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Variations in Stage at Diagnosis, Surgical Treatment, and Survival among Patients of Metropolitan Residence: An Analysis of Gastric Adenocarcinoma Patients Using the National Cancer Data Base, 2004-2012

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By

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B.S.
Michigan State University
2013

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Rollins School of Public Health of Emory University
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Variations in Stage at Diagnosis, Surgical Treatment, and Survival among Patients of Metropolitan Residence: An Analysis of Gastric Adenocarcinoma Patients Using the National Cancer Data Base, 2004-2012

By Meghan Raycraft

Background: Gastric cancer outcomes may differ by demographic and socioeconomic characteristics even after taking clinical factors into consideration. This study evaluated predictors of late diagnosis, surgery receipt and post diagnosis survival among gastric cancer patients included in the National Cancer Data Base from 2004-2012.
Methods: The focus of these analyses was on the role of residence in metropolitan versus non-metropolitan areas. Separate multivariable logistic regression analyses were performed to evaluate the associations of residence with two outcomes: late stage cancer diagnosis and receipt of surgical procedure with curative intent. Multivariable Cox proportional hazards models were used to examine the association between survival and metropolitan residence status after controlling for various patient, disease, and treatment-related variables. Separate models were used for stages I-III.
Results: Patients residing metropolitan areas, those from non-metropolitan areas adjacent to metropolitan areas and those living in areas non-adjacent to metropolitan areas did not differ with respect to the likelihood of late diagnosis or surgery receipt. Associations between metropolitan residence and survival differed by disease stage. Among patients with stage III disease, the difference between metropolitan and non-metropolitan residence was significantly associated with worse survival with hazard ratios (95% confidence intervals) of 1.13 (1.03, 1.23) and 1.20 (1.06, 1.35), respectively, for residencies adjacent and non-adjacent to metropolitan areas. **Conclusions:** These results indicate the possible underlying residence-based differences in survival among gastric cancer patients treated with surgery.

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BACKGROUND

Gastric cancer ranks high among malignancies in terms of worldwide mortality burden (1, 2) and disability-adjusted life years lost (2, 3). Although this disease has relatively low incidence in the United States (4-6), no cost-effective screening tests are available; thus, most patients present with advanced stages (2, 4, 5, 7). Gastric cancer prognosis is generally poor (1-3). Of approximately 26,370 patients diagnosed annually in the U.S., an estimated 10,730 die of the disease (8).

Around 90% of gastric cancers are adenocarcinomas, located in the most superficial layer of the stomach (2). Two types of gastric cancer are recognized based on primary location of the tumor; cardia (proximal) gastric cancer arises from the upper portion of the stomach and noncardia (distal) gastric cancer arises from the other parts of the organ. The two types of the gastric cancer differ in terms of risk factors and incidence (2, 9, 10). Whereas overall gastric cancer incidence rates have been declining in most of the world, incidence rates of cardia gastric cancer have remained stable or increased (2, 6, 9).

Risk factors unique to cardia gastric cancer include obesity and gastroesophageal reflux disease (2, 9). A unique risk factor for noncardia gastric cancer is *Helicobacter pylori* infection, which is associated with low socioeconomic status and certain dietary patterns, and is estimated to account for up to 70% of global gastric cancer cases (2). Risk factors for both types include increasing age, male sex, smoking, and race (in the U.S., white race is a risk for cardia gastric cancer and Hispanic race as a risk for noncardia gastric cancer) (2, 11).

Gastric cancer treatment is complex, and patterns and standards of screening and care differ across the world (1, 2, 5, 6, 12). Surgery is currently the only curative treatment option, but is often not possible due to the advanced stage of disease at presentation (3, 5). Survival is related to stage at diagnosis and the combination of therapies used (13). A 2014 analysis of data from the National Cancer Data Base (NCDB) showed increasing use of chemoradiotherapy across all facility types (14), but care variation still exists and overall clinical outcomes remain poor (15). Factors associated with better outcomes include treatment at a higher volume hospital (4, 6, 7, 13, 15), multidisciplinary treatment (5), younger age (7, 16), Asian race (16), female sex (7, 16), earlier stage (16), lower grade (16), distal location (16), multimodality treatment (16) and treatment at teaching hospital (16).

