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ORIGINAL ARTICLE

A population-based study of ethnicity and breast cancer stage at diagnosis in Ontario

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ABSTRACT

Background

Breast cancer stage at diagnosis is an important predictor of survival. Our goal was to compare breast cancer stage at diagnosis (by American Joint Committee on Cancer criteria) in Chinese and South Asian women with stage at diagnosis in the remaining general population in Ontario.

Methods

We used the Ontario population-based cancer registry to identify all women diagnosed with breast cancer during 2005–2010, and we applied a validated surname algorithm to identify South Asian and Chinese women. We used logistic regression to compare, for Chinese or South Asian women and for the remaining general population, the frequency of diagnoses at stage II compared with stage I and stages II–IV compared with stage I.

Results

The registry search identified 1304 Chinese women, 705 South Asian women, and 39,287 women in the remaining general population. The Chinese and South Asian populations were younger than the remaining population (mean: 54, 57, and 61 years respectively). Adjusted for age, South Asian women were more often diagnosed with breast cancer at stage II than at stage I [odds ratio (OR): 1.28; 95% confidence interval (CI): 1.08 to 1.51] or at stages II-IV than at stage I (OR: 1.27; 95% CI: 1.08 to 1.48); Chinese women were less likely to be diagnosed at stage II than at stage I (OR: 0.82; 95% CI: 0.72 to 0.92) or at stages II-IV than at stage I (OR: 0.73; 95% CI: 0.65 to 0.82).

Conclusions

Breast cancers were diagnosed at a later stage in South Asian women and at an earlier stage in Chinese women than in the remaining population. A more detailed analysis of ethnocultural factors influencing breast screening uptake, retention, and care-seeking behavior might be needed to help inform and evaluate tailored health promotion activities.

KEY WORDS

Breast cancer, ethnicity, stage, South Asian ethnicity, Chinese ethnicity

1. BACKGROUND

In high-income countries, breast cancer mortality has been declining since the early 1990s because of a combination of breast cancer awareness, screening, and improvements in treatment[1–3]. In Canada, a country with universal access to health care and longstanding breast cancer awareness and advocacy programs, rates of participation in breast screening have plateaued and remain below the target of more than 70% for women 50–69 years of age[4].

Notwithstanding current debates about the value of organized screening mammography[3,5,6], the effects of breast awareness programs and screening, whether by mammography or clinical breast examination, or both, remain unclear for populations in which cancer myths, stigma, and taboos are prevalent[7]. Since the early 2000s, significant efforts have been undertaken by public health units, principal cancer agencies, and researchers to identify populations who remain underserved, including those at risk of lesser access to or utilization of cancer services. Those priority populations include immigrants and ethnocultural minority communities[8–13]. Pilot programs have been implemented to improve breast cancer awareness and screening among immigrant and ethnocultural minority women in Ontario[14–22], but it remains unclear whether such initiatives are making an impact; current trends would suggest otherwise[4,12,15].

Reports from the United Kingdom and North America suggest that women from minority groups are among the least likely to participate in cancer screening and might experience worse survival[8–12,23–27]. In the United States, most studies have compared breast cancer screening uptake and clinical outcomes for black, Hispanic, and non-Hispanic white women[28–30]. When reported, data for heterogeneous Asian populations are often grouped together, for example "Asian–Pacific Islander" in the United States or "Asian," categories that do not distinguish between East, Southeast, and South Asian (SA) ethnicities[31]. Broad classifications of ethnocultural populations could potentially mask important differences in health beliefs, practices, and clinical outcomes[26]. Community-based social science research also describes sociocultural barriers to seeking care for a breast or gynecologic symptom, particularly among SA women[13,22,32–34]. Migration or ethnocultural minority status alone might not be good predictors of care-seeking or cancer screening behavior, and the extent to which such factors might affect stage at diagnosis or clinical outcomes is not clear.

