Original Article

Population-Based Cancer Survival in Canada and the United States by Socioeconomic Status: Findings from the CONCORD-2 Study

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Abstract: Background: Population-based cancer survival provides insight into the effectiveness of health systems to care for all residents with cancer, including those in marginalized groups. Methods: Using CONCORD-2 data, we estimated 5-year net survival among patients diagnosed 2004–2009 with one of 10 common cancers, and children diagnosed with acute lymphoblastic leukemia (ALL), by socioeconomic status (SES) quintile, age (0–14, 15–64, ≥65 years), and country (Canada or United States). Results: In the lowest SES quintile, survival was higher among younger Canadian adults diagnosed with liver (23% vs 15%) and cervical (78% vs 68%) cancers and with leukemia (62% vs 56%), including children diagnosed with ALL (92% vs 86%); and higher among older Americans diagnosed with colon (62% vs 56%), female breast (87% vs 80%), and prostate (97% vs 85%) cancers. In the highest SES quintile, survival was higher among younger Americans diagnosed with stomach cancer (33% vs 27%) and younger Canadians diagnosed with liver cancer (31% vs 23%); and higher among older Americans diagnosed with stomach (27% vs 22%) and prostate (99% vs 92%) cancers. Conclusions: Among younger Canadian cancer patients in the lowest SES group, greater access to health care may have resulted in higher cancer survival, while higher screening prevalence and access to health insurance (Medicare) among older Americans during the period of this study may have resulted in higher survival for some screen-detected cancers. Higher survival in the highest SES group for stomach and liver may relate to treatment differences. Survival differences by age and SES between Canada and the United States may help inform cancer control strategies.

Key words: *breast, Canada, cancer, cervix, colon, leukemia, liver, net, population-based, prostate, survival, United States*

Introduction

Cancer is the leading cause of death in Canada, and it may become the leading cause of death in the United States.[1,2] The numbers of new diagnoses and deaths from cancer are likely to continue to rise because of growing and aging populations in both countries.[2,3] An increase in the number of new cancer patients and survivors poses a challenge to the health care systems in Canada and the United States with a need to detect, diagnose, and treat cancers and provide appropriate follow-up care for survivors. Implementation of effective cancer-related health care services and cancer control initiatives is critical to responding to these challenges.

Population-based cancer survival estimates include all patients diagnosed with cancer in a defined geographic area, such as a state or province, regardless of their age, race, immigrant status, income, or access to health insurance and health care. As such, population-based cancer survival is a measure of the overall effectiveness of the health care system to deliver services to all patients and survivors, including marginalized groups. Along with incidence and mortality data, survival is a key metric for evaluating cancer care and cancer control initiatives in the population.[4-6]

Population-based cancer survival for many leading cancers is among the highest in the world in Canada and the United States.[6] However, survival has been shown to be associated with social and economic status in high-income countries,[7-10] including those with universal health insurance, such as Canada,[11-13] with survival tending to be lower among those with lower incomes. Such disparities represent large numbers of potentially avoidable premature deaths, and they place a large economic burden on communities that are economically or socially marginalized.[14]

When comparing survival with the United States, Gorey[15-19] and Boyd[20] have reported a Canadian survival advantage for several common cancers among the very poor. The authors posited that this advantage may have resulted from better access to health care because of universal health

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insurance coverage in Canada. These comparative studies were limited in their geographic coverage and did not account for the availability of health insurance (Medicare) to older adults in the United States.

CONCORD is a program for the global surveillance of population-based cancer survival.[6] In 2015, CONCORD-2 published 5-year survival trends for patients diagnosed from 1995–2009 with 1 of 10 common cancers in 67 countries, including Canada and the United States. The study provided a unique opportunity to compare cancer survival between Canada and the United States. We speculated that the previously reported survival advantage among Canadian patients in the lowest economic group may have been limited to patients younger than 65 years, for whom health insurance coverage was higher in Canada than in the United States. Because older adults in the United States are eligible for Medicare, we further speculated that survival should be comparable in Canada and the United States among this age group because both Canadians and Americans had access to health insurance. To aid in the interpretation of these results, we have also reported corresponding cancer incidence rates.

Methods and Materials

We used CONCORD-2 data for patients diagnosed with cancer during 2004–2009 and followed up to December 31, 2009, from 33 statewide registries, covering approximately 73% of the US population, and 10 provincial registries, covering more than 99% of the Canadian population, and which agreed for their data to be included in this study. Site and histology information, coded to the *International Classification of Diseases for Oncology*, third edition (ICD-O-3),[21] was used to examine cancers of the stomach, colon, rectum, liver, lung, female breast, cervix, ovary, and prostate in adults, and adult leukemia and childhood acute lymphoblastic leukemia (ALL) using CONCORD-2 cancer site definitions (Table 1).

