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Divergent trends for gastric cancer incidence by anatomical subsite in US adults

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Abstract

Background and aim—Age-specific analyses of non-cardia gastric cancer incidence reveal divergent trends among US whites: rates are declining in individuals aged 40 years and older but rising in younger persons. To investigate this heterogeneity further, incidence trends were evaluated by anatomical subsite.

Methods—Gastric cancer incidence data for 1976–2007 were obtained from the US National Cancer Institute’s Surveillance, Epidemiology, and End Results (SEER) Program and the US Centers for Disease Control and Prevention’s National Program of Cancer Registries (NPCR). Incidence rates and estimated annual percentage change were calculated by age group (25–39, 40–59 and 60–84 years), race/ethnicity and subsite.

Results—Based on data from the nine oldest SEER registries (covering ~10% of the US population), rates for all non-cardia subsites decreased in whites and blacks, except for corpus cancer, which increased between 1976 and 2007 with estimated annual percentage changes of 1.0% (95% CI 0.1% to 1.9%) for whites and 3.5% (95% CI 1.8% to 5.2%) for blacks. In contrast, rates for all non-cardia subsites including corpus cancer declined among other races. In combined data from NPCR and SEER registries (covering 89% of the US population), corpus cancer significantly increased between 1999 and 2007 among younger and middle-aged whites; in ethnic-specific analyses, rates significantly increased among the same age groups in non-Hispanic whites and were stable among Hispanic whites. Age-specific rates for all subsites declined or were stable in this period among blacks and other races.

Conclusions—Long- and short-term incidence trends for gastric cancers indicate a shifting distribution by anatomical subsite. Corpus cancer may have distinctive aetiology and changing risk factor exposures, warranting further investigation.

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BACKGROUND

Gastric cancer is the second most common cause of death from cancer worldwide.¹ Overall incidence rates for gastric cancer have steadily declined over the past 50 years, particularly in developed countries. These declines have been most pronounced for tumours of the non-cardia stomach, which are considered attributable to chronic *Helicobacter pylori* infection.²

Age-specific analyses of non-cardia gastric cancer incidence trends reveal divergent patterns in the USA. Rates among whites are declining in older adults but rising in younger persons.³ To characterise these differing age-related trends further and to guide future aetiological investigation, we analysed age- and race-specific gastric cancer incidence by anatomical subsite.

MATERIALS AND METHODS

Data source

Cases of primary invasive gastric cancer diagnosed between 1976 and 2007 among persons aged 25–84 years were identified in population-based data from the US National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) Program⁴ and the US Centers for Disease Control and Prevention's National Program of Cancer Registries (NPCR). The nine oldest SEER registries cover ~10% of the US population, and the combined SEER and NPCR data used in this report cover 89.4% of the US population (all states except Arkansas, Mississippi, Nevada, North Carolina, South Dakota, Tennessee and Virginia, as well as the District of Columbia).

SEER diagnoses are validated by microscopic confirmation, and case ascertainment is >96% for cancers diagnosed or treated in hospitals in the covered geographic areas.⁵ All NPCR registries meet the six US Cancer Statistics publication criteria⁶: (1) case ascertainment is ≥90% complete; (2) ≤5% of cases are ascertained solely on the basis of a death certificate; (3) ≤3% of cases are missing information on sex; (4) ≤3% of cases are missing information on age; (5) ≤5% of cases are missing information on race; and (6) ≥97% of the registry's records passed a set of single-field and interfield computerised edits that test the validity and logic of data components. Our research did not involve use of personal identifying information from these cancer registration data, so institutional review board approval and informed consent were not applicable.

Anatomical subsite was specified according to the WHO classification: cardia, fundus, corpus, antrum, pylorus, lesser curvature, greater curvature, overlapping and unspecified (International Classification of Diseases for Oncology, third edition (ICD-O-3) codes C16.0–C16.9). Non-cardia subsites were considered to include fundus, corpus, antrum, pylorus, lesser and greater curvatures (see supplementary figure 1 online). For some analyses, cancers of unspecified subsite were assumed to be proportionately distributed among the eight specified subsites weighted by their age- and race/ethnicity-specific frequencies in each year. Cases of lymphoma, leukaemia, mesothelioma and Kaposi sarcoma were excluded (ICD-O-3 codes 9050–9055, 9140 and 9590–9989). Demographic variables included age at diagnosis (25–39, 40–59 and 60–84 years), race (white, black and other/unknown, the latter mainly representing Asian descent) and, for whites, ethnicity (non-Hispanic and Hispanic).

