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An International Comparison of Breast Cancer Survival: Winnipeg, Manitoba and Des Moines, Iowa, Metropolitan Areas

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Abstract

PURPOSE—Extending previous Canadian-United States cancer survival comparisons in large metropolitan areas, this study compares breast cancer survival in smaller metropolitan areas: Winnipeg, Manitoba and Des Moines, Iowa.

METHODS—Manitoba and Iowa cancer registries, respectively, provided a total of 2,383 and 1,545 women with breast cancer (1984 to 1992, followed until December 31, 1997). Socioeconomic data for each person's residence at the time of diagnosis was taken from population censuses.

RESULTS—Socioeconomic status and breast cancer survival were directly associated in the US cohort, but not in the Canadian cohort. Compared with similar patients in Des Moines, residents of the lowest fifth of income areas in Winnipeg experienced a significant 5-year survival advantage (survival rate ratio [SRR] =1.14). In these lowest income areas, the Canadian survival advantage was larger among women aged 25 to 64 years (SRR = 1.23), and this was observed in the middle fifth of income areas among this younger cohort (SRR = 1.11). The Canadian survival advantage even seemed apparent in the poorest neighborhoods with relatively high representations of Aboriginal people (SRR = 1.16).

CONCLUSION—This study replicated the finding of advantaged Canadian cancer survival in smaller metropolitan areas that had been consistently observed in larger metropolitan areas. Canada's single payer health care system seems to offer similar advantages across a number of diverse urban contexts.

Keywords

Cancer; Survival; Socioeconomic Factors; Health Insurance; Canada; United States; Urban Population; Cohort Study; Epidemiologic Study; Effect Modifier

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INTRODUCTION

The past decade has seen significant changes in the way health care is financed and delivered in both Canada and the US. During this era of shifts to more conservative North American governments, heated political debates about health care and other welfare state program reforms have tended to focus on their costs. For example, while health care in the US largely shifted to management by for-profit health maintenance organizations, Canada aimed for greater health care efficiency by shifting fiscal responsibility from the federal government to the provinces. The obvious importance of health care costs notwithstanding, rational policy decisions probably cannot be made without similarly accepting the importance of the other side of cost-benefit equation benefits. Indeed, the observation of relatively beneficial or detrimental health care outcomes can provide empirical sentinels for the informing of policy decisions by epidemiologic and allied sciences.

Cancer survival is one such sentinel health care outcome. Because diverse types of cancers are, in aggregate, relatively common over the life course, and early diagnosis and access to the best available treatments can result in relatively good prognoses with a high quality of life among the majority of patients. Cancer survival is one good indicator of a health care system's effectiveness. Recent comparisons between Canada, with universal access to necessary medical health care, and the US, with a multitiered health care system in which insurance inadequacy is a prevalent problem, have been instructive in this regard (1). These international comparisons have consistently observed significantly shorter survival among those of lower socioeconomic status (SES) for nearly all of the most common types of cancer in the US, while a consistent pattern of no association between SES and survival has been observed in Canada (2–5). As for the critical between-country comparisons, consistent Canadian survival advantages have been observed for nearly all of the most common types of cancer among the residents of the lowest income areas and also among the residents of some lower middle-class and working-class neighborhoods. Moreover, the observed Canadian advantages have been largest among patients less than 65 years of age. The consistent pattern of findings of this series of retrospective cohorts arising from diverse contexts (Toronto, ON; Detroit, MI; San Francisco, CA; Seattle, WA; Hartford, CT; and Honolulu, HI) seems to point compellingly toward the different health care systems in Canada and the US as its most cogent explanation.

