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Use of Adjuvant Chemotherapy among Stage II Colon Cancer Patients in 10 Population-Based National Program of Cancer Registries

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Abstract

Background—Some guidelines advise adjuvant chemotherapy be considered after surgical resection for high-risk stage II colon cancer patients; however, high-risk criteria are poorly defined and the long-term benefits are still debated. This study documents patterns of care by selected patient and tumor characteristics using a US population-based cohort of stage II colon cancer patients diagnosed in 2011.

Methods—Data were collected from 10 specialized cancer registries participating in the Centers for Disease Control and Prevention's National Program of Cancer Registries' Enhancing Cancer Registry Data for Comparative Effectiveness Research project. The data were used to describe characteristics of stage II colon cancer patients treated by surgery to evaluate factors associated with receiving adjuvant chemotherapy.

Results—Of the 3,891 stage II colon cancer patients, 14.3% were treated with surgery and adjuvant chemotherapy compared to 82.9% by surgery alone. The patients treated with adjuvant chemotherapy were predominately non-Hispanic white (66.1%), of younger age, and had private insurance (39.9%). Compared to surgery alone, the 5 characteristics associated with adjuvant therapy were younger age (adjusted odds ratio [AOR] for 5-year decrease below 75 years, 1.25; $P < .001$); more advanced stage (IIB/IIC vs IIA) (AOR, 4.79; $P < .001$); lymphovascular invasion (AOR, 1.76, $P < .001$); higher grade (III/IV vs I/II) (AOR, 1.84; $P < .001$); and registry area.

Conclusions—In this population-based cohort, younger patients with more advanced stage II colon tumors, with lymphovascular invasion, and poor differentiation were more likely to receive

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adjuvant chemotherapy in addition to surgery. These characteristics align with high-risk profiles defined in guidelines. Ongoing data collection on outcomes, including recurrence and survival, will help clarify the benefits of adjuvant treatments for stage II colon patients.

Keywords

adjuvant; cancer registries; chemotherapy; colonic neoplasms; National Program of Cancer Registries; stage II

Background

In 2012, colon cancer was the fourth leading cause of cancer incidence and mortality in the United States, representing 71% of the cancers of large intestine (colon and rectum), with an age adjusted incidence rate of 27.8 per 100,000 persons.[1] While surgery has been the primary curative treatment mode for colon cancer, adjuvant chemotherapy has been shown to decrease the risk of recurrence in some patients.[2–4] However, early assessments of the survival benefits of adjuvant therapy did not support its use for all resected stage II colon cancer patients.[2,4] The American Society of Clinical Oncology's (ASCO) guidelines indicated in 2004[3] that clinical trial evidence was insufficient to recommend adjuvant chemotherapy but the benefits in stage III patients could be considered in making treatment decisions in high-risk stage II patients. Following these recommendations, the benefit of adjuvant chemotherapy for stage II cancer cases was assessed in multiple studies[5–7] with varied conclusions. Based on evidence from randomized clinical trials, Jonker et al argued high-risk stage II patients had survival more similar to stage III disease with a 5-year overall survival of 40% to 50%.[8] However, their resulting conclusions mirrored ASCO's guidelines since the risks of adjuvant chemotherapy are significant and must be weighed against the possible benefits.[8]

Similar to previous recommendations, the National Comprehensive Cancer Network 2016 treatment guidelines for surgically resected, stage II colon cancer patients include adjuvant treatment options ranging from clinical trial recruitment and initiation of standard follow-up testing, to considering specific chemotherapies.[10] However, the risks related to chemotherapy contrasted with the potential for reduced recurrence makes this decision a complex one. Therefore, while the identification of high-risk stage II patients is critical when determining adjuvant treatment approaches, the definition of what constitutes *high risk* is unclear.[9] A number of factors that could place a patient into a high-risk category have been suggested; however, a single list of proven prognostic characteristics has not been identified. Tumor characteristics studied which may be prognostic include vascular invasion, T4 lesion, bowel perforation, inadequately sampled lymph nodes, poor differentiation, bowel obstruction, and microsatellite instability;[3, 8] those with less evidence include KRAS (mutation indicative of poorer survival and no benefit from adjuvant therapy[11]) and carcinoembryonic antigen (CEA).[12] Clinical trials have not been able to clearly identify specific prognostic factors, in part due to insufficient numbers of patients with these characteristics who can be prospectively followed.[13]