Statistical analysis

To assess long- and short-term trends, separate analyses were conducted of the nine oldest SEER registries (SEER9) for 1976–2007, and of the combined data from NPCR and five SEER state registries (NPCR+SEER) for 1999–2007.

Incidence rates (cases per year per 100 000 population) and corresponding 95% CIs were calculated by anatomical subsite, age group and race/ethnicity. Due to limited numbers of counts for some anatomical subsites, sex differences were not assessed. Incidence rates were age standardised (age-standardised rate (ASR)) to the 2000 US population by the direct method. For SEER9, counts and populations were summed over 4-year intervals. Overall incidence rates were plotted on a log-linear scale such that a slope of 10° approximated a rate of change of 1% per year.⁷ Rate calculations for both SEER9 and NPCR +SEER were performed using SEER*Stat (version 6.6.2; available at <http://seer.cancer.gov/seerstat>).

Temporal trends in the ASR were quantified by the estimated annual percentage change (EAPC) using the weighted least squares log-linear regression.⁸ CIs were generated by two-sided t statistics and by parametric bootstrap calculations⁹ for $\alpha=5\%$, with CIs excluding zero considered statistically significant.

RESULTS

A total of 57 058 and 148 185 gastric cancer cases diagnosed at ages 25–84 years were recorded in SEER9 (1976–2007) and NPCR+SEER (1999–2007) registries, respectively. In SEER9, 24.6% of cases were located in the cardia, 6.3% in the corpus, 38.8% in other non-cardia sites, 9.7% in overlapping sites and 20.6% in an unspecified subsite. The corresponding proportions for NPCR+SEER were 29.4, 7.9, 33.7, 6.6 and 22.4%, respectively.

Age-adjusted incidence rates for the SEER9 registries varied by anatomical subsite and race from 1976 to 2007 (figure 1). Incidence rates for cardia cancer significantly increased in whites, but not among blacks or other races. Incidence rates for cancer of the gastric corpus significantly increased among both whites and blacks, but significantly decreased for other races, with corresponding EAPCs of 1.0, 3.5 and -2.4% , respectively (table 1). Age-specific analyses showed that the increases were significant for middle-aged whites and for all age groups in blacks. Rates of antral cancers significantly increased in younger whites and significantly decreased in middle- and older aged whites. For all three races, overall incidence rates for other non-cardia subsites as well as for overlapping and unspecified subsites decreased over time. Using alternative overall rates that assumed known anatomical distribution for all cases, EAPCs for corpus cancer were 0.9% (95% CI 0.5% to 1.4%) for whites, 3.9% (95% CI 2.7% to 5.1%) for blacks and -2.2% (95% CI -2.9% to -1.5%) for other races.

Based on data from NPCR+SEER, the incidence of gastric corpus cancer significantly increased during 1999–2007 among younger and middle-aged whites, with corresponding EAPCs of 4.5% and 3.4%, respectively (table 2). In ethnic-specific analyses, the increase was statistically significant among the same age groups in non-Hispanic whites (EAPCs of 5.7% for 25–39 years and 3.6% for 40–59 years) whereas rates did not significantly change in Hispanic whites (EAPCs of 0.2% and 0.2%, respectively). Among blacks, EAPC for gastric corpus cancer was negative for persons aged 25–39 years and positive for those aged 40–59, but neither change was significantly different from zero. For other races, the EAPC for gastric corpus cancer was negative for ages 60–84 years and positive for other age groups, but none of these estimates was statistically significant. Age-specific rates for all other subsites declined or were stable for all three race groups. Based on rates assuming classification of anatomical subsite for all cases, EAPCs for corpus cancer were 4.7% (95% CI 0.2% to 9.2%) for whites aged 25–39 years, 4.1% (95% CI 2.3% to 5.9%) for whites aged 40–59 years, 5.3% (95% CI -1.1% to 11.7%) for non-Hispanic whites aged 25–39 years and 4.5% (95% CI 2.3% to 6.6%) for non-Hispanic whites aged 40–59 years.

As a sensitivity analysis, we analysed SEER9 data for 1999–2007 to determine whether the short-term trends for blacks differed by population studied. Age-specific EAPCs were: 14.3% (95% CI –52.8% to 177.1%) for ages 25–39, –0.8% (95% CI –17.6% to 19.5%) for ages 40–59 and –1.4% (95% CI –3.4% to 0.6%) for ages 60–84 years.