A decline in gastric cancer incidence and mortality in industrialized countries has increased attention toward social, environmental, socioeconomic (3, 11), and lifestyle (8) risk factors. Socioeconomic status is related to differential exposure to *H. pylori* bacteria, certain occupational exposures, and diet and substance use habits (9, 11). Socioeconomic effects may be mediated by factors related to healthcare access, treatment, and characteristics of treatment facilities (9, 16). While gastric cancer has higher incidence in lower socioeconomic strata, mechanisms of this association remain unclear (17). Underlying cultural and lifestyle factors that contribute to socioeconomic status require further investigation in the context of gastric cancer risk (11, 17). Race is associated with differences in presentation, treatment, and survival of gastric cancer in the United States (2, 6, 9, 15, 16, 18). These disparities may be explained by differences in health insurance status, annual household incomes, American Joint Committee on

Cancer (AJCC) disease stage at presentation, facility type and volume, and receipt of adjuvant multimodality therapy (9, 15).

Additional risk factors may include residence in rural regions. (9, 11). However, most of the available research has been regional (16) and there is limited understanding of the roles of ethnicity, socioeconomic variables, residential factors and facility-related variables in gastric cancer outcomes across the Unites States (15, 16).

With these knowledge gaps in mind, the purpose of this study was to evaluate predictors of survival after gastric cancer surgery using national data covering the 9-year period from 2004 through the end of 2012. An additional research aim was to evaluate factors associated with differences in stage of gastric cancer at diagnosis and differences in receipt of surgical treatment that may reflect underlying disparities in gastric cancer care.

METHODS

Data source

The National Cancer Data Base (NCDB) was established in 1989 by the American College of Surgeons Commission on Cancer (CoC) and later supported by the American Cancer Society to systematically collect data from hospital cancer registries (19). Cases from CoC approved facilities (15), including teaching hospitals, comprehensive cancer centers, and community cancer programs, are included (16). These types of facilities provide care to 75% of cancer cases nationwide (15, 19). NCDB data describe characteristics of patients, tumors, and treatment (16, 19) and allow analyses of clinical and socioeconomic factors that are thought to influence cancer care and outcomes.

Eligibility and selection

The patient population in this study includes gastric cancer cases from the NCDB, as defined by primary site according to the International Classification of Diseases, 9th Revision, diagnosed from 2004 through 2012. These include cases originating from a primary site of the cardia, fundus of stomach, body of stomach, gastric antrum, pylorus, lesser curvature of the stomach, and greater curvature of the stomach. Cases originating from the stomach but not otherwise specified were excluded. Cases were limited to those with invasive behavior and diagnosed as stage I-IV according to AJCC Clinical Stage Group 6th edition staging. Only cases of a patient's first or only cancer were included. Because of our interest in socio-demographic variables and metropolitan residence, patients whose status was unknown or undefined with respect to race, AJCC stage, treatment facility type, or residence were excluded.

Variable classification

The main exposure of interest was metropolitan status based on the county of residence at the time of diagnosis. NCDB defines metropolitan, urban, or rural status by county population size and location relative to a metropolitan area, based on classifications from the USDA Economic Research Service. These classifications distinguish county federal information processing (FIPS) codes by population size, degree of urbanization, and adjacency to a metropolitan area. The NCDB separates counties into nine categories, of which the following were considered metropolitan: counties in metropolitan areas with populations of 1 million, counties in metropolitan areas with populations ranging from 250,000 to 1 million, and counties in metropolitan areas with populations fewer than 250,000. All other counties were considered non-metropolitan, including those described as: urban population of 20,000 or more adjacent or non-adjacent to a metropolitan area, urban population of 2,500 to 19,999 adjacent or non-adjacent to a metropolitan area, and completely rural or less than 2,500 urban population, adjacent or non-adjacent to a metropolitan area. Adjacent and non-adjacent counties (of any population) were considered in two separate, non-metropolitan groups characterized by their proximity to a metropolitan area. Three different analyses used three dependent variables of interest: 1) AJCC stage at diagnosis (III-IV vs. I-II); 2) receipt of surgical treatment, defined as any surgical procedure at a CoC facility for a patient with stage I-III disease (Yes vs. No); and 60-month overall survival. Survival analyses were limited to patients who received procedures coded for surgery with curative intent.

Demographic and clinical covariates included age, sex, race, primary site, histologic grade, Charlson-Deyo comorbidity score, and treatment facility type. Age at diagnosis was grouped into ten-year age groups with the exception of patients under 50 and older than 80 years. Race/ethnicity was categorized as: Non-Hispanic White (NHW), African American (AA), Asian/Pacific Islander (API), and Hispanic. Primary site was defined as described by selection criteria. Histologic grade was dichotomized as grades 1-2 vs. grades 3-4. The Charlson-Deyo comorbidity score is a single value that represents a cumulative summary of up to ten specified comorbid conditions; a score of 0 indicates no comorbid conditions were recorded for the patient.