Prior population-based studies have been limited with respect to geographic and population characteristics, including age.[14–16] Given the variation in clinical recommendations and the lack of precision in defining high-risk stage II colon cancer patients, receipt of adjuvant chemotherapy may vary significantly by characteristics of the tumor as well as patient characteristics.[15] Focusing on stage II colon cancer cases diagnosed in 2011, we evaluated the use of adjuvant treatment by tumor and patient characteristics in a population-based study that spanned 10 US states and included people of all ages, genders, and races/ethnicities in these areas.

Methods

Detailed methods of the National Program of Cancer Registries (NPCR) Enhancing Cancer Registry Data for Comparative Effectiveness Research (CER) project have previously been described.[17] In brief, in addition to the North American Association of Central Cancer Registries (NAACCR) standard data variables[17, 18] that population-based cancer registries routinely collect (eg, patient demographics, tumor characteristics, and cancer stage), the 10 NPCR CER specialized registry areas (including the entire states of Alaska, Colorado, Idaho, Louisiana, New Hampshire, North Carolina, Rhode Island and Texas, as well as 13 counties of the California Sacramento region, and 5 Miami, Florida metro counties) also collected expanded patient information. This includes census tract-level socioeconomic status, tumor biomarkers, and detailed first course of cancer-directed treatment.[17,19]

First course of cancer treatment was defined as the therapy regimen that was given or planned at the time of initial diagnosis, prior to disease recurrence or progression.[19] In addition to the routinely collected detailed information on surgery and radiation, the CER project also collected complete adjuvant treatment occurring within 12 months of diagnosis. The chemotherapy data included each chemotherapy agent's name and Chemotherapy National Service Center (NSC) number, plus start and end dates of chemotherapy by agent.

Data were abstracted from hospital and nonhospital (for example, outpatient and independent hematology/oncology practice groups) sources. Cases were followed back to treating physician and/or facility to obtain missing information. First course of treatment received within 12 months of diagnosis was edited and consolidated so that the data could be provided for comparative effectiveness of treatments. All CER areas ran their data through the NAACCR Hispanic Identification Algorithm[20] and the NAACCR Asian/Pacific Islander Identification Algorithm.[21] They also participated in linkages with the Indian Health Service to improve the quality of their data on race and ethnicity.[22]

In this study, cases were male and female patients diagnosed in 2011 with colon cancer (American Joint Commission on Cancer, 7th edition [AJCC-7] criteria;[23] primary site C18.0–18.9 and all histologies except 9050–9055, 9140, and 9590–9992) at stage II, categorized using the Collaborative Stage AJCC-7 derived stage group variable.[24] Data from the November 2014 submission to the Centers for Disease Control and Prevention were used in this analysis. We excluded patients who died 30 days or less after resection (n = 152), were identified only through a death certificate or autopsy report (n = 3), were missing race (n = 8), were missing sex or were coded as "other" sex (n = 1), or whose adjuvant

chemotherapy was initiated 365 days or more after resection (n = 2), resulting in 3,891 stage II colon cancer patients in the analysis.