DISCUSSION

Our study demonstrated subsite-specific differences in gastric cancer incidence over time. Based on data for the entire 32 year study period, ASRs for gastric corpus cancer rose among whites and blacks, whereas all other race- and subsite-specific ASRs declined. Data from the most recent 9 years indicated a significant increase in gastric corpus cancer rates for whites and for non-Hispanic whites aged 25–39 and 40–59 years. However, the recent age-specific trends among blacks as well as among other races were not statistically significant. Although subsite-specific rates for younger age groups are based on small numbers with large variance, these patterns extend previous observations of age-specific differences in the US for non-cardia gastric cancer incidence overall.³

Rates of gastric cancer are higher in Hispanic than US non-Hispanic whites,¹⁰ which may contribute to some of the long- and short-term trends we observed for whites overall. The population fraction of Hispanic origin has increased from 6.4% in 1980¹¹ to 14.6% in 2006,¹² and Hispanics are somewhat younger than the US population overall.¹² However, there are no obvious demographic shifts to account for the long-term increases in gastric corpus cancer among non-Hispanic whites or blacks.

H pylori infection is the primary risk factor for non-cardia gastric cancer.² The prevalence of *H pylori* seropositivity increases with age in the USA, which may reflect decreasing risk of childhood exposure for successive birth cohorts.^{13–17} Thus, infection trends would seemingly favour decreasing (not increasing) rates of gastric corpus cancer. Assuming the corpus-specific increases are not artefactual, the role of cofactors for rising risk should be considered.

Histamine-2-receptor antagonists and proton pump inhibitors, the most common treatments to reduce gastric acid production, first entered the US market in 1976 and 1989, respectively.¹⁸ Acid inhibitor treatment affects the pattern of *H pylori* colonisation within the stomach and leads to development of a corpus-predominant atrophic gastritis, a precursor lesion for cancer.^{19,20} Oxidative stress, a putative mechanism of gastric carcinogenesis, significantly increases in the corpus mucosa of *H pylori*-infected subjects after long-term acid suppression.²¹ Although it has been suggested that the long-term effects of these medications may increase the risk of gastric cancer, results of most formal studies have been inconclusive.^{22,23}

The disappearance of *H pylori* infection may have been accompanied by compensatory changes in the gastric microbiota and emergence of other infectious agents, some of which may be carcinogenic. In particular, Epstein–Barr virus (EBV) has been found in ~9% of non-cardia gastric cancer cases worldwide.²⁴ The mechanism by which EBV may contribute to gastric carcinogenesis is uncertain, but several lines of evidence support its aetiological role: (1) monoclonality of viral episomes in the tumour²⁵; (2) distinct clinical features of EBV-carrying gastric carcinomas as compared with EBV-negative tumours²⁶; (3) characteristic molecular markers, including specific chromosomal aberrations, a transcription pattern resembling but not identical to nasopharyngeal carcinomas, and expression of the EBV *BARF1* gene²⁷; and (4) EBV reactivation preceding clinical presentation of gastric precancerous or cancerous lesions, as indicated by elevated antibodies to viral capsid and nuclear antigens.^{28,29} EBV-positive tumours are preferentially

located in the corpus and other non-antral portions of the stomach,²⁴³⁰ which may have particular relevance for the shifting subsite distribution we detected.

Tobacco smoking has been reported to have a causal role in the development of gastric cancer.³¹ Based on a meta-analysis including 18 cohort studies, smoking is significantly associated with both cardia and non-cardia cancers.³² In addition, smoking may contribute to the persistence of *H pylori* infection¹⁷ and to increased risk of its eradication failure.³³³⁴ However, smoking has been declining among US adults in recent decades,³⁵ so this factor would not explain the increases we observed.

Another hypothesis to consider is the carcinogenic effects of obesity, which is increasing markedly in the USA.³⁶ A meta-analysis of 10 observational studies found no statistically significant association with non-cardia gastric cancer (OR 1.26: 95% CI 0.89 to 1.78).³⁷ However, the possibility of a specific association with gastric corpus cancer has not been investigated.