Statistical Analysis

Detailed descriptions of the CONCORD-2 study, including quality control procedures, data evaluation and statistical methods, have been published.[4,6] Briefly, we estimated 5-year net survival (%) for each cancer, using the complete approach[22] and the Pohar Perme estimator.[23,24] To produce survival estimates that were robustly comparable between countries, we adjusted for background mortality in each country using life tables by age (single year), sex, calendar year, and socioeconomic status (SES), and by race in the United States.[25,26] SES was categorized into quintiles and ordered from lowest to highest at the national level in the United States and within individual provinces in Canada. For the United States, the SES quintiles were created from county-level SES index scores, which included factors such as income, poverty, unemployment, education, and house value.[27] For Canada, SES was defined by neighborhood income assigned at the postal code level.[28] Survival estimates for all ages combined were age-standardized using the International Cancer Survival Standard (ICSS) weights.[29] Between-country differences in the survival estimates in the lowest and highest SES groups were commented on when the 95% CIs did not overlap, and if the survival estimates differed by at least 5%.

Results

Table 2 shows the number of adults and children diagnosed with one of the 10 cancers of interest during 2004–2009 in Canada and the United States by SES quintile (all cases, lowest, highest) and age group. Our analyses included 4,163,672 patients diagnosed in the United States and 587,785 diagnosed in Canada, including 12,047 and 1,355 children, respectively.

Table 3 shows 5-year survival (%) for adults diagnosed with one of the 10 cancers of interest, and children diagnosed with ALL during 2004–2009 in Canada and the United States by age and SES for all patients combined, and

Table 1. CONCORD-2 Study Cancer Site Definitions[6]

Cancer site	*Incidence (ICD-O-3) 21*
Stomach	C16·0–C16·6, C16·8–C16·9
Colon	C18·0–C18·9, C19·9
Rectum	C20.9, C21·0–C21·2, C21·8
Liver (and intrahepatic bile duct)	C22·0–C22·1
Lung (and bronchus)	C34·0–C34·3, C34·8–C34·9
Breast	C50·0–C50·6, C50·8–C50·9
Cervix	C53·0–C53·1, C53·8–C53·9
Ovary	C48·0–C48·2, C56·9, C57·0–C57·4, C57·7–C57·9
Prostate	C61·9
Leukemia	9670, 9687, 9727, 9728, 9729, 9800, 9801, 9805, 9820, 9823, 9826, 9832, 9833, 9835, 9836, 9837, 9840, 9860, 9861, 9866, 9867, 9870, 9871, 9872, 9873, 9874, 9891, 9895, 9896, 9897, 9910, 9920, 9930, 9931, 9940, 9984, 9987
Childhood ALL	9727, 9728, 9729, 9835, 9836, 9837

ALL, acute lymphoblastic leukemia; ICD-O-3, *International Classification of Diseases for Oncology,* third edition.

Table 2. Number of Adults (15–99 Years) Diagnosed with 1 of 10 Common Cancers and Children (0–14 Years) Diagnosed with Acute Lymphoblastic Leukemia (ALL) During 2004–2009 in Canada and the United States, by SES Quintile and Age Group

Cancer site	Country	Total patients	*SES quintile*			
			Lowest		Highest	
			15–64 y	65–99 y	15–64 y	65–99 y
Stomach	Canada	18,187	1,276	2,710	1,010	1,870
	US	101,475	7,599	12,936	6,590	11,309
Colon	Canada	89,037	5,038	12,860	5,528	10,565
	US	534,721	42,031	74,391	30,990	54,866
Rectum	Canada	30,741	2,513	3,708	2,601	2,954
	US	164,021	17,309	17,864	14,027	12,489
Liver	Canada	10,665	1,174	1,451	658	1,010
	US	92,571	9,209	8,490	8,436	7,778
Lung	Canada	133,060	10,517	21,685	6,436	12,914
	US	955,184	78,536	143,529	44,126	94,163
Breast	Canada	123,360	12,200	10,449	16,057	9,141
	US	926,271	95,309	76,455	105,882	63,236
Cervix	Canada	8,086	1,493	399	1,067	222
	US	60,263	10,791	2,852	7,305	1,721
Ovary	Canada	17,079	1,572	1,734	1,727	1,487
	US	116,459	10,500	11,135	11,555	9,372
Prostate	Canada	132,175	7,077	14,474	12,381	17,001
	US	1,033,091	76,963	127,391	79,985	99,332
Leukemia	Canada	24,040	1,713	2,983	1,894	2,718
	US	167,569	13,033	19,972	12,456	15,579
ALL (children)	Canada	1,355	262	NA	273	NA
	US	12,047	2,050	NA	2,228	NA

NA, not applicable; SES, socioeconomic status.