Frequencies and percentages were calculated for patients' demographics, tumor, and treatment characteristics using SAS 9.3 (SAS Institute). Demographic characteristics included: sex, race/ethnicity, age, chronic disease status (using Charlson comorbidity index comorbidities,[25] which were grouped into 3 categories: *non-Charlson comorbidity*, *1 Charlson comorbidity* or *2 or more Charlson comorbidities*; those who were coded as having no comorbidity were set to *unknown*, as this category could have included both individuals having no comorbid conditions and situations where there was no mention of comorbidity in the medical record), insurance payer, and US census tract level measures of family poverty status and urbanization. Census tracts were created by geocoding patient's residence at the time of diagnosis and linking case data with Census Bureau census tract level socioeconomic indicators, including family poverty level (percent of families below Federal poverty level) and urbanization (100% urban setting, 100% rural setting, and mixed urban and rural settings).[17] Tumor characteristics were stage category (IIA, IIB, or IIC based on whether the primary tumor is classified as T3, T4a, or T4b, respectively[17]), grade, number of nodes examined (total number of regional lymph nodes that were removed and examined by a pathologist), and lymphatic and/or vascular invasion (as reported in the pathology report). Treatment was categorized as surgery-only or surgery plus adjuvant chemotherapy, based on dates of surgery and start date of chemotherapy and a valid NSC chemotherapy agent for treating colon cancer.

Statistically significant ($P < .05$) characteristics associated with patients receiving adjuvant chemotherapy in addition to surgical resection were assessed using logistic regression. Due to a high percentage of missing comorbidity data, a multivariate analysis was conducted using multiple imputations for missing data. The imputation was conducted using R (3.14–5)[26] software, Hmisc[27] package's *aregImpute* function. This method consists of multiple imputations using predictive mean matching. Ultimately, the imputed data were not used because characteristics associated with patients receiving adjuvant chemotherapy did not differ and also the significance level of association in the models using imputed and non-imputed data did not differ greatly. Furthermore, comorbidity was not significant after adjusting for other covariates and was excluded from the final model.

The final model was developed using backward elimination variable selection. The linearity assumption for the continuous age variable was tested using restricted cubic spline functions[28] and it was found to be nonlinear. The age variable was transformed in the final model using a linear spline. Age was split into 2 linear segments at age 75 and the odds ratios for this continuous variable are presented for 5-year increments. Additional information on restricted cubic spline regression and transforming independent variables is available at http://support.sas.com/resources/papers/proceedings16/5621-2016.pdf (Croxford R. Restricted cubic spline regression: a brief introduction. SAS Paper 5621-2016). Cases missing adjuvant chemotherapy information (n = 110) were excluded from the final model. Patient's sex and race/ethnicity were controlled for in the final model, although they were not significant. Modeling was conducted in R (version 3.1.1).[27]

Results

Of the 3,891 stage II colon cancer patients diagnosed in the 10 specialized registry areas, 14.3% (n = 557) were treated with adjuvant chemotherapy following surgery and 82.9% (n = 3,224) were treated with surgery alone (Table 1). The percent distributions of sex between the treatment groups were similar; 52.0% of the surgery alone and 51.2% of the surgery plus adjuvant patients were women. The distribution of race/ethnicity for surgery-only patients and surgery plus adjuvant patients was 70.1% vs 66.1% non-Hispanic white, 12.2% vs 14.4% non-Hispanic black, and 14.6% vs 16.3% Hispanic (Table 1). The patients who were treated with adjuvant chemotherapy were younger (median age: 60.9 years) compared to surgery-only patients (median age: 70.7 years). Correspondingly, there was a higher percent of patients with 2 or more Charlson comorbidity conditions among the surgery-only patients compared to those receiving adjuvant therapy (10.6% vs 5.9%, respectively). A larger proportion of surgery-only patients were covered by Medicare alone (44.6%) than those treated with surgery and adjuvant chemotherapy (28.0%) (Table 1).

The 2 treatment groups were similar in sociodemographic characteristics. The census level assessment of poverty (ie, patients who lived in a census tract where ≥20% of families had incomes below the Federal poverty line in the last 12 months) for surgery-only patients and surgery plus adjuvant patients was 17.4% and 14.2%, respectively. Also, the percent of surgery-only patients living in a 100% urban census tract, as defined by the US Census, was 58.9% and 52.4% for patients also receiving adjuvant chemotherapy (Table 1).