Finally, the incidence trends we observed might be related to changes in diet. Epidemiological studies have associated high salt or salted food consumption with risk of non-cardia gastric cancer.³⁸ Indeed, US salt consumption may have risen over the last 30 years. Per capita sales of food-grade salt rose ~55% between 1983 and 1998.³⁹ Also, reported sodium intake increased between the National Health and Nutrition Examination Surveys (NHANES) of 1971–1974 and NHANES of 1999–2000.⁴⁰⁴¹ However, a meta-analysis of 24 h urine sodium excretion studies (an indirect, but objective measure of salt intake) did not support an increase over the past several decades.⁴²

Also, low consumption of fresh fruits and vegetables may increase the risk of non-cardia gastric cancer.⁴³ Trends in food availability data indicate that the US population had increasing access to fruits and vegetables between 1970 and 2005.⁴⁴ However, survey data from NHANES, the Behavioural Risk Factor Surveillance System, the National Health Interview Survey, the National Cancer Institute's 5 A Day for Better Health Program and the US Department of Agriculture consistently indicate that reported fruit and vegetable consumption have changed little over the last two^{45–51} or even three decades.^{4052–55} While diet differs by race/ethnicity and socioeconomic status,⁵⁰⁵³ these differentials have been stable over time and would not explain the trends we observed.

Notably, long- and short-term trends among blacks apparently differ, with a rise in corpus cancer that plateaued prior to the most recent period of analysis. Trends for the period 1999–2007 in SEER9 are consistent with those based on NPCR +SEER combined, indicating that the difference may be associated with time period rather than geographic area.

The increases in corpus cancer affected a broad range of ages among whites and blacks. Interestingly, antral cancer also increased among whites aged 25–39 years. Since corpus and antrum cancers together represent approximately half of all non-cardia cases, the increasing trend in these two subsites is consistent with previous observations that non-cardia gastric cancer overall has increased in young whites.³

Furthermore, we did not observe an increase in gastric corpus cancer in other races (mainly of Asian descent). This group has higher age-specific prevalence of *H pylori* infection, indicating that decreases in childhood acquisition may have been achieved more recently than among whites and blacks.⁵⁶ The marked impact of declining age-specific prevalence of this primary gastric cancer risk factor could potentially obscure countervailing cofactor trends apparent among lower incidence groups.

The strengths of this study are the quality and time span of the underlying data. SEER and NPCR combined capture nearly all gastric cancer cases occurring in the USA. However, our analysis may have been limited by incomplete and/or uncertain designation of anatomical subsite. Although the specialised literature tends to distinguish gastric pathology for the proximal (eg, cardia), middle (eg, corpus) and distal (eg, antrum) portions of the stomach, 27% of the non-cardia cases in NPCR+SEER were assigned to the lesser and greater curvatures by the WHO classification. Moreover, gastric cancer with unspecified subsite declined from 29% in 1976 (for SEER) to 19% in 2007 (for NPCR +SEER), so some of the increase in corpus cancers probably reflects redistribution from the unspecified category. Under the assumption that this shift affected all specific subsites equally, the observed trends were not substantially modified, although the increase among non-Hispanic whites aged 25–39 years was no longer statistically significant. In addition, corpus cancer increased in some race and age groups but not in others cared for by the same health providers. Thus, temporal trends in clinical practice would not be a likely explanation for the shift.

We are not aware of other changes in routine pathological practices or the introduction of screening programmes that may have affected our findings. Nevertheless, given the small proportion of all gastric cancer represented by corpus cancer and the large drop in cases with an unspecified subsite, we cannot dismiss artefact due to biased re-classification as a contributor to the increased rates of corpus cancer.

Other limitations of this study are common to all registry-based analyses, including the retrospective review and lack of risk factor data. Furthermore, non-standardised pathological classification precluded analyses by histological subtype, which could have been additionally informative. Finally, we were unable to assess sex differences due to small samples sizes.

In conclusion, our analysis indicates that gastric corpus cancer may be epidemiologically distinct from other non-cardia carcinomas. The increasing incidence of cancers at this anatomical subsite warrants examination in other populations and studies addressing the potential causes.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Significance of this study

What is already known about this subject?

- Overall incidence rates for non-cardia gastric cancer have steadily declined over the past 5 decades, particularly in developed countries.
- Age-specific analyses of non-cardia gastric cancer incidence in the USA reveal divergent trends. Rates among whites are declining in older adults but rising in younger persons.
- Tumours of the non-cardia stomach are thought to have the same risk factors and represent a homogeneous entity.