Note: Cancers are ordered by International Classification of Diseases for Oncology, third edition (ICD-O-3) codes.
Participating provincial registries: Alberta, British Columbia, Manitoba, New Brunswick, Newfoundland*, Nova Scotia, Ontario, Prince Edward Island, Quebec, Saskatchewan.

* Newfoundland did not report SES data and is only represented in the totals for all deprivation quintiles combined.
Participating state registries: Alabama, Alaska, California, Colorado, Connecticut, Delaware, Florida, Georgia, Hawaii, Idaho, Iowa, Kentucky, Louisiana, Mississippi, Montana, New Hampshire, New Jersey, New Mexico, New York, Ohio, Oklahoma, Oregon, Pennsylvania, Tennessee, Texas, Maryland, Nebraska, North Carolina, South Carolina, Utah, West Virginia, Washington, and Wyoming.

for patients in the lowest SES and highest SES quintiles. In the lowest SES group, 5-year survival was higher among younger adults in Canada than in the United States for cancers of the liver (23.1% vs 15.1%) and cervix (78.4% vs 68.2%) and for leukemia (62.0% vs 56.2%). Between-country differences in survival estimates narrowed between the lowest and highest SES quintiles for cervical cancer in younger women (Figure 1). Among children diagnosed with ALL in the lowest SES group, 5-year survival was higher in Canada (92.4%) than in the United States (85.5%). Among older adults in the lowest SES group, 5-year survival was higher in the United States than in Canada among patients diagnosed with cancers of the colon (61.8% vs 56.1%), female breast (87.2% vs 79.2%), and prostate (97.1% vs 85.2%). Between-country differences in survival estimates narrowed between the lowest and highest SES quintiles for colon and prostate cancers in older adults (Figures 1 and 2). In the highest SES quintile, survival was higher among younger Americans diagnosed with stomach cancer (33.4% vs 26.9%) and younger Canadians diagnosed with liver cancer (30.6% vs 23.3%). Survival was higher among older Americans diagnosed with stomach (26.5% vs 21.5%) and prostate (98.9% vs 92.3%) cancers.

Discussion

Canada and the United States are countries with similar cultural and socioeconomic backgrounds, and, in many ways, similar medical care. However, they differ in their approach to health insurance and cancer screening. Between-country survival differences within the lowest

Table 3. Five-Year Survival for Adults (10 Cancers of Interest) and Children (ALL), 2004–2009							
		Age–standardized					
		All		Lowest SES		Highest SES	
		NS (%)	95% CI	NS (%)	95% CI	NS (%)	95% CI
Stomach							
	Canada	24.5	23.6 – 25.5	23.7	21.7 – 25.8	24.4	22.0 – 26.8
	United States	29.2	28.7 – 29.6	26.7	25.8 – 27.7	30.1	29.0 – 31.2
Colon							
	Canada	62.1	61.6 – 62.7	59.5	58.2 – 60.7	64.9	63.6 – 66.2
	United States	65.2	65.0 – 65.4	63.4	62.9 – 63.9	65.8	65.2 – 66.4
Rectum							
	Canada	63.0	62.0 – 64.0	58.8	56.7 – 61.0	65.8	63.5 – 68.0
	United States	64.5	64.0 – 64.9	61.3	60.3 – 62.3	66.0	64.9 – 67.1
Liver							
	Canada	17.1	15.9 – 18.3	13.6	11.5 – 5.7	21.1	18.1 – 24.1
	United States	14.9	14.4 – 15.3	11.7	10.8 – 12.5	17.8	16.8 – 18.8
Lung							
	Canada	17.4	17.1 – 17.7	16.1	15.4 – 16.8	18.9	18.0 – 19.8
	United States	19.1	18.9 – 19.2	16.0	15.7 – 16.3	21.6	21.2 – 21.9
Breast							
	Canada	85.1	84.6 – 85.6	82.8	81.7 – 83.8	87.9	86.8 – 89.1
	United States	89.1	88.9 – 89.3	86.8	86.3 – 87.3	90.5	90.1 – 91.0
Cervix							
	Canada	66.8	65.2 – 68.5	66.6	63.4 – 69.7	66.3	61.8 – 70.8
	United States	63.0	62.3 – 63.6	59.3	57.9 – 60.6	67.1	65.5 – 68.8
Ovary							
	Canada	39.8	38.6 – 41.0	37.0	34.4 – 39.6	42.4	39.6 – 45.1
	United States	41.1	40.7 – 41.6	37.5	36.5 – 38.6	42.6	41.5 – 43.7
Prostate							
	Canada	91.2	90.8 – 91.6	89.3	88.3 – 90.4	93.6	92.7 – 94.5
	United States	97.8	97.6 – 98.0	96.7	96.3 – 97.1	98.1	97.6 – 98.5
Leukemia (adults)							
	Canada	55.6	54.6 – 56.6	52.4	50.2 – 54.7	59.5	57.2 – 61.7
	United States	52.5	52.1 – 52.9	49.8	48.9 – 50.7	55.2	54.3 – 56.2
ALL (children)							
	Canada	91.1	88.9 – 93.2	92.4	88.1 – 96.7	92.1	87.5 – 96.7
	United States	88.0	87.1 – 88.9	85.5	83.3 – 87.7	89.4	87.4 – 91.3

ALL, acute lymphoblastic leukemia; NS, net survival; SES, socioeconomic status (quintile).