Statistical analysis

All statistical analyses were conducted using SAS 9.4 (SAS Institute, Cary, NC, USA). Chi-square tests were performed to examine distributions of categorical variables by metropolitan status.

Separate multivariable logistic regression analyses were performed to evaluate the associations of metropolitan residence with two outcomes: late stage cancer diagnosis (AJCC stage III or IV) and receipt of surgery with curative intent. The first logistic regression model included all eligible patients and the second model was based on a subset of the cohort participants with non-metastatic disease (AJCC stage I-III). Covariates in both analyses included sex, race/ethnicity, age group, primary site, histologic grade, Charlson-Deyo score, and treatment facility type. Results of logistic regression models were expressed as adjusted odds ratios (ORs) and corresponding 95% confidence intervals (CIs).

A survival analysis was conducted among cases that received surgical procedures performed with curative intent with AJCC stage I-III disease. Kaplan-Meier curves were constructed to examine patient survival according to metropolitan residence and race and the comparisons were accompanied by the corresponding log-rank tests. Based on examination of the Kaplan-Meier curves, certain categorical variables were collapsed to fewer categories or dichotomized to facilitate the analysis.

Multivariable Cox proportional hazards models were used to examine the association between survival and metropolitan residence status after controlling for various patient, disease, and treatment-related variables. Separate models were used for each AJCC stage (I-III) due to known variation in prognosis due to different stages of disease (13, 16). The proportional hazards assumption was assessed by examining log-minus-log plots for each variable and predictors that did not satisfy the assumption were included as strata in each model. Results of the Cox models were expressed as adjusted hazard ratios (HRs) and the corresponding 95% CIs.

RESULTS

Descriptive analysis

As shown in Table 1, 37,092 gastric adenocarcinoma patients met the inclusion criteria. Significant differences were observed ($p<0.05$) based on metropolitan residence with respect to all demographic, disease, and treatment characteristics with the exception of Charlson-Deyo comorbidity score. Metropolitan areas had higher proportions of patients under the age of 50 and over the age of 80 years. Over 60% of patients in all areas were male, with the largest proportion of males in non-metropolitan areas not adjacent to a metropolitan area (70%). The proportion of NHW patients was greater in non-metropolitan areas (83-86%), compared with the metropolitan areas (63%). API patients, constituting the smallest proportion of cases, were more represented in metropolitan areas (10%) compared with non-metropolitan areas (1-2%). In all areas, most cases presented with AJCC stage I-III disease. Cardia gastric cancers represented the majority of cases, though the percentage in non-metropolitan areas was larger (50-52%) than that in metropolitan areas (39%). The gastric antrum was the most common noncardia primary site (17-23%) of gastric cancer in all areas. Nearly 60% of cases, irrespective of residency type, presented with grade 3 or 4 disease. Less than 10% of patients in all areas had a Charlson-Deyo score greater than 1, with most having no recorded comorbidities. The majority of patients received care at comprehensive community cancer programs, followed by academic/research centers, though treatment at an academic/research program was more common in patients living in metropolitan areas (44%), followed by non-metropolitan areas adjacent to metropolitan areas (41%) and those non-adjacent to a metropolitan area (37%).

Predictors of late-stage diagnosis

Results of multivariate logistic regression analysis assessing predictors of late (AJCC stage III-IV) gastric cancer diagnosis are presented in Table 2. There was no difference in late stage diagnosis among patients living in non-metropolitan areas compared with those of metropolitan residence. Using females as a reference, males were more likely to be diagnosed at late stage of disease (OR: 1.16, 95% CI: 1.10, 1.21). Hispanic (OR: 1.11, 95% CI: 1.03, 1.20) and AA (OR: 1.10, 95% CI: 1.03, 1.18) patients were at slightly increased odds of late stage diagnosis compared with NHW patients. Cases with histologic grade 3 or 4 were more likely to be diagnosed at advanced stage (OR: 2.56, 95% CI: 2.44, 2.68). Patients older than 50 years at diagnosis were less likely to be diagnosed at a later stage, as were those with cancer of most noncardia primary sites. Overlapping lesions of the stomach were more likely to present at late stage (OR: 1.37, 95% CI: 1.25, 1.50), compared with cardia gastric cancer. Charlson-Deyo score greater than 1 was associated with decreased odds of late stage diagnosis (OR: 0.78, 95% CI: 0.72, 0.85). Compared with those treated at academic/research programs, patients treated at community cancer programs (OR: 1.13, 95% CI: 1.05, 1.23) and those at comprehensive community cancer programs (OR: 1.11, 95% CI: 1.06, 1.16) were slightly more likely to be diagnosed with late stage disease.