What are the new findings?

- Based on data from the nine oldest US cancer registries (covering ~10% of the population), the incidence of gastric corpus cancer significantly increased during 1976–2007 among whites and blacks, whereas all other race- and subsite-specific age-standardised rates declined.
- Data from 1999 to 2007, covering 89% of the US population, indicated a significant increase in gastric corpus cancer rates for younger and middle-aged whites and non-Hispanic whites.
- Our analysis indicates that gastric corpus cancer may be epidemiologically distinct from other non-cardia carcinomas.

How might it impact on clinical practice in the foreseeable future?

- The increasing incidence of cancers of the gastric corpus warrants examination in other populations and studies addressing the potential causes.

Figure 1.

Age-standardised incidence rates of gastric cancer among whites, blacks and other races by anatomical subsite, SEER9 (Surveillance, Epidemiology, and End Results) registries, 1976–2007.

Age-standardised rate (ASR) and estimated annual percentage change of gastric cancer by anatomical subsite and race, SEER9 registries, 1976–2007

Table 1

Anatomical subsite	Race	ASR (25–84 years)	Age groups			
			25–39 years EAPC (95% CI)	40–59 years EAPC (95% CI)	60–84 years EAPC (95% CI)	25–84 years EAPC (95% CI)
C16.0-Cardia	Whites	3.3	1.8 (0.1 to 3.5)	-0.1 (-1.1 to 0.8)	1.2 (0.3 to 2.0)	0.8 (0.0 to 1.6)
	Blacks	2.0	0.8* (-5.4 to 7.4)	-0.4 (-2.1 to 1.4)	0.5 (-1.3 to 2.2)	0.2 (-1.2 to 1.8)
	Others	2.4	1.1* (-3.0 to 5.2)	0.4* (-1.2 to 1.9)	0.2 (0.0 to 0.5)	0.3 (0.0 to 0.7)
C16.1-Fundus	Whites	0.5	0.8* (-1.5 to 3.3)	-0.9 (-2.6 to 0.8)	-2.8 (-3.6 to -1.9)	-2.3 (-3.1 to -1.5)
	Blacks	0.9	-	-1.2* (-3.5 to 1.3)	-0.8 (-2.4 to 0.8)	-0.8 (-2.3 to 0.7)
	Others	0.7	-	-3.0* (-5.6 to -0.4)	-3.4* (-6.0 to -0.8)	-3.3 (-5.5 to -1.0)
C16.2-Corpus	Whites	0.6	3.2* (-1.5 to 8.1)	2.1 (0.8 to 3.4)	0.7 (-0.5 to 2.0)	1.0 (0.1 to 1.9)
	Blacks	1.4	6.2* (2.2 to 10.5)	2.9* (0.7 to 5.1)	3.5* (1.6 to 5.5)	3.5 (1.8 to 5.2)
	Others	2.2	-3.2* (-7.1 to 0.8)	-4.9* (-6.7 to -3.0)	-1.7 (-3.1 to -0.2)	-2.4 (-3.7 to -1.1)
C16.3-Antrum	Whites	1.6	4.4* (1.8 to 7.1)	-1.6 (-2.6 to -0.7)	-2.5 (-3.2 to -1.8)	-2.3 (-2.9 to -1.7)
	Blacks	4.6	-1.1* (-4.4 to 2.4)	-2.7 (-4.1 to -1.3)	-1.9 (-2.9 to -1.0)	-2.1 (-2.8 to -1.3)
	Others	6.3	-0.6* (-4.7 to 3.7)	-2.7 (-4.2 to -1.2)	-2.4 (-3.2 to -1.5)	-2.4 (-3.2 to -1.6)
C16.4-Pylorus	Whites	0.3	-	-4.4* (-6.5 to -2.2)	-3.6 (-4.2 to -3.0)	-3.8 (-4.5 to -3.1)
	Blacks	0.9	-	-1.7* (-5.3 to 2.0)	-1.7 (-4.3 to 1.0)	-1.8 (-4.0 to 0.4)
	Others	0.7	-	-5.0* (-7.5 to -2.5)	-2.3* (-4.9 to 0.3)	-2.9 (-5.0 to -0.8)
C16.5-Lesser curvature	Whites	1.0	-1.8* (-4.7 to 1.2)	-3.9 (-5.4 to -2.4)	-3.4 (-4.2 to -2.7)	-3.5 (-4.1 to -2.9)
	Blacks	2.5	-1.1* (-6.0 to 4.1)	-4.5 (-6.5 to -2.4)	-3.3 (-4.7 to -1.8)	-3.5 (-5.0 to -1.9)
	Others	2.9	-2.6* (-6.4 to 1.3)	-2.9 (-5.0 to -0.8)	-1.6 (-3.6 to 0.4)	-1.9 (-3.6 to -0.1)
C16.6-Greater curvature	Whites	0.5	-2.3* (-6.7	to -2.3) 2.0 (-3.7 to -0.2)	-2.8 (-3.2 to -2.3)	-2.6 (-3.0 to -2.2)
	Blacks	1.0	-3.8* (-8.5 to 1.0)	-2.4* (-4.4 to -0.3)	-3.0 (-4.3 to -1.7)	-2.9 (-3.9 to -1.9)
	Others	1.2	-	-2.4* (-4.9 to 0.2)	-0.8* (-3.7 to 2.1)	-1.2 (-3.6 to 1.4)
C16.8-Overlapping lesion	Whites	1.0	-1.1* (-3.3 to 1.3)	-3.8 (-4.6 to -3.0)	-4.6 (-5.7 to -3.4)	-4.3 (-5.3 to -3.4)
	Blacks	2.2	-0.7* (-5.2 to 4.0)	-3.3 (-4.9 to -1.6)	-3.5 (-4.4 to -2.5)	-3.3 (-3.9 to -2.7)