SES group suggest a role for greater access to health care in younger adults in Canada and more frequent screening in older adults in the United States.

Access to Health Insurance

In Canada, health insurance is available to all residents through provincial and territorial health insurance plans jointly funded by the provinces, territories, and the federal government. In the United States, health insurance is available through a combination of private insurers and public programs. The US federal and state governments directly fund, or help to fund, insurance programs such as Medicare and Medicaid, which cover older adults and the very poor and disabled, respectively. Most adults under the age of 65 years obtain health insurance through their employer or purchase private insurance directly. However, during the time period of our study, approximately 17% of adults under the age of 65 years in the lowest income group were uninsured.[30]

Previous studies have shown that, in the United States, the uninsured and those on Medicaid were more likely to be diagnosed with advanced-stage cancers, to receive less

Table 3, cont. Five-Year Survival for Adults (10 Cancers of Interest) and Children (ALL), 2004–2009							
		Younger adults (15–64 years)					
		All		Lowest SES		Highest SES	
		NS (%)	95% CI	NS (%)	95% CI	NS (%)	95% CI
Stomach							
	Canada	27.6	26.0 – 29.1	27.4	24.1 – 30.8	26.9	23.3 – 30.6
	United States	32.2	31.7 – 32.6	29.5	28.1 – 30.9	33.4	31.8 – 35.1
Colon							
	Canada	65.9	65.1 – 66.7	62.0	60.0 – 64.0	68.3	66.5 – 70.1
	United States	67.4	67.2 – 67.6	65.1	64.4 – 65.8	69.3	68.5 – 70.0
Rectum							
	Canada	69.5	68.2 – 70.7	64.1	61.3 – 66.9	72.0	69.2 – 74.7
	United States	71.8	71.4 – 72.1	67.8	66.8 – 68.9	75.6	74.4 – 76.7
Liver							
	Canada	25.0	23.1 – 26.8	23.1	19.5 – 26.8	30.6	25.9 – 35.2
	United States	19.4	19.0 – 19.7	15.1	13.9 – 16.2	23.3	22.0 – 24.7
Lung							
	Canada	21.0	20.4 – 21.5	19.0	18.0 – 20.1	22.7	21.3 – 24.1
	United States	21.2	21.0 – 21.3	17.8	17.4 – 18.1	24.9	24.3 – 25.5
Breast							
	Canada	88.9	88.6 – 89.3	86.8	85.9 – 87.8	91.0	90.3 – 91.7
	United States	89.3	89.2 – 89.4	86.2	85.8 – 86.6	91.6	91.3 – 91.8
Cervix							
	Canada	79.5	78.1 – 80.8	78.4	75.6 – 81.2	80.0	76.6 – 83.4
	United States	71.8	71.5 – 72.2	68.2	67.0 – 69.4	75.9	74.6 – 77.3
Ovary							
	Canada	57.3	55.7 – 58.8	54.9	51.3 – 58.5	57.8	54.3 – 61.3
	United States	57.1	56.6 – 57.5	52.0	50.5 – 53.4	59.4	58.0 – 60.8
Prostate							
	Canada	97.3	96.9 – 97.7	96.9	95.9 – 98.0	98.2	97.5 – 98.8
	United States	98.6	98.5 – 98.7	97.7	97.3 – 98.1	98.9	98.6 – 99.1
Leukemia (adults)							
	Canada	66.5	65.2 – 67.8	62.0	58.9 – 65.1	70.0	67.3 – 72.6
	United States	60.7	60.3 – 61.0	56.2	55.0 – 57.4	65.2	64.0 – 66.3

ALL, acute lymphoblastic leukemia; NS, net survival; SES, socioeconomic status (quintile).

optimal treatment, and to have lower survival than those with insurance.[31-35] These uninsured and underinsured men and women were less likely to be screened or to receive antiviral treatment for their hepatitis infections (a risk factor for liver cancer) and were less likely to be referred for and receive evidenced-based treatment, including liver transplant, following a diagnosis of liver cancer.[36,37] Among women, cervical cancer screening was lowest among US women without insurance and women who reported no usual source of health care.[38] Between-country cervical cancer survival differences narrowed in younger women with increasing SES, likely reflecting the increased prevalence of cervical cancer screening with incressing SES among women in both countries.[38,39] In the United States, survival among adults, adolescents, and children diagnosed with leukemia was reported to be lower among the uninsured and those on Medicaid than among patients who were insured or who were in higher SES families.[40-42]

Between-country survival differences did not narrow, or narrowed only somewhat, with increasing SES for younger adults diagnosed with liver cancer or leukemia, including children diagnosed with ALL. For these cancers, Canadian survival estimates in adults were consistently slightly higher than US estimates across all SES groups.