Predictors of receipt of surgery with curative intent among AJCC stage I-III patients

Results of multivariate logistic regression analysis for predictors of receipt of surgical treatment with curative intent among AJCC stage I-III patients are presented in Table 3. Non-metropolitan residence was not significantly associated with surgical treatment regardless of proximity to metropolitan areas. Using NHW as the reference

category, API patients were more likely to receive surgery (OR: 1.27, 95% CI: 1.10, 1.46); the corresponding measures of association were in the opposite direction for AA (OR: 0.69, 95% CI: 0.63, 0.76) and Hispanics (OR: 0.82, 95% CI: 0.74, 0.91). All noncardia primary sites were associated with increased odds of curative surgical resection compared with cardia gastric cancers, with the result particularly pronounced for cancers of the lesser curvature (OR: 5.39, 95% CI: 4.69, 6.20). Other characteristics significantly associated with decreased odds of surgery were age 60 years or older, grade 3 or 4 disease, and treatment at a community cancer program or comprehensive community cancer program.

Predictors of survival among AJCC stage I-III surgically treated patients

Overall, 28,322 patients with AJCC stage I-III disease and surgical treatment with curative intent were eligible for survival analysis. As shown in Figure 1, those of metropolitan residence had consistently higher 60-month survival after gastric cancer diagnosis, compared with those of non-metropolitan residence. Patients residing in non-metropolitan areas that were adjacent to metropolitan areas demonstrated better survival than those non-adjacent to metropolitan areas (overall p-value<0.001). Further, as shown in Figure 2, API patients demonstrated consistently higher survival after gastric cancer diagnosis, compared with other racial and ethnic groups (overall p-value<0.001). Because API patients exhibited different trends compared with other races, race was dichotomized as API as one group and NHW, AA, and Hispanic together as a second group. Similarly, community cancer programs and comprehensive community cancer programs were combined into a single category and compared to academic/research programs.

Among those with stage I disease, non-metropolitan residence adjacent to a metropolitan area was associated with slightly worse survival compared with those of

metropolitan residence (HR: 1.25, 95% CI: 1.10, 1.41). The same was true for non-metropolitan areas that were not adjacent to a metropolitan area (HR: 1.24, 95% CI: 1.05, 1.47). Among those with stage II disease, no significant variation in overall survival existed in regards to metropolitan residence. For patients with stage III disease, non-metropolitan residence was significantly associated with poorer overall survival both for patients living adjacent to (HR: 1.13, 95% CI 1.03, 1.23) and not adjacent to (HR: 1.20, 95% CI: 1.06, 1.35) metropolitan areas.

Predictors significantly associated with poorer survival among those with stage I disease included age greater than 50 years, male sex (HR: 1.23, 95% CI: 1.13, 1.34) and higher Charlson-Deyo scores (for scores greater than 1, HR: 1.90, 95% CI: 1.69, 1.23). Factors significantly associated with improved survival among those with Stage I disease included API race (HR: 0.60, 0.51, 0.71) and treatment at an academic/research program (HR: 0.78, 95% CI: 0.72, 0.85). The magnitude of associations with age, sex, race, and Charlson-Deyo score weakened with increasing stage. The association between treatment at an academic/research program and better survival was strongest for patients with stage I disease and weakest for patients with stage II disease at diagnosis.

DISCUSSION

In a national sample of gastric adenocarcinoma cases, patients residing in metropolitan and non-metropolitan (rural or small urban) areas differ in regards to both demographic and clinical characteristics. Despite this, non-metropolitan residence was not significantly associated with late stage diagnosis after adjusting for other demographic and clinical factors. Further, non-metropolitan residence was not significantly associated with receipt of surgical treatment with curative intent among patients with stage I-III disease. These results for non-metropolitan residence did not differ by proximity to a metropolitan area. Unlike the results for the stage of diagnosis and surgery receipt, we found there was better post diagnosis survival among surgically treated patients of metropolitan residence compared with those of non-metropolitan residence both adjacent to and not adjacent to metropolitan areas. This association is most pronounced among patients with stage I and stage III disease.

In considering predictors of late stage diagnosis, our findings indicate that older patients were less likely to be diagnosed at a later stage; these results require further investigation, but perhaps rarity of gastric cancer in younger people (2), combined with lack of routine screening in the U.S. (2, 4), leads to lack of diagnosis in younger ages. Likewise, while not investigated in our analyses, it may be likely for patients with higher Charlson-Deyo scores to be diagnosed at earlier stages because their existing comorbidities may result in them having more contact with the healthcare system. Or, perhaps gastric cancer in healthier patients may not be immediately considered due to its rarity in the U.S. (2, 4). Further investigation is also needed to understand why patients treated at

community and comprehensive community cancer centers might be diagnosed at later stages.