Ontario has a population estimated in 2014 to be 13,678,700[35], of which 29.2% are foreign-born[36]. Most immigrants are from China and South Asia (including India, Pakistan, Sri Lanka, and Bangladesh)[36]. In Canada, cancer survival rates are comparable to those the United Kingdom, Australia, and European countries with similar health systems[37]; coverage by primary care providers (particularly in urban communities in which most newcomers and immigrants settle) is adequate[9,12,21]; female family practitioners and ethnic minority doctors constitute a high proportion of physicians[38]; and information on breast cancer screening is provided in multiple languages—and yet screening uptake remains lowest in neighbourhoods with the highest proportion of ethnic minority and immigrant women, particularly those from South Asia[9,12].

Chinese-Canadian communities were among the first of Canada's ethnocultural groups to be offered tailored health promotion information on breast cancer[16,20,39,40], but whether those initiatives are improving cancer outcomes remains unclear. More detailed data about ethnicity and immigration status would help to inform health policy, to target and tailor ethnoculturally appropriate health promotion initiatives, and to track the resulting clinical effects. Examining the association between ethnicity and stage at diagnosis is an important step in understanding cancer outcomes.

We set out to describe and compare breast cancer stage at diagnosis in Chinese and SA women and in the remaining general population in Ontario.

2. METHODS

2.1 Data Sources

Our study used population-based administrative health care databases in Ontario. The Ontario Cancer Registry is a passive registry that includes incident cancer cases and patients who have died of cancer (except nonmelanoma skin cancer) since 1964[41]. Cancer Care Ontario collects stage data based on the staging criteria of the American Joint Committee on Cancer or the Collaborative Stage initiative[42]. For cases with more than one valid stage value, a resolved "best stage" is derived based on a pre-specified algorithm. To summarize the procedure for selecting best stage, the algorithm chooses collaborative stage if available; otherwise, the stage group supplied by the regional cancer centre at which treatment occurred is used, if available.

The Ontario Health Insurance Plan pays physician claims based on fee-for-service billing. The Ontario Breast Screening Program is the province's public, organized screening program for eligible women 50–74 years of age[43]. Breast cancer screening for women outside of the specified age range (opportunistic screening) is also free for women in Ontario. The Discharge Abstract Database of the Canadian Institute for Health Information contains information about inpatient hospitalizations, and the National Ambulatory Care Reporting System includes data on emergency room visits and same-day outpatient surgery. These datasets were linked using unique encoded identifiers and analyzed at the Institute for Clinical Evaluative Sciences. We used the previously validated Ontario Diabetes Database[44] to examine physician-diagnosed diabetes, and we obtained vital statistics from the Registered Persons Database.

2.2 Study Design and Population

Our retrospective population-based cross-sectional study of women with breast cancer compared breast cancer stage at diagnosis in three mutually exclusive groups: Chinese women, SA women, and the remaining general population. That is, "general population" is defined here as women with breast cancer in Ontario who were not identified as either Chinese or SA.

The study population consisted of women diagnosed with incident breast cancer (ICD-9 code: 174) between January 1, 2005, and December 31, 2010, based on records in the Ontario Cancer Registry. Women with *in situ* breast cancer and those not eligible for Ontario Health Insurance Plan coverage in the year before the breast cancer diagnosis were excluded. The analysis included only women for whom stage information was available. Stage data from an Ontario regional cancer centre was available for 75% of the women diagnosed during 2005–2006. From 2007 onward, valid stage information was available for more than 90% of the women, and from 2010 onward, collaborative stage data were available for all women with stage information.

Ontario administrative health care data do not include ethnicity, and so we applied two previously validated surname lists to identify women of SA and

Chinese ethnicity[45]. The positive predictive value was 89.3% for the SA list and 91.9% for the Chinese list. To maximize positive predictive value, surnames that were not unique to the ethnic origins of interest were excluded. Our lists therefore had lower sensitivities (50.4% for the SA list and 80.2% for the Chinese list)[45].

Baseline characteristics at the time of breast cancer diagnosis included age, place of residence, and socioeconomic status (which was described using the average neighbourhood household income quintile based on postal code linked to census data)[46]. History of cancer before the diagnosed breast cancer was obtained from the Ontario Cancer Registry, and history of diabetes, from the Ontario Diabetes Database. For each woman in the cohort, comorbidity was described using the weighted John Hopkins Aggregated Diagnosis Group score in the 2 years before the breast cancer diagnosis[47] and the score for the Charlson comorbidity index in the 5 years before the breast cancer diagnosis (excluding the cancer variables from the Charlson comorbidity index)[48]. Contact with the health care system was assessed by examining the number of visits to a family or general practitioner in the 2 years before the breast cancer diagnosis.