There were differences in the tumor characteristics of the 2 treatment groups. These included stage: the surgery-only patients had a higher frequency of stage IIA (89.5%) than the patients treated with surgery and adjuvant chemotherapy (65.7%). Surgery-only patients also had a lower frequency of grade III cancer (14.0%) compared to patients treated with adjuvant chemotherapy (21.5%); and lymphovascular invasion was present less frequently among surgery-only patients (11.3%) than patients treated with surgery and adjuvant chemotherapy (20.8%). However, the 2 groups were similar in regards to the number of nodes examined: 85.2% and 85.1% of the surgery-only patients and surgery plus adjuvant therapy patients, respectively, had 12 or more nodes examined (Table 1).

Table 2 shows the 5 characteristics associated with a patient being treated by surgery and adjuvant chemotherapy: younger age (in age segment below 75 years, every 5-year decrease was associated with an adjusted odds ratio [AOR] of 1.25; 95% CI, 1.18–1.31; and for age segment above 75 years, every 5-year decrease was associated with AOR of 2.80; 95% CI, 2.12–3.68); higher stage (AOR comparing IIB/IIC to IIA, 4.79; 95% CI, 3.71–6.17); higher tumor grade (AOR comparing Grade High III/IV vs Low I/II, 1.84; 95% CI, 1.41–2.40); the presence of lymphovascular invasion (AOR comparing invasion to no invasion, 1.76; 95% CI, 1.34–2.31); and registry area (for example, AOR comparing North Carolina to Texas, 1.54; 95% CI, 1.12–2.11 and AOR comparing Rhode Island to Texas, 2.61; 95% CI, 1.37–4.98).

Discussion

For patients with surgically resected stage II colon cancer, adjuvant chemotherapy is not always beneficial[29] or routinely recommended. Identification of characteristics that indicate a higher risk of recurrence or progression is important in avoiding the risks associated with chemotherapy in patients who are not likely to benefit.[3,8] We examined the use of adjuvant therapy in a population-based study utilizing data from 10 population-based cancer registries which collected expanded data for colorectal cancer patients diagnosed in 2011. The inclusion of all stage II colon cancer patients allows an unbiased examination to the use of adjuvant chemotherapy in this study population.

Only 14.3% of stage II colon cancer patients in our study were treated with adjuvant chemotherapy after surgery. Those treated with adjuvant chemotherapy tended to be younger (median age, 60.9 years) than those treated with surgery alone (median age, 70.7 years). There was a nonlinear relationship between chemotherapy and age. When age was modeled as 2 linear segments, we found that, among patients younger than 75 years, those 5 years younger had 1.25 times the odds of receiving surgery and adjuvant chemotherapy compared to someone 5 years older. Among patients older than 75 years, the effect was larger: someone 5 years younger had 2.80 times the odds of receiving surgery and adjuvant chemotherapy than an individual 5 years their senior.

Adjuvant chemotherapy was more frequently used in patients whose cancer was a stage IIB or IIC and somewhat more common for those with a high grade tumor or lymphovascular invasion. Having 2 or more Charlson comorbidities and Medicare-only insurance was more common among those with surgery alone. We did find geographic differences in treatment patterns (specifically, more adjuvant chemotherapy in Idaho, Louisiana, North Carolina and Rhode Island); however, we did not detect an obvious regional effect. Our statistical modeling included race and ethnicity in addition to demographics: insurance status, urban/rural residence, Charlson comorbidities, and poverty status based on census tracts. In the final model, the factors significantly associated with receiving adjuvant therapy following surgery were: younger age, stage (IIB/IIC vs IIA), grade (high vs low); lymphovascular invasion (presence vs absence) and registry area. More advanced stage of disease (stage IIB/C) was the strongest indicator for adjuvant therapy with an adjusted odds ratio of 4.79 (3.71–6.17) when compared to stage IIA patients.