So far, this research's inferences are most legitimately generalized to large metropolitan areas with populations of one to four million people. Large metropolitan samples were originally selected because they probably offer substantial control for health care service endowments. In both Canada and the US, primary care, as well as specialized cancer care services (oncologists, surgeons, investigative [e.g., laboratory] and therapeutic [e.g., radiation therapy facilities]), are readily available in such areas. Critical between-country comparisons then tested their relative accessibility. We think that Toronto, Ontario was a good place to start examining the Canadian situation. Because one out of every seven Canadian residents lives in Toronto, its use probably provided a significant external validity benefit. Still, as an alternative to the health insurance hypothesis, it could be conjectured that Toronto's large health care service endowment is so unrepresentative of the rest of Canada that the cancer survival advantages observed among the residents of its relatively low income areas as compared with similarly poor Americans may not be replicable in other Canadian locales. The present analysis tests this alternative hypothesis by means of a systematic replication of previous Canada-US cancer survival comparisons with samples from two smaller cities with populations ranging from one half to three-quarters of a million people: Winnipeg, Manitoba, and Des Moines, Iowa.

This analysis focuses on a type of cancer that is perhaps of greatest public health significance in North America breast cancer. In addition to being the most common cancer among North American women, breast cancer fits the above outlined exemplar of a good health care indicator very well: early diagnosis and access to the best available treatments are predictive of good prognoses with a high quality of survivable life. Moreover, breast cancer survival outcomes have consistently fit the pattern of a Canadian survival advantage across all of our Canada—US comparisons in relatively low-income areas. Also of note, other US analyses have found social factors such as SES, race and ethnicity to be rather strongly associated with breast cancer screening practices, prognostic factors such as the stage of disease at the time of diagnosis, as well as access to the best available treatment (6–15). Among Canadian samples, however, such associations have been found either non-significant or much smaller. (16–20). The pattern of American associations is consistent with the health insurance hypothesis because various low SES or underclass groups including people of color are known to be at much greater risk than others of being uninsured or under-insured. Such inadequate health insurance statuses are highly associated with the nonreceipt of primary care, cancer screening services and various cancer treatments across a variety of US contexts (1, 21–25). We therefore hypothesized that, similar to Canadian survival advantages observed in larger metropolitan areas, relatively poor breast cancer patients in Winnipeg, Manitoba would survive longer than their similarly poor counterparts in Des Moines, Iowa.

METHODS

Study participants were residents of metropolitan Winnipeg, Manitoba (population of 650,000 in 1991) and Des Moines, Iowa (400,000 in 1990) (26–28) The data sources were the Manitoba Cancer Registry and the US Surveillance Epidemiology and End Results (SEER) program. Definitions of the study cohorts were constrained by power calculations and the date of last follow-up of the US cohort: December 31, 1997 (29, 30). A 5-year survival analysis was based on cumulative incident first primary breast cancer cases diagnosed from 1984 to 1992. Power calculations based on the between-country breast cancer survival comparisons reported in previous studies as well as the following criteria (power $[1 - \beta] = 0.80$, $\alpha = 0.05$), (2–5, 31) determined that there would be sufficient power to detect a survival rate ratio (SRR) of 1.10 among all of the patients and a SRR of 1.20 among the smaller sample of patients aged 25 to 64 years. All first primary malignant cancers of the breast among adult women (25 or older) were included in the analysis: 2383 women in Winnipeg and 1545 women in Des Moines.

As did our previous studies, the present analysis used a census-based SES measure (census tract proportion meeting a “low income” criterion in Canada and “poverty” threshold in the US) to define relative income quantiles. These, respective, Statistics Canada and US Bureau of the Census, indices of economic impoverishment or deprivation are conceptually similar. Both of them are based on annual household income from all sources, adjusted for household size, and tied to the consumer price index. The Canadian low-income cutoff is a more liberal criterion though, approximately equal in 1990 to 1991 to 200% of the US poverty threshold (32). The analytic goal for the use of such census-based socioeconomic measures was the aggregation of people with cancer into relative quintiles, that is, low- to high-income areas within countries. Geographic coding was based on each person's residence at the time of diagnosis: coded as postal codes (converted to census tracts) (33) in the Manitoba data set and as census tracts in the SEER data set. The statistical power criteria noted above allowed for comparison between corresponding Winnipeg and Des Moines income area quintiles. The relative quintile ranking of US census tracts was observed to be nearly identical whether 100%, 150% or 200% poverty threshold criteria were used. We therefore chose to use the most straightforward and prevalent one—the standard (100%) poverty threshold. Other issues of predictive and face validity, also supported our selection of the arguably, simplest, and most straightforward income-based socioeconomic measures (34–40). Across developed nations including Canada and the US, when socioeconomic-health associations exist, income has repeatedly been observed to be highly associated with various morbid and mortal outcomes than education or occupation (41–44). The unidimensional constructs of relatively "low income" or "poverty" areas, vs. more abstract mulifactorial statistical constructions that may, for example, simultaneously model five or more socioeconomic dimensions, are easily identifiable and well understood, not only by scholars, but by most residents of North America's cities (45).