Cancer Screening

The higher survival for colon, female breast, and prostate cancers among older adults in the United States compared to Canada may reflect the different approaches

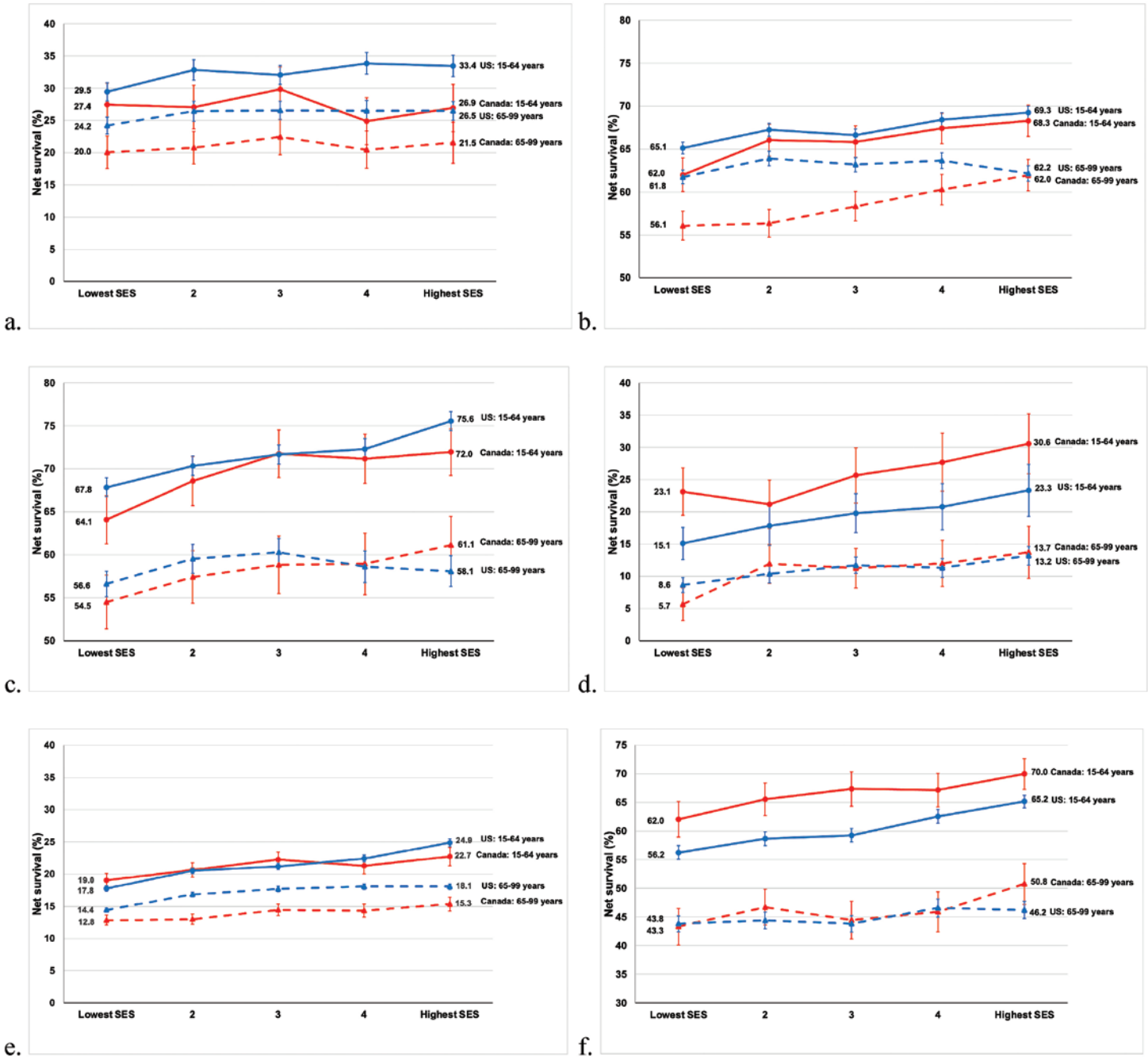
Table 3, cont. Five-Year Survival for Adults (10 Cancers of Interest) and Children (ALL), 2004–2009							
		Older adults (65–99 years)					
		All		Lowest SES		Highest SES	
		NS (%)	95% CI	NS (%)	95% CI	NS (%)	95% CI
Stomach							
	Canada	21.3	20.1 – 22.5	20.0	17.5 – 22.6	21.5	18.4 – 24.7
	United States	26.2	25.8 – 26.7	24.2	22.9 – 25.5	26.5	25.0 – 27.9
Colon							
	Canada	58.5	57.7 – 59.2	56.1	54.4 – 57.8	62.0	60.1 – 63.8
	United States	63.0	62.7 – 63.2	61.8	61.0 – 62.6	62.2	61.3 – 63.1
Rectum							
	Canada	58.0	56.6 – 59.5	54.5	51.4 – 57.6	61.1	57.8 – 64.5
	United States	58.8	58.3 – 59.3	56.6	55.1 – 58.1	58.1	56.3 – 59.9
Liver							
	Canada	10.7	9.2 – 12.2	5.7	3.1 – 8.2	13.7	9.7 – 17.8
	United States	10.9	10.5 – 11.3	8.6	7.5 – 9.8	13.2	11.8 – 14.6
Lung							
	Canada	13.8	13.4 – 14.2	12.8	12.1 – 13.6	15.3	14.3 – 16.4
	United States	16.9	16.7 – 17.0	14.4	14.1 – 14.8	18.1	17.6 – 18.5
Breast							
	Canada	82.1	81.3 – 82.9	79.2	77.5 – 81.0	86.1	84.3 – 88.0
	United States	89.0	88.7 – 89.2	87.2	86.4 – 87.9	89.7	88.9 – 90.5
Cervix							
	Canada	43.2	39.0 – 47.4	44.0	36.2 – 51.8	47.0	36.1 – 57.9
	United States	48.2	47.1 – 49.3	44.8	41.6 – 48.0	52.6	48.6 – 56.6
Ovary							
	Canada	27.7	26.0 – 29.3	24.1	20.6 – 27.6	31.9	27.9 – 35.9
	United States	30.1	29.6 – 30.5	27.9	26.4 – 29.4	30.8	29.1 – 32.5
Prostate							
	Canada	88.7	88.1 – 89.4	85.2	83.5 – 86.8	92.3	91.0 – 93.6
	United States	98.4	98.2 – 98.6	97.1	96.5 – 97.7	98.9	98.3 – 99.5
Leukemia (adults)							
	Canada	46.2	44.7 – 47.6	43.3	40.1 – 46.5	50.8	47.2 – 54.3
	United States	44.9	44.4 – 45.3	43.8	42.4 – 45.2	46.2	44.7 – 47.7