To evaluate prior breast cancer screening behaviour, we used data from Ontario Breast Screening Program and fee codes for bilateral mammography from the Ontario Health Insurance Plan to locate screening mammograms in the period from 3 years to 60 days before the cancer diagnosis date.

2.3 Statistical Analysis

Using logistic regression for the primary analyses of breast cancer stage at diagnosis (stage II vs. stage I and stages II-IV vs. stage I), we compared SA women and Chinese women with the remaining general population of women diagnosed with breast cancer in Ontario. Unadjusted analyses and analyses adjusted for age (<50, 50–69, and ≥70 years of age) were conducted.

2.4 Sensitivity Analyses

Because the rate of diabetes is higher in the SA population than in the general or Chinese population in Ontario[49], and because diabetes is associated with a lower breast cancer screening rate[50], we used a model to further examine the interaction of ethnicity and diabetes and to explore whether diabetes was an effect modifier. All analyses were performed using the SAS software application (version 9.3: SAS Institute, Cary, NC, U.S.A.).

2.5 Ethics Approval

The research ethics board of Sunnybrook Health Sciences Centre approved the study.

3. RESULTS

Our cohort included 45,075 women with breast cancer from the general Ontario population. Within that cohort, 1543 women were identified as Chinese, and 798 as SA. The analyses included 41,296 women for whom stage data were available (Figure 1).

Table I shows baseline patient characteristics, including age, income, residence, primary care visits, comorbidity index, and prior screening mammography for the identified cohort. Compared with women from the remaining general population, Chinese and SA women were more likely to be less than 50 years of age at diagnosis with breast cancer ($p < 0.001$). More than 60% of the Chinese and SA women had been living in the province of Ontario for more than 15 years. Only 7.4% of Chinese and 10.5% of SA women had resided in Ontario for fewer than 5 years (data not shown).

More than 98% of the women in all groups had made a primary care visit in the 24 months preceding their diagnosis. Compared with the remaining general population, the SA and Chinese groups had made more visits in the preceding 24 months, and in both ethnocultural groups, more women than the provincial average had seen a primary care provider in the preceding 24 months. Compared with the Chinese women, the SA women had made significantly more primary care visits ($p < 0.001$). Diabetes was more common in SA women (23.5%) than in Chinese women (14.4%) or in the remaining general population (14.8%, $p < 0.001$).

Compared with the remaining general population, fewer SA women had a history of breast screening in the period from 3 years to 60 days before their diagnosis (48.9% vs. 54.9%, $p = 0.002$). Prior breast screening was not significantly different between Chinese women and the remaining general population ($p = 0.079$).

Figure 2 shows stage at diagnosis for the three groups of women. Unadjusted and adjusted for age, SA women were diagnosed at a more advanced stage than were women in the remaining general population: The adjusted odds ratio (OR) for stage II compared with stage I breast cancer was 1.28 [95% confidence interval (CI): 1.08 to 1.51; Table II]. The adjusted OR for higher (II–IV) compared with lower (I) stage was 1.27 (95% CI: 1.08 to 1.48) for SA women compared with women in the remaining general population. Compared with women in the remaining general population, Chinese women were less likely to be diagnosed at stage II (OR for II vs. I: 0.82; 95% CI: 0.72 to 0.92) and at a higher stage (OR for II–IV vs. I: 0.73; 95% CI: 0.65 to 0.82). The results were similar when the model was adjusted for diabetes (data not shown).

