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Wait times for surgical and adjuvant radiation treatment of breast cancer in Canada and the United States: Greater socioeconomic inequity in America

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Abstract

Purpose—The demand for cancer care has increased among aging North American populations as cancer treatment innovations have proliferated. Gaps between supply and demand may be growing. This study examined whether socioeconomic status has a differential effect on waits for surgical and adjuvant radiation treatment (RT) of breast cancer in Canada and the US.

Methods—Ontario and California cancer registries provided 929 and 984 breast cancer cases diagnosed between 1998 and 2000 in diverse urban and rural places. Residence-based socioeconomic data were taken from censuses. Cancer care variables were reliably abstracted from health records: stage, receipt of surgery and RT, and waits from diagnosis to initial and initial to adjuvant treatment. Median waits were compared within- and between-country with the non-parametric Mann-Whitney U-test. Categorically long, age-adjusted wait comparisons used the Mantel-Haenszel chi-square test.

Results—There were significant associations between lower socioeconomic status and longer surgical waits, lower access to adjuvant RT and to longer RT waits across diverse places in California. None were observed in Ontario. The two cohorts did not practically differ on access to surgery or on surgical waits. Compared with their counterparts in California, low-income Ontarians, particularly those in small urban places, gained greater access to RT, while high-income Americans had shorter waits for RT.

Conclusions—This historical study contextualized Canada's "waiting-list problems" with evidence on breast cancer care, where lower income Americans seemed to have waited as long as similar Canadians. Many more low-income Americans seemed to experience the longest wait of all for adjuvant care. They simply did not receive it. In contrast to stark American socioeconomic inequity, this study evidenced remarkable equity in Canadian breast cancer care.

Clinical and common wisdom converged in the 1990s to ignite scientific and political interest in Canada's "waiting-list problem."[1–3] Social and clinical forces also converged to spur particular interest in increased waits for cancer care. The demand for cancer care

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increased among an aging Canadian population as cancer treatment innovations proliferated, and it seemed that the gap between supply and demand may have been getting larger in Canada than in America.[4,5] However, the only previous study to test that hypothesis found no significant treatment delay differences among women diagnosed with breast cancer in 1988 in Washington state and the province of British Columbia.[6] No study has since compared evidence on cancer care delays in Canada and the United States (US).

Breast cancer care has been most studied in this field. For a number of reasons it seems a sentinel indicator of health care performance. The most common type of cancer among Canadian and American women, its prognosis is excellent with early diagnosis and timely access to the best treatments.[7,8] Moreover, surgical innovations and new adjuvant radiation therapies (RT) after both breast conserving surgery and mastectomy were advanced over the past 20 years,[4,9] so their timely access seems of legitimate clinical and policy concern. The possibility of socioeconomic status (SES)-treatment delay associations has been a related concern. Most Canadian studies have consistently found no relationship between SES and waits for breast cancer surgery or adjuvant RT.[10–12] The two Ontario-wide studies that did observe very modest inverse income-wait associations, however, confounded place and SES.[13,14] Such provincial analyses do not enable one to tell which of the province's diverse places with their possibly different health care service endowments, the observed income-wait gradients may best represent. Though less studied in the US, breast cancer care delays seem much more strongly associated with SES (being poor) and related social circumstances ranging from being under- or uninsured to being African American.[15–17] The only previous Canada-America comparative study of wait times for breast cancer care did not account for either SES or place.[6] This one will.

Consistent with a health insurance theory, shorter breast cancer survival has frequently been observed among women of lower SES in the US, with its multitiered health care system in which insurance inadequacy is prevalent. While a very modest to null association between SES and breast cancer survival has been observed in Canada where necessary medical care is universally covered.[18–20] Critical between-country comparisons have also been consistent with the health insurance explanation,[21,22] demonstrating particular Canadian survival advantages among residents of the lowest income areas.[18,19] Consistent with this well known international SES-breast cancer survival pattern, we hypothesized the following: (1) Within-country: Wait times for initial surgery and adjuvant RT would be associated with SES in the US (lower SES would wait longer), but not in Canada. (2) Between-country: Where differences exist, relatively high-income Americans would be advantaged, whereas, relatively low-income Canadians would be advantaged. This study also explored these hypotheses across diverse places: large metropolitan areas, smaller cities and rural areas.