Anatomical subsite	Race	ASR (25-84 years)	Age groups			
			25-39 years EAPC (95% CI)	40-59 years EAPC (95% CI)	60-84 years EAPC (95% CI)	25-84 years EAPC (95% CI)
C16.9-Not otherwise specified	Others	2.9	-5.7* (-7.6 to -3.7)	-5.4 (-7.7 to -3.0)	-5.2 (-7.6 to -2.8)	-5.3 (-7.3 to -3.3)
	Whites	2.4	0.0 (-3.9 to 4.1)	-2.7 (-3.8 to -1.6)	-3.5 (-4.5 to -2.6)	-3.3 (-4.3 to -2.2)
	Blacks	4.5	0.3* (-2.0 to 2.6)	-1.4 (-2.4 to -0.4)	-1.6 (-2.5 to -0.7)	-1.5 (-2.3 to -0.8)
	Others	3.7	-1.4* (-5.0 to 2.4)	-2.1 (-3.4 to -0.8)	-3.0 (-3.9 to -2.1)	-2.7 (-3.5 to -2.0)

* Estimates based on <16 cancer cases for at least one 4-year period.

EAPC, estimated annual percentage change; SEER, Surveillance, Epidemiology, and End Results.

Age-standardised rate (ASR) and estimated annual percentage change of gastric cancer by anatomical subsite and race, NPCR+SEER registries, 1999–2007