Descriptive profiles of the resultant income areas that are displayed in Table 1, demonstrate two important points: (i) the construct validity of this study's ecological measures of relative SES are supported by the clear median income hierarchies observed in both Winnipeg and Des Moines; and (ii) even though statistics of Canada's low income criterion is much more liberal than the US Census Bureau's poverty threshold, the corresponding Winnipeg-Des Moines relative income areas are strikingly similar in terms of typical incomes. In fact, the relatively small absolute income differences that do exist probably serve to make this study's hypothesis test a conservative one. For example, in the lowest income quintile areas, households in Des Moines had an average annual income advantage of $2000, but their counterparts in Winnipeg are still hypothesized to have a cancer survival advantage. Moreover, the local patterns of income differentials among this study's samples seem distinctly different from the well-known national ones where the differences between the rich and the poor are larger in the US. Within this study's analytic context (aggregate relative socioeconomic areal fifths in Winnipeg, 1991 and Des Moines, 1990 [median household income]), the difference between the highest and lowest quintiles was actually larger, nearly 20% larger, in the Canadian sample. This pattern seems to lend further credence to the notion that this study's Canada-US comparison on breast cancer survival is probably a rather conservative one.

This study's specific metropolitan data sets were nearly identical on data quality indicators. In both cases, more than 96% of their residences (census tracts) at the time of diagnosis were coded; those missing residential data were censored at the time of diagnosis. More than 96% of their breast cancers were microscopically confirmed and less than 0.5% of them were

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enumerated on the basis of death certificates only. While it is true that between-country case ascertainment differences do exist, particularly with regard to the registration of second primaries (involving the same histologic site, e.g., right and left breast [less than 5% of all breast cancer patients]) (46–49). Such methodological differences probably cannot confound this study analysis as it was restricted to first primaries. This analytic plan, therefore, puts the emphasis on patient's first point of entry into the, respective, Canadian or American cancer care systems.

Observed survival rates were directly age-adjusted using this study's combined Winnipeg-Des Moines population of breast cancer patients across the following age strata: 25 to 44, 45 to 54, 55 to 64, 65 to 74, and 75 years of age or older (50). Relative survival rates based on life table methods were not calculable across this study's unique Canadian and US socioeconomic quintiles as the age and time-dependence of competing risks in such areas are unknown. Among all of the women with breast cancer who were dead at five-year follow-up, 81% died as a direct result of cancer, while among the sample of patients diagnosed before age 65, nearly all subsequent deaths were attributable to their cancer (93%). Survival comparisons across specific income area strata were then accomplished so that survival rate ratios (SRRs) were greater than 1.00 if Winnipeg residents were advantaged. Ninety-five percent confidence intervals around SRRs were based on the Mantel-Haenszel chi-square test (50, 51). And survival trends across income quintiles were tested (α criterion of 0.05) by means of the Mantel extension procedure (52, 53).

RESULTS

First, concerning within-country analyses, it was observed that the Winnipeg breast cancer cohort demonstrated no association between SES and survival, while the Des Moines cohort did (Table 2). As compared with Des Moines' highest income area, five-year survival rates were significantly lower in Des Moines' middle and lowest income areas (SRRs of 0.90 and 0.79, respectively), representing a statistically significant trend that is probably due to the relatively low survival rate in the lowest quintile. As hypothesized, the two country's aggregate breast cancer patient cohorts did not differ significantly on survival in any but the lowest income areas. Among these relatively lowest income groups, a significantly higher survival rate was observed in Winnipeg (SRR = 1.14). Finally and more specifically, in these lowest income areas, the Winnipeg survival advantage was greater among women aged 25 to 64 (SRR =1.23), and it was also observed in the middle fifth of income areas among this younger cohort (SRR = 1.11).