A previous study using the National Cancer Institute's Surveillance, Epidemiology, and End Results Program (SEER), a U.S. population-based registry program, found no association between metropolitan residence and diagnosis of late stage cardia gastric adenocarcinoma (20). The study did find differences in overall survival among metropolitan and non-metropolitan patients with cardia gastric adenocarcinoma (20). Our study examines this relationship in greater detail by providing separate adjusted estimates for each disease stage and by differentiating between non-metropolitan counties that are adjacent and not-adjacent to metropolitan areas.

Strengths and weaknesses

Unlike prior regional studies of the impact of metropolitan residence on cancer treatment and outcomes (16), our research extends to the entire United States over a 9-year period and includes data from facilities which capture about 70% of cancer cases in the U.S. annually (15). Further, the incorporation of multiple analyses for different outcomes related to cancer treatment and survival allows for greater insights on how associations between patient demographic and clinical factors change based on advancing stages of cancer at diagnosis and type of treatment delivered.

An important limitation of this study is that the NCDB data are limited to patients who received care at CoC accredited hospitals. It is possible that patients included in the present analyses differ from other patients in important ways. Further, a number of variables that may be related to cancer stage at diagnosis, receipt of surgical treatment, and survival are not included in the NCDB. For example, data on physician characteristics and

type of chemotherapy are not included, nor is cause of death specified as cancer. Additionally, all data on metropolitan residence are aggregated at the county level and individual measures of socioeconomic status are not available.

These limitations notwithstanding, our study offers important observations about the possible relationship between metropolitan versus non-metropolitan residence and gastric cancer prognosis. While residence appeared to be unrelated to both timing of diagnosis and surgery receipt, there was evidence of worse survival among surgically treated gastric cancer patients who were diagnosed with advanced disease and who resided in non-metropolitan areas. The association was particularly evident for patients whose residence was not adjacent to a metropolitan area. Taken together, these observations point towards possible differences in quality of care.

FUTURE DIRECTIONS

In light of limitations of the NCDB, our results require confirmation; if the results are confirmed, future research should focus on factors that may explain the residential disparities in gastric cancer survival, particularly among patients with more advanced disease. Further, future analyses should investigate mechanisms behind the stronger association between residence and survival in patients with stage I and III disease, compared with stage II disease. Additional factors that need to be considered in future analyses include more detailed residential variables (e.g., census tract- rather than county-based data), individual-level sociodemographic measures (e.g., income, education, and health insurance status), provider characteristics (e.g., specialty, years of experience, surgery volume) and more information about type of treatment received. These additional

data may provide understanding of how patient's residence affects gastric cancer prognosis and post-diagnosis survival.

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TABLES

Table 1. Characteristics of patients with gastric adenocarcinoma from the National Cancer Data Base, 2004-2012, stratified by patient's residence at the time of diagnosis (N = 37,092).

	Metropolitan		Non-Metropolitan				
	N=31,391 (84.63%)		Adjacent[1] N=3,870 (10.43%)		Not Adjacent N=1,831 (4.94%)		
Characteristic	N	%	N	%	N	%	p[2]
Age group at diagnosis							<0.001
< 50	3,523	11.22%	367	9.48%	163	8.90%	
50-59	5,822	18.55%	734	18.97%	324	17.70%	
60-69	8,146	25.95%	1,135	29.33%	500	27.31%	
70-79	8,284	26.39%	1,067	27.57%	528	28.84%	
80 or older	5,616	17.89%	567	14.65%	316	17.26%	
Sex							<0.001
Female	11,396	36.30%	1,173	30.31%	546	29.82%	
Male	19,995	63.70%	2,697	69.69%	1,285	70.18%	
Race							<0.001
White, non-Hispanic	18,685	63.37%	2,941	83.10%	1,400	86.00%	
Black, non-Hispanic	4,412	14.96%	422	11.92%	120	7.37%	
Asian/Pacific Islander, non Hispanic	2,831	9.60%	40	1.13%	35	2.15%	
Hispanic	3,557	12.06%	136	3.84%	73	4.48%	
AJCC[3] stage at diagnosis							<0.001
Stage I	11,194	35.66%	1,232	31.83%	595	32.50%	
Stage II	7,696	24.52%	1,007	26.02%	490	26.76%	
Stage III	10,444	33.27%	1,393	35.99%	641	35.01%	
Stage IV	2,057	6.55%	238	6.15%	105	5.73%	
Primary Site							<0.001
Cardia	12,155	38.72%	2,011	51.96%	914	49.92%	
Fundus of stomach	1,285	4.09%	145	3.75%	61	3.33%	
Body of stomach	2,780	8.86%	257	6.64%	109	5.95%	
Gastric antrum	7,117	22.67%	647	16.72%	324	17.70%	
Pylorus	985	3.14%	119	3.07%	61	3.33%	
Lesser curvature	3,205	10.21%	294	7.60%	143	7.81%	
Greater curvature	1,467	4.67%	141	3.64%	87	4.75%	
Overlapping lesion of stomach	2,397	7.64%	256	6.61%	132	7.21%	
Histologic grade							0.033
1 or 2	12,194	38.85%	1,577	40.75%	688	37.58%	
3 or 4	19,197	61.15%	2,293	59.25%	1,143	62.42%	
Charlson-Deyo Score							0.128
0	21,554	68.66%	2,601	67.21%	1,218	66.52%	
1	7,225	23.02%	919	23.75%	449	24.52%	
>1	2,612	8.32%	350	9.04%	164	8.96%	
Facility type							<0.001
Academic/research program	13,880	44.22%	1,592	41.14%	680	37.14%	
Community cancer program	2,700	8.60%	519	45.45%	313	17.09%	
Comprehensive community cancer program	14,811	47.18%	1,759	45.45%	838	45.77%	
Surgery received							0.028
Yes	25,576	81.51%	3,108	80.35%	1,454	79.50%	
No	5,800	18.49%	760	19.65%	375	20.50%	