ALL, acute lymphoblastic leukemia; NS, net survival; SES, socioeconomic status (quintile).

to screening in the 2 countries. The United States uses opportunistic screening (ie, requests for screening come from individuals or health care providers) whereas Canada uses a combination of opportunistic and population-based, programmatic screening, with a significant emphasis on the latter in most provincial/territorial jurisdictions for colorectal, female breast, and cervical cancers. With programmatic screening, the provincial public health sector invites all eligible residents to participate in screening. For these cancers, screening use was lowest in the lowest SES groups and increased with increasing income in both countries.[38,39] Cancer screening use was generally consistent with each country's specific guidelines, particularly regarding age at initiation, with higher screening prevalence reported in the United States than in Canada for these cancers in all age groups.[43]

Colorectal cancer screening has been shown to reduce colorectal cancer incidence and death rates.[44] In the 2000s, both the Canadian Task Force on Preventive Health Care (CTFPHC) and the US Preventive Services Task Force (USPSTF) recommended colorectal cancer screening beginning at age 50 years.[45,46] However, while Medicare began covering colorectal cancer screening for eligible adults in the United States beginning in the late 1990s, programmatic colorectal cancer screening in Canada did not begin until 2007, when Alberta, Manitoba, and Ontario became the first provinces to announce programmatic screening. The lower incidence rates (Table 4) and higher colon cancer

Figure 1. Five-Year Net Survival (%) for Adults (Aged 15–99 Years) Diagnosed with 1 of 6 Common Cancers During 2004–2009 in Canada and the United States; Separately for Younger Adults (Aged 15–64 Years) and Older Adults (Aged 65–99 years) by Socioeconomic Status (SES) Quintiles (a, stomach; b, colon; c, rectum; d, liver; e, lung; f, leukemia)