Methods

A prospective study of 10-yr breast cancer survival in Ontario and California provided baseline data for this retrospective cohort of women ≥25 yr diagnosed between January 1, 1998 and December 31, 2000 (ICD-9 code = 174). It was originally powered to detect 15% survival rate differences between three socioeconomic strata within three types of places ($\alpha = .05$ [2-tailed] and power $(1 - \beta) = .80$). Total samples of 990 each were originally required for Ontario and California.[23] Provincial and state over-samples (1,050 each), stratified by place, were randomly selected from megalopolises with more than 5 million residents (greater metropolitan Toronto [GMT] and the San Francisco bay area [SFBA]), small cities with populations between 300,000 and 400,000 (Windsor-Essex county and Modesto-Stanislaus county), and small rural places with populations of less than 10,000 and population densities less than 400 people per km^2.[24–28] Key study variables that had been routinely coded by the California Cancer Registry ([CCR] summary stage, receipt of

surgery, RT and the dates required to calculate waits) were retrospectively abstracted in the same manner from hospital and physician office-based patient charts for the Ontario Cancer Registry (OCR) sample.[29,30] Only 53 of the patient charts were lost to retrospective review and these did not differ on key study variables (age, year of diagnosis, place and SES) from the 997 that were. Respectively, 22 and 33 cases of disease that had already metastasized by the time of diagnosis were excluded from the Ontario and California samples. Then, cases with missing data on key study variables were excluded. All had < 5% missing data, and such missing statuses were not associated with other key study variables. Chemotherapy (CT) dates were prevalently missing in the Ontario (11%) and California (18%) samples, so waits for adjuvant CT, probably not validly calculable, were not included in this study. Respective samples for analysis were 929 and 984 in Ontario and California. Analyses of 300 or more per group were able to test this study's hypotheses non-directionally ($\alpha = .05$ [2-tailed] and power $(1 - \beta) = .80$), whereas, comparisons of groups of 100 or more could as powerfully test directional or 1-tailed hypotheses.[23] Smaller subsample analyses were considered explorations.

The OCR and CCR surveille the most populace province and state, respectively, contributing to their national cancer surveillance systems with demonstrated accuracy. They both ascertain nearly all breast cancer cases (> 98%) with nearly perfect rates of microscopic confirmation and nearly nil rates of autopsy or death certificate only ascertainment.[31–36] The CCR has also incorporated additional physician follow back procedures to more completely capture stage and treatment data than is typical of most other US registries.[37] The OCR routinely receives hospital separation reports, pathology reports and reports from cancer treatment centers across the province. As for the OCR enhancement, an inter-rater reliability assessment of the first 150 patient health records was accomplished with three abstractors trained by an experienced cancer registrar. Agreements were extremely high for both discrete (κ coefficients ranged from .88 to .96) and continuous variables (agreement percentages were all greater than 98%).

Census-based SES measures (census tract proportion meeting a "low-income" criterion in Canada [census subdivisions in rural Canada] and "poverty" threshold in the US) of demonstrated predictive validity defined relative income quantiles.[18,19,38,39] These, respective, Statistics Canada and US Census Bureau, indices of economic impoverishment are conceptually similar. Both are based on annual household income from all sources and adjusted for household size. The Canadian low-income cutoff is more liberal though, approximately equal to 200% of the US poverty threshold.[18,24,25] But they seemed to achieve their analytic goal of similarly aggregating women with breast cancer into relative tertiles, that is, low- to high-income areas within countries. Ontario SES tertiles were defined as follows: high-income areas (low income prevalence 0.0% to 7.4% [median household income $73,200 CAD]), middle-income (7.5–14.1% [$51,300], and low-income (14.2–52.8% [$38,400]). California SES tertiles were defined as follows: high-income (0.8–6.0% [$75,900 USD]), middle-income (6.1–11.6% [$51,500], and low-income (11.7–62.0% [$34,000]).

