintile	2.0 (1.5–2.8)
First-degree relative with breast cancer	2.7 (1.1–6.5)
Hosmer–Lemeshow *p* value = 0.6	
Predictors of no nodal surgery v. nodal surgery (*n* = 627)	
Age > 70 yr	1.54 (0.9–2.5)
Not employed	1.85 (1.1–3.1)
Nonsmoker	1.97 (1.3–3.1)
Previous breast cancer	3.66 (2.2–6.2)
Hosmer–Lemeshow *p* value = 0.9	
Predictors of SLNB v. ALND (*n* = 493)	
No previous breast cancer	3.00 (1.3–7.0)
Stage 0–1 disease	166.26 (64.8–426.6)
Stage 2 disease	26.58 (11.1–63.9)
Stage 3–4 disease	Reference
Hosmer–Lemeshow *p* value = 0.9	
Predictors of chemotherapy (*n* = 623)	
Age < 51 yr	5.25 (2.9–9.4)
Stage 0–1 disease	Reference
Stage 2 disease	7.50 (4.40–13.1)
Stage 3–4 disease	36.64 (19.5–68.6)
Employed	4.84 (2.9–7.9)
Married	1.90 (1.2–3.0)
Hosmer–Lemeshow *p* value = 0.7	
Predictors of radiation therapy for breast-conserving surgery cases (*n* = 347)	
Employed	3.06 (1.1–8.3)
No comorbidities	9.34 (1.2–71.2)
Hosmer–Lemeshow *p* value = 0.6	
Predictors of hormonal therapy for ER/PR-positive cases (*n* = 468)	
Employed	3.55 (2.1–60.5)
Stage 0–1 disease	Reference
Stage 2 disease	7.45–(2.1–5.8)
Stage 3–4 disease	14.00 (5.8–33.8)
Hosmer–Lemeshow *p* value = 0.2	

ALND = axillary lymph node dissection; CI = confidence interval; ER/PR = estrogen/progesterone receptor; OR = odds ratio; SLNB = sentinel lymph node biopsy.

potential factors: patient factors, tumour factors, local experience and guidelines. Many factors also can influence decisions that patients make. In our urban Canadian centre, we examined the relation between socioeconomic status and breast cancer treatment and found that socioeconomic status was related only to reconstruction rates after mastectomy and not to other surgical interventions. In addition, patients more than 70 years of age were less likely than younger patients to undergo axillary surgery, including sentinel node biopsy and axillary dissection. This might be explained by the findings from a randomized controlled trial that axillary surgery can be avoided in older women receiving hormonal therapy, with no adverse oncologic outcomes.[29]

A US study showed that patients in lower socioeconomic classes were less likely than those in higher socioeconomic classes to undergo breast-conserving surgery owing to larger tumour size at the time of diagnosis.[30] Such results were not observed in our study. This may be partially attributable to Canada's universal health coverage but also to an ongoing effort to make screening more accessible, especially for women in lower socioeconomic status neighbourhoods.[25,26] In the Hamilton region, a "Screen for Life" bus was initiated in 2012, and more than 600 patients were screened in its first year of operation. The program targeted neighbourhoods with low socioeconomic status and poor access to screening centres, and cultural groups less inclined to accept cancer screening.[31,32] Such programs have also been used in northern Ontario, where access to health care is limited, and in urban neighbourhoods with lower socioeconomic status.

International studies have shown that patients with lower socioeconomic status are less likely than those with higher socioeconomic status to receive adjuvant chemoradiation.[11,12,33] Most of the studies were conducted in 2-tier health care systems; however, a recent study from Ontario showed that socioeconomic status affected breast cancer treatment and outcomes in a universal health care system.[12] We also found that patients who were not employed (including homemakers and those who were unemployed, receiving disability support or retired) were less likely than employed patients to receive systemic and radiation treatment in a publicly funded health care system. The explanation for this is unclear, as systemic and radiation therapies are generally covered by public health insurance; there may be limitations in coverage of certain drugs, and there may be other, ancillary costs (such as transportation and costs related to side effects of treatment) associated with these therapies that discourages treatment. It also unknown whether these therapies are recommended but not accepted by patients, or whether different recommendations are made by oncologists based on employment status, as these details were not included in our data collection. A more detailed study focused on this issue would elucidate whether patients with low socioeconomic status are receiving fewer systemic and radiation therapies owing to access versus patient choice versus recommendation by the medical or radiation oncologist.