Table 2

Anatomical subsite	Race/ethnicity	ASR (25–84 years)	Age groups			
			25–39 years EAPC (95% CI)	40–59 years EAPC (95% CI)	60–84 years EAPC (95% CI)	25–84 years EAPC (95% CI)
C16.0-Cardia	Whites	3.1	1.3 (–1.1 to 3.8)	–1.1 (–2.1 to –0.2)	–0.0 (–0.8 to 0.7)	–0.3 (–1.0 to 0.4)
	Non-Hispanic whites	3.1	1.4 (–1.3 to 4.2)	–1.0 (–1.9 to –0.1)	0.2 (–0.6 to 0.9)	–0.1 (–0.8 to 0.6)
	Hispanic whites	2.3	–1.1* (–10.8 to 9.6)	–1.6 (–3.5 to 0.4)	–2.2 (–4.4 to 0.1)	–2.0 (–3.9 to 0.0)
	Blacks	1.9	–5.2* (–13.3 to 3.7)	0.9 (–1.6 to 3.4)	0.2 (–2.2 to 2.7)	0.3 (–1.9 to 2.6)
	Others	2.4	–0.5* (–6.7 to 6.1)	1.8 (–3.6 to 7.5)	–0.8 (–2.8 to 1.2)	–0.2 (–1.8 to 1.5)
C16.1-Fundus	Whites	0.4	4.5* (–3.8 to 13.6)	1.0 (–1.9 to 4.0)	–2.5 (–3.5 to –1.5)	–1.4 (–2.2 to –0.7)
	Non-Hispanic whites	0.4	1.3* (–9.2 to 13.1)	0.5 (–2.8 to 4.0)	–2.8 (–4.3 to –1.3)	–1.9 (–2.9 to –1.0)
	Hispanic whites	0.7	–	1.3 (–5.9 to 9.0)	–1.7 (–6.4 to 3.2)	–0.8 (–3.7 to 2.2)
	Blacks	0.8	–1.3* (–8.6 to 6.6)	1.3 (–2.9 to 5.6)	2.5 (–1.7 to 6.7)	2.1 (–0.9 to 5.1)
	Others	0.7	3.8* (–19.3 to 33.5)	4.5* (–4.0 to 13.8)	–0.6 (–5.2 to 4.2)	0.9 (–2.9 to 4.9)
C16.2-Corpus	Whites	0.7	4.5 (1.1 to 8.1)	3.4 (2.0 to 4.8)	0.0 (–1.1 to 1.2)	0.9 (0.1 to 1.8)
	Non-Hispanic whites	0.6	5.7* (0.7 to 11.0)	3.6 (1.6 to 5.7)	–0.3 (–1.4 to 0.7)	0.6 (–0.2 to 1.4)
	Hispanic whites	1.6	0.2* (–4.0 to 4.5)	0.2 (–3.4 to 3.9)	–0.9 (–3.1 to 1.4)	–0.6 (–1.9 to 0.7)
	Blacks	1.5	–1.6* (–11.2 to 9.1)	1.1 (–3.3 to 5.6)	1.6 (–2.3 to 5.7)	1.4 (–1.9 to 4.9)
	Others	1.8	3.8* (–2.5 to 10.4)	5.4 (–1.4 to 12.7)	–0.4 (–5.9 to 5.3)	0.9 (–4.0 to 6.0)
C16.3-Antrum	Whites	1.2	1.5 (–3.9 to 7.1)	0.0 (–1.2 to 1.2)	–3.2 (–3.6 to –2.7)	–2.4 (–2.9 to –2.0)
	Non-Hispanic whites	1.0	2.6 (–4.0 to 9.7)	–0.6 (–2.5 to 1.4)	–3.5 (–3.9 to –3.0)	–2.8 (–3.3 to –2.3)
	Hispanic whites	3.2	–3.0 (–7.8 to 2.1)	–1.6 (–3.2 to 0.1)	–4.9 (–6.4 to –3.4)	–4.2 (–5.3 to –3.0)
	Blacks	3.7	0.7* (–8.1 to 10.4)	–0.5 (–1.5 to 0.6)	–1.5 (–2.9 to 0.0)	–1.2 (–2.3 to –0.1)
	Others	5.0	6.1* (–4.0 to 17.2)	0.5 (–2.1 to 3.2)	–2.7 (–4.9 to –0.5)	–1.9 (–4.0 to 0.3)
C16.4-Pylorus	Whites	0.2	–2.9* (–14.4 to 10.3)	–1.6 (–5.1 to 2.0)	–3.0 (–6.0 to –0.0)	–2.8 (–5.1 to –0.4)
	Non-Hispanic whites	0.2	–2.9* (–18.4 to 15.6)	–1.4 (–6.4 to 3.9)	–3.5 (–5.7 to –1.3)	–3.2 (–5.1 to –1.2)
	Hispanic whites	0.6	–6.5* (–20.0 to 9.3)	–3.8* (–9.8 to 2.6)	–3.9 (–10.4 to 3.1)	–3.9 (–8.7 to 1.1)