Both the Ontario and California wait distributions were distinctly skewed. Many more patients experienced relatively short waits than long ones. So median waits (days) were compared within- and between-country with the non-parametric Mann-Whitney U-test. Long wait rates were then compared with age-adjusted rate ratios (RR). All rates were directly age-adjusted, using this study's combined Ontario-California population of cases as the standard. So, all of the rates within any table may be directly compared. Confidence intervals (95% CI) around RRs were based on the Mantel-Haenszel chi-square test[40,41] and, as some of this study's hypotheses were exploratory, 90% CIs were also reported in the text for findings that "approached statistical significance." The long wait criterion for surgery

was two months. Long wait criteria for adjuvant RT were six (node negative disease) or seven months (node positive disease) post-surgery if RT was preceded by CT, four months if it was not.[15,42–46] These previous studies suggested that such waits, comprised of systemic delays and necessary waiting (investigations, preparation for treatment and post-surgical recovery periods) may be associated with disease recurrence, metastases and shorter survival. This study's descriptive epidemiologic analyses will allow for the practical empirical planning of future multivariate analyses of the relationships between breast cancer care waits and survival in Canada and the United States.

Results

Surgery

Nearly every study participant received initial breast cancer-directed surgery (99%), and such access did not differ by country, place, or SES. Surgical interventions were typically lumpectomy for node negative disease and mastectomy for node positive disease on both sides of the border (not shown in Table 1). The associations of country, place and SES with surgical waits are displayed in Table 1. Overall, women with breast cancer in Ontario typically waited 3 days longer for surgery than did their counterparts in California, and they were also more likely to have experienced relatively long waits of 60 days or longer (RR = 1.39, 95% CI 1.00, 1.93). Though significantly different in a statistical sense, in a clinical-policy sense overall surgical waits seemed quite similar between Ontario and California: median waits of a little more than a week differed by only 3 days, long wait rates differed only slightly (7.9% and 5.7%), and nine of every ten patients received surgery within seven or six weeks, respectively.

Longer Canadian surgical waits seemed only applicable in large metropolitan areas, the SFBA being slightly advantaged compared with GMT. No between-country differences on median or long waits were observed in small cities or rural places. The residents of low-income areas in California experienced longer surgical delays than did the residents of high-income areas (typically 48 vs 35 days, 8.6% vs 4.2% waited 60 or more days, RR = 2.05, 95% CI 1.14, 3.69). No such income-surgical wait associations were observed in the province of Ontario as a whole or in GMT, Windsor or in the province's rural places. In contrast, nearly significant trends suggested that low-income may be associated with longer waits in diverse California places: SFBA (RR = 2.12, 90% CI 1.00, 4.49) and rural places (RR = 2.29, 90% CI 1.01, 5.20). These data also suggested between-country advantages among relatively high-income Americans in large metropolitan areas (RR = 2.19, 90% CI 1.06, 4.50) and among low-income Canadians in smaller cities (RR = 0.48, 90% CI 0.23, 0.99). Waiting times were similar across low- to high-income strata of rural places in Ontario and California.