4. DISCUSSION

Compared with the general population of women diagnosed with breast cancer in Ontario, SA women

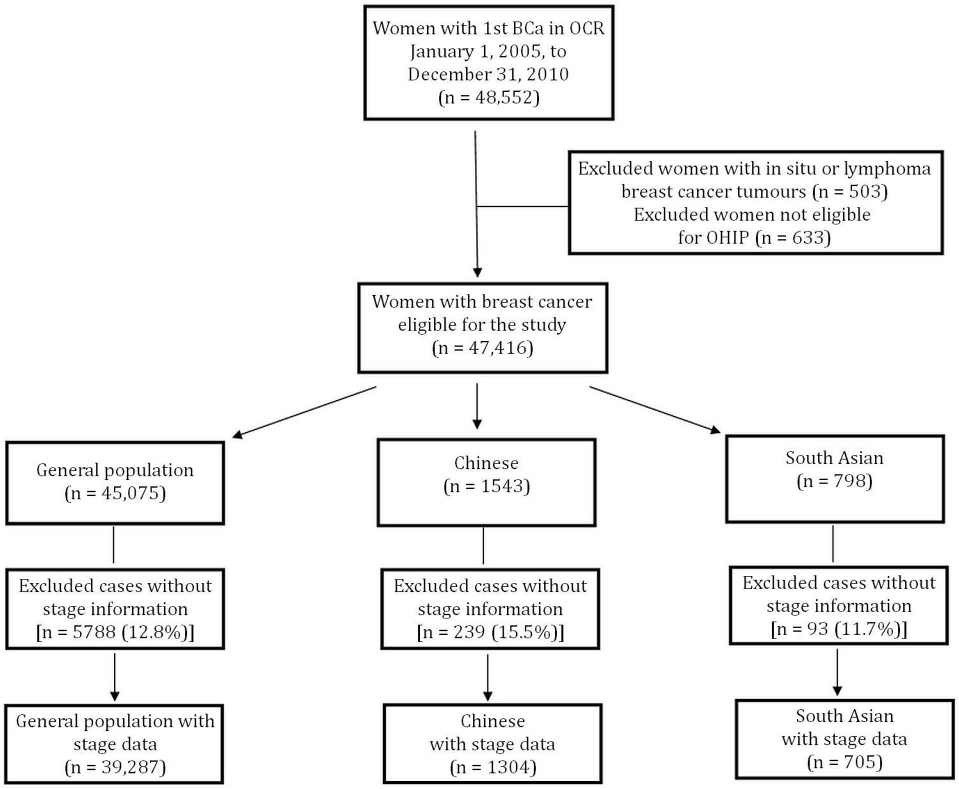

FIGURE 1 Study population. OCR *= Ontario Cancer Registry;* OHIP *= Ontario Health Insurance Plan.*

were more likely to be diagnosed at a later stage, and Chinese women were less likely to be diagnosed at a later stage. Those findings suggest important differences across ethnocultural groups that could have an effect on survival.

Population-based studies in the United States and the United Kingdom have described disparities in breast cancer stage and survival associated with race, ethnicity, socioeconomic status, and immigration[23,26,28–31]. The literature on breast cancer disparities in the United States has focused mainly on African American and non-Hispanic white women[29,30]. Much has been written on the possible causes of ethnocultural disparities in clinical outcomes, including differences along each part of the clinical continuum: screening, diagnosis, treatment, and follow-up care. Although some evidence suggests underutilization of cancer services and lower rates of treatment completion and follow-up, results are inconsistent when adjusted for insurance and other factors[27–30].

Although SA populations in the United States, the United Kingdom, and Canada are very large and heterogeneous, few studies have reported on cancer disparities in their communities. Gomez *et al.*[26] reported on breast cancer mortality among U.S.-born and foreign-born women from 6 Asian ethnocultural subgroups. With the exception of Japanese-born women, survival was poorer for all foreign-born Asian women compared with the reference group of U.S.-born Japanese women and their ethno-specific U.S.-born counterparts. The authors suggest that acculturation might partly explain the differences in breast cancer survival between U.S.- and foreign-born Asian women, and highlights the need for more social science research on cultural values relevant to health behaviours.