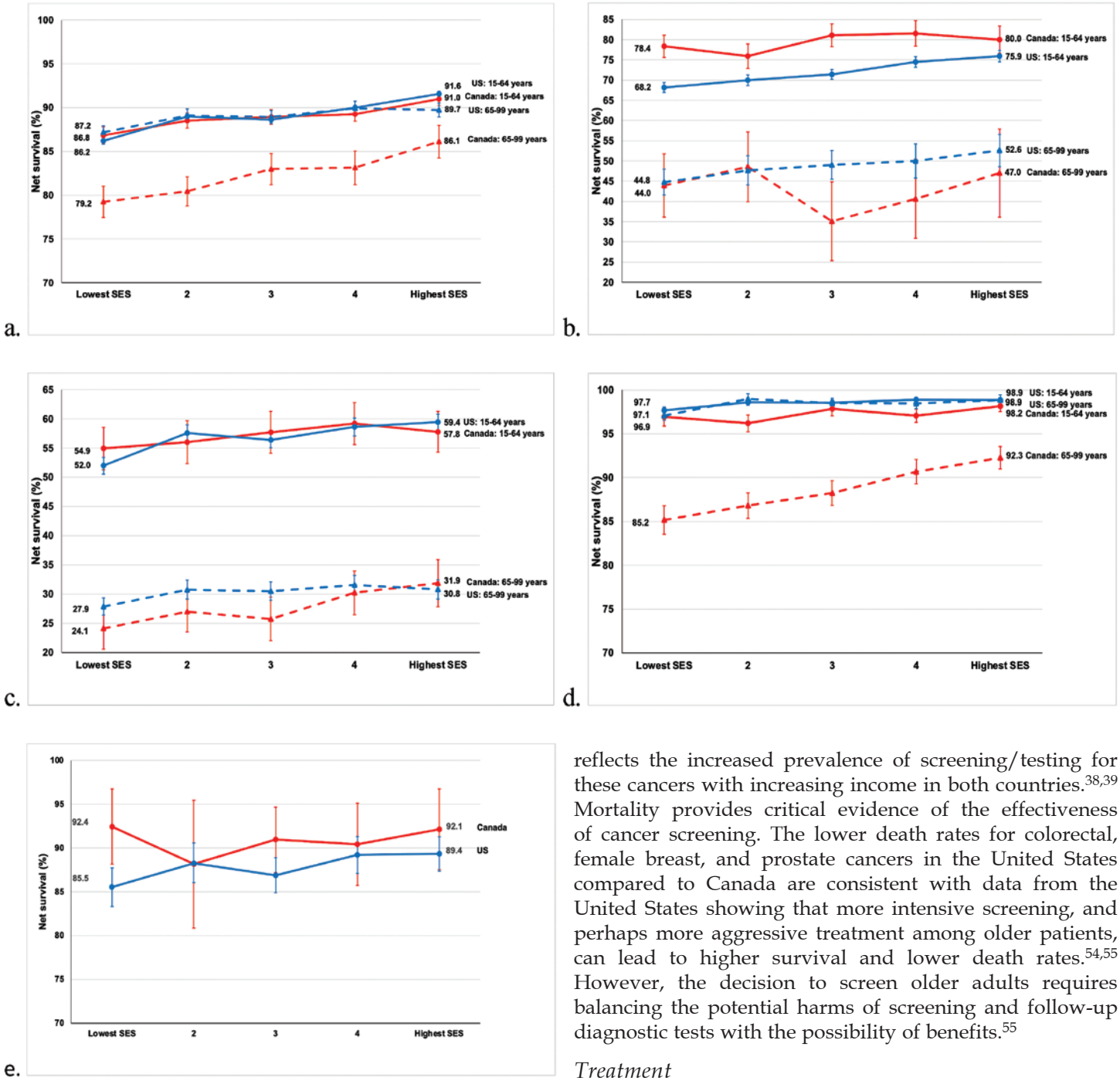


survival among older adults in the United States may reflect high screening prevalence in the United States compared to Canada and the fact that widespread programmatic screening for colorectal cancer in Canada occurred largely after the period covered by this study.

Both the USPSTF and the CTFPHC recommended breast cancer screening during the 2000s, although the age at initiation (40 years vs 50 years, respectively) and frequency of screening (annual vs biannual, respectively) differed between the United States and Canada.[47-49] The earlier initiation and higher frequency of screening in the United States than in Canada may have contributed to both higher breast cancer incidence (Table 4) and higher survival among older women in the United States.

The introduction of the prostate-specific antigen (PSA) test during the late 1980s was associated with an increase in the incidence of prostate cancer in both Canada and the United States.[50] During the period of this study, neither the USPSTF nor the CTFPHC recommended prostate cancer screening for men at average risk.[51,52] However, in 2003, the American Cancer Society recommended that annual PSA testing and digital rectal examination should be offered to

Figure 2. Five-year Net Survival (%) for Adults (Aged 15–99 years) Diagnosed with 1 of 4 Common Cancers and Children (Aged 0–14 Years) Diagnosed with Acute Lymphoblastic Leukemia (ALL) During 2004–2009 in Canada and the United States; Separately for Younger Adults (Aged 15–64 Years) and Older Adults (Aged 65–99 Years) by Socioeconomic Status (SES) Quintiles (a, breast [women]; b, cervix; c, ovary; d, prostate; e, ALL)



asymptomatic men who have a life expectancy of at least 10 years starting at age 50.[53] Higher prevalence of PSA testing may account for higher prostate cancer incidence (Table 4) and higher survival in older men in the United States compared to Canada.