[1]Adjacent to a metropolitan area
[2]Results of a chi-square test with significance level 0.05
[3]American Joint Committee on Cancer

Table 2. Analysis of predictors of late stage (AJCC[1] stage 3 or stage 4) diagnosis of gastric adenocarcinoma among patients from the National Cancer Data Base, 2004-2012 (N = 37,092).

	Early Stage N = 22,214 (59.89%)		Late Stage N = 14,878 (40.11%)			
Characteristic	N	%	N	%	OR	95% CI
Age Group						
< 50	2,081	9.37%	1,972	13.25%	1.00 (ref)	
50-59	3,780	17.02%	3,100	20.84%	0.93	(0.86, 1.01)
60-69	5,749	25.88%	4,032	27.10%	0.84	(0.77, 0.91)
70-79	6,189	27.86%	3,690	24.80%	0.73	(0.67, 0.79)
80 or older	4,415	19.87%	2,084	14.01%	0.60	(0.55, 0.66)
Sex						
Female	8,144	36.66%	4,971	33.41%	1.00 (ref)	
Male	14,070	63.34%	9,907	66.59%	1.16	(1.10, 1.21)
Race						
White, non-Hispanic	13,879	66.88%	9,147	65.81%	1.00 (ref)	
Black, non-Hispanic	2,947	14.20%	2,007	14.44%	1.10	(1.03, 1.18)
Asian/Pacific Islander, non-Hispanic	1,806	8.70%	1,100	7.91%	0.92	(0.85, 1.00)
Hispanic	2,121	10.22%	1,645	11.84%	1.11	(1.03, 1.20)
Metropolitan residence						
Metropolitan	18,890	85.04%	12,501	84.02%	1.00 (ref)	
Non-metropolitan, adjacent to metropolitan	2,239	10.08%	1,631	10.96%	1.08	(1.00, 1.16)
Non-metropolitan, not adjacent to metropolitan	1,085	4.88%	746	5.01%	0.99	(0.89, 1.10)
Primary Site						
Cardia	8,777	39.51%	6,303	42.36%	1.00 (ref)	
Fundus of stomach	980	4.41%	511	3.43%	0.74	(0.66, 0.83)
Body of stomach	2,043	9.20%	1,103	7.41%	0.72	(0.66, 0.79)
Gastric antrum	5,032	22.65%	3,056	20.54%	0.81	(0.76, 0.87)
Pylorus	681	3.07%	484	3.25%	0.96	(0.84, 1.10)
Lesser curvature	2,283	10.28%	1,359	9.13%	0.78	(0.72, 0.85)
Greater curvature	1,110	5.00%	585	3.93%	0.72	(0.64, 0.81)
Overlapping lesion of stomach	1,308	5.89%	1,477	9.93%	1.37	(1.25, 1.50)
Charlson-Deyo Score						
0	14,797	66.61%	10,576	71.08%	1.00 (ref)	
1	5,349	24.08%	3,244	21.80%	0.88	(0.84, 0.93)
>1	2,068	9.31%	1,058	7.11%	0.78	(0.72, 0.85)
Histologic grade						
1 or 2	10,588	47.66%	3,871	26.02%	1.00 (ref)	
3 or 4	11,626	52.34%	11,007	73.98%	2.56	(2.44, 2.68)
Facility type						
Academic/research program	9,838	44.29%	6,314	42.44%	1.00 (ref)	
Community cancer program	2,105	9.48%	1,427	9.59%	1.13	(1.05, 1.23)
Comprehensive community cancer program	10,271	46.24%	7,137	47.97%	1.11	(1.06, 1.16)