While our study provides population-based data, there were limitations with respect to the analysis. Because cancer registry data are based on clinically-relevant data available in the medical chart and some factors known to influence patterns of care are not routinely and consistently captured in clinical documentation, we were unable to examine some variables of interest such as patient’s preference. We were not able to examine individual level measures of poverty or “urbanicity” and instead used area-based measures. We also did not have needed detail to explore the differences identified among the registry areas. With respect to high-risk tumor characteristics, we were not able to examine colon obstruction or microsatellite instability, which may have influenced treatment decisions[13] (the project did not collect data on colon obstruction and, while microsatellite instability was collected, the number of missing values was too high to allow for inclusion in the analyses). Though

information on comorbidities was collected from medical charts and data linkages for this study, we could not discern between those instances where no comorbidities existed and when data were missing. Consequently, a large proportion of the comorbidity information was treated as missing. There were indications in the modeling that those with 2 or more Charlson comorbidities were less likely to receive adjuvant chemotherapy; however, multiple imputation was used to impute missing comorbidity data and comorbidities overall were not significant in the final model. The presence of comorbid conditions has been shown to be associated with less aggressive treatment in other population-based studies.[15,30,31]

Increasing age is often associated with the presence of comorbid conditions and both are related to cancer survival.[32] The relationship between age, comorbidity, and cancer is a complex, influencing the risk of cancer occurrence, treatment, and outcomes.[29,33,34] In our study, increasing age was significantly associated with less aggressive treatment, but we were not able to fully explore the possible confounding relationship between age and comorbidities. However, a meta-analysis of treatment in colorectal cancer patients of all stages indicated that older patients in good health otherwise had survival benefits from the use of chemotherapy.[32] Health insurance status has been found to influence many aspects of cancer care[35]; however, it is also strongly correlated with age because of the eligibility criteria for Medicare coverage. Because of this collinearity, insurance was removed from the final model for our study.

Conclusions

Within the 10 geographic areas included in this study, surgery is often used alone for stage II colon cancer patients, particularly for stage IIA. In addition, in most, though certainly not all cases, adjuvant therapy was focused on patients with the higher risk characteristics that had been identified in practice-based guidelines at the time that treatment decisions were made. These findings correspond with guideline recommendations that adjuvant chemotherapy should not be routinely administered and physicians consider discussing the option with patients who are at risk of recurrence.[3,10,13] Given the variation in the characteristics of the states and regions included in this study, the surgical and chemotherapy practices are likely similar to those that would be found throughout the United States. Our study included all ages, genders, races, and income levels which can only be accomplished through a large population-based cohort. This population is being followed and data collected on recurrence, progression, and mortality. Subsequent comparative effectiveness analyses based on these data will provide population-based assessments of survival outcomes among these patients.

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Table 1

Selected Demographic, Tumor, and Treatment Characteristics of Individuals with Stage II Colon Cancer Diagnosed in 2011[a,b,] within 10 NPCR Cancer Registry Areas

	Stage II Colon Cancer		Stage II, Surgery Alone		Stage II, Surgery and Adjuvant Chemotherapy	
	n = 3,891		n = 3,224		n = 557	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Treatments classification						
Surgery alone	3,224	82.9	3,224	100.0	N/A	.
Chemotherapy alone	__[c]	__[c]	N/A	.	N/A	.
Surgery and adjuvant chemotherapy	557	14.3	N/A	.	557	100.0
Neo-adjuvant chemotherapy	—	—	N/A	.	N/A	.
No surgery or chemotherapy	41	1.1	N/A	.	N/A	.
Incomplete data[d]	45	1.2	N/A	.	N/A	.
Sex						
Male	1,879	48.3	1,547	48.0	272	48.8
Female	2,012	51.7	1,677	52.0	285	51.2
Race-ethnicity						
Non-Hispanic white	2,699	69.4	2,261	70.1	368	66.1
Non-Hispanic black	485	12.5	392	12.2	80	14.4
Hispanic	589	15.1	472	14.6	91	16.3
Non-Hispanic other[e]	118	3.0	99	3.1	18	3.2
Age (years)						
0–49	299	7.7	183	5.7	104	18.7
50–59	609	15.7	456	14.1	135	24.2
60–69	951	24.4	749	23.2	167	30.0
70–79	1,071	27.5	926	28.7	119	21.4
≥ 80	961	24.7	910	28.2	32	5.8
Age (years) – Median						
	69.2		70.7		60.9	