Adjuvant Radiation Therapy

RT receipt—The associations of country, place and SES with rates of adjuvant RT are displayed in Table 2. For node negative breast cancer RT rates did not differ by place or income within Ontario and the aggregate between-country rates did not differ for either treatment group: surgery with adjuvant RT alone or surgery with adjuvant CT and RT. It did seem that within California smaller cities such as Modesto were disadvantaged. Whether (RR = 0.69, 95% CI 0.48, 0.99) or not (RR = 0.80, 95% CI 0.65, 0.98) they also received CT, patients there were significantly less likely to have received RT. Patients who resided in low-income areas of California seemed to experience similar risks of not receiving adjuvant RT, respectively, RR = 0.77 (90% CI 0.59, 1.00) and RR = 0.77 (95% CI 0.63, 0.94). Rates of adjuvant RT were greater among Ontario patients who resided in relatively low-income areas than among their California counterparts for both treatment groups: no CT (RR = 1.23,

95% CI 1.01, 1.39) and CT (RR = 1.39, 90% CI 1.03, 1.88). In fact, for both node negative and node positive breast cancer, RT rates among low-income patients in Ontario did not differ from those of high-income patients in California.

A similar pattern of findings was observed for node positive breast cancer, but the social gradients in California were steeper and the consequent between-country differences in low-income areas, indicative of Canadian advantage, were larger: no CT (RR = 3.18, 95% CI 1.41, 7.15) and CT (RR = 1.48, 95% CI 1.07, 2.04). Also, for node positive disease the aggregate between-country RT rates were greater in Ontario for both treatment groups, respectively, RR = 1.49 (95% CI 1.01, 2.19) and RR = 1.25 (95% CI 1.08, 1.45). Finally, the Canadian access advantage seemed particularly pronounced in small cities. Patients in Windsor, Ontario who did not receive CT, for example, were much more likely to receive adjuvant RT than were otherwise similar patients in Modesto, California: node negative (RR = 1.33, 95% CI 1.08, 1.63) and node positive (RR =2.53, 95% CI 1.16, 5.52) breast cancer. It may be that health care endowments in each country's, respective, large urban and small rural places are similarly adequate and inadequate.

RT waits—The associations of country and SES with waits for adjuvant RT are displayed in Table 3. The pattern of within- and between-country findings was similar for different places, so they were aggregated in the interest of statistical power. Also, in the interest of statistical power, two, rather than three, income groups are displayed. Waits for adjuvant RT were consistently not associated with income in Ontario, but they consistently were in California: node negative disease treated with surgery and adjuvant RT alone (RR = 2.76, 95% CI 1.08, 7.02), and node positive disease treated with surgery and adjuvant RT alone (RR = 9.46, 90% CI 1.31, 68.34) or with surgery and adjuvant CT and RT (RR = 1.98, 95% CI 1.09, 3.61). Finally, relatively high-income women with breast cancer in Ontario typically waited one to two months longer for adjuvant RT than their counterparts in California did. Between-country waits, however, did not typically differ significantly among relatively low-income patients.

Discussion

Study hypotheses about the differential effects of SES on initial surgical and adjuvant RT of breast cancer among adult women in diverse Ontario and California places were generally supported. Relatively low SES was consistently associated with longer surgical waits, lower access to adjuvant RT as well as to longer RT waits in California. No such associations were observed for any of the Ontario samples. In the between-country analyses, we found that, overall, the Canadian and American women with breast cancer did not differ much on their access to surgery and, in fact, they were also remarkably similar on their surgical waits. As compared with their international counterparts, however, relatively low-income Canadian women with breast cancer tended to gain greater access to adjuvant RT, while relatively high-income American women, who ultimately did gain access to such needed RT, tended to have shorter waits for it. America it seems may have "waiting list problems" of its own. However, because of America's multiple payer structure these may operate much less transparently than wait lists in single payer Canada. After all, could not non-treatment be fairly characterized the longest possible "wait?"