[1]American Joint Committee on Cancer

Table 3. Analysis of predictors of receipt of any surgical procedure among patients with AJCC[1] stage I-III gastric adenocarcinoma from the National Cancer Data Base, 2004-2012 (N = 34,673)

	No Surgery N = 6,351 (18.32%)		Surgery N = 28,322 (81.68%)			
Characteristic	N	%	N	%	OR	95% CI
Age Group						
< 50	444	6.99%	3,268	11.54%	1.00 (ref)	
50-59	886	13.95%	5,499	19.42%	0.93	(0.82, 1.06)
60-69	1,449	22.82%	7,693	27.16%	0.78	(0.69, 0.88)
70-79	1,702	26.80%	7,587	26.79%	0.57	(0.50, 0.64)
80 or older	1,870	29.44%	4,275	15.09%	0.23	(0.20, 0.26)
Sex						
Female	2,040	32.12%	10,188	35.97%	1.00 (ref)	
Male	4,311	67.88%	18,134	64.03%	0.98	(0.91, 1.04)
Race						
White, non-Hispanic	4,377	74.15%	17,354	65.49%	1.00 (ref)	
Black, non-Hispanic	746	12.64%	3,832	14.46%	0.69	(0.63, 0.76)
Asian/Pacific Islander, non Hispanic	265	4.49%	2,401	9.06%	1.27	(1.10, 1.46)
Hispanic	515	8.72%	2,912	10.99%	0.82	(0.74, 0.91)
Metropolitan residence						
Metropolitan	5,294	83.36%	24,025	84.83%	1.00 (ref)	
Non-metropolitan, adjacent to metropolitan	708	11.15%	2,922	10.32%	1.05	(0.95, 1.16)
Non-metropolitan, not adjacent to metropolitan	349	5.50%	1,375	4.85%	1.05	(0.92, 1.21)
AJCC stage at diagnosis						
Stage I	2,085	32.83%	10,926	38.58%	1.00 (ref)	
Stage II	1,647	25.93%	7,541	26.63%	0.91	(0.84, 0.98)
Stage III	2,619	41.24%	9,855	34.80%	0.72	(0.67, 0.77)
Primary Site						
Cardia	3,928	60.85%	10,513	37.12%	1.00 (ref)	
Fundus of stomach	220	3.46%	1,187	4.19%	2.44	(2.08, 2.87)
Body of stomach	417	6.57%	2,483	8.77%	2.85	(2.53, 3.22)
Gastric antrum	843	13.27%	6,650	23.48%	4.19	(3.81, 4.60)
Pylorus	119	1.87%	950	3.35%	4.37	(3.54, 5.39)
Lesser curvature	279	4.39%	3,089	10.91%	5.39	(4.69, 6.20)
Greater curvature	138	2.17%	1,444	5.10%	5.12	(4.23, 6.20)
Overlapping lesion of stomach	407	6.41%	2,006	7.08%	2.36	(2.09, 2.67)
Charlson-Deyo Score						
0	4,392	69.15%	19,243	67.94%	1.00 (ref)	
1	1,344	21.16%	6,740	23.80%	1.19	(1.10, 1.28)
>1	615	9.68%	2,339	8.26%	0.89	(0.80, 0.99)
Histologic grade						
1 or 2	2,470	38.89%	11,496	40.59%	1.00 (ref)	
3 or 4	3,881	61.11%	16,826	59.41%	0.84	(0.78, 0.89)
Facility type						
Academic/research program	2,500	39.36%	12,706	44.86%	1.00 (ref)	
Community cancer program	788	12.41%	2,494	8.81%	0.59	(0.53, 0.65)
Comprehensive community cancer program	3,063	48.23%	13,122	46.33%	0.86	(0.81, 0.92)

[1]American Joint Committee on Cancer

Table 4. Analysis of predictors[1] of 60-month overall survival among patients with AJCC[2] stage I, II, or III gastric adenocarcinoma with receipt of any surgical procedure from the National Cancer Data Base, 2004-2012 (N = 28,322).