	Stage II Colon Cancer		Stage II, Surgery Alone		Stage II, Surgery and Adjuvant Chemotherapy	
	n = 3,891		n = 3,224		n = 557	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Chronic disease status						
Non-Charlson comorbidity	1,411	36.3	1,130	35.1	240	43.1
1 Charlson comorbidity	828	21.3	697	21.6	111	19.9
≥ 2 Charlson comorbidity	382	9.8	341	10.6	33	5.9
No comorbidity or missing data	1,270	32.6	1,056	32.8	173	31.1
Payer						
No insurance	230	5.9	163	5.1	58	10.4
Private	1,057	27.2	807	25.0	222	39.9
Public: Medicaid	375	9.6	312	9.7	51	9.2
Public: Medicare (only)	1,638	42.1	1,438	44.6	156	28.0
Public: Medicare and private	365	9.4	322	10.0	35	6.3
Other[f]	125	3.2	98	3.0	20	3.6
Unknown/missing	101	2.6	84	2.6	—	—
Poverty group (census level)[g]						
Not in poverty	3,192	82.0	2,644	82.0	476	85.5
Poverty	674	17.3	560	17.4	79	14.2
Unknown/missing	25	0.6	20	0.6	—	—
Urban/Rural (census level)[h]						
100% urban	2,240	57.6	1,899	58.9	292	52.4
100% rural	369	9.5	297	9.2	65	11.7
Mixed urban and rural	1,260	32.4	1,010	31.3	199	35.7
Unknown/missing	22	0.6	18	0.6	—	—
Derived stage[i]						
Stage IIA	3,305	84.9	2,884	89.5	366	65.7
Stage IIB	294	7.6	193	6.0	94	16.9
Stage IIC	285	7.3	143	4.4	95	17.1
Stage II NOS	—	—	—	—	—	—

	Stage II Colon Cancer		Stage II, Surgery Alone		Stage II, Surgery and Adjuvant Chemotherapy	
	n = 3,891		n = 3,224		n = 557	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Grade						
Well differentiated (I)	317	8.2	270	8.4	42	7.5
Moderately differentiated (II)	2,811	72.2	2,386	74.0	366	65.7
Poorly differentiated (III)	591	15.2	452	14.0	120	21.5
Undifferentiated (IV)	65	1.7	49	1.5	16	2.9
Unknown/missing	107	2.8	67	2.1	—	—
Lymphovascular invasion						
Not present	2,668	68.6	2,269	70.4	370	66.4
Present	484	12.4	363	11.3	116	20.8
Not applicable	125	3.2	101	3.1	17	3.1
No information in pathology report	299	7.7	230	7.1	40	7.2
Missing	315	8.1	261	8.1	—	—
Number of nodes examined						
0	78	2.0	22	0.7	—	—
1–11	521	13.4	435	13.5	75	13.5
≥12	3,266	83.9	2,748	85.2	474	85.1
Unknown/missing	26	0.7	19	0.6	—	—

N/A, not applicable; NOS, not otherwise specified; NPCR, National Program of Cancer Registries.

[a] American Joint Commission on Cancer 7th Edition definition of colon cancer. Excludes those with death certificate diagnosis only/autopsy diagnosis only, sex unknown or other, or race unknown.

[b] Demographics of patients with multiple sequence numbers are only reported once; this excludes 31 observations.