Adjunct Exploratory Analysis

Nearly all of Des Moines' residents are white (94%), but less than two-thirds of Winnipeg's residents have been so categorized by recent censuses, and one of its most prevalent minorities are Aboriginal people (26–28). The Manitoba Cancer Registry does not code race or ethnicity. Selection of a Winnipeg low-income area with relatively high Aboriginal representation allowed for another, probable conservative, test of the health insurance hypothesis (i.e., the Canadian sample for this analysis probably had much greater Aboriginal representation than the American one). Nineteen census tracts comprised of 15% or more

Aboriginals that were all among Winnipeg's lowest socio-economic quintile (median Aboriginal prevalence of 24%, median low income prevalence of 53%, and median household income of $15,150) were substituted for the original 31-tract low-income area quintile. Replication of the original analyses with this Aboriginal-concentrated low-income area found that the SES-breast cancer survival nonassociation in Winnipeg remained as did the survival advantages enjoyed by relatively poor "Winnipegers" (e.g., patients aged 25 to 64, Winnipeg vs Des Moines' lowest income quintile; SRR = 1.16 [95% CI; 0.98, 1.38 and 90% CI; 1.01, 1.34]).

DISCUSSION

This study demonstrates the breast cancer survival advantage of Canadians relative to Americans in smaller metropolitan areas that previously had been consistently observed in larger metropolitan areas. Significant, though distinctly nonmonotonic, SES-breast cancer survival gradients were observed in the US cohort, but not in the Canadian one. The impact of these different within-country SES-survival associations were specifically observed in relatively poorer areas where there are higher residential concentrations of such categorical groups as the poor, the so-called near poor, including the working poor, as well as better-off working people, even including members of the middle-class, who, for a number of social structural and economic reasons, are periodically or chronically uninsured or underinsured in the US. These are the kinds of impoverished to middle income areas where the cancer survival advantages enjoyed by Canadian patients seem to be most apparent. Furthermore, such Canadian advantage seems to be greater among younger women (not yet entitled to Medicare coverage in the US), and to be maintained even in the poorest neighborhoods with relatively high representations of Aboriginal people. This study's pattern of findings further substantiates the health insurance hypothesis as an explanation for Canadian-US differences in cancer survival in diverse urban contexts. Its findings are consistent with estimates that more than a third of all breast cancer patients in the US do not receive the minimum expected best available treatments (9, 54, 55). And more generally, this study's findings are consistent with the recently observed strong associations of income inequality with health care access (failure to receive needed care, difficulty getting care), affordability (problems paying medical bills, failure to fill prescriptions due to cost) and mortal outcomes in the US, but not in Canada (56, 57). One clear effect of Canada's comprehensive social policies, of which universal access to health care seems most cogent, is that the quality of health care received seems generally not to be related to the ability to pay for it. Most citizens would probably agree that this should be one central goal of any health care system.

Having found further suggestive evidence of the equitable access and quality of health care enjoyed by urban Canadians, it ought to be noted that Canada is not without health care and social inequities. For example, though Aboriginal status was apparently not associated with the quality of cancer care in this study's Winnipeg sample, Aboriginal status was very strongly associated with low income status. As for health care, significant variabilities in access and outcomes have been observed within various provinces (16, 58–64) but such gradients seem more probably to be a function of different regional health care service endowments, rather than of personal income or other SES-related differences. For example, primary care as well as specialized health care services is obviously far less available in the furthest outlying northern rural expanses of many provinces. Policies to effectively diminish health care inequities in such regions will necessarily be quite different from those needed to effect similar change in US metropolitan areas. Better knowledge is needed though to effectively steer such policy decision on both sides of the border. Future research that integrates the knowledge of physicians, epidemiologists, human geographers, allied scientists and policy makers will not only be better able to extend this field's internal and external validity, but also to produce practical knowledge capable of steering health care policies in Canada and the United States.