Anatomical subsite	Race/ethnicity	ASR (25-84 years)	Age groups			
			25-39 years EAPC (95% CI)	40-59 years EAPC (95% CI)	60-84 years EAPC (95% CI)	25-84 years EAPC (95% CI)
C16.5-Lesser curvature	Blacks	0.6	-4.1* (-16.1 to 9.7)	-2.0 (-6.7 to 3.0)	-2.3 (-7.4 to 3.2)	-2.2 (-6.0 to 1.7)
	Others	0.6	0.1* (-15.8 to 19.0)	0.2* (-9.5 to 10.9)	-5.3 (-9.4 to -1.0)	-4.2 (-8.5 to 0.4)
	Whites	0.6	-2.6* (-8.0 to 3.1)	-1.8 (-3.8 to 0.3)	-4.3 (-6.0 to -2.6)	-3.7 (-5.0 to -2.4)
	Non-Hispanic whites	0.5	-0.4* (-8.0 to 7.8)	-2.6 (-5.0 to -0.1)	-5.3 (-7.3 to -3.3)	-4.7 (-6.4 to -3.0)
	Hispanic whites	1.5	-7.0* (-13.8 to 0.3)	-3.1 (-6.9 to 0.9)	-2.0 (-3.5 to -0.4)	-2.4 (-4.0 to -0.9)
	Blacks	1.5	-3.2* (-12.8 to 7.5)	-3.1 (-6.4 to 0.4)	-1.3 (-4.0 to 1.6)	-1.8 (-3.6 to 0.1)
C16.6-Greater curvature	Others	2.2	-3.6* (-13.7 to 7.7)	-0.6 (-6.3 to 5.6)	-1.9 (-3.9 to 0.1)	-1.6 (-3.7 to 0.5)
	Whites	0.3	-1.0* (-7.0 to 5.4)	-3.1 (-6.3 to 0.3)	-4.5 (-6.0 to -3.0)	-4.0 (-5.6 to -2.4)
	Non-Hispanic whites	0.3	1.5* (-7.5 to 11.2)	-3.1 (-6.2 to 0.2)	-4.5 (-6.2 to -2.8)	-4.0 (-5.5 to -2.5)
	Hispanic whites	0.7	-7.2* (-12.9 to -1.1)	-5.0 (-10.0 to 0.2)	-6.3 (-9.9 to -2.6)	-6.0 (-9.4 to -2.5)
	Blacks	0.7	-1.6* (-14.2 to 12.9)	4.0 (-1.9 to 10.3)	-2.6 (-6.7 to 1.7)	-0.8 (-4.2 to 2.8)
	Others	0.9	-1.9* (-16.5 to 15.4)	-5.5* (-11.0 to 0.4)	-5.9 (-11.6 to 0.1)	-5.8 (-9.8 to -1.5)
C16.8-Overlapping lesion	Whites	0.6	1.8 (-2.9 to 6.8)	-0.6 (-3.2 to 2.0)	-4.3 (-5.4 to -3.2)	-3.1 (-3.9 to -2.4)
	Non-Hispanic whites	0.5	-2.1* (-6.4 to 2.4)	-2.9 (-5.1 -0.7)	to -4.7 (-5.6 to -3.9)	-4.3 (-4.9 to -3.6)
	Hispanic whites	1.5	2.6* (-5.4 to 11.4)	1.4 (-3.1 to 6.1)	-4.7 (-8.3 to -1.0)	-2.8 (-5.5 to 0.1)
	Blacks	1.2	-2.9* (-8.3 to 2.8)	1.7 (-3.1 to 6.9)	-5.0 (-8.5 to -1.5)	-3.3 (-5.9 to -0.7)
	Others	1.5	5.9* (-8.0 to 21.9)	-2.3 (-7.2 to 2.9)	-5.6 (-9.0 to -2.1)	-4.4 (-6.6 to -2.1)
	Whites	1.9	3.0 (-1.5 to 7.7)	-0.8 (-2.6 to 1.0)	-3.0 (-3.9 to -2.0)	-2.2 (-3.2 to -1.3)
C16.9-Not otherwise specified	Non-Hispanic whites	1.7	2.4 (-1.9 to 6.8)	-1.6 (-3.4 to 0.3)	-3.3 (-4.1 to -2.5)	-2.7 (-3.5 to -1.9)
	Hispanic whites	4.1	0.0 (-8.0 to 8.7)	-0.8 (-3.5 to 2.1)	-3.4 (-6.6 to -0.1)	-2.5 (-5.2 to 0.2)
	Blacks	4.7	-3.3 (-7.4 to 1.0)	-0.2 (-2.5 to 2.1)	-3.4 (-4.4 to -2.3)	-2.6 (-3.7 to -1.6)
	Others	4.1	0.9* (-6.1 to 8.5)	-0.3 (-3.2 to 2.7)	-3.0 (-4.9 to -1.1)	-2.1 (-3.4 to -0.9)

* Estimates based on <16 cancer cases for at least 1 year.

EAPC, estimated annual percentage change; NPCR, National Program of Cancer Registries; SEER, Surveillance, Epidemiology, and End Results.