Several population-based studies in the United Kingdom, a country whose health insurance coverage and cancer care system are comparable to those in Canada, revealed particularly low rates of breast, cervical, and colorectal cancer screening among women of SA ancestry[24,27,51]. Szczepura and colleagues[23] compared breast and colorectal cancer screening patterns over time for 5 SA ethnic groups and “non-Asians.” In multivariate analysis, ethnicity was the major factor in screening uptake. Compared with their non-Asian counterparts, the SA groups showed significantly lower breast and colorectal screening rates. Overall uptake increased with successive rounds of invitations, and breast screening disparities appeared to decline over time (adjusted for age and deprivation); however, compared with non-Asian women, all groups, excepting Hindu–Gujarati women, underwent significantly less breast cancer screening. Although the degree of deprivation (assessed using the Carstairs Index) was associated with uptake in all groups, the strength

TABLE I Characteristics of patients with breast cancer in Ontario, 2005–2010

Variable	*Population group*		
	General	*Chinese*	*South Asian*
Patients (*n*)	39,287	1304	705
Mean age (years)	61.0±13.7	54.4±12.8[a]	56.8±13.0[a]
Age category [*n* (%)][a]			
<50 Years	8719 (22.2)	541 (41.5)	208 (29.5)
50–69 Years	19,491 (49.6)	575 (44.1)	384 (54.5)
≥70 Years	11,077 (28.2)	188 (14.4)	113 (16.0)
Income quintile [*n* (%)]			
1 (lowest)	6858 (17.5)	230 (17.6)	135 (19.1)
2	7464 (19.0)	287 (22.0)[b]	131 (18.6)
3	7641 (19.4)	263 (20.2)	177 (25.1)[a]
4	8338 (21.2)	286 (21.9)	135 (19.1)
5 (highest)	8856 (22.5)	233 (17.9)[a]	127 (18.0)[b]
Mean primary care visits (*n*)	13.7±12.7	14.3±10.6	16.3±12.6[a]
At least 1 visit	38,539 (98.1)	1292 (99.1)[b]	698 (99.0)
Prior screening mammography [*n* (%)]	21,568 (54.9)	748 (57.4)	345 (48.9)[b]
Prior cancer [*n* (%)]	2089 (5.3)	36 (2.8)[a]	19 (2.7)[b]
Diabetes [*n* (%)]	5812 (14.8)	188 (14.4)	166 (23.5)[a]
Mean weighted ADG	13.1±10.5	12.4±10.4[b]	13.7±10.3
CCI score [*n* (%)][a]			
Missing	10,253 (26.1)	617 (47.3)	251 (35.6)
0	23,609 (60.1)	607 (46.5)	378 (53.6)
1	3562 (9.1)	59 (4.5)	54 (7.7)
≥2	1863 (4.7)	21 (1.6)	22 (3.1)

[a] Compared with the remaining general population, statistically significant at $p < 0.001$.

[b] Compared with the remaining general population, statistically significant at $p < 0.05$.

ADG = aggregated diagnosis group; CCI = Charlson comorbidity index.

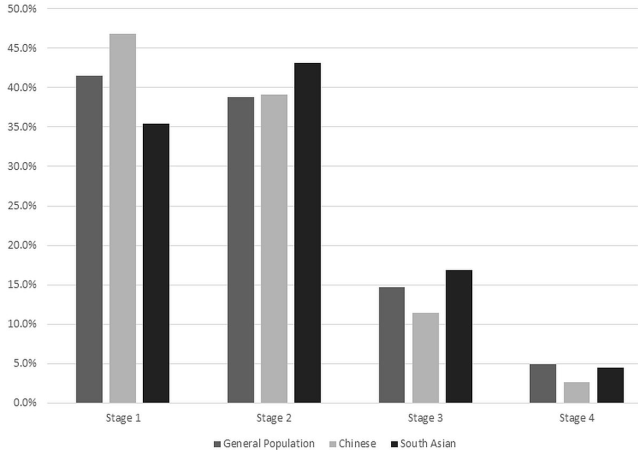

FIGURE 2 *Breast cancer stage distribution by ethnicity in Ontario.*

of the association was less for the SA than for the non-Asian group. The authors concluded that the low breast and colorectal screening rates in the study's SA population were not explained by differences in age, sex, or socioeconomic status.

Glazier and colleagues[9] applied spatial and epidemiologic mapping techniques to health administrative databases and census tract data in the Greater Toronto Area to describe mammography use by neighbourhood, according to high and low categories of income and immigration, and found that South Asians were more likely to reside in regions with the lowest screening utilization. Lofters *et al.*[12] later reported that the SA population in Ontario shows the lowest utilization of breast, cervical, and colorectal cancer screening. Our research also shows lower rates of screening in SA women.