[c] Frequencies and percentages suppressed if fewer than 16 cases were reported in a specific category.

[d] Treatment classification was not possible as information on the patient's surgery data, chemotherapy and/or chemotherapeutic agent information were missing.

[e] Non-Hispanic other includes American Indian or Alaskan Native and Asian or Pacific Islander.

[f] Other insurance includes Tricare, Veterans Affairs, and Indian/Public Health Service.

[g] Not in poverty defined as <20% of census tract families had income below Federal poverty line in last 12 months; Poverty defined as: ≥20% of census tract families had income below poverty line in last 12 months.

[h] A census tract residence was considered urban if all households in that census tract were considered to be in an urban setting as defined by the Census Bureau, rural if all households in that census tract were considered to be in a rural setting, and mixed if some of the households in the census tract were considered to be in an urban setting and some in a rural setting.

[i] American Joint Commission on Cancer 7th Edition Stage Group from coded fields using Collaborative Stage algorithm.

Table 2

Characteristics Associated with Being Treated by Surgery and Adjuvant Chemotherapy vs Surgery Alone for Individuals with Stage II Colon Cancer Diagnosed in 2011 within 10 NPCR Cancer Registries

Characteristic	Unadjusted Odds Ratio	95% CI	P	Adjusted Odds Ratio	95% CI	P
Age, 5-year decrease in the below 75 years segment	1.21	1.16–1.27	<.001	1.25	1.18–1.31	<.001
Age, 5-year decrease in the above 75 years segment	2.42	1.91–3.07	<.001	2.80	2.12–3.68	<.001
Stage (IIB/IIC vs IIA)[a]	4.43	3.60–5.46	<.001	4.79	3.71–6.17	<.001
Grade (High III/IV vs Low I/II)	1.77	1.42–2.19	<.001	1.84	1.41–2.40	<.001
Lymphovascular invasion (invasion vs no invasion)	1.96	1.55–2.48	<.001	1.76	1.34–2.31	<.001
Sex (male vs female)	1.04	0.86–1.24	.71	0.95	0.77–1.18	.66
Race/ethnicity						
Non-Hispanic black vs Non-Hispanic white	1.25	0.96–1.63	.39	0.95	0.69–1.31	.75
Hispanic vs Non-Hispanic white	1.19	0.92–1.52	.70	1.15	0.82–1.60	.41
Non-Hispanic other vs Non-Hispanic white	1.12	0.67–1.87	.94	0.97	0.50–1.87	.92
NPCR CER area or registry						
Alaska vs Texas	0.94	0.37–2.43	.61	0.75	0.24–2.36	.62
California-Sacramento[b] vs Texas	0.71	0.45–1.14	.02	0.91	0.51–1.59	.73
Colorado vs Texas	1.14	0.80–1.65	.88	1.20	0.77–1.86	.42
Florida-Metro Miami[c] vs Texas	1.22	0.92–1.61	.79	1.28	0.91–1.81	.16
Idaho vs Texas	1.57	0.94–2.62	.22	2.16	1.18–3.95	.01
Louisiana vs Texas	1.88	1.40–2.53	<.001	2.05	1.42–2.97	<.001
North Carolina vs Texas	1.46	1.12–1.90	.08	1.54	1.12–2.11	.01
New Hampshire vs Texas	0.60	0.29–1.26	.05	0.70	0.31–1.58	.39
Rhode Island vs Texas	2.06	1.19–3.57	.03	2.61	1.37–4.98	<.01

NPCR, National Program of Cancer Registries.

[a] American Joint Commission on Cancer 7th Edition Stage Group from coded fields using Collaborative Stage algorithm

[b] California-Sacramento includes Alpine, Amador, Calaveras, El Dorado, Nevada, Placer, Sacramento, San Joaquin, Sierra, Solano, Sutter, Yolo, and Yuba counties.

[c] Florida-Miami includes Broward, Hillsborough, Miami-Dade, Orange, and Palm Beach counties.