Possible Alternative Explanations

Our assertion that a relative lack of health insurance and a consequent lack of access to health care services among relatively poor American cancer patients is the most plausible explanation for the rather consistent pattern of Canadian survival advantages observed in this and other studies was based on three empirically grounded assumptions: (i) more than half of the residents of Des Moines' lowest areal income fifth were poor or "near poor" (up to 200% of the federally established poverty criterion); (ii) various relatively low socioeconomic and underclass statuses are known to be strongly associated with being uninsured or underinsured in the US; and (iii) such associations cannot possibly exist in Canada, as insurance status pertinent to necessary medical care is not even a variable, but rather a constant—every resident is so ensured under Canada's Medicare Act (1,2–5,28). Therefore, this study's income-based critical comparison groups—cancer patients who resided at the time of their diagnosis in the relatively lowest fifth of income areas in Winnipeg, Manitoba and Des Moines, Iowa—probably served as close respective proxies for well-ensured vs. relatively inadequately ensured groups. By definition then, a factor that could represent a similar or more plausible alternative or confounding explanation would, we think, have to minimally meet the following three criteria: (i) be strongly associated with socioeconomic or insurance status in the US, but not with SES in Canada; (ii) differ significantly between Canada and the US, particularly among their respective poorest people; and (iii) be an independent moderate or stronger risk or protective factor for cancer survival. For these reasons we think that, while any number of other behavioral or cultural factors, for example, are probably integral to a thorough understanding of health care outcomes, it is unlikely that any of them can rival the potent ability of health insurance to explain the observed Canadian-American cancer survival differentials.

One such possible alternative explanation for this study's findings that could be advanced concerns the actual income differentials in the US and Canada. The economic divide between relatively rich and poor Americans is large and growing, and it is well known to be larger than the Canadian divide (65, 66). Therefore, the greater marginalization of some relatively poor Americans could possibly contribute to their cancer survival disadvantage, over and above their lack of access to the best available health care. Two arguments essentially rule out this demographic pattern as a potent confounding explanation. First, as noted in this study's methods sections, not only were this study's Canadian and American samples not representative of the typically noted cross-national differential (American greater than Canadian economic inequality), but they, in fact, demonstrated a slight between-country difference in the opposite direction (Canadian [Winnipeg, Manitoba] greater than

American [Des Moines, Iowa] economic inequality [confounding criteria #2 not met, between-country difference was counter-hypothetical]). Among this study's sample, although economic marginalization was likely be greater among the relatively poor Canadian subsample, they still enjoyed a significant survival advantage compared with their American counterparts. Within this particular study sample's context then, the findings certainly seem most consistent with systemic, rather than with personal or cultural explanations. Second, while it is true that studies of income inequality and mortality among developed nations have observed attenuated Canadian vs. American associations (56, 67–69). Because they have all focused on mortality, which is a function of both incidence and survival, their designs leave the myriad possible causes of disease occurrence and survival confounded (70). None of this field's studies have focused on survival, per se, and most of the purported inequality correlates (e.g., life style factors, stress) that are the primary hypothesized causes of mortality, have been consistently empirically linked with the occurrences of various diseases including cancer, but not necessarily with their survival. We are unaware of any studies that have demonstrated an independent link between such measures of economic inequality and cancer survival in Canada, the US or elsewhere (confounding criteria #3 not met). Therefore, though income inequality most assuredly has very important worldwide public health implications, particularly with respect to the incident causes of disease (e.g., tumor initiation and progression), it probably does not provide a plausible alternative explanation for this study's cancer survival-based findings.

Life style factors such as diet, physical activity, body mass, smoking and alcohol consumption, that were alluded to above, are another constellation of factors that would certainly seem to warrant consideration as possible alternative explanations for this study's central findings. However, upon closer examination, we think that it is quite clear that life style factors, in aggregate, do not meet any of the three confounding definitional criteria: (i) various SES-life style factor associations are well known to exist in both the US and Canada, not merely in the US; (ii) though we are unaware of any studies that have specifically compared the low income areas of Winnipeg and Des Moines on these factors, prevalence studies of general Canadian and US populations contemporary with this one's data collection phase have found very small prevalent differences on life style-related factors, typically on the order of magnitude of only plus or minus 2%; and (iii) life style factors that have been observed to be strongly associated with cancer occurrence, only seem to be weakly associated with cancer survival, if at all (71–74, 75–82). Again, though of obvious public health significance in both Canada and the US, particularly with respect to the occurrence of cancer as well as other prevalent morbid outcomes, extant knowledge of life style factors does not seem at all consistent with this study's observed Canadian cancer survival advantage among the relatively poor. Therefore, we do not think that such factors even minimally confound the hypothesized health insurance-survival relationship.