This study's findings differ substantially from those of the only other study that compared waits for breast cancer care in Canada and America.[6] Whereas, it found no significant differences between Canada and the United States in treatment delays, we observed a pattern of potentially important between-country differences. The earlier study tested only the main effect of country. It did not account for SES in any of its analyses. Consistent with previous Canada-US comparisons of breast cancer survival, we found that SES seems to act as an

effect modifier in breast cancer treatment analyses. That is, notable country by SES interactions were observed. Americans tended to be advantaged among the residents of relatively high-income areas (12 comparisons: six American and one Canadian advantage, five null), and Canadians tended to be advantaged among the residents of relatively low-income areas (5 Canadian and 1 American advantage). It seems that the potentially deleterious affects of low SES among women with breast cancer may be more effectively buffered by the universally accessible Canadian health care system. The American system of health care, on the other hand, may tend to compound the numerous advantages that those of means already enjoy.

Methodological Issues

This study could conceivably be methodologically limited in a number of ways. First, some of its findings that were based on relatively small samples were indeed exploratory. However, such explorations tended to be systematically replicated by more powerful tests. Approximately one-third each of this study's findings could be characterized as powerful ($\alpha < .05$ [2-tailed] and power $\geq .80$), marginally powerful ($\alpha < .05$ [1-tailed] and power $\geq .80$) and exploratory ($\alpha < .10$ [2-tailed] and power $< .80$). It is this study's overall pattern of findings, replicated across exploratory to more statistically powerful comparisons that seems compelling. This study could also be limited by prevalent outpatient treatment incompletion rates that have been identified as potentially problematic among North American cancer registries.[15,47] For a number of reasons we think that this study's pattern of findings is probably not potently confounded by this potential methodological problem. First, for this study's breast cancer care analyses, both the CCR and OCR were enhanced substantially beyond the North American norm. Second, the hospital-based surgical analyses were unlikely to have been affected at all. Third, missing data on RT was not prevalent and did not differ significantly between countries. And fourth, CT wait-related variables were identified as prevalently missing so such waits were not analyzed or reported. Again, we think that it is the overall pattern of within- and between-country findings across hospital-based and outpatient treatments that is compelling and robust. Finally, this retrospective cohort's long-term prospective survival analysis will not be completed for a few more years, though this baseline analysis suggests their likely clinical significance. In the mean time, Cancer Care Ontario, the agency responsible for the province's cancer services, seems aware of their policy significance. For example, through care planning efforts and increased investments in cancer treatment centers, RT equipment and personnel, typical RT waits that had been identified as too long in 1999 have already been shortened by more than 30%.[48,49]

Conclusions

This historical study contextualized Canada's "waiting-list problems" with evidence on breast cancer care, where relatively low-income Americans probably waited as long as or may even have waited longer than low-income Canadians for initial surgical and adjuvant RT. In stark contrast to American socioeconomic inequity across a number of diverse urban and rural contexts, this study evidenced remarkable equity in the surgical and adjuvant treatment of breast cancer in Canada during an era of increasing demand for such care.

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TABLE 1

Associations of Country, Place and Socioeconomic Status with Wait Time From Diagnosis to Initial Cancer-Directed Surgery in Ontario and California: Women with Non-Metastasized Breast Cancer Diagnosed Between 1998 and 2000