	Stage I N = 10,926 (38.58%)		Stage II N = 7,541 (26.63%)		Stage III N = 9,855 (34.80%)	
Characteristic	HR	95% CI	HR	95% CI	HR	95% CI
Age Group						
< 50	1.00 (ref)		1.00 (ref)		1.00 (ref)	
50-59	1.30	(1.05, 1.60)	1.04	(0.89, 1.22)	1.04	(0.94, 1.16)
60-69	1.35	(1.10, 1.65)	1.28	(1.10, 1.48)	1.27	(1.16, 1.40)
70-79	2.16	(1.78, 2.63)	1.68	(1.46, 1.94)	1.66	(1.51, 1.83)
80 or older	4.01	(3.30, 4.88)	2.94	(2.53, 3.43)	2.33	(2.09, 2.60)
Sex						
Female	1.00 (ref)		1.00 (ref)		1.00 (ref)	
Male	1.23	(1.13, 1.34)	1.10	(1.02, 1.20)	1.03	(0.97, 1.10)
Race						
White, Black, or Hispanic	1.00 (ref)		1.00 (ref)		1.00 (ref)	
Asian/Pacific Islander, non Hispanic	0.60	(0.51, 0.71)	0.65	(0.56, 0.76)	0.79	(0.71, 0.89)
Metropolitan Residence						
Metropolitan	1.00 (ref)		1.00 (ref)		1.00 (ref)	
Non-metropolitan, adjacent to metropolitan	1.25	(1.10, 1.41)	1.04	(0.92, 1.17)	1.13	(1.03, 1.23)
Non-metropolitan, not adjacent to metropolitan	1.24	(1.05, 1.47)	1.06	(0.90, 1.26)	1.20	(1.06, 1.35)
Charlson-Deyo Score						
0	1.00 (ref)		1.00 (ref)		1.00 (ref)	
1	1.20	(1.09, 1.31)	1.28	(1.17, 1.39)	1.11	(1.04, 1.19)
>1	1.90	(1.69, 2.13)	1.57	(1.37, 1.79)	1.30	(1.17, 1.44)
Facility type						
Community or comprehensive community cancer program	1.00 (ref)		1.00 (ref)		1.00 (ref)	
Academic/research program	0.78	(0.72, 0.85)	0.93	(0.86, 1.00)	0.85	(0.81, 0.90)

[1]American Joint Committee on Cancer

[2]Covariates not satisfying the proportional hazards assumption were included as strata, including: grade, histologic type, and year of diagnosis.

FIGURES AND FIGURE LEGENDS

Figure 1. The 60-month overall survival of patients with stage I-III gastric adenocarcinoma receiving surgical treatment of the primary site, as illustrated by metropolitan residence (National Cancer Data Base, 2004-2012).

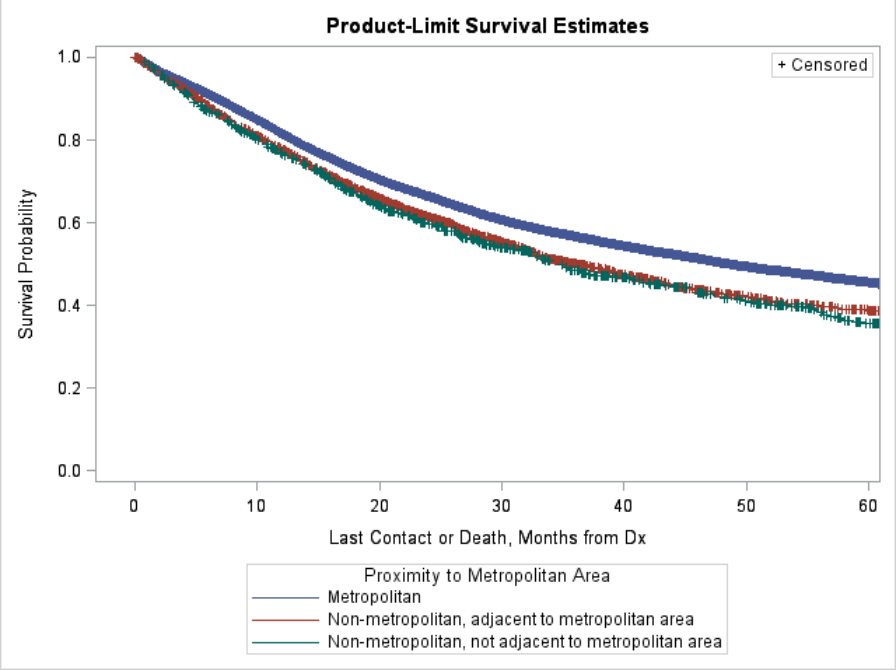

Figure 2. The 60-month overall survival of patients with stage I-III gastric adenocarcinoma receiving surgical treatment of the primary site, as illustrated by race (National Cancer Data Base, 2004-2012).