Cultural hypotheses related to various differences between social classes or ethnic groups on cancer preventive behaviors and rates of cancer screening participation have been developed, but remain largely untested. Actually though, the few studies that do exist seem to suggest that it is knowledge and relatedly, the level of achieved education, rather than any culture-specific minority group attitude or belief differences which may account for much of the observed differences on cancer screening (83–88). This phenomenon probably accounts for at least some of the cancer survival disadvantage among relatively poor Americans, and as such is closely aligned with the health insurance hypothesis. It tends to indict America's inequitable distribution of essential social resources—education and health care. As for the specific ethnic groups that this study indirectly compared—Native or Aboriginal people of Canada and the US—similar socioeconomic and related disadvantages (e.g., rural vs urban, reserve vs off-reserve residence), particularly with respect to the occurrence of various diseases including cancer, have been observed among both Canadian and American Aboriginals as compared with their respective within-country white counterparts (89–93). Thus, ethnic and related cultural factors do not seem to meet any of the three definitional confounding criteria. Unfortunately, various ethnic minority groups, including Aboriginal people in Canada and the United States, still experience multiple systemic disadvantages. Though this is an issue of profound public health and social policy significance, it does not seem to provide a convincing alternative explanation for this study's observed, Aboriginal-specific, Canadian cancer-survival advantage.

Finally, this study was methodologically limited and potentially confounded by its inability to accomplish stage-specific analyses (the Manitoba Cancer Registry did not routinely include breast cancer stage during this study's incident time frame). SES-specific cancer stage compositional differences might be hypothesized, for example, to account for the observed between-country differences in survival. We agree that they probably do account for some, but not all of the differential. The only stage-stratified study that we are aware of in this field found a 5% survival advantage among Ontario patients with localized glottic cancer as compared with similarly staged American patients (94). However, this study did not account for SES. Our health insurance theory leads to the prediction that the Canadian stage-adjusted survival advantage would be even larger among, respective, low-income Canadian and American strata. This and related hypotheses await future testing. Our own as well as other within-US analyses have found that cancer stage and treatment differences are both strongly associated with health insurance status and survival, each accounting for approximately half of the criterion survival variability (1, 41, 95). Moreover, in the US cancer stage at the time of diagnosis is itself probably largely determined by multiple systemic, health-insurance mediated factors: a lack of pre-symptomatic primary care, post-symptomatic delays to primary care, even so-called personal delays, related to not having a usual source of care or having experienced a lack of primary care continuity, and delays to cancer care (diagnosis and treatment) that may be related to a lack of effective screening, investigation, oncology referral, other referrals such as surgery, or follow-up advocacy (96–101). Between-country outcome comparisons notwithstanding, it is acknowledged that we yet have much to learn about respective within-country health care processes, pre- and post-diagnosis, in both Canada and the US. In response, it is our ongoing intention to plan and carry out ever more complex and coherent international population health and health systems analyses. Our own research group as well as a number of others of which we are aware, for example, are planning to add stage and treatment variables to various samples of Canadian provincial cancer registries. Such enhanced databases will ultimately allow for more coherent within- (e.g., pre-post health care policy changes) and between-country comparisons of the processes and outcomes of cancer care in Canada and the US.

CONCLUSION

This study replicated the finding of advantaged Canadian cancer survival in smaller Canadian and American metropolitan areas that had been consistently observed in larger such metropolitan areas. During this study cohort's retrospective time frame the—mid 1980s to the mid 1990s—more inclusive health care insurance coverage in Canada vs. America, particularly among each country's respective relatively poor people, seems the most plausible explanation for such Canadian survival advantages. Canada's single payer health care system seems to have offered similar advantages across a number of diverse urban contexts. Such historical findings may serve as sentinel cautions against future policies that would transform Canada's single payer health care system into a multitiered one and as concomitant policy incentives to provide all Americans with health insurance.