	Ontario							California							Ontario vs California			
	Days Waited			60+ Days Wait				Days Waited			60+ Days Wait							
	n	Mdn	90%kv	Rate	RR*	95%	CI†	n	Mdn	90%kv	Rate	RR*	95%	CI†	MDD	RR	95%	CI†
Province & State	929	11	49	.079				984	8	42	.057				3§	**1.39**	**1.00**	**1.93**
Places																		
GMT & SFBA	300	13	53	.095	1.00			327	8	43	.055	1.00			5§	**1.74**	**1.52**	**2.08**
Windsor & Modesto	324	11	48	.081	0.85	0.55	1.31	329	10	43	.068	1.23	0.63	2.40	1	1.19	0.71	1.99
Rural places	305	10	43	.068	0.72	0.45	1.14	328	7	41	.051	0.93	0.52	1.67	3	1.33	0.72	2.46
Income Groups																		
High	314	12	50	.084	1.00			326	7	35	.042	1.00			5§	**1.99**	**1.04**	**3.80**
Middle	305	14	51	.082	0.97	0.35	2.70	330	8	42	.045	1.07	0.73	1.57	6§	**1.81**	**1.09**	**3.00**
Low	310	10	49	.074	0.88	0.48	1.60	328	9	48*	.086	**2.05**	**1.14**	**3.69**	1	0.86	0.49	1.50
Income Groups Within Places																		
GMT & SFBA																		
High	143	9	49	.094	1.00			206	7	34	.043	1.00			2	**2.19**	**0.93**	**5.15‡**
Middle	83	17*	56	.102	1.08	0.37	3.14	81	11*	51	.062	1.43	0.45	4.52	6§	1.65	0.66	4.15
Low	74	11	57	.103	1.09	0.70	1.69	40	9	57	.090	**2.12**	**0.84**	**5.34‡**	2	1.14	0.15	8.69
Windsor & Modesto																		
High	122	12	45	.087	1.00			24	10	28	.042	1.00			2	2.09	0.73	12.53
Middle	92	14	59	.104	1.19	0.20	7.18	142	4	38	.045	1.08	0.51	2.30	10§	**2.30**	**1.00**	**5.29**
Low	110	8	43	.047	0.53	0.21	1.33	163	13	50	.097	2.33	0.70	7.74	−5§	**0.48**	**0.20**	**1.15‡**
Rural Places																		
High	49	13	49	.062	1.00			96	8	36	.034	1.00			5	1.82	0.33	9.91

	Ontario							California							Ontario vs California			
	Days Waited			60+ Days Wait				Days Waited			60+ Days Wait							
	n	Mdn	90%kv	Rate	RR*	95%	CI†	n	Mdn	90%kv	Rate	RR*	95%	CI†	MDD	RR	95%	CI†
Middle	130	10	36	.045	0.72	0.13	4.03	107	9	42	.055	1.62	0.56	4.70	1	0.82	0.28	2.41
Low	126	7	50	.094	1.51	0.49	4.63	125	6	42	.078	**2.29**	**0.85**	**6.19**‡	1	1.21	0.56	2.59

Notes. The pattern of within- and between-country findings was similar for node negative and node positive breast cancer, so they were aggregated in the interest of statistical power. The 10%kv or 10th percentile was immediate post-diagnostic hospitalization with surgery within 3 days, and this did not differ by country, place or SES so it is not displayed. n = number of incident breast cancer cases, Mdn = median, 90%kv = 90th percentile, RR = rate ratio, CI = confidence interval, MDD = median days difference, GMT = greater metropolitan Toronto and SFBA = San Francisco Bay Area. Bolded RRs and CIs are statistically significant.

*A rate ratio of 1.00 is the baseline.

†Confidence intervals are based on the Mantel-Haenszel chi-square test.

‡90% confidence interval does not include the null (P < 0.10).

§Median wait differed significantly from baseline (within-country) or between-countries: Mann-Whitney U-test, $P < 0.05$.

TABLE 2

Associations of Country, Place and Socioeconomic Status with Post-Surgical Radiation Therapy Rate in Ontario and California: Women with Non-Metastasized Breast Cancer Diagnosed Between 1998 and 2000