Interestingly, married patients were 1.9 times more likely to receive chemotherapy than unmarried patients, presumably owing to increased social support and social networks. A retrospective cohort study using the National

Table 4. Univariate analysis of patient demographic and socioeconomic factors versus nodal surgery

Variable	No. (%) of patients*			No. (%) of patients*		
	Nodal surgery *n* = 545	No nodal surgery *n* = 176	*p* value	Sentinel lymph node biopsy *n* = 317	Axillary lymph node dissection† *n* = 228	*p* value
Age at diagnosis, yr						
< 51	129 (23.7)	20 (11.4)	< 0.001	62 (19.6)	67 (29.4)	0.008
51–70	283 (51.9)	81 (46.0)		181 (57.1)	102 (44.7)	
> 70	133 (24.4)	75 (42.6)		74 (23.3)	59 (25.9)	
Obese						
Yes	206 (39.0)	49 (30.2)	0.04	117 (38.2)	89 (40.1)	0.7
No	322 (61.0)	113 (69.8)		189 (61.8)	133 (59.9)	
Employment						
Employed	233 (43.5)	44 (25.7)	< 0.001	133 (42.8)	100 (44.4)	0.7
Not employed	303 (56.5)	127 (74.3)		178 (57.2)	125 (55.6)	
Marital status						
Married	354 (65.2)	93 (52.8)	0.003	210 (66.7)	144 (63.2)	0.4
Not married	189 (34.8)	83 (47.2)		105 (33.3)	84 (36.8)	
First-degree relative with breast cancer						
Yes	120 (22.9)	39 (25.3)	0.5	80 (26.2)	40 (18.3)	0.03
No	404 (77.1)	115 (74.7)		225 (73.8)	179 (81.7)	
Smoking status						
Smoker/previous smoker	240 (44.3)	49 (28.3)	< 0.001	131 (41.6)	109 (48.0)	0.1
Never smoked	302 (55.7)	124 (71.7)		184 (58.4)	118 (52.0)	
No. of comorbidities						
0	149 (27.3)	34 (19.3)	0.03	83 (26.2)	66 (28.9)	0.48
≥ 1	396 (72.7)	142 (80.7)		234 (73.8)	162 (71.0)	
Income quintile						
1	112 (20.8)	35 (19.9)	0.9	54 (17.2)	58 (25.7)	0.2
2	110 (20.4)	31 (17.6)		65 (20.8)	45 (19.9)	
3	108 (20.0)	40 (22.7)		66 (21.1)	42 (18.6)	
4	106 (19.7)	34 (19.3)		65 (20.8)	41 (18.1)	
5	103 (19.1)	36 (20.4)		63 (20.1)	40 (17.7)	
% of census tract population who completed college or university						
> 40	230 (42.4)	74 (42.0)	> 0.99	135 (42.8)	95 (41.8)	0.2
31–40	179 (33.0)	58 (33.0)		111 (35.2)	68 (30.0)	
< 31	133 (24.5)	44 (25.0)		69 (21.9)	64 (28.2)	
% of census tract population who immigrated in previous 5 yr						
> 30	151 (27.8)	48 (27.3)	0.3	84 (26.7)	67 (29.5)	0.8
21–30	161 (29.7)	63 (35.8)		96 (30.5)	65 (28.6)	
< 21	230 (42.4)	65 (36.9)		135 (42.8)	95 (41.8)	
Previous breast cancer						
Yes	47 (8.6)	40 (22.7)	< 0.001	27 (8.5)	20 (8.8)	0.9
No	498 (91.4)	136 (77.3)		290 (91.5)	208 (91.2)	
Disease stage (TNM)						
0–1	233 (42.8)	90 (51.1)	0.005	205 (64.7)	28 (12.3)	< 0.001
2	185 (33.9)	37 (21.0)		105 (33.1)	80 (35.1)	
3–4	127 (23.3)	49 (27.8)		7 (2.2)	120 (52.6)	

*Numbers do not sum to total in all cases because of missing data.
†Includes cases with sentinel lymph node biopsy and axillary lymph node dissection, or axillary lymph node dissection alone.

Cancer Institute Surveillance, Epidemiology, and End Results (SEER) database[34] showed that, compared to married women, unmarried women were more likely to receive their breast cancer diagnosis at a later stage, were less likely to receive therapy and had higher mortality, which reaffirms the importance of social support for patients to complete diagnostic and therapeutic care.