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Selected Abbreviations and Acronyms

SRR	survival rate ratio
SEER	Surveillance epidemiology and end results

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TABLE 1

Descriptive profiles of census tract-based income quintile areas in Winnipeg, Manitoba (1991) and Des Moines, Iowa (1990)

	Winnipeg, Manitoba[a]			Des Moines, Iowa[b]		
	Low Income Prevalence[c]		Median[d] Income	Poverty Prevalence[c]		Median[d] Income
Income Groups	**Range**	**Median**		**Range**	**Median**	
Highest						
1	0.40 to 7.99	5.15	$47,090	0.00 to 2.99	2.32	$44,050
2	8.00 to 14.29	11.50	$39,110	3.00 to 5.69	4.60	$36,370
3	14.30 to 19.99	16.45	$32,265	5.70 to 7.79	6.75	$30,165
4	20.00 to 32.59	26.00	$26,043	7.80 to 12.24	9.25	$26,890
5	32.60 to 77.40	45.10	$17,500	12.25 to 44.50	20.00	$19,570
Lowest						

[a] Population of 652,395 in 1991: 155 census tracts with a mean population of 4,209 (SD = 1,681).

[b] Population of 392,686 in 1990: 98 census tracts with a mean population of 4,007 (SD = 1,696). Includes Dallas, Polk and Warren Counties.

[c] Percentage of households in census tract with low incomes (Canada) or poor (US).

[d] Census tract median annual household income in US dollars.

TABLE 2

Association of income quintile areas with breast cancer 5-year survival in Winnipeg, Manitoba and Des Moines, Iowa: Women were diagnosed from 1984 to 1992 and followed-up to December 31, 1997

	Winnipeg, Manitoba				Des Moines, Iowa				Winnipeg/Des Moines Cases	
Income group	**n**	**SR**	**SRR[a]**	**(95%CI)[b]**	**n**	**SR**	**SRR[a]**	**(95% CI)[b]**	**SRR[a]**	**(95% CI)[b]**
All Women Aged 25 and Over										
Highest	351	0.748	1.00		313	0.786	1.00		0.95	(0.87, 1.04)
	491	0.733	0.98	(0.89, 1.07)	363	0.739	0.94	(0.86, 1.03)	0.99	(0.88, 1.11)
Middle	622	0.755	1.01	(0.95, 1.07)	325	0.707	0.90	(0.82, 0.99)	1.07	(0.98, 1.16)
	536	0.726	0.97	(0.89, 1.06)	332	0.739	0.94	(0.86, 1.03)	0.98	(0.89, 1.08)
Lowest	383	0.710	0.95	(0.87, 1.04)	212	0.621	0.79	(0.71, 0.88)	1.14	(1.01, 1.28)
Women Aged 25 to 64										
Highest	266	0.794	1.00		191	0.854	1.00		0.93	(0.85, 1.01)
	321	0.786	0.99	(0.91, 1.07)	233	0.820	0.96	(0.88, 1.05)	0.96	(0.88, 1.04)
Middle	370	0.778	0.98	(0.90, 1.07)	196	0.700	0.82	(0.74, 0.91)	1.11	(1.01, 1.22)
	263	0.799	1.01	(0.89, 1.15)	135	0.811	0.95	(0.87, 1.04)	0.99	(0.90, 1.09)
Lowest	201	0.754	0.95	(0.85, 1.06)	113	0.615	0.72	(0.63, 0.82)	1.23	(1.06, 1.43)

Notes. n = number of incident cancer cases; SR = survival rate; SRR = survival rate ratio; CI = confidence interval. Data for women aged 65 and over are not shown separately because none of their within- or between-country comparisons were minimally statistically significant. Only the survival trends across income quintiles in the Des Moines samples were significant (all cases [$p = .039$] and those less than 65 years of age [$p = .018$]).

[a] A survival rate ratio of 1.00 is the baseline.

[b] Confidence intervals are based on the Mantel-Haenszel chi-squared test.