	Ontario					California					Ontario vs. California		
	n	Rate	RR*	95%	CI†	n	Rate	RR*	95%	CI†	RR	95%	CI†
Node Negative Breast Cancer													
Places Within Treatment Groups													
No chemo-therapy	478	.553				513	.514				1.08	0.96	1.22
GMT & SFBA	143	.529	1.00			162	.565	1.00			0.94	0.80	1.10
Windsor & Modesto	156	.603	1.14	0.93	1.40	179	.453	**0.80**	**0.65**	**0.98**	**1.33**	**1.08**	**1.63**
Rural places	179	.542	1.02	0.82	1.27	172	.506	0.89	0.73	1.09	1.07	0.88	1.30
Chemo-therapy	140	.650				180	.608				1.07	0.91	1.30
GMT & SFBA	55	.659	1.00			64	.643	1.00			1.02	0.79	1.31
Windsor & Modesto	50	.602	0.91	0.66	1.26	55	.447	**0.69**	**0.48**	**0.99**	1.35	0.91	2.01
Rural places	35	.690	1.05	0.78	1.41	57	.556	0.86	0.65	1.13	1.24	0.91	1.69
Income Within Treatment Groups													
No chemo-therapy	478	.553				513	.514				1.08	0.96	1.22
High	148	.503	1.00			169	.601	1.00			**0.84**	**0.69**	**1.02**‡
Middle	157	.554	1.10	0.90	1.34	165	.470	**0.78**	**0.64**	**0.96**	**1.18**	**0.96**	**1.43**‡
Low	173	.572	1.14	0.94	1.39	179	.464	**0.77**	**0.63**	**0.94**	**1.23**	**1.01**	**1.39**
Chemo-therapy	140	.650				180	.608				1.07	0.91	1.30
High	58	.638	1.00			62	.613	1.00			1.04	0.81	1.34
Middle	42	.714	1.12	0.85	1.47	70	.691	1.13	0.86	1.48	1.03	0.87	1.22
Low	40	.654	1.03	0.66	1.61	48	.472	**0.77**	**0.57**	**1.05**‡	**1.39**	**0.97**	**1.99**‡

	Ontario					California					Ontario vs. California		
	n	Rate	RR*	95%	CI†	n	Rate	RR*	95%	CI†	RR	95%	CI†
Node Positive Breast Cancer													
Places Within Treatment Groups													
No chemo-therapy	96	.440				77	.296				**1.49**	**1.01**	**2.19**
GMT & SFBA	31	.427	1.00			21	.432	1.00			0.99	0.69	1.42
Windsor & Modesto	32	.485	1.14	0.77	1.69	25	.192	**0.44**	**0.17**	**1.15**‡	**2.53**	**1.16**	**5.52**
Rural places	33	.454	1.06	0.73	1.54	31	.342	0.79	0.43	1.45	**1.33**	**0.79**	**2.23**‡
Chemo-therapy	204	.725				202	.582				**1.25**	**1.08**	**1.45**
GMT & SFBA	67	.734	1.00			73	.773	1.00			0.95	0.82	1.10
Windsor & Modesto	85	.735	1.00	0.93	1.07	67	.522	**0.67**	**0.52**	**0.87**	**1.41**	**1.09**	**1.82**
Rural places	52	.711	0.97	0.76	1.24	62	.538	**0.70**	**0.55**	**0.89**	**1.32**	**1.00**	**1.74**
Income Within Treatment Groups													
No chemo-therapy	96	.440				77	.296				**1.49**	**1.01**	**2.19**
High	29	.448	1.00			18	.555	1.00			0.81	0.46	1.44
Middle	33	.395	0.88	0.52	1.50	28	.328	**0.59**	**0.31**	**1.11**‡	1.20	0.66	2.19
Low	34	.441	0.98	0.43	2.24	31	.139	**0.25**	**0.10**	**0.62**	**3.18**	**1.41**	**7.15**
Chemo-therapy	204	.725				202	.582				**1.25**	**1.08**	**1.45**
High	75	.780	1.00			74	.647	1.00			**1.21**	**0.97**	**1.52**‡
Middle	68	.719	0.92	0.77	1.10	65	.640	0.99	0.90	1.09	1.12	0.92	1.37
Low	61	.693	0.89	0.75	1.06	63	.468	**0.72**	**0.54**	**0.96**	**1.48**	**1.07**	**2.04**

Notes. Receipt of chemotherapy did not differ by country, place or SES. Chemotherapy groups are displayed to distinguish and compare relatively homogeneous clinical groups: node negative or node positive breast cancer, respectively, typically treated with lumpectomy or mastectomy, followed by chemotherapy and radiation therapy or radiation therapy alone. n = number of incident breast cancer cases, RR = rate ratio, CI = confidence interval, GMT = greater metropolitan Toronto and SFBA = San Francisco Bay Area. Bolded RRs and CIs are statistically significant.