Socioeconomic status has been shown to influence the frequency of breast reconstruction in the US, Australia, England and Denmark.[18–21,35] In 2008, the rate of

Table 5. Univariate analysis of patient demographic and socioeconomic factors versus neoadjuvant and adjuvant therapies

Variable	No. (%) of patients* Chemotherapy *n* = 256	No. (%) of patients* No chemotherapy *n* = 461	*p* value	No. (%) of patients* Radiation therapy† *n* = 342	No. (%) of patients* No radiation therapy *n* = 51	*p* value	No. (%) of patients Hormonal therapy‡ *n* = 390	No. (%) of patients No hormonal therapy *n* = 146	*p* value
Age at diagnosis, yr									
< 51	99 (38.7)	50 (10.8)	< 0.001	63 (18.)	5 (9.8)	< 0.001	89 (22.8)	16 (11.0)	< 0.001
51–70	135 (52.7)	228 (49.4)		199 (58.)	20 (39.2)		210 (53.8)	52 (35.6)	
> 70	22 (8.6)	183 (39.7)		80 (23.)	26 (51.0)		91 (23.3)	78 (53.4)	
Obese									
Yes	91 (36.2)	161 (37.0)	0.8	130 (39.)	16 (34.0)	0.49	140 (37.0)	51 (37.2)	> 0.99
No	160 (63.7)	274 (63.0)		201 (61.)	31 (66.0)		238 (63.0)	86 (62.8)	
Employment									
Employed	156 (61.7)	120 (26.7)	< 0.001	143 (43.)	9 (18.0)	0.001	169 (43.9)	27 (19.1)	< 0.001
Not employed	97 (38.3)	330 (73.3)		191 (57.)	41 (82.0)		216 (56.1)	114 (80.8)	
Marital status									
Married	185 (72.3)	259 (56.4)	< 0.001	228 (67.)	28 (4.9.)	0.1	242 (62.2)	83 (57.2)	0.3
Not married	71 (27.7)	200 (43.6)		114 (33.)	23 (45.1)		147 (37.8)	62 (42.8)	
First-degree relative with breast cancer									
Yes	47 (18.8)	111 (26.2)	0.03	79 (24.)	13 (31.7)	0.2	85 (22.8)	36 (27.5)	0.3
No	203 (81.2)	313 (73.8)		255 (76.)	28 (68.3)		287 (77.2)	95 (72.5)	
Smoking status									
Smoker/previous smoker	118 (46.6)	169 (36.9)	< 0.001	137 (40.)	15 (30.0)	0.2	178 (45.8)	50 (34.7)	0.02
Never smoked	135 (53.4)	289 (63.1)		205 (60.)	35 (70.0)		211 (54.2)	94 (65.3)	
No. of comorbidities									
0	93 (36.3)	90 (19.5)	< 0.001	100 (29.)	5 (9.8)	0.003	97 (24.9)	28 (19.2)	0.2
≥ 1	163 (63.7)	371 (80.5)		242 (71.)	46 (91.2)		293 (75.1)	118 (80.8)	
Income quintile									
1	49 (19.2)	98 (21.5)	0.2	67 (20.)	11 (21.6)	0.9	76 (19.6)	32 (22.4)	0.2
2	46 (18.0)	94 (20.6)		57 (17.)	9 (17.6)		69 (17.8)	36 (25.2)	
3	45 (17.6)	102 (22.4)		71 (21.)	13 (25.5)		85 (21.9)	29 (20.3)	
4	56 (22.0)	83 (18.2)		68 (20.)	9 (17.6)		80 (20.6)	23 (16.1)	
5	59 (23.1)	79 (17.3)		74 (22.)	9 (17.6)		78 (20.1)	23 (16.1)	
% of census tract population who completed college or university									
> 40	116 (45.5)	186 (40.5)	0.4	146 (43.)	13 (25.5)	0.05	101 (26.0)	49 (34.0)	0.01
31–40	82 (32.2)	154 (33.6)		118 (35.)	25 (49.0)		123 (31.6)	59 (41.0)	
< 31	57 (22.4)	119 (25.9)		76 (22.)	13 (25.5)		165 (42.4)	36 (25.0)	
% of census tract population who immigrated in previous 5 yr									
> 30	65 (25.5)	133 (29.0)	0.6	89 (26.)	18 (35.3)	0.1	101 (26.0)	43 (29.9)	0.6
21–30	83 (32.5)	140 (30.5)		105 (31.)	19 (37.2)		123 (31.6)	46 (31.9)	
< 21	107 (42.0)	186 (40.5)		146 (43.)	14 (27.4)		165 (42.4)	55 (38.2)	
Previous breast cancer									
Yes	22 (8.6)	64 (13.9)	0.04	26 (8.)	3 (5.9)	0.7	36 (9.2)	24 (16.4)	0.02
No	234 (91.4)	397 (86.1)		316 (92.)	48 (94.1)		354 (90.8)	122 (83.6)	
Disease stage (TNM)									
0–1	41 (16.0)	280 (60.7)	< 0.001	213 (62.)	28 (54.9)	0.3	121 (31.0)	96 (65.8)	< 0.001
2	89 (34.8)	131 (28.4)		112 (33.)	18 (35.3)		145 (37.2)	40 (27.4)	
3–4	126 (49.2)	50 (10.8)		17 (5.)	5 (9.8)		124 (31.8)	10 (6.8)	