Women from South Asia might not be exposed to health promotion dealing with preventive practices or to breast health education in particular. Moreover, cultural values, fears and stigma with respect to cancer could pose significant barriers to care-seeking for a breast problem and to participation in cancer screening after migration to countries with such programs[13,21,22,26,32]. Community-based programs that emphasize the value of maintaining individual health in the interests of the whole family and that capitalize on collectivist decision-making and goal orientation can be particularly useful for successful

TABLE II Odds ratios for more advanced stage at diagnosis in Chinese and South Asian populations than in the remaining general population

Population comparison	*Logistic regression*							
	Stages II–IV vs. I				*Stage II vs. I*			
	Unadjusted		*Adjusted*[a]		*Unadjusted*		*Adjusted*[a]	
	OR	*95% CI*	*OR*	*95% CI*	*OR*	*95% CI*	*OR*	*95% CI*
Chinese vs. general	0.80	0.72 to 0.90	0.73	0.65 to 0.82	0.89	0.79 to 1.01	0.82	0.72 to 0.92
South Asian vs. general	1.29	1.10 to 1.51	1.27	1.08 to 1.48	1.30	1.10 to 1.54	1.28	1.08 to 1.51

[a] Adjusted for the age categories <50, 50–69, ≥70.
OR = odds ratio; CI = confidence interval.

health promotion in certain ethnocultural groups. In Ontario, some Chinese and other ethnocultural community agencies, in collaboration with cancer agencies and public health and primary care groups have been very active in that regard, offering workshops, sociocultural tailoring of health promotion materials, and use of existing social advocacy platforms to encourage healthy lifestyles, including cancer screening[13,20–22,40,52].

The strengths of our study include the large number of women in the Ontario dataset, the diversity of which is reflected in the numbers of Chinese and SA women. Cancer Care Ontario provides stewardship for cancer care in the province, including the development of programs in evidence-based care, clinical practice guidelines, and regional “scorecards” that monitor performance indicators and targets for breast, cervical, and colorectal screening programs. The scorecards include synoptic reporting and data collection with centralized quality assurance and oversight. As in the rest of Canada, Ontario’s publicly-funded health insurance program covers all costs related to breast cancer screening, diagnostic interventions, surgery, radiotherapy, and intravenous chemotherapy; data capture is therefore complete for the entire population.

Our study has several important limitations. The surname algorithm used in the analysis has a positive predictive value of 89.3% for the SA list and 91.9% for the Chinese list[45]; however, our SA surname list purposively excluded many Muslim names that are also common to Arab populations of the Middle East and North Africa, as well as to other non-SA populations. Thus, the achieved sensitivity was lower: 50.4% for the SA list compared with 80.2% for the Chinese list. The resulting dataset therefore likely excluded many women from Bangladesh and Pakistan, and many Muslim women from other SA countries. Given the evidence from other jurisdictions, which suggests particularly low cancer screening uptake among Muslim women[23,53], the disparities reported in our study could have been underestimated. A past history of breast screening might not reflect the most recent screening behaviour, and we were not able to determine whether the index breast cancer diagnosis was detected by screening or because of a breast symptom. Lastly, although stage at diagnosis is a well-established predictor for breast cancer recurrence and survival, differences in other factors that could potentially affect clinical outcomes from breast cancer, including choice of and adherence to treatment protocols, were not analyzed in the present study.

5. CONCLUSIONS

Our study found that ethnicity was associated with breast cancer stage at diagnosis. Compared with Chinese women or the remaining general population in Ontario, SA women had more advanced disease at diagnosis. Our results suggest that we might be observing improvements in access to and utilization of breast cancer services within the Chinese communities of Ontario. Hopefully, other historically underserved ethnocultural minority populations living in Ontario—notably SA women—might soon benefit from carefully developed health promotion and access programs currently in progress. More detailed analyses of ethnocultural factors influencing breast screening uptake, retention, and care-seeking behavior are needed to help inform and evaluate tailored health promotion activities.

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results, analysis, opinions, and conclusions reported in this paper are those of the authors and are independent from the funding sources, ICES and CCO.

7. CONFLICT OF INTEREST DISCLOSURES

We have read and understood *Current Oncology*'s policy on disclosing conflicts of interest, and we declare that we have none.

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