*A rate ratio of 1.00 is the baseline.

[†] Confidence intervals are based on the Mantel-Haenszel chi-square test.

[‡] 90% confidence interval does not include the null ($P < 0.10$).

TABLE 3

Associations of Country and Socioeconomic Status with Post-Surgical Wait Time to Radiation Therapy in Ontario and California: Women with Non-Metastasized Breast Cancer Diagnosed Between 1998 and 2000

	Ontario						California									
	Days Waited			Long Wait*			Days Waited			Long Wait*			Ontario vs California			
	n	Mdn	90%kv Rate	RR†	95%	CI ‡	n	Mdn	90%kv Rate	RR†	95%	CI ‡	MDD	RR	95%	CI†
Income Within Treatment Groups																
Node Negative Breast Cancer																
No chemo-therapy	257	82	139	.209				256	50	104	.056			32¶	**3.73**	**2.23**	**6.23**
High	117	83	127	.169	1.00			146	51	80	.041	1.00		32¶	**4.12**	**1.86**	**9.10**
Low	140	82	151	.221	1.31	0.77	2.22	110	49	110	.113	**2.76**	**1.08**	**7.02**	33¶	**1.96**	**1.05**	**3.66**
Chemo-therapy	93	165	270	.321				110	144	225	.225				21¶	1.43	0.92	2.21
High	52	151	259	.307	1.00			63	142	224	.192	1.00			9	1.60	0.88	2.92
Low	41	175	274	.363	1.18	0.67	2.07	47	147	243	.325	1.69	0.90	3.19	28	1.12	0.68	1.84
Node Positive Breast Cancer																
No chemo-therapy	41	92	165	.242				24	58	174	.066				34¶	**3.67**	**0.92**	**14.56§**
High	21	100	202	.230	1.00			13	55	73	.035	1.00			45	**6.57**	**0.70**	**61.73§**
Low	20	87	141	.333	1.45	0.55	3.81	11	58	174	.331	**9.46**	**0.73**	**122.58§**	29	1.01	0.87	1.17
Chemo-therapy	148	205	263	.394				125	164	246	.283				41¶	**1.39**	**0.99**	**1.94§**
High	73	209	274	.377	1.00			68	148	236	.170	1.00			61¶	**2.22**	**1.30**	**3.79**
Low	75	203	261	.407	1.08	0.82	1.43	57	169	249	.337	**1.98**	**1.09**	**3.61**	34	1.21	0.82	1.80

Notes. Receipt of chemotherapy did not differ by country, place or SES. Chemotherapy groups are displayed to distinguish and compare relatively homogeneous clinical groups: node negative or node positive breast cancer, respectively, typically treated with lumpectomy or mastectomy, followed by chemotherapy and radiation therapy or radiation therapy alone. n = number of incident breast cancer cases, Mdn = median, 90%kv = 90th percentile, RR = rate ratio, CI = confidence interval, MDD = median days difference. Bolded RRs and CIs are statistically significant.

*Long wait criterion was six (180 days [node negative disease]) or seven months (210 days [node positive disease]) if radiation therapy was preceded by chemotherapy, four months (120 days) if it was not.

†A rate ratio of 1.00 is the baseline.

[‡] Confidence intervals are based on the Mantel-Haenszel chi-square test.

[§] 90% confidence interval does not include the null ($P < 0.10$).

[¶] Median wait differed significantly from baseline (within-country) or between-countries: Mann-Whitney U-test, $P < 0.05$.