*Numbers do not sum to total in all cases because of missing data.
†To breast and/or nodes in patients who had breast-conserving surgery.
‡In patients who were positive for estrogen/progesterone receptor.

immediate reconstruction was 11.7% in Ontario.[30] Hamilton is considered to have good access to plastic surgery, and the rate of immediate reconstruction in our cohort was 15%. We found a strong association between socioeconomic status and rate of breast reconstruction in our study cohort: the odds of breast reconstruction doubled with each increase in income quintile among women aged 51–70. Past studies have suggested that patients with lower socioeconomic status have more comorbidities,[36] which makes them less ideal candidates for tissue-based reconstruction. One study showed that the rate of complications following breast reconstruction was also higher in patients in the lowest income quintile.[37] Implant-based reconstruction can be a less morbid procedure than autologous reconstruction, but it requires multiple visits to the clinic and repeat surgery to exchange the expander to a permanent implant once the ideal size is reached. This may entail a financial burden in terms of prolonged time off work and travel costs, making it less attractive for women with lower socioeconomic status. Reconstruction after mastectomy has been associated with better quality of life.[38] Increased public awareness and policy change are needed to make this a more available option for patients of lower socioeconomic status.

Strengths and limitations

Our demographic and clinical data were obtained directly from chart review, which allowed for more accurate and detailed information, with minimal missing data (about 10%, less than that in socioeconomic status studies using amalgamated data[39,40]). Because of the regional nature of breast cancer management in our centre, the chart review allowed us to retrieve extensive and complete data. However, it was a retrospective review and does not have the potential advantages of a prospective, amalgamated database. We were unable to obtain individual patient information for income, education and immigration status but, rather, used the neighbourhood average from the census tract. Furthermore, we used 2006 census data, as the 2011 census was a short form that did not contain variables of interest for this study. However, it is unlikely that there was marked change in economic status within the few years from the census to the data collection period (2010–2011). If there were absolute changes in income, it is even less likely that these changes would have affected quintile distributions.

Conclusion

Despite universal health care funding, socioeconomic status appeared to affect breast cancer care in our Hamilton cohort in terms of neoadjuvant and adjuvant therapies, and breast reconstruction. Future directions include evaluation of socioeconomic status with the rate of screening and stage at diagnosis to see whether socioeconomic status has an impact before initiation of breast cancer treatment. It would also be interesting to evaluate whether there is any correlation between socioeconomic status, accessibility to a primary care physician, primary care practice models, and early breast cancer detection and diagnosis. Further research is required to more precisely determine how socioeconomic factors affect care, to identify such disparities and make all forms of breast cancer treatment more accessible to those with lower socioeconomic status.

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Funding: Funding was provided by a grant from McMaster Surgical Associates. The funding source played no role in the design, conduct or reporting of this study.

Competing interests: None declared.

Contributors: J. Li, S. Cornacchi, F. Farrokhyar, N. Johnston, S. Forbes, S. Reid and P. Lovrics designed the study. J. Li, S. Cornacchi, N. Johnston, N. Hodgson, S. Lovrics and K. Lucibello acquired the data, which J. Li, S. Cornacchi, F. Farrokhyar, S. Reid and P. Lovrics analyzed. J. Li, S. Cornacchi and P. Lovrics wrote the article, which all authors reviewed and approved for publication.

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