Between-country survival differences narrowed with increasing SES in older adults for colon, breast, and prostate cancers, as survival increased with increasing SES, most noteably for Canadians. This narrowing of differences likely reflects the increased prevalence of screening/testing for these cancers with increasing income in both countries.[38,39] Mortality provides critical evidence of the effectiveness of cancer screening. The lower death rates for colorectal, female breast, and prostate cancers in the United States compared to Canada are consistent with data from the United States showing that more intensive screening, and perhaps more aggressive treatment among older patients, can lead to higher survival and lower death rates.[54,55] However, the decision to screen older adults requires balancing the potential harms of screening and follow-up diagnostic tests with the possibility of benefits.[55]

Treatment

Survival was higher in the highest SES group in the United States than in Canada following a diagnosis of stomach cancer in both younger and older adults. Survival was higher in Canada following a diagnosis of liver cancer among younger adults in the highest SES groups. Higher survival for these cancers, and the fact that survival was modestly but consistently higher across all SES quintiles for cervical cancer, liver cancer, and leukemia in Canada and stomach cancer in the United States, may relate to treatment differences.

Table 4. Incidence Rates Among Participating Registries (2004–2009)						
Cancer Sites	*United States*	*Canada*	*United States*	*Canada*	*United States*	*Canada*
	All ages	**All ages**	**15–64 y**	**15–64 y**	**≥65 y**	**≥65 y**
Stomach	10.8	12.5	4.8	5.2	39.3	47.7
Colon	54	59.7	22.6	22.2	204.9	239.8
Liver	9.7	7.3	6.1	3.8	26.9	24
Female breast	173.6	157.9	124.6	111.8	408.7	379.1
Cervix	10.6	10	10.3	10	11.9	10.1
Prostate	224.6	198.7	104.1	81.1	803.4	763.5
Leukemia	16.9	17.2	8.1	8.2	59.1	60.4
Childhood ALL (0–14 years)	4.2	4.2	NA	NA	NA	NA

ALL, acute lymphoblastic leukemia; NA, not applicable.

Conclusion

Our study found that 5-year survival differed according to SES between Canada and the United States for several common cancers. Among younger adults in the lowest SES group, greater access to health insurance and health care may have resulted in somewhat higher cancer survival in Canada for liver and cervical cancers and leukemia, including children with ALL; while higher cancer screening prevalence, coupled with access to health insurance (including Medicare), may have resulted in higher survival among older adults in the United States for colon, female breast, and prostate cancers. An examination of stage distribution and stage-specific survival for these cancers may provide insight as to whether these survival differences reflect true benefits to patients through better treatment and more intensive screening or merely reflect lead time biases resulting from more frequent and earlier interactions with the health care community. However, survival for lung cancer and ovarian cancer, which are often detected at an advanced stage of disease, and where opportunities for earlier diagnosis and treatment options are limited, showed similar survival patterns by SES in both Canada and the United States.

The relevance of this study from the US perspective lies in the fact that it included patients diagnosed with cancer just prior to the implementation of the Patient Protection and Affordable Care Act of 2010, which expanded health care and health insurance to more Americans.[56] We would expect survival in the United States to improve in the lowest SES group—particularly in those states that expanded Medicaid coverage in 2010—and nationwide following the expansion of insurance coverage in 2014. In Canada, we would expect colon cancer survival to improve as programmatic colorectal cancer screening was rolled out throughout Canada. Comparative analyses of population-based cancer survival can help to measure progress in the achievement of these objectives and help identify opportunities to improve health systems and guide public health actions to improve cancer outcomes.

Strengths and Limitations

Our study had several notable strengths. First, CONCORD-2 provided very high population coverage of cancer survival for Canada (99%) and the United States (73%). Second, CONCORD-2 produced robustly comparable survival estimates.[4] All registries collected a uniform set of high-quality cancer survival data and survival estimates were comparable because death ascertainment was virtually complete.[57] During this period, participating registries ascertained almost all deaths among their cancer patients through linkages with their respective state or provincial vital records offices and with their national death indices. In addition, participating registries followed a common protocol in which their data were centrally evaluated and analyzed, including the use of life tables, which adjusted for differences in background mortality.

However, our study had several limitations. Neither US nor Canadian cancer registries collect patient-level SES. Therefore, SES was ecologically defined using county of diagnosis in the United States and postal code in Canada. In addition, SES was defined somewhat differently in Canada (income) and the United States (SES index). SES quintiles reflect the socioeconomic gradient in each country. We recommend caution when comparing between-country SES-specific survival estimates. This study did not collect stage data from participating registries because stage data were not available from all cancer registries during the